

**Draft Environmental Impact
Statement for the Proposed
Amendment to Permits 00030 and
00030A for the Continental Mine:
Expansion of the Yankee Doodle
Tailings Impoundment and
Associated Facilities**

March 2019

**CONTINENTAL MINE
MONTANA RESOURCES, LLP
SILVER BOW COUNTY, MONTANA**

DEQ
Montana Department
of Environmental Quality

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March 22, 2019

RE: Notice of release and public comment period for the Draft Environmental Impact Statement for Montana Resources, LLC's amendment application for expansion of the existing Yankee Doodle Tailings Impoundment.

Dear Interested Party:

The Montana Department of Environmental Quality (DEQ) has released a Draft Environmental Impact Statement (EIS) for Montana Resources, LLC's (Montana Resources) amendment application. The amendment application affects multiple operating permits held by Montana Resources. Approval of the amendment application would allow Montana Resources to raise the western embankment of the existing Yankee Doodle Tailings Impoundment (YDTI) to an elevation of 6450 feet, extend the northern boundary of the impoundment, and add other facilities to support this impoundment project. The Montana Resources' Yankee Doodle Tailings Impoundment is located adjacent to and northeast of Butte, Montana.

Montana Resources applied to DEQ for an amendment on October 6, 2017, under the Metal Mine Reclamation Act, Section 82-4-301, *et seq.*, Montana Code Annotated (MCA). Pursuant to Section 82-4-337, MCA, DEQ determined that Montana Resources' amendment application was complete and compliant and, on August 31, 2018, issued Montana Resources a draft amendment approval. Electronic copies of the applications may be viewed by visiting the website (<http://deq.mt.gov/Land/hardrock>).

The Montana Environmental Policy Act (MEPA), Section 75-1-201, *et seq.*, MCA, requires the preparation of an environmental impact statement for state actions that may significantly affect the quality of the human environment. The EIS must include a detailed statement on the environmental impact of the proposed action, alternatives to the proposed action, and a no action alternative. DEQ analyzed several alternatives: a No Action Alternative, a Proposed Action Alternative based on Montana Resources' application submitted to DEQ, and three additional alternatives.

DEQ has identified the West Embankment Drain (WED) Pumpback Elimination at Closure Alternative as the agency's preferred alternative. This alternative incorporates all the features in the Proposed Action Alternative except for it would eliminate pumping the potentially poor-quality seepage water collected in the WED extraction pond back to the tailing pond for approximately 20 years post-closure. WED Pumpback Elimination at Closure Alternative seepage would be diverted to the Continental Pit for storage or to the Horseshoe Bend Treatment Plant for treatment and discharge under the Superfund remedy.

DEQ's Preferred Alternative presents a different scenario for YDTI water management at closure, which necessitates recognition of U.S. Environmental Protection Agency's authority over long-term water management and treatment at the site under the Butte Mine Flooding Operable Unit. Discussions and coordination with all parties in the 2002 Butte Mine Flooding Operable Unit Consent Decree would be needed to review the options and feasibility for handling and treating this water, the potential use of existing or upgraded facilities and infrastructure (e.g. Horseshoe Bend Treatment Plant), and to amend their agreement accordingly.

The Draft EIS is available for public comment from March 22, 2019 – April 22, 2019. All comments submitted to DEQ will become part of the public record for this project and are available for public review, along with the name(s) of the commenter(s). The Draft EIS has been posted on DEQ's website at (<http://deq.mt.gov/Public/eis>).

Digital copies of the Draft EIS may be requested by contacting Craig Jones at (406) 444-0514.

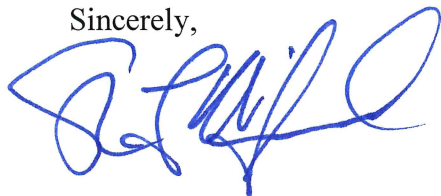
An open house and public meeting will be held to provide the public with information on the proposed project and to provide an opportunity for the public to submit written and/or oral comments. The meeting will be held on Wednesday, April 10 from 5:30-8:30 pm at the Clarion Inn Copper King, 4655 Harrison Avenue, in Butte. The open house portion of the meeting will be held from 5:30 – 6:30 pm. Then, from 6:30 – 8:30 pm, the public will have an opportunity to provide oral and/or written testimony on the Draft EIS.

Written comments may be submitted at the public meeting. In addition, comments may be submitted via electronic mail at DEQMTResourcesMEPA@mt.gov, or postal mail at:

Craig Jones
Department of Environmental Quality
P.O. Box 200901
Helena, MT 59601

Comments on the Draft EIS must be received on or before Monday, April 22, 2019.

Sincerely,



Shaun McGrath
Director
Department of Environmental Quality

EXECUTIVE SUMMARY

This Executive Summary provides an overview of the draft Environmental Impact Statement (EIS) for the proposed amendment to Montana Resources, LLP (MR) Operating Permits 00030 and 00030A related to the expansion of the Yankee Doodle Tailings Impoundment (YDTI) and changes to associated facilities. The EIS describes the resources potentially affected by the proposed amendment activities. This summary does not provide all the information contained in the EIS. If more detailed information is desired, please refer to the EIS and the reports and other sources referenced within.

This EIS presents descriptions of the Proposed Action and alternatives, including the No Action Alternative and other alternatives described in Chapter 2; descriptions of the affected environment for all potentially affected resources (Chapter 3); an analysis of the impacts of the alternatives (Chapters 3 and 4); and a summary and comparison of the alternatives in Chapter 5.

PURPOSE AND NEED

DEQ's purpose and need in conducting the environmental review is to act upon MR's application to amend Operating Permits Nos. 00030 and 00030A to expand the capacity of the YDTI. The proposed amendment would raise the elevation of the YDTI West Embankment from 6,405 feet to 6,450 feet, to match the presently permitted elevations of the East-West and the North-South embankments. The proposed amendment would allow for increased tailings storage and a commensurate extension of the northern boundary of the tailings pond, a new rock disposal site, expand an existing rock disposal site, provide for construction of a closure spillway and new soil stockpiles, and revise the operation, reclamation, and closure phases of the impoundment. The proposed amendment would allow for an additional 9 years of operation of the mine at current production levels. However, continued operations under the proposed amendment would be limited by production rates and the capacity of the YDTI, and should DEQ approve the amendment, it would not specify a duration for operations.

DEQ will decide which alternative should be approved in DEQ's Record of Decision (ROD) 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. This EIS was prepared to satisfy this MEPA requirement. Prior to beginning its environmental review under MEPA, DEQ reviewed MR's amendment application and determined that it was complete and complied with the MMRA and issued a

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draft permit amendment. Issuance of the draft permit amendment as a final permit amendment is the proposed state action subject to this environmental review under Section 82-4-337(1)(f), MCA.

PROJECT LOCATION AND HISTORY

MR operates an open pit copper-molybdenum mine adjacent to the city of Butte, Montana in Silver Bow County (**Figure ES-1**). The Continental Mine produces copper sulfide concentrate, molybdenum disulfide concentrate, and copper precipitate (cement copper) for sale in the United States and world markets. MR operates the Continental Mine under Operating Permits 00030, 00030A, 00041, and 00108. The Continental Pit, the site of active mine operations, is currently permitted to produce ore in excess of 20 years; however, ore reserves may exceed those reported in MR's Operations Plan (February 2018).

Mine Site History

The area surrounding Butte has been actively mined for generations. Gold placer mining was conducted in the Upper Clark Fork area in the 1860s and 1870s and included the development of mining camps along Silver Bow Creek. Hard rock mining for silver ore began in the 1870s, resulting in a more permanent settlement of the area.

Extensive polymetallic underground mines were developed beneath Butte through the first half of the 20th century and open pit mining began at the Berkeley Pit in 1955. Construction of the YDTI began in 1963, utilizing waste rock from the Berkeley Pit. In 1977 Atlantic Richfield Company (AR) purchased the mine through a merger with the Anaconda Company. Mining activity in the Berkeley Pit was reduced in the early 1980s due to low metal prices, ultimately ending in April 1982. District dewatering pumps were turned off, allowing the underground mines and the Berkeley Pit to gradually fill with water from the bedrock and alluvial aquifers and site runoff once mining operations ceased.

Montana Resources, Inc. (MRI) purchased the property from the Anaconda Company, a wholly owned subsidiary of Atlantic Richfield, and began mining the East Berkeley (Continental) Pit in 1986. Mining permits were transferred from MRI to Montana Resources, LLP, a general partnership (MR) in 1989. Waste rock from the Continental Pit was used to continue construction of the YDTI. MR suspended mining operations from 2000 to 2003 due to high electricity prices; however, mining and processing operations recommenced in 2003 (Montana Resources 2018a).

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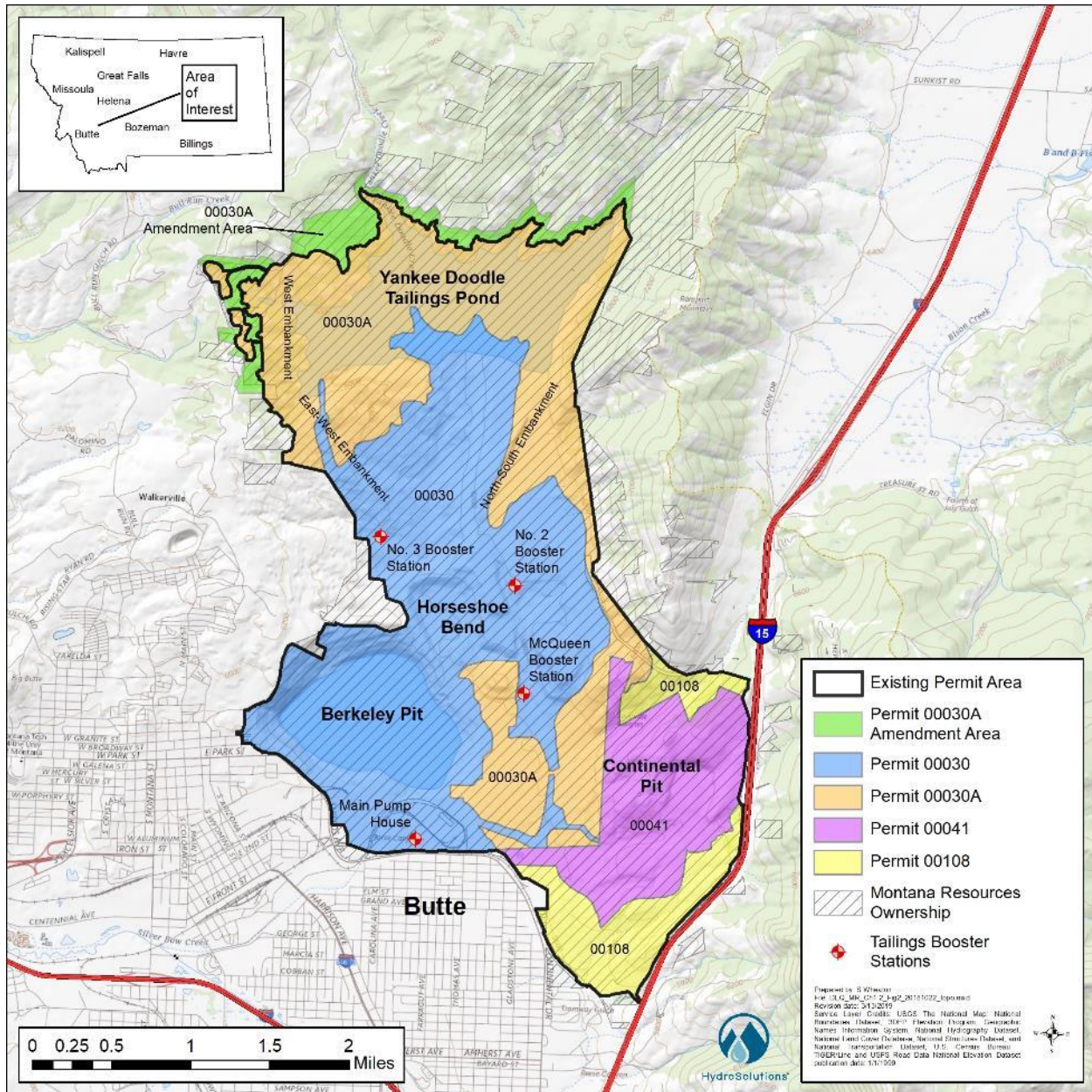


Figure ES-1. Location of the Montana Resources Continental Mine showing permit area boundaries.

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 provides a comparison of environmental conditions without the proposal and establishes a baseline for evaluating the Proposed Action and the other alternatives. MEPA requires the consideration of the No Action Alternative, even if it fails to meet the purpose and need or would not be able to satisfy environmental permitting standards.

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Under the No Action Alternative, MR would continue to operate under its existing operating permits. The tailings storage capacity in the YDTI would remain unchanged, the northern boundary of the YDTI would not be expanded, disturbed acreage would not be increased, and revisions to the existing reclamation and closure plans would not be necessary. Tailings storage capacity would allow mining operations to continue through 2022, and mining would be limited to the current permits which include Operating Permits 00030, 00030A, 00041, and 00108, along with associated amendments, modifications, and revisions. A summary of all operating permits and components can be found in Montana Resources Continental Mine Operations Plan dated February 2017 and revised February 2018 (Montana Resources 2018a).

PROPOSED ACTION: ON SITE TAILINGS AND WATER CONTAINMENT

The Proposed Action would raise the West Embankment to match the presently permitted elevations of the East-West and North-South embankments. It would also extend the northern boundary of the impoundment, which would allow continued tailings deposition and extend operations at the Continental Mine. The West Embankment would be raised 45 feet from an elevation of 6,405 feet to 6,450 feet. As the pond fills to the increased capacity, it would extend the northern boundary of the tailings pond to an elevation of approximately 6,428 feet. A gravity controlled subsurface seepage collection drain, known as the West Embankment Drain (WED), would intercept seepage before it migrates west of the impoundment.

The proposed amendment would increase the total area of Permit 00030A by approximately 237 acres, but only 99 of these acres would be disturbed to accommodate the West Embankment raise and YDTI expansion. Disturbed areas would include increased tailings storage, construction, topsoil storage, roads, and monitoring wells. Although the proposed amendment would affect mine facilities that are located within Operating Permit 00030, it would not authorize the disturbance of any additional land under Operating Permit 00030. Other associated facilities are proposed and would include additional non-ore storage area developed in an existing rock disposal site (RDS), a new RDS, stockpile areas for soil and alluvium, access roads, and long-term monitoring sites within Operating Permits 00030 and 00030A. A closure spillway has been conceptually designed to provide a system for releasing water from the tailings impoundment to the Continental Pit, subject to the Butte Mine Flooding Operable Unit (BMFOU) requirements.

To achieve the geotechnical objectives for beach development, enhance embankment stability, and limit the potential for internal erosion, the practice of inundating the tailings beach with water to manage wind-blown dust would be phased out. The potential for tailings dusting would be managed using multiple discharge points or by other means to wet the beach by recycling water within the mine area during critical periods.

During operations, the impoundment receives tailings suspended in water and as the tailings particles settle out, the remaining water clarifies and forms the supernatant pond. The term supernatant refers to the liquid lying above a solid residue after settling, in this case the water

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in the tailings pond sitting above the tailings solids. Closure would include dewatering of the impoundment via seepage to the WED and Horseshoe Bend, as well as through evaporation. The tailings beach or dry area and a Transition Zone would be incrementally exposed by dewatering as the size of the supernatant pond is reduced. The tailings beach would remain dry and the Transition Zone would retain water, but it would dry out as the pond edge recedes. The reclamation of the beach and Transition Zone would include the incremental capping and revegetation as the areas become accessible and stable for truck traffic. Final reclamation would include a partial wet closure with a reclaimed beach and Transition Zone, and a pond volume of approximately 1,000 acre-feet.

The Transition Zone would comprise tailings slimes deposited under the pond's surface, rather than the coarser materials found in the exposed beach tailings. Slimes are composed of finer silt and clay particles while the beach comprises sand like particles. As the dewatering transitions, the slimes closest to the supernatant pond would remain saturated with water due to their inherent moisture holding capacity while the slimes nearest the beach would "crust" over as they dry. The beach, Transition Zone, and water level would be monitored monthly to assess the potential to disperse dust, and if dust is detected, MR would be required to implement its dust control plan.

As areas become accessible during reclamation, further mitigations would include the placement of a 6-inch thick rockfill cap over areas to facilitate equipment operation, placement of capping material and revegetating the Transition Zone. Other areas could be controlled by maintaining and using rubber wheeled equipment to apply dust suppressant as needed.

Long-term dust control would be achieved during closure through reclamation of the tailings beach and Transition Zone by capping with a 28-inch thick amended alluvial cap and following the revegetation plan.

OTHER ALTERNATIVES EVALUATED

DEQ evaluated three additional alternatives focused on the reclamation timing and attributes. These alternatives are conceptual in nature and were designed to minimize environmental impacts and to address issues identified during scoping and interagency consultation.

The other alternatives evaluated include mitigations developed to address specific environmental impacts and to avoid, minimize, rectify, or eliminate these impacts during the three stages of the Proposed Action - construction, operation, and reclamation. Mitigations focused on reducing the time before reclamation activities can begin and the total time for reclamation completion. Section 2.4 describes the alternatives in greater detail and **Table 2.4-1** summarizes each alternative and describes how the alternative would affect aspects of the Proposed Action.

The three alternatives evaluated in addition to the No Action and the Proposed Action are:

- The Accelerated Drawdown Alternative,

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- The Elimination of the West Embankment Drain Pumpback (WED) at Closure Alternative, and
- The Alternative Capping Methods Alternative.

ADDITIONAL PLANNING AND COORDINATION

In 1982, the US Environmental Protection Agency (USEPA) proposed that Silver Bow Creek be added to the National Priority List (NPL), and it was listed as a Superfund site in 1983. The Butte Area was added to the Silver Bow Creek site in 1987 (USEPA 2018a). A total of four contiguous areas in the upper Clark Fork River Basin have been designated as Superfund sites by the USEPA pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (1980). These sites are the Silver Bow Creek/Butte Area Site, the Anaconda Smelter Site, the Milltown Reservoir/Clark Fork River Site, and the Montana Pole Treating Plant Site. The Silver Bow Creek/Butte Area Superfund Site is currently further separated into seven Operable Units (OUs).

For general context, the USEPA regulates how responsible parties manage waters that enter and may eventually leave the Berkeley Pit and maintaining ground water levels in and around the BMFOU to ensure that mine-affected waters are managed and treated, if necessary, to meet water quality standards before they are discharged. The monitoring and management of ground water in the BMFOU, including the Continental Mine site, and perpetual treatment of waters that leave the mine site (whether from the Berkeley Pit, Continental Pit, or the Horseshoe Bend) are regulated by USEPA under Superfund. DEQ's Hard Rock Mining Bureau consults and coordinates with EPA, but the MMRA operating permits do not address water management that falls under Superfund. In 2002, a Consent Decree was finalized that clarified responsibilities for the water monitoring and management among the court-identified responsible parties (AR and the MR Group) with oversight by USEPA (Consent Decree for the Butte Mine Flooding Site 2002).

EPA and DEQ were co-plaintiffs in the 2002 Consent Decree and work together in the regulation of the Butte Area Superfund site. Therefore, MR's proposed amendment and the action alternatives will be evaluated for consistency with existing agreements and regulatory stipulations under Superfund and the Consent Decree.

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 primary issues of concern related to the Proposed Action include:

- Water management;
- Air quality;
- Reclamation schedule;
- Stability of the YDTI;
- Life of the mine and socioeconomic effects; and

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- Implications for BMFOU.

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

Some of the mitigation measures proposed are outside DEQ's authority to impose under the MMRA. Therefore, DEQ's ability to require such measures may be limited. In these situations, applicants have the discretion to decide whether or not to employ mitigating measures.

ALTERNATIVES CONSIDERED AND DISMISSED

Under MEPA, a reasonable alternative is one that is practical, technically possible, and economically feasible. In addition, 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 agency representatives and MR as required by Section 75-1-201(1)((B)(IV)(C)(II), MCA. Some were eliminated from further analysis. Each alternative and the reason for dismissal is described in Section 2.6. The alternatives dismissed include:

1. Dry closure of YDTI through upstream diversions for tributaries;
2. Off-site tailings storage;
3. Tailings storage in Berkeley Pit;
4. Alternative tailings management strategies; and
5. Alternative post-closure topography.

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. The more substantive consequences are presented in **Tables ES-1, ES-2, and ES-3** below. Detailed resource impacts analyses are provided in Chapter 3 (primary impacts) and Chapter 4 (cumulative and secondary impacts).

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The following tables summarize the substantive impacts identified in Chapters 3 and 4 of the DEIS for each of the alternatives. This is meant to facilitate a comparison based on the impacts most likely to occur or those that would have the potential to affect some aspect of the human environment in a substantial way. The full discussion of all potential impacts is contained in Chapters 3 and 4 in the resource-specific subsections.

Table ES-1					
Summary of the Primary Impacts of the No Action, Proposed Action, and other Alternatives organized by Resource Area.					
	No Action	Proposed Action	Accelerated Drawdown at Closure	Elimination of West Embankment Drain Pumpback at Closure	Alternative Capping Methods
Geology and Minerals	No impacts.	Disturbance to the geology of the West Embankment area would occur. Supernatant pond area would increase to the north. Drainages entering the pond would be impacted by sediment and pond water.	The impacts to the geology resources under this alternative would be identical to the Proposed Action, except for the potential reduction in time for reclamation.	The impacts to the geology resources under this alternative would be identical to the Proposed Action, except for the timing of the reclamation.	The impacts to the geology resources under this alternative would be identical to the Proposed Action, except for the potential reduction in time for reclamation.
Geotechnical Stability	No impacts.	A slight decrease in the calculated Factor of Safety values as a result of increasing the height of the West Embankment by 45 feet and from increasing the storage of tailings materials and process water.	Primary impacts would be identical to the Proposed Action. Reduction in the impounded water volume may relieve weight on the embankment.	Primary impacts would be identical to the Proposed Action. Reduction in the impounded water volume may relieve weight on the embankment.	Primary impacts would be identical to the Proposed Action
Soils and Reclamation	No impacts.	Impacts to the native soils include soil salvage and stockpiling ahead of construction and tailings inundation. The disturbed area within Operating Permit 00030A would increase by about 99 acres to accommodate increased tailings storage, West Embankment construction, topsoil storage, roads, and monitoring wells. Associated facilities, including a new RDS, an addition to an existing RDS, soil and alluvium stockpiles, access roads, and long-term monitoring sites are proposed within existing disturbed areas. Reclamation of the YDTI would be essentially the same as previously permitted. The reclamation plan includes grading, capping, and revegetation of the embankment and beach; and wet closure of the open water component with a pond volume smaller than the operation condition; and grading, capping, and revegetation of associated facilities.	The soils and the reclamation methods and procedures under this alternative are identical to the Proposed Action, except for the timing of the reclamation.	The soils and the reclamation methods and procedures under this alternative are identical to the Proposed Action, except for the timing of the reclamation.	This alternative would not allow for even placement of the alluvial material; material would segregate during the discharge process. Methods to prevent segregation of alluvial material would need to be developed to make this a viable alternative with respect to its potential impacts on soil resources and reclamation success.

Table ES-1 Summary of the Primary Impacts of the No Action, Proposed Action, and other Alternatives organized by Resource Area.					
	No Action	Proposed Action	Accelerated Drawdown at Closure	Elimination of West Embankment Drain Pumpback at Closure	Alternative Capping Methods
Surface and Ground Water	No impacts to ground water are anticipated. Water balance modeling indicates following completion of mining operations, the supernatant pond volume will reach an equilibrium volume about seven years later than under the Proposed Action. The supernatant pond water's chemical composition is forecast to be similar to local surface runoff within about 20 years of closure.	No impacts to ground water are anticipated because of natural conditions and engineered mitigation measures, primarily the WED, which are intended to maintain hydrodynamic containment of YDTI seepage. The pumpback of WED seepage to the supernatant pond is predicted to occur for 20 years until the saturated elevation within the facility is below the invert elevation of the WED. Under average climate conditions, the supernatant pond will reach an equilibrium volume of approximately 1,000 acre-feet. MR will maintain alkaline conditions in the YDTI pond during operations and with the addition of lime following closure, if needed.	Drawdown of the supernatant pond to the equilibrium volume would occur over about 1 to 16 years (Table 2.5-2) as opposed to over 30 years in the Proposed Action and No Action alternatives. Pumpback of seepage collected in the WED would cease sooner because the pond would be rapidly drawn below the critical level, potentially reducing or eliminating the need for lime to maintain alkaline pond conditions.	This alternative would reduce impacts in the same manner as the Accelerated Drawdown at Closure alternative, except pond drawdown would take longer. Eliminating the WED pumpback would potentially result in reaching the equilibrium pond volume (1,000 acre-feet) 7 years sooner than under the Proposed Action.	No impacts to ground water quality are anticipated. Water for milling and slurry transport would be sourced from the supernatant pond, so a closed loop system would be maintained, which would result in a similar supernatant pond drawdown profile as under the Proposed Action. The additional capping proposed could theoretically reduce or stop tailings acidification that may occur under other alternatives, although MR has already committed under the Proposed Action to maintain alkaline pond conditions using lime if needed.
Vegetation and Wetlands	No Impacts	Conversion of up to approximately 99 acres of forested and shrublands to open water for the duration of the project due to inundation.	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action.
Wildlife	No Impacts	Habitat loss (especially deciduous forest) associated with the 99 additional acres inundated.	Primary impacts would be similar to the Proposed Action; possibly of shorter duration.	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action; possibly of shorter duration.
Aquatics	No impacts	Loss of short sections (<0.1 mile each) of lower channel for three tributary streams. Possible reduction in habitat for fish in Yankee Doodle Creek. Loss of instream habitat for macroinvertebrates for the duration of the project.	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action.
Cultural Resources	No Impacts	No impacts to significant cultural resources	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action.
Socioeconomics	No Impacts	Beneficial impact of jobs and tax revenue for longer duration	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action.
Land Use	No Impacts	Temporary change of land use for 99 additional acres that are new disturbance until reclamation is completed.	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action.

Table ES-1					
Summary of the Primary Impacts of the No Action, Proposed Action, and other Alternatives organized by Resource Area.					
	No Action	Proposed Action	Accelerated Drawdown at Closure	Elimination of West Embankment Drain Pumpback at Closure	Alternative Capping Methods
Visual Resources	No significant impacts	No significant impacts	No significant impacts	No significant impacts	No significant impacts
Noise	No Impacts	Increase noise levels at residences in the West Ridge area.	Primary impacts would be identical to the Proposed Action	Primary impacts would be identical to the Proposed Action	Primary impacts would be identical to the Proposed Action
Air Quality	Minor primary impacts meeting ambient air quality standards	Minor primary impacts with no increase in ambient air impacts, but the potential for long term impacts is increased with respect to the No Action	Minor primary impacts with no increase in ambient air impacts, but the potential long-term impacts are decreased in comparison to Proposed Action, due to reduced reclamation timeline	Minor primary impacts with no increase in ambient air impacts, but the potential long-term impacts are decreased in comparison to Proposed Action	Minor primary impacts with no increase in ambient air impacts, but the potential short-term impacts are decreased in comparison to Proposed Action

The following table is a summary of the secondary impacts discussions in Section 4.5. Please see the resource specific subsections for more details on the rationale for these impacts.

Table ES-2					
Summary of the Secondary Impacts of the No Action, Proposed Action, and other Alternatives organized by Resource Area.					
	No Action	Proposed Action	Accelerated Drawdown at Closure	Elimination of West Embankment Drain Pumpback at Closure	Alternative Capping Methods
Geology and Minerals	No Secondary Impacts	No Secondary Impacts	No Secondary Impacts	No Secondary Impacts	No Secondary Impacts
Geotechnical Stability	No Secondary Impacts	No Secondary Impacts	No Secondary Impacts	No Secondary Impacts	No Secondary Impacts
Soils and Reclamation	No Secondary Impacts	Secondary impacts similar to impacts associated with the No Action Alternative except for potential erosion due to the addition of 85.4 acres of soil salvaged.	Secondary impacts of this Alternative are similar to the Proposed Action except that topsoil would spend less time in a stockpile prior to placement and revegetation.	Secondary impacts of this Alternative are similar to the Proposed Action except that topsoil would spend less time in a stockpile prior to placement and revegetation.	Secondary impacts similar to the Proposed Action. The potential for reducing wind erosion would be possible. The addition of extra water to move the capping materials into place may have the opposite effect of speeding the reclamation effort and slow the reclamation process due to the extra water being added.
Surface and Ground Water	No Secondary Impacts	No Secondary Impacts	Management of water pumped from the YDTI under this alternative may lead to secondary impacts. If water drawn from the YDTI is stored in the Continental Pit, the estimated time for the Continental Pit to reach its critical level could change from 137 to 110 years. Additionally, the reclamation timeframe for the YDTI would be reduced under this alternative.	If WED pumpback water is diverted and stored in the Continental Pit under this alternative, the timeframe for the Continental Pit to reach its critical level would be reduced, although less so compared to the Accelerated Drawdown at Closure alternative because a smaller volume of YDTI water would ultimately be stored. To preclude acidification of the Continental Pit lake, WED seepage would be amended with lime to neutralize acidity. The reclamation timeframe for the YDTI	No Secondary Impacts

Table ES-2					
Summary of the Secondary Impacts of the No Action, Proposed Action, and other Alternatives organized by Resource Area.					
	No Action	Proposed Action	Accelerated Drawdown at Closure	Elimination of West Embankment Drain Pumpback at Closure	Alternative Capping Methods
				would also be reduced under this alternative.	
Vegetation and Wetlands	No Secondary Impacts	Changes to vegetation in areas inundated or adjacent to the inundated areas due to soil moisture and changing conditions.	Secondary impacts would be similar to the Proposed Action. Time to total reclamation may be reduced by as much as 20 to 30 years if the tailings consolidate as modeled. This would allow more rapid reseeding and replanting which may be substantial in terms of vegetation succession, overall land appearance, and wildlife use.	Secondary impacts would be similar to the Proposed Action. Time to total reclamation may be reduced by as much as 7 years if the tailings dry sooner and allow more rapid reseeding and replanting.	Secondary impacts would be similar to the Proposed Action. Time to total reclamation may be reduced if the tailings dry sooner and allow more rapid reseeding and replanting.
Wildlife	No Secondary Impacts	Temporary reduced carrying capacity for some wildlife species. Disturbance from elevated noise levels.	Secondary impacts would be similar to the Proposed Action. However, this alternative may allow these land uses to be achieved as much as two to three decades sooner, which may be substantial in terms of vegetation succession, overall land appearance, and wildlife use.	Secondary impacts would be similar to the Proposed Action.	Secondary impacts would be similar to the Proposed Action.
Aquatics	No Secondary Impacts	Changes in the tributary channel conditions adjacent to inundated area.	Secondary impacts would be identical to the Proposed Action.	Secondary impacts would be identical to the Proposed Action.	Secondary impacts would be identical to the Proposed Action.
Cultural Resources	No Secondary Impacts	No Secondary Impacts	No Secondary Impacts	No Secondary Impacts	No Secondary Impacts
Socioeconomics	No Secondary Impacts	Beneficial effect from MR jobs and tax revenue for longer duration	Secondary impacts would be similar to the Proposed Action.	Secondary impacts would be similar to the Proposed Action.	Secondary impacts would be similar to the Proposed Action.
Land Use	No Secondary Impacts	Negligible effects from vegetation shifts	Secondary impacts would be identical to the Proposed Action. However, this alternative may allow post-closure land uses to be achieved as much as 20 to 30 years sooner, which may be substantial in terms of vegetation succession, overall land appearance, and wildlife use.	Secondary impacts would be identical to the Proposed Action.	Secondary impacts would be identical to the Proposed Action.
Visual Resources	No Secondary Impacts	No significant impacts	No significant impacts	No significant impacts	No significant impacts
Noise	No Secondary Impacts	Wildlife avoidance of area, including winter habitats.	Secondary impacts would be identical to the Proposed Action	Secondary impacts would be identical to the Proposed Action	Secondary impacts would be identical to the Proposed Action
Air Quality	Minor secondary impacts	Minor secondary impacts with an increase in potential for long term secondary impacts with respect to the No Action	Minor secondary impacts with a decrease in potential long term secondary impacts with respect to the Proposed Action	Minor secondary impacts with a decrease in potential long term secondary impacts with respect to the Proposed Action	Minor secondary impacts with a decrease in potential short term secondary impacts with respect to the Proposed Action

The following table is a summary of the cumulative impacts discussions in Section 4.2. Please see the resource specific subsections for more details on the rationale for these impacts.

Table ES-3 Summary of the Cumulative Impacts of the No Action, Proposed Action, and other Alternatives organized by Resource Area.					
	No Action	Proposed Action	Accelerated Drawdown at Closure	Elimination of West Embankment Drain Pumpback at Closure	Alternative Capping Methods
Geology and Minerals	No cumulative impacts	Continued mining would remove the minerals available in and around the Continental Mine. The cumulative impact to minerals and geology when combined with the past and future activity in the area would be measurable, but these impacts would not be considered adverse as the removal of minerals is part of the purpose and need of the Proposed Action.	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action
Geotechnical Stability	No cumulative impacts	A slight decrease in the calculated Factor of Safety values as a result of increasing the height of embankment by 45 feet and from increasing the storage of tailings materials and process water.	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action
Soils and Reclamation	No cumulative impacts	No cumulative impacts to soil and reclamation.	The only change to soil and reclamation would be in the timing compared to the Proposed Action. No cumulative impacts to soil and reclamation.	The only change to soil and reclamation would be in the timing compared to the Proposed Action. No cumulative impacts to soil and reclamation.	The only change to soil and reclamation would be in the timing compared to the Proposed Action. No cumulative impacts to soil and reclamation.
Surface and Ground Water	There would be no cumulative impacts to ground water. During operations, a Superfund-managed pilot-scale treatment test at HsB Water Treatment Plant will require pumpback of minimally treated Horseshoe Bend seepage into the supernatant pond. This may lead to temporary increases in TDS, sulfate, and other constituents in the supernatant pond. Following closure, cumulative impacts to the BMFOU would increase because the YDTI supernatant pond and Horseshoe Bend seepage would no longer be managed in a closed loop by MR.	There would be no cumulative impacts to ground water due to proposed strategies for hydrodynamic containment. During operations, cumulative effects would be the same as for the No Action Alternative, including the effect of the Superfund pilot-scale treatment project. Closure-related cumulative effects to the BMFOU would be deferred by about 9 years compared to the No Action Alternative because mine operations would keep Horseshoe Bend seepage in a closed loop during the extended life of the mine. After closure, cumulative	Cumulative impacts would be similar to those anticipated for the Proposed Action except that they will differ during the accelerated drawdown period. During this time, excess water could potentially be stored in the Continental Pit, or a BMFOU treatment facility would directly receive water from the supernatant pond, which would result in a large volume of water and chemical load requiring treatment sooner compared to the No Action and Proposed Action alternatives.	Cumulative effects would be similar to those anticipated for the Accelerated Drawdown at Closure Alternative except that potential BMFOU facilities would receive WED seepage flow, at a lower rate than the Accelerated Drawdown scenario, and for a longer period of time.	Cumulative impacts associated with the Alternative Capping Methods Alternative would be the same as under the Proposed Action. No makeup water from outside the YDTI system would be required to process and transport the cap material slurry. Therefore, no changes to post-closure water management would be required.

Table ES-3					
Summary of the Cumulative Impacts of the No Action, Proposed Action, and other Alternatives organized by Resource Area.					
	No Action	Proposed Action	Accelerated Drawdown at Closure	Elimination of West Embankment Drain Pumpback at Closure	Alternative Capping Methods
	Rather, the seepage would become the responsibility of the BMFOU to manage, resulting in increased water volume and chemical constituent loading to the BMFOU.	effects would be the same as under the No Action alternative, with the addition of the possibility that water from the YDTI could end up in the Continental Pit via a proposed emergency spillway.			
Vegetation and Wetlands	No cumulative impacts	Minor changes in vegetation composition and mosaic in the context of the surrounding mined area. Cumulative impacts would be negligible.	Cumulative impacts would be similar to the Proposed Action	Cumulative impacts would be similar to the Proposed Action	Cumulative impacts would be similar to the Proposed Action
Wildlife	No cumulative impacts	Minor additional cumulative habitat losses if additional residential development in cumulative effects area	Cumulative impacts would be similar to the Proposed Action	Cumulative impacts would be similar to the Proposed Action	Cumulative impacts would be similar to the Proposed Action
Aquatics	No cumulative impacts	Minor additional changes to aquatic habitat in the mouths of the tributary streams. In the context of the Silver Bow Creek watershed, these impacts are negligible.	Cumulative impacts would be similar to the Proposed Action	Cumulative impacts would be similar to the Proposed Action	Cumulative impacts would be similar to the Proposed Action
Cultural Resources	No cumulative impacts	No cumulative impacts	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action
Socioeconomics	No cumulative impacts	No cumulative impacts	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action
Land Use	No cumulative impacts	No cumulative impacts	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action
Visual Resources	No cumulative impacts	No cumulative impacts	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action
Noise	No cumulative impacts	No cumulative impacts	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action
Air Quality	Minor cumulative impacts	Minor cumulative impacts with an increase in potential for cumulative impacts with respect to the No Action	Minor cumulative impacts with a decrease in potential for cumulative impacts with respect to the Proposed Action	Minor cumulative impacts with a decrease in potential for cumulative impacts with respect to the Proposed Action	Minor cumulative impacts with a decrease in potential for cumulative impacts with respect to the Proposed Action

PREFERRED ALTERNATIVE

ARM 17.4.617(9) requires an agency to state a preferred alternative in the draft EIS, if one has been identified, and to give its reason for the preference. DEQ has identified the West Embankment Drain (WED) Pumpback Elimination at Closure Alternative as the agency's preferred alternative.

Under the Proposed Action, the impoundment seepage captured by the WED would be pumped back into the impoundment after mining ceases (closure). It is estimated that this would occur for approximately 20 years, or until the tailings pond level decreases to the point that the West Embankment Drain no longer captures impoundment seepage. Pumping the impoundment seepage captured by the WED back into the impoundment would maintain a closed loop so that water only permanently exits the facility through evaporation or through seepage at Horseshoe Bend, where it is captured and treated under the Superfund remedy. Because the impoundment seepage captured by the WED is anticipated to be acidic with elevated ion and metal concentrations, the seepage would be treated with lime to limit the acidification of the remnant tailings pond. When the WED ceases to capture impoundment seepage, it would be grouted to prevent continued discharge. The rate of reclaiming the surface of the impoundment is contingent upon safe access to dry tailings, which relies on draining the tailings pond to a steady state ("equilibrium").

Under the WED Pumpback Elimination at Closure alternative, the impoundment seepage captured by the WED would be diverted to the Continental Pit for storage (i.e. within the previously approved closure pit lake) or to the Horseshoe Bend Treatment Plant for treatment and discharge under the Superfund remedy. If the WED effluent is routed to the Continental Pit for storage, it would first be treated, if necessary, to eliminate acidity and maintain alkaline conditions in the Continental Pit lake. This would eliminate the need to maintain pumpback systems for decades post-closure, and the need to lime the impoundment seepage captured by the WED to mitigate acidification of the tailings pond. Furthermore, water balance modeling indicates that draining the tailings pond to a steady state would be accelerated by approximately 7 years by eliminating the return of tailing seepage back to the pond. As a result, the schedule for reclaiming the exposed tailings surfaces would be accelerated. Finally, the WED would not be grouted at some point after cessation of tailings disposal in the impoundment, but would be allowed to continue to function as a drain. This would maintain a more robust groundwater divide between the tailings impoundment and groundwater resources to the west of the West Ridge. For these reasons, the WED Pumpback Elimination at Closure alternative was selected as the agency's preferred alternative.

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 the permit amendment application contains all necessary information and whether the proposed amendment satisfies the substantive requirements of the MMRA.

Executive Summary

DEQ determined that MR's permit amendment application was complete and compliant on August 31, 2018 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 even though DEQ believes that there is environmental benefit to the WED Pumpback Elimination at Closure Alternative. However, if after the public comment period, DEQ still prefers the WED Pumpback Elimination at Closure alternative, the applicant and BMFOU parties could voluntarily agree to the alternative.

The WED Pumpback Elimination at Closure Alternative presents a different scenario for YDTI water management at closure, which necessitates recognition of USEPA's authority over long-term water management and treatment at the site under the BMFOU. Discussions and coordination with all parties in the 2002 BMFOU Consent Decree would be needed to review the options and feasibility for handling and treating this water, the potential use of existing or upgraded facilities and infrastructure (e.g. HsB Water Treatment Plant), and to amend the agreement accordingly.

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1 PURPOSE AND NEED FOR ACTION

1.1 INTRODUCTION

This draft environmental impact statement (EIS) was prepared for the proposed permit amendments submitted by Montana Resources, LLP (MR) for the Continental Mine in Silver Bow County, Montana. On October 6, 2017, MR submitted an application to amend Operating Permit 00030 (Amendment 3) and Operating Permit 00030A (Amendment 10) to the Montana Department of Environmental Quality (DEQ). The amendments address proposed changes to the Yankee Doodle Tailings Impoundment (YDTI) at the Continental Mine in Butte, Montana.

DEQ prepared this draft EIS to present the analysis of possible environmental consequences of five alternatives: the No Action Alternative, the Proposed Action: On-Site Tailings Storage and Water Containment, the Accelerated Drawdown at Closure Alternative, the Elimination of West Embankment Drain Pumpback at Closure Alternative, and the Alternative Capping Methods Alternative. The five alternatives are described in detail in Chapter 2.

1.2 PURPOSE AND NEED

DEQ's purpose and need in conducting the environmental review is to act upon MR's application to amend Operating Permits Nos. 00030 and 00030A to expand the capacity of the YDTI. The proposed amendment would raise the elevation of the YDTI West Embankment from the 6,405 feet to 6,450 feet, to match the presently permitted elevations of the East-West and the North-South Embankments. The proposed amendment would allow for increased tailings storage and a commensurate extension of the northern boundary of the tailings pond, a new rock disposal site, expand an existing rock disposal site, provide for construction of a closure spillway and new soil stockpiles, and revise the operation, reclamation, and closure phases of the impoundment. The proposed amendment would allow for an additional 9 years of operation of the mine at current production levels. However, continued operations under the proposed amendment would be limited by production rates and the capacity of the YDTI, and should DEQ approve the amendment, it would not specify a duration for operations. DEQ's action on the proposed amendments would be governed by the substantive provisions of the MMRA.

The proposed amendment would increase the total area of Permit 00030A by approximately 237 acres, but only 99 of these acres would be disturbed to accommodate the West Embankment raise and YDTI expansion. Although the proposed amendment would affect mine facilities that are located within Operating Permit 00030, it would not authorize the disturbance of any additional land under Operating Permit 00030.

The Montana Environmental Policy Act (MEPA) (Section 75-1-201, *et seq.*, Montana Code Annotated (MCA), requires an environmental review of actions taken by the State of Montana that may significantly affect the quality of the human environment. This EIS was prepared to satisfy this MEPA requirement. Prior to beginning its environmental review under MEPA, DEQ reviewed MR's amendment application and determined that it was complete and complied

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with the Metal Mine Reclamation Act (MMRA), Section 82-4-301, *et seq.*, MCA, and issued a draft permit amendment on August 31, 2018. Issuance of the draft permit amendment as a final permit amendment is the proposed state action subject to this environmental review under Section 82-4-337(1)(f), MCA.

DEQ will decide which alternative should be approved in DEQ's Record of Decision (ROD) based on information provided in the amendment application, the analysis in the EIS, and the substantive provisions of the MMRA. 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.

1.3 PROJECT LOCATION AND HISTORY

MR operates an open pit copper-molybdenum mine adjacent to the city of Butte, Montana in Silver Bow County (**Figure 1.3-1**). The Continental Mine produces copper sulfide concentrate, molybdenum disulfide concentrate, and copper precipitate (cement copper) for sale in the United States and world markets. MR operates the Continental Mine under Operating Permits 00030, 00030A, 00041, and 00108. The Continental Pit, the site of active mine operations, is currently permitted to produce ore for in excess of 20 years; however, ore reserves may exceed those reported in MR's Operations Plan (February 2018).

This section is a summary of information on the project location, mine site history, and current operations provided in the amendment application, which is available online at <http://deq.mt.gov/land/hardrock>.

1.3.1 Mine Site History

The area surrounding Butte has been actively mined for generations. Gold placer mining was conducted in the Upper Clark Fork area in the 1860s and 1870s and included the development of mining camps along Silver Bow Creek. Hard rock mining for silver ore began in the 1870s, resulting in a more permanent settlement of the area. Marcus Daly developed the Anaconda Copper Mining Company (ACM), organized the ACM properties with the assets of the Standard Oil Company in 1899, and included other mine properties owned by Augustus Heinze in 1906 and W. A. Clark in 1910. Extensive polymetallic underground mines were developed beneath Butte through the first half of the 20th century and by 1950, the ACM controlled all mining operations in Butte (Montana Resources 2018a).

ACM began open pit mining at the Berkeley Pit in 1955. Construction of the YDTI began in 1963, utilizing waste rock from the Berkeley Pit. The ACM sold all its corporate assets to the Atlantic Richfield Company (AR) in 1977. In 1980, AR suspended all smelting activities in Anaconda and Great Falls (Montana Resources 2018a).

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Mining activity in the Berkeley Pit was reduced in the early 1980s due to low metal prices, ultimately ending in April 1982. District dewatering pumps were turned off, allowing the underground mines and the Berkeley Pit to gradually fill with water from the bedrock and alluvial aquifers and site runoff once mining operations ceased.

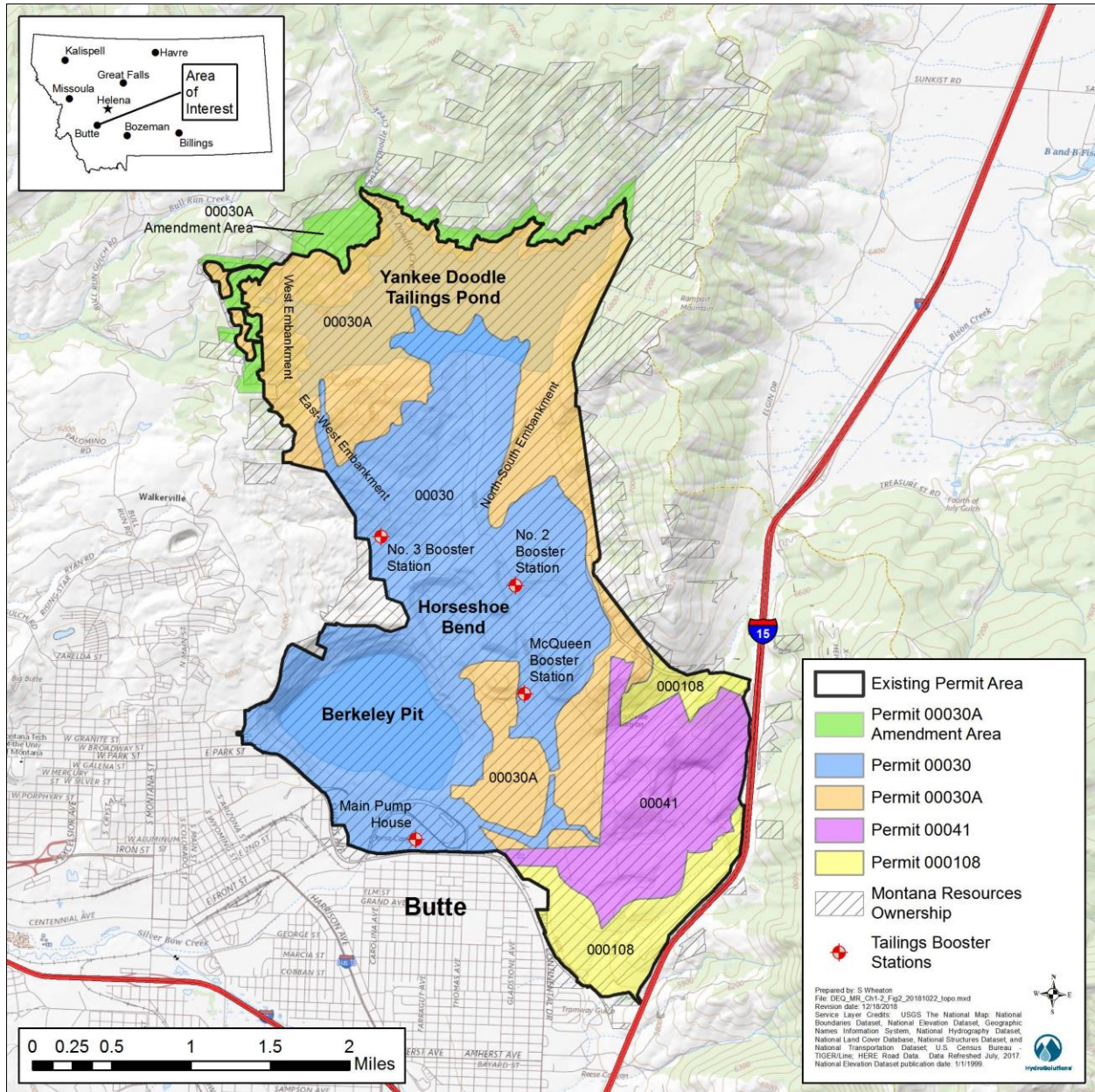


Figure 1.3-1. Project Location and internal permit boundaries for the Montana Resources Amendment Application.

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Montana Resources, Inc. (MRI) purchased the property from the ACM and began mining the East Berkeley (Continental) Pit in 1986. Mining permits were transferred from MRI to Montana Resources, LLP, a general partnership (MR) in 1989. Waste rock from the Continental Pit was used to continue construction of the YDTI. MR ceased to operate the leach dump pads in 1999 but then resumed limited leaching in 2004, with gradually increasing volume and leaching of dumps by September 2012. MR suspended mining operations from 2000 to 2003 due to high electricity prices; however, mining and processing operations recommenced in 2003 (Montana Resources 2018a).

1.3.2 Current Operations

On October 6, 2017, MR submitted an application to amend Operating Permits 00030 and 00030A. The proposed amendment would raise the elevation of the YDTI West Embankment from the 6,405 feet to 6,450 feet, to match the presently permitted elevations of the East-West and the North-South Embankments. The amendment would allow for increased tailings storage and a commensurate extension of the northern boundary of the tailings pond, a new rock disposal site, expansion of an existing rock disposal site, provide for construction of a closure spillway and new soil stockpiles, and revise the operation, reclamation, and closure phases of the impoundment. The proposed amendment would allow for an additional 9 years of operation of the mine at current production levels.

The land covered by Operating Permits 00030 and 00030A includes portions of: Section 1, T3N R8W, Section 6, T3N R7W, Section 36, T4N R8W, Section 31, T4N R7W, Section 30, T4N R7W, Section 29, T4N R7W, and Section 32, T4N R7W. The current facilities and land ownership boundaries are shown on **Figure 1.3-1**.

The proposed amendment would increase the total area of Permit 00030A by approximately 237 acres, but only 99 of these acres would be disturbed to accommodate the West Embankment raise and YDTI expansion. Although the proposed amendment would affect mine facilities that are located within Operating Permit 00030, it would not authorize the disturbance of any additional land under Operating Permit 00030.

1.3.3 Superfund and the Butte Mine Flooding Operable Unit

The following sections describe some of the regulatory actions and documents that have affected management of the Butte Mine Flooding Operable Unit (BMFOU) since its establishment in the 1980s. These actions reflect changes in conditions at the site, changes in regulations, and updates to models used to evaluate the site. These materials are intended to provide context for the actions and alternatives evaluated in this EIS. This EIS does not attempt to describe all aspects of the management of the BMFOU, the interagency planning and management commitments, or the complex history and development of the Butte Mining Complex. The references section of the EIS includes bibliographic information for cited documents should the reader wish to examine the primary sources.

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For general context, the U.S. Environmental Protection Agency (USEPA) regulates the waters that enter and may eventually leave the Berkeley Pit and requires control of ground water levels in and around the BMFOU to ensure that mine-affected waters are managed and treated, if necessary, to meet water quality standards before they are discharged. The monitoring and management of ground water in the BMFOU, including the Continental Mine site, and perpetual treatment of waters that leave the mine site (whether from the Berkeley or Continental pits or the Horseshoe Bend) are regulated by the USEPA under Superfund. DEQ's Hard Rock Mining Bureau consults and coordinates with USEPA, but the MMRA operating permits do not address water management that falls under Superfund. In 2002, a Consent Decree was finalized that clarified responsibility for the water monitoring and management to the court-identified responsible parties (AR and the MR Group) with oversight by USEPA (Consent Decree for the Butte Mine Flooding Site 2002). Section 1.3.3.1 provides more detail on the Consent Decree.

In 1982, the USEPA proposed that Silver Bow Creek be added to the National Priority List (NPL), and it was listed as a Superfund site in 1983. The Butte Area was added to the Silver Bow Creek site in 1987 (USEPA 2018a). A total of four contiguous areas in the upper Clark Fork River Basin have been designated as Superfund sites by the USEPA pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (1980). These sites are the Silver Bow Creek/Butte Area Site, the Anaconda Smelter Site, the Milltown Reservoir/Clark Fork River Site, and the Montana Pole Treating Plant Site. The Silver Bow Creek/Butte Area Superfund Site is currently further separated into seven Operable Units (OUs). Details on the OUs most relevant to the proposed amendment are provided below.

- The BMFOU includes most of MR's mine permit area (**Figure 1.3-2**). The boundaries of the BMFOU are the Continental Divide to the east, Silver Bow Creek to the south, Missoula Gulch to the west, and the Yankee Doodle Creek and Moulton Reservoir watersheds to the north (USEPA 2018a). Descriptions of features within the BMFOU are provided in the following section.
- Butte Priority Soils OU (BPSOU) is a five square mile area that includes the town of Walkerville, along with the part of the Butte Hill that is north of Silver Bow Creek, west of the Berkeley Pit, and east of Big Butte. It also includes a section of land extending south from Silver Bow Creek to Timber Butte. The BPSOU includes residential yards, mine dumps, contaminated railroad beds, and stormwater drainages on the Butte Hill and in Walkerville.
- The Butte Active Mine Area OU (BAMAOU) is contained within the BMFOU and the boundary is established to coincide with the operating permit area for the mine operations. USEPA has deferred authority for mine permitting decisions, such as this amendment, to DEQ (USEPA and DEQ 2001).

The Berkeley Pit is filling with water originating from: the surrounding bedrock aquifer, which includes several thousand miles of flooded underground mine workings; the surrounding

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alluvial aquifer; and additional surface inflows. The Horseshoe Bend area is a discharge point where several million gallons per day of contaminated alluvial ground water surfaces at the base of the tailings impoundment. This discharge historically flowed to the Berkeley Pit, but USEPA ordered the capture and use of Horseshoe Bend flow in the mining operation from April 15, 1996 until July 1, 2000, when the mining operation was suspended (USEPA and DEQ 2002).

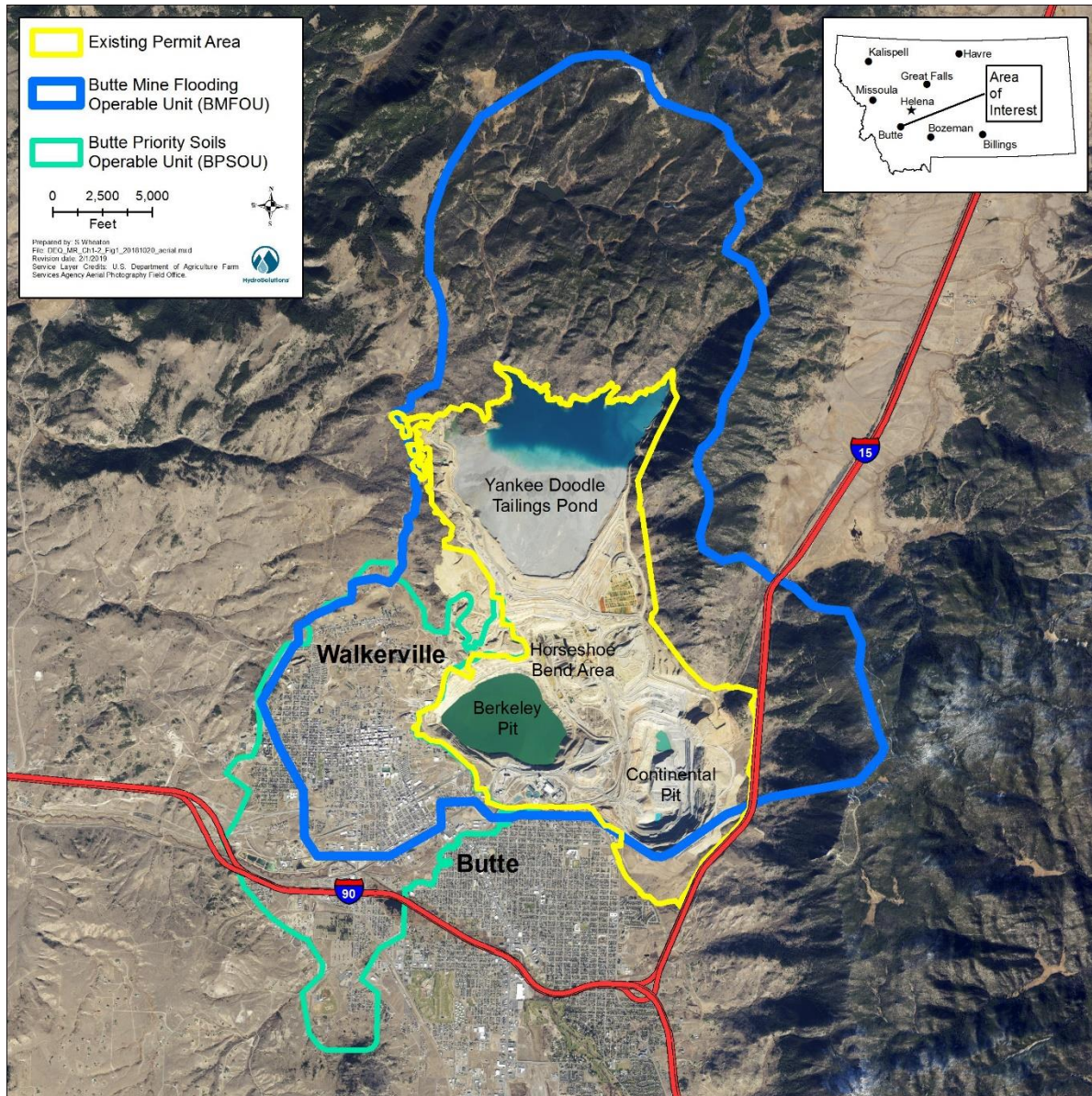


Figure 1.3-2. Montana Resources Continental Mine Permit boundary and the Butte Mine Flooding Operable Unit boundary.

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Following the suspension of mining, the Horseshoe Bend flow was no longer treated and integrated into the tailings circuit, so the contaminated Horseshoe Bend water was directed back to the Berkeley Pit. Under the requirements in the 1994 ROD, this triggered the final design process for a Water Treatment Plant at Horseshoe Bend (the HsB Water Treatment Plant), which was approved by USEPA in 2002. The HsB Water Treatment Plant is a lime precipitation high density sludge (HDS) Water Treatment Plant capable of treating average flows of 5 million gallons per day (MGD) and peak flows of 7 MGD. It was designed to be capable of treating Horseshoe Bend water, Continental Pit, and Berkeley Pit water when it becomes necessary.

1.3.3.1 2002 Consent Decree

A consent decree is a legal document, approved by a judge, that formalizes an agreement reached between USEPA and Potentially Responsible Parties (PRPs) through which PRPs will conduct all or part of a cleanup action at a Superfund site; cease or correct actions or processes that are polluting the environment; or otherwise comply with USEPA initiated regulatory enforcement actions to resolve the contamination at the Superfund site involved. In 2002 a consent decree formalized and described the actions that DEQ, representing the State of Montana, and USEPA have agreed that the PRPs (identified in the 2002 Consent Decree as AR and the MR Group) will take in the BMFOU.

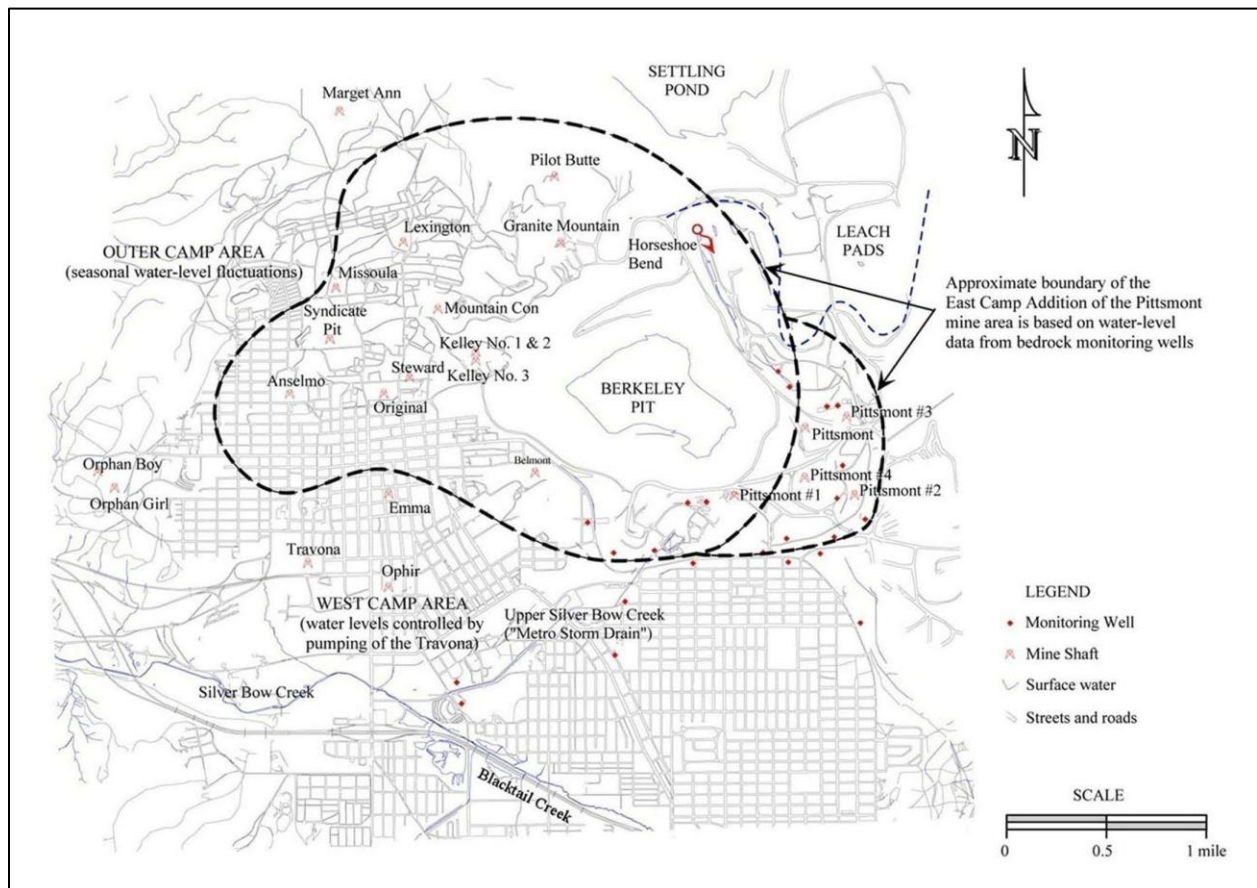
As described in the 2002 Consent Decree, the BMFOU site consists of:

- The waters within the Berkeley Pit;
- The underground mine workings hydraulically connected to the Berkeley Pit;
- The alluvial aquifer near the Berkeley Pit which drains into the Berkeley Pit;
- The bedrock aquifers, including the bedrock aquifer water in and near the Continental Pit;
- Other contributing sources of inflow to the Berkeley Pit/East Camp system, including surface runoff, leach pad, and stormwater that enters the Berkeley Pit from the BPSOU; tailings slurry circuit overflows; and Horseshoe Bend surface water flows;
- The Travona/West Camp ground water system, unless that ground water discharge becomes part of the BPSOU response actions upon approval by EPA, in consultation with the state; and
- The surface area designated for the potential development of a sludge repository.

Presently, because all bedrock ground water in the East Camp area flows toward the Berkeley Pit, and because the Travona/West Camp removal action controls releases from that system, contaminated mine water is being contained in the East and West camps. The East Camp is largely encompassed within the southern portion of the BMFOU. The West Camp area is to the southwest of the Berkeley Pit (**Figure 1.3-3**). However, if ground water levels continue to rise beyond critical elevation levels, the hydraulic gradient could change,

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and contaminated water could flow out of the East and West Camps into the surrounding alluvial ground water and eventually to Silver Bow Creek. To prevent this from occurring, USEPA and DEQ determined that the water levels in the BMFOU boundary must not rise above the critical water level (CWL) of 5,410 feet for the East Camp and 5,435 feet for the West Camp.



Source: 2011 BMFOU report (MBMG 2012)

Figure 1.3-3 Approximate location of the East and West Camp Areas in relation to the Town of Butte, Montana.

1.3.3.2 2002 Explanation of Significant Differences

Also in 2002, the USEPA and DEQ evaluated the actions prescribed in a 1994 Record of Decision (ROD) for the BMFOU and updated the ROD where significant differences were identified. The significant differences were caused by new standards, changes in existing permits, or transfers of responsibility among the Operable Units (USEPA and DEQ 2002). The remedy (remedial actions) selected in the 1994 Record of Decision (ROD) (USEPA 1994), as amended by the 2002 Explanation of Significant Differences (ESD), included the following components:

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- Control of inflow from Horseshoe Bend with exceptions for short-term flows to the Berkeley Pit;
- Routing of stormwater runoff from upper areas of BPSOU to the Berkeley Pit;
- Treatment of surface water and ground water from Horseshoe Bend and Continental Pit at the HsB Water Treatment Plant and the potential use of water in the mining process or discharge to Silver Bow Creek;
- Allowance for placement of HsB Water Treatment Plant sludges in the Berkeley Pit;
- Treatment of West Camp water in the Butte Treatment Lagoons under BPSOU activities; and
- If water is discharged to Silver Bow Creek after treatment at the HsB Water Treatment Plant (instead of being used in active mining operations), it must meet all applicable surface water discharge standards identified in the ROD and ESD.

In addition to the changes in how water is managed in the area, the ESD included these changes:

- The Upgradient Bypass condition in the 1994 ROD was modified to accommodate potential wet closure of Yankee Doodle Tailings Pond;
- Authority for the management and reclamation of the sludge repository was transferred from the DEQ mine permit to Superfund through the BMFOU; and
- Complete transfer of authority for Yankee Doodle Tailings Pond dam stability monitoring to DEQ via the MMRA permitting process (USEPA and DEQ 2002).

The interaction between the BPSOU and the BMFOU was also further defined to state that the storm water runoff from certain areas within the BPSOU boundaries would be routed under USEPA Superfund orders and directions to the Berkeley Pit. The treatment of this storm water becomes a responsibility transferred to the BMFOU after it enters the Berkeley Pit.

The West Camp water is treated at the BPSOU Lower Area One treatment lagoon system (Butte Treatment Lagoons). The treatment of this water is a responsibility that was transferred to the BPSOU activities during treatability studies but has since been returned to the BMFOU.

Other changes in responsibility and water management established that Continental Pit water that would accumulate post-mining would be treated in the HsB Water Treatment Plant, and allowed HsB Water Treatment Plant sludges to be placed in the Berkeley Pit without offsetting water withdrawals.

EPA issued a decision document (Response Decision Deferral Document, USEPA and DEQ, 2001) with the concurrence of DEQ which adjusted boundaries between USEPA's BMFOU and the BAMAOU and announced USEPA's intent to refrain from taking Superfund action at the BAMAOU and to defer to State mine permit actions (like this amendment) for environmental cleanup of that area. USEPA reserved the right to exercise CERCLA authority at the site should

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the reclamation plan not be implemented by MR and/or enforced by DEQ, or the bonding proves inadequate to cover the cost of reclamation required by the permit.

1.3.3.3 Integration of the Proposed Amendments

The background information on the history and current regulatory context is necessary for evaluation of the proposed amendment and any alternatives or stipulations. DEQ examines amendment applications for consistency and compliance with the MMRA (Section 82-4-301, *et seq.*, MCA), the Montana Water Quality Act (Section 75-5-101, *et seq.*, MCA), the Clean Air Act of Montana (Section 75-2-101, *et seq.*, MCA), and other relevant legislation and regulations. In addition, the Superfund status of the BMFOU and DEQ's position as a party in the 2002 Consent Decree requires that any actions proposed at the Continental Mine must be consistent with the 2002 Consent Decree and other decision documents that direct management within the BMFOU. Furthermore, actions that have the potential to affect conditions at facilities within the BMFOU such as the Horseshoe Bend area or the Berkeley Pit must be coordinated with EPA.

1.4 SCOPE OF THE DOCUMENT

The geographic scope of this EIS covers the lands within the Continental Mine permit boundaries that may be affected by an alternative being analyzed, with a focus on those lands within the permits to be amended, 00030 and 00030A (**Figure 1.3-1**). The EIS will only disclose potential impacts within the state of Montana as required by MEPA (75-1-201(2)(a), MCA). Five alternatives are described and evaluated in detail in this EIS. Chapter 2 describes the No Action Alternative, the Proposed Action: On-Site Tailings Storage and Water Containment, the Accelerated Drawdown at Closure Alternative, the Elimination of West Embankment Drain at Closure Alternative, and the Alternative Capping Methods Alternative. The action alternatives include additional mitigation measures developed by DEQ. The five alternatives are described in detail in Chapter 2.

Chapter 3 describes the existing environment and environmental consequences to the resource areas from implementation of the alternatives. Resource areas discussed in detail include: geology and minerals, geotechnical engineering, soils and reclamation, surface and ground water, vegetation, wildlife, aquatics, cultural resources, socioeconomics, land use, visuals, noise, and air quality. Chapter 4 describes the cumulative, unavoidable, irreversible, irretrievable, and secondary impacts that may occur under the alternatives. Chapter 5 provides a comparison of alternatives, Chapter 6 documents agency consultation and coordination, and Chapter 7 lists the preparers. Chapter 8 contains the glossary and acronym list and Chapter 9 lists the references cited in the EIS.

1.5 AGENCY ROLES AND RESPONSIBILITIES

DEQ is responsible for administrating the MMRA and the administrative rules adopted to implement the MMRA. DEQ is responsible for issuing and amending operating permits under the MMRA. **Table 1.5-1** lists the regulatory authority and permits issued by DEQ and EPA.

Table 1.5-1. Regulatory Authority and Responsibilities of the DEQ and USEPA related to the Montana Resources Permit Amendment.

Regulatory Authority	Purpose
Department of Environmental Quality	
Metal Mine Reclamation Act (Section 82-4-301, <i>et seq.</i> , MCA)	MMRA regulates the mining of ore or rock in the state to provide adequate environmental protection. Mining must comply with state environmental laws and administrative rules. Approval may include stipulations for mine operation and reclamation. A sufficient reclamation bond must be posted with the state before an operating permit or operating permit amendment is issued.
MEPA Analysis of Impacts (75-1-102, MCA)	To disclose possible impacts to the human environment.
Montana Water Quality Act, (75-2-101, <i>et seq.</i> , MCA), Montana Pollutant Discharge Elimination System (MPDES) for Active Mine Area	To establish effluent limits, treatment standards, and other requirements for point source discharges to state waters, including ground water for active mine areas. Discharges to waters may not violate water quality standards.
Clean Air Act of Montana, (75-5-101, <i>et seq.</i> , MCA)	To control particulate emissions of more than 25 tons per year.
US Environmental Protection Agency	
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as Superfund (42 U.S.C. §§9601-9675)	Allows USEPA to clean up contaminated sites. It also forces the parties responsible for the contamination to either perform cleanups or reimburse the government for EPA-led cleanup work. When there is no viable responsible party, Superfund gives USEPA the funds and authority to clean up contaminated sites.
National Priorities List (subset of Superfund sites)	Long-term remedial response actions, that permanently and significantly reduce the dangers associated with releases or threats of releases of hazardous substances that are serious, but not immediately life threatening.

1.5.1 Metal Mine Reclamation Act

DEQ's hard-rock mine permitting and amendment process is governed by the MMRA. MMRA requires review of each application in stages: a deficiency review, a completeness and compliance determination that may lead to issuance of a draft permit or draft permit

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amendment, and a decision. DEQ regulates the mining of all ore, rock, or substances except oil, gas, bentonite, clay, coal, sand, gravel, peat, soil materials and uranium under the MMRA. DEQ is required to issue timely and complete operating permit decisions for mining and reclamation of hard rock operations. In addition, the permitting process ensures appropriate public involvement through compliance with MEPA.

Once DEQ receives an operating permit amendment application, the agency reviews it for completeness and compliance under the MMRA. DEQ may request additional information or modification of the application in order to deem it complete or ensure compliance with mine reclamation, water quality, and air quality regulations. After the mine operator responds to any deficiencies and DEQ has determined the application to be complete and compliant under the MMRA, DEQ issues a draft operating permit amendment. This is the point in the process where review under MEPA begins. Issuance of the draft permit amendment as a final permit amendment is the state action subject to MEPA. DEQ has one year within which to conduct the environmental review. The MMRA provides the substantive requirements governing DEQ's action on permit and permit amendment applications. MEPA is procedural. The purpose of requiring an environmental review under MEPA is to assist the legislature in determining whether laws are adequate to address impacts to Montana's environment and to inform the public and public officials of potential impacts resulting from decisions made by state agencies (Section 75-1-102(1), MCA).

DEQ reviews all amendment applications for completeness and compliance with 82-4-337 (amendments to a permit) and 82-4-336 (reclamation plan), MCA, and the rules implementing that section and all information necessary to initiate processing. As part of this review, DEQ reviews the materials submitted for any deficiencies corresponding to requirements under Administrative Rules of the State of Montana (ARM) Title 17 Chapter 24, Subchapter 1. Deficiency notices are submitted to the proponent and specify what information is missing or incomplete.

An application is considered complete and compliant once all deficiencies have been addressed and DEQ determines the substantive provisions of the MMRA are met. DEQ determines the appropriate level of environmental review under MEPA, either an Environmental Assessment (EA) or an EIS. An EIS is required where DEQ determines that the application involves a major action significantly affecting the environment (ARM 17.4.608). Alternatively, DEQ may prepare an EA to determine whether preparation of an EIS is required. In addition, ARM 17.4.617(9) permits DEQ to identify the agency's preferred alternative in an EIS, if any, and the reasons for the preference. Upon completion of the environmental review, DEQ issues a Record of Decision document.

1.5.2 Montana Resources Continental Mine: YDTI Amendment

DEQ received an amendment application from MR on October 6, 2017. After several reviews and deficiency responses that addressed DEQ concerns, DEQ determined the application was

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complete and complied with the requirements of the MMRA. On August 31, 2018, DEQ issued a draft permit amendment. The draft permit triggered the MEPA process. Issuance of the draft permit amendment as a final permit amendment is the proposed state action subject to an environmental review under MEPA.

The purpose of MR's proposed amendment is to increase the capacity of the YDTI by raising the elevation of the West Embankment to match the presently permitted elevations of the other two embankments and extending the northern boundary of the impoundment. The proposed elevation raise is supported by a Design Document that contains statutory requirements detailed in Section 82-4-376, *et seq.*, MCA. Changes to MR's operating permits that would result from this proposed amendment are described under the Proposed Action in Chapter 2.

1.5.3 Other Agency Roles

1.5.3.1 US Environmental Protection Agency (Superfund)

As noted earlier, the Silver Bow Creek area was added to the National Priority List in 1982, and it was listed as a Superfund site in 1983. The Butte Area was added to Silver Bow Creek site in 1987. From 1988 to 2005, USEPA completed several removal actions to clean up areas around former smelter sites, mine waste dumps, railroad beds, stream banks and channels, and residential yards to address immediate human health and environmental risks (USEPA 2018a).

Removal and cleanup actions have been completed to address immediate threats to human health and the environment in Butte. Cleanup, operation and maintenance, sampling, and monitoring actions are ongoing. Throughout the Superfund cleanup in Butte, USEPA has completed four, Five-Year Reviews to determine how the remedy is working and if it remains protective of human health and the environment (USEPA 2018a). The last Five-Year Review was completed in 2016. USEPA is the lead agency for overseeing and enforcing the cleanup at the Butte Area Superfund Site with the exception of the Streamside Tailings Operable Unit (SSTOU) (USEPA 2016). DEQ is the support agency representing the State of Montana for all OUs except the SSTOU, where it is the lead agency. USEPA is responsible for conducting the site-wide Five Year Review which compares monitoring results with the remedy prescriptions and assesses efficacy. PRPs finance and implement cleanup at the Site, with the exception of the SSTOU where DEQ is implementing the remedy using funds provided by the PRP. DEQ reviews the Five Year Reviews and provides input to EPA.

EPA and DEQ published an Explanation of Significant Differences for the BMFOU ROD that modified some aspects of the ROD but retained other aspects and CERCLA requirements. USEPA and DEQ were co-plaintiffs in the 2002 Consent Decree and work together in the regulation of the Butte Area Superfund site. Therefore, MR's proposed amendment and the action alternatives will be evaluated for consistency with existing agreements and regulatory stipulations under Superfund and the Consent Decree.

1.5.3.2 Independent Review Panel

The Independent Review Panel (IRP) consists of three engineers or specialists as required by 82-4-377, MCA. The IRP is tasked with reviewing the design documents for the YDTI including the proposed changes to the West Embankment and increased operating capacity. The IRP reviewed these documents and assessed the completeness and scientific rigor of aspects including, but not limited to, the geotechnical investigations of the site, any models used to evaluate the designs, demonstration that the expansion of the facility meets the minimum requirements for a new tailings facility (82-4-376(2)(i), MCA) or that it does not reduce the tailings storage facility's original design factors of safety and seismic event design criteria, and several analyses of the site's performance under flooding and site stressors. The design documents must also be certified by an engineer of record (EOR) (82-4-375, MCA) and are submitted to DEQ as part of the amendment review process. More details on the roles of the IRP and the EOR are provided in Chapter 2, Section 2.2.

1.6 PUBLIC INVOLVEMENT

MEPA provides two opportunities for public review and comment on an EIS. The first opportunity occurs at the initiation of a project during scoping and the second opportunity occurs after the environmental analysis is made available in the draft document. The purpose of scoping is to gather input from the public, agencies, and organizations on the issues of concern and potential alternatives that would meet the purpose and need for a project.

1.6.1 Scoping

The scoping period for the MR YDTI EIS began on September 14, 2018 and ended on October 15, 2018. DEQ published legal notice of the scoping period and meeting in the *Montana Standard* on September 16, 23, 30, and October 7 and 14, 2018. The legal notice was also published on DEQ's website beginning on September 12, 2018.

DEQ held a public scoping meeting and open house in Butte, Montana on October 4, 2018. Approximately 100 people attended the meeting. DEQ provided a court reporter for transcribing oral comments during the meeting and accepted written comments at the meeting, as well as comments submitted via email and postal mail prior to the deadline. The transcript of the meeting and written comments are included in the Administrative Record for the project.

1.6.2 Scoping Comments

DEQ collected written 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. Each substantive comment was categorized based on the topic or topics it discussed. During the development of alternatives considered in the EIS, DEQ will take into consideration the issues brought forward in these comments.

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DEQ received 22 written comments during the scoping period in addition to the 10 comments made verbally by individuals at the October 4, 2018 scoping meeting. Some commenters submitted multiple comment documents. Comments and concerns expressed included:

- Socioeconomic effects of the MR mine operation;
- Air and water quality concerns;
- Stability of geologic faults underlying the mine; and
- Stability of the embankment system.

1.7 ISSUES OF CONCERN

The primary issues of concern related to the Proposed Action include:

- Water management;
- Air quality;
- Reclamation schedule;
- Stability of the YDTI;
- Life of the mine and socioeconomic effects; and
- Implications for the BMFOU.

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2 DESCRIPTION OF ALTERNATIVES

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

2.1 DEVELOPMENT OF ALTERNATIVES

To be considered for further analysis, each potential alternative had to meet the purpose and need of increasing the storage capacity of the tailings impoundment. An alternative must be reasonable, in that the alternative is achievable under current technology and is economically feasible as determined solely by the economic viability for similar projects having similar conditions and physical locations and determined without regard to the economic strength of the specific project sponsor (75-1-201, (1)(b)(iv)(C)(I), MCA). "Alternatives" may include design parameters, mitigation, or controls other than those incorporated into a Proposed Action by an applicant or by DEQ prior to preparation of an EA or draft EIS (ARM 17.4.603(2)(a)(ii)). An alternatives analysis under MEPA does not include an analysis of alternatives to the proposed project itself (75-1-220(1), MCA).

MEPA requires the analysis of the Proposed Action, reasonable alternatives to the Proposed Action, and the No Action alternative. During the course of the environmental analysis, DEQ 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 criteria for reasonableness. These alternatives are summarized in Section 2.8, Alternatives Considered but Dismissed from Further Analysis.

2.1.1 Elevations and Datums

In order to maintain consistency with the proposed amendment application materials, maps and figures related to the Continental Mine presented in this EIS reference the site coordinate system known as the Anaconda Mine Grid established by the ACM in 1957. The Anaconda Mine Grid is based on a vertical datum established in 1915. Elevations in this EIS are generally stated in Anaconda Mine Grid coordinates with respect to the ACM Vertical Datum, which is typically 52.6 feet higher than the U.S. Geological Survey (USGS) datum (slight variations in the elevation correction factor occur around the mine). Information on areas outside of the mine boundary or provided by sources other than MR are presented in the USGS datum or elevation above mean sea level (AMSL).

2.2 DESIGN DOCUMENTS, INDEPENDENT REVIEW PROCESS, AND ENGINEER OF RECORD

In accordance with 82-4-377, MCA, an IRP is contracted with the operator or permit applicant to review 1) the design document, 2) the underlying analysis, 3) assumptions for consistency, and 4) assess the practicable application of current technology in the proposed design of a mine tailings storage facility. The panel submits its review and any recommended modifications to the operator or permit applicant and DEQ. The panel's determination is conclusive. The EOR is

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required to modify the design document to address the recommendations of the panel and certify the completed design document.

Section 82-4-376, MCA, describes the design document requirements for an operator proposing to expand an existing tailings storage facility and is the governing legislation for preparation of the expansion design. The requirements include:

“An evaluation indicating that the proposed tailings storage facility will be designed, operated, monitored, and closed using the most applicable, appropriate, and current technologies and techniques practicable given site-specific conditions and concerns.”

The MMRA further defines the word “practicable” to mean the following:

“Available and capable of being implemented after taking into consideration cost, existing technology, and logistics in light of the overall project purposes.” (82-4-303(25), MCA)

The alternative assessment completed by Knight Piesold on MR’s behalf fulfills the requirements of the legislation by comparing the alternatives for continued tailings storage in order to provide a transparent rationale for the selection of certain alternatives (Knight Piesold 2017a).

An application for a permit or a permit amendment for a new tailings storage facility or expansion of an existing tailings storage facility must include the designation of an EOR and contact information. As described in 82-4-375, MCA, the responsibilities of the EOR include the following:

- 1) Review the design and other documents pertaining to the tailings storage facility;
- 2) Certify and seal designs or other documents pertaining to the tailings storage facility submitted to DEQ;
- 3) Complete an annual inspection of the tailings storage facility;
- 4) Notify the operator when credible evidence indicates the tailings storage facility is not performing as intended; and
- 5) Immediately notify the operator and DEQ when credible evidence indicates that the tailings storage facility presents an imminent threat or a high potential for imminent threat to human health or the environment.

The responsibility of the IRP is to provide an evaluation indicating whether the proposed YDTI expansion is designed, and will be operated, monitored, and closed, using the most applicable, appropriate, and current technologies and techniques practicable, given site-specific conditions and concerns. The IRP determined that the design document for expansion of the YDTI addresses all MCA requirements. Based on the selection of appropriate parameters and sound technical evaluations, the IRP accepted the adequacy of the design (Montana Resources, LLP 2017).

2.3 NO ACTION ALTERNATIVE

MEPA requires an analysis of the No Action Alternative. The No Action Alternative provides a comparison of environmental conditions without the proposal and establishes a baseline for evaluating the Proposed Action and the other alternatives. MEPA requires the consideration of the No Action Alternative, even if it fails to meet the purpose and need or would not be able to satisfy environmental permitting standards.

2.3.1 Introduction to the Alternative

Under the No Action Alternative, MR would continue to operate under its existing operating permits. The tailings storage capacity in the YDTI would remain unchanged, the northern boundary of the YDTI would not be expanded, disturbed acreage would not be increased, and revisions to the existing reclamation and closure plans would not be necessary. MR mining operations would continue through 2022 and be limited to the current permits which include Operating Permits 00030, 00030A, 00041, and 00108, along with associated amendments, modifications, and revisions. A summary of all operating permits and components can be found in Montana Resources Continental Mine Operations Plan dated February 2017 and revised February 2018 (Montana Resources 2018a).

2.3.2 Permit Boundary and Disturbed Area Description

The permit boundary for currently permitted Operating Permits 00030 and 00030A, along with the area that would be added to Permit 00030A under the Proposed Action, is shown on **Figure 1.3-1**. Under the No Action Alternative, no acreage would be disturbed outside of the current permitted design area. The height of the West Embankment would remain at 6,405 feet, the northern boundary of the YDTI would not be expanded, and disturbed acreage would not be increased. Distribution of currently permitted acreage is shown in **Table 2.3-1** (Montana Resources 2018b).

**Table 2.3-1
Acreages Associated with MR Operations – Currently Permitted Design**

Location	Area (Acres) ^a
N-S and E-W Embankments	
Reclaimed Slope (2.7H:1V)	209
Reclaimed Slope (2H:1V)	64
West Embankment	
Reclaimed Slope (3H:1V)	118 ^g
Reclaimed Slope (2.5H:1V)	8 ^g
Slope above Precipitation Plant (Riprap)	14
Reclaimed Crest	166
Reclaimed Beach	
At Closure ^b	806
At Pond Equilibrium ^c	1,305
Transition Zone ^d	

**Table 2.3-1
Acreages Associated with MR Operations – Currently Permitted Design**

Location	Area (Acres)^a
At Closure ^b	232
At Pond Equilibrium ^c	122
Pond	
At Closure ^b	560
At Pond Equilibrium ^c	171
SUB-TOTAL YDTI AT CLOSURE	2,177
Associated Facilities	
North RDS ^e	
Reclaimed Slopes	-
Reclaimed Top/Benches	-
Great Northern RDS	133
Reclaimed Slopes	
Reclaimed Top/Benches	
New Reclamation Material Stockpiles	
Soil	27
Alluvium (temporary) ^f	
SUB-TOTAL ASSOCIATED FACILITIES	160

Source: (Montana Resources 2018b, Knight Piesold 2019a, Knight Piesold 2019b)

^aAreas are plan areas, not sloped areas; totals are ±1 acre due to rounding. Numbers in this table are estimates based on the most recent 2018 KP Water Balance and 2019 KP Surface Modeling Tables.

^bClosure for the currently permitted design is 2022 and 2031 for the 6,450 design.

^cEquilibrium in the current permit is assumed at a pond volume of about 500 acre-feet. However, to facilitate comparison with the proposed amendment, acreages are provided for an approximate 1,000 acre-feet pond. Both the currently permitted design and the 6,450 design assume a freshwater input of 1 MGD.

^dThe Transition Zone is assumed to be about 800 feet wide along the beach and pond boundary.

^eThe North RDS covers about 92 acres of the embankment, primarily the previously permitted face of the North-South Embankment.

^fTemporary alluvium stockpiles are within the footprints of the North and Great Northern RDS.

^gIncludes areas disturbed by construction of the starter dike and WED.

2.3.3 YDTI West Embankment and Water Management

The elevation of the West Embankment would remain at 6,405 feet and not be raised to the proposed elevation of 6,450 feet to match the presently permitted elevations of the East-West and North-South Embankments. Storage capacity of the YDTI would not be increased beyond the currently approved conditions, which would likely support continued mining operations until closure in 2022.

Water management would be expected to continue as permitted. MR monitors surface water quality at several sites within and adjacent to the mine. The locations of monitoring sites are

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shown on **Figure 2.3-1**. The Berkeley Pit and Horseshoe Bend area monitoring sites are sampled as part of the BMFOU. The monitoring program continuously evolves with changes in the operation and site conditions. MR annual reports for the mining permits present current surface water monitoring locations and sampling results. The ground water monitoring data are included in monthly BMFOU reports. Yankee Doodle, Dixie, and Silver Bow creeks drain directly into the YDTI supernatant pond. The term supernatant refers to the liquid lying above a solid residue after settling, in this case the water in the tailings pond sitting above the tailings solids. Drainages along the east side of the permit area (e.g., Woodville Gulch and Horse Canyon) drain westward into rock disposal sites (RDS), the Continental Pit, YDTI, or the Clearwater Ditch. The Clearwater Ditch begins on the west side of Interstate-15 and extends along the east and south sides of the project site. It collects runoff from RDSs located along the east side of the permit area and the Hillcrest dump to the south, transporting it to a collection pond near the Butte Concentrator where it is used for makeup water needs.

The west side of the permit area is located near the drainage divide separating the mine area from Bull Run Creek and Oro Fino Gulch, where surface water flows west. Any ephemeral surface water that flows east from this divide into the mine area is redirected by the West Embankment of the YDTI or enters the YDTI.

Ground water in much of the mine area is dominated by flow toward, and into, the Berkeley Pit. Ground water occurs in three general units: alluvium, weathered bedrock, and competent bedrock. The weathered bedrock zone generally acts as a confining layer between the alluvium and competent bedrock in parts of the permit area and has similar appearance and hydrologic properties as the overlying alluvium/colluvium in other areas (i.e., peripheral to the YDTI). There is a large ground water cone of depression surrounding the Berkeley Pit.

The WED is a subsurface aggregate drain, designed to intercept seepage migrating west from the YDTI above an elevation of 6,350 feet (Knight Piesold 2017b). The WED has been constructed as approved by DEQ in Amendment 9 to Operating Permit 00030A (February 2015). The WED is constructed along the upstream toe of the West Embankment and drains by gravity to the south to a permanent Extraction Pond. Additional details about the function of the WED and seepage pumpback systems are described in Section 2.4.3. The majority of water input into YDTI originates from tailings slurry, which enters the YDTI at a rate of approximately 22 million gallons per day. The current gains and losses of water to the YDTI from the water balance model are shown in **Table 2.3-2** and would continue under the No Action Alternative.

Under the No Action Alternative, the tailings pond would not exceed the operational elevation of 6,360 feet and would not have the potential to impact ground water gradients to the west. The WED would still effectively capture seepage moving west from the YDTI pond, but at a lesser flow than what is anticipated for increasing pond elevations as part of the Proposed Action.

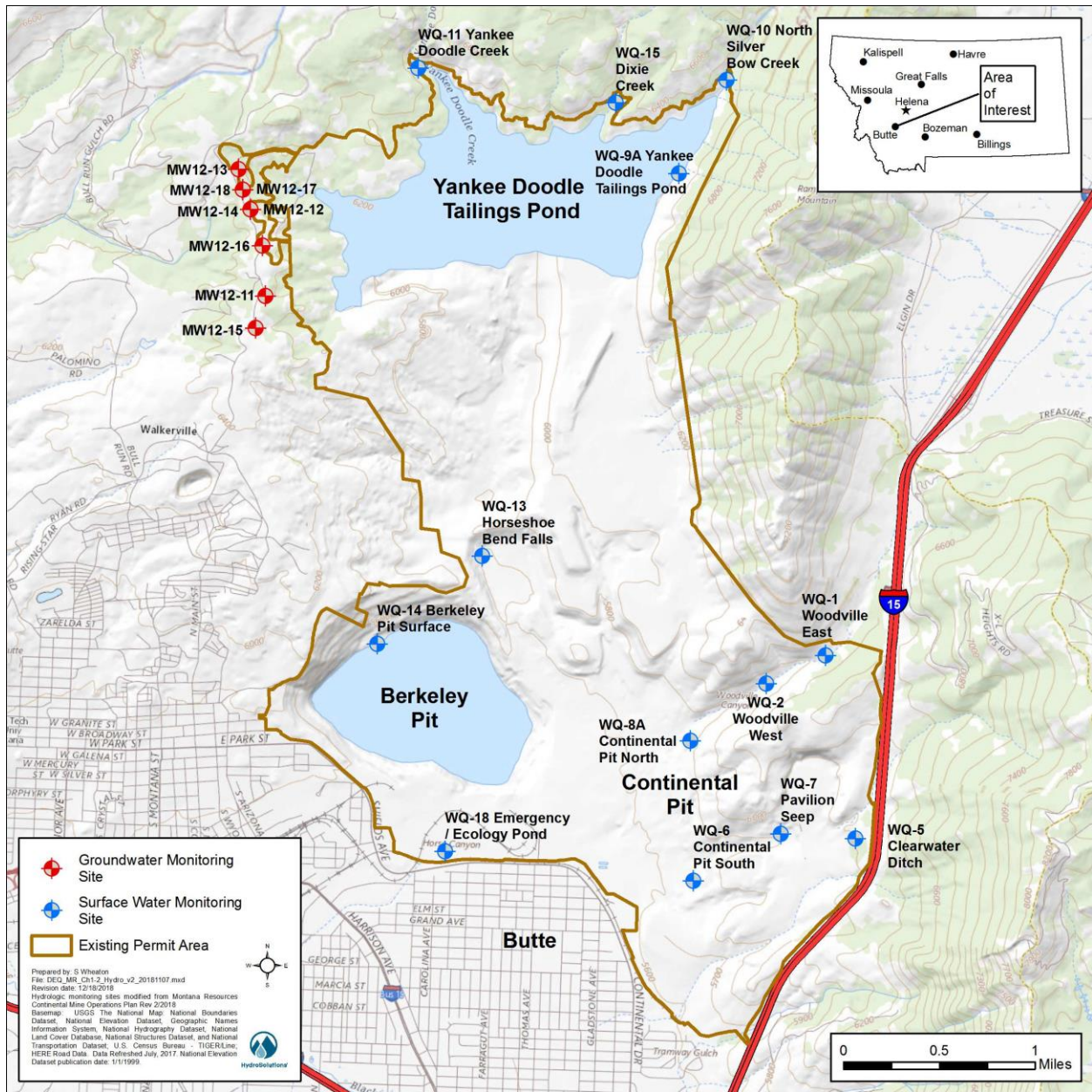


Figure 2.3-1. Current hydrologic monitoring sites, Yankee Doodle Tailings Impoundment and Continental Mine Operations.

**Table 2.3-2.
Gains and losses of water to the YDTI**

Source	Average Flow Contribution for 2007-2012 (MGD)	Water Quality Model Assumption
<i>2007 to 2012 Gains (26.45MGD)</i>		
Rainfall on Pool	0.62	Assumed equal to 1 mg/L for major ions
Runoff from Beach	0.14	Assumed 50 % of concentration in tailings slurry to account for partial dilution by rainfall. Only applies to operational period. For post-closure two contact water scenarios (Worst and Probable Case) were simulated.
Runoff to Tailings from Upgradient Watershed	0.70	Based on average water quality at surface water (SW) stations for upper Silver Bow, Yankee Doodle, and Dixie Creek.
Water in Tailings Slurry	21.59	Determined using solver routine in Excel to generate best fit to pool chemistry.
Water Pumped from Horseshoe Bend Area	0.00	Measured during times when Horseshoe Bend was pumped to YDTI.
West Embankment Drain	0.00	8 components of flow each have distinct water quality. No flow from WED in calibration period as West Embankment not yet constructed.
Makeup Water	3.36	Silver Lake water source.
<i>2007 to 2012 Losses (26.47 MGD)</i>		
Pool Evaporation	1.25	No effect on chemical load but increases concentration.
Water Lost to Void Space	4.40	Concentration assumed to be same as previous time step in model.
Seepage Loss	4.34	Concentration assumed to be same as previous time step in model.
Water Reclaimed for Processing in Mill	16.44	Concentration assumed to be same as previous time step in model.
<i>Pool</i>		
Pool	Average 2007-2012 20,950 ac ft	Model prediction compared to pond water quality measurements for calibration period.

Source: (Schafer Limited LLC 2018)

Notes: Gains and losses of water for the YDTI based on the water balance model completed by Knight Piesold 2017.

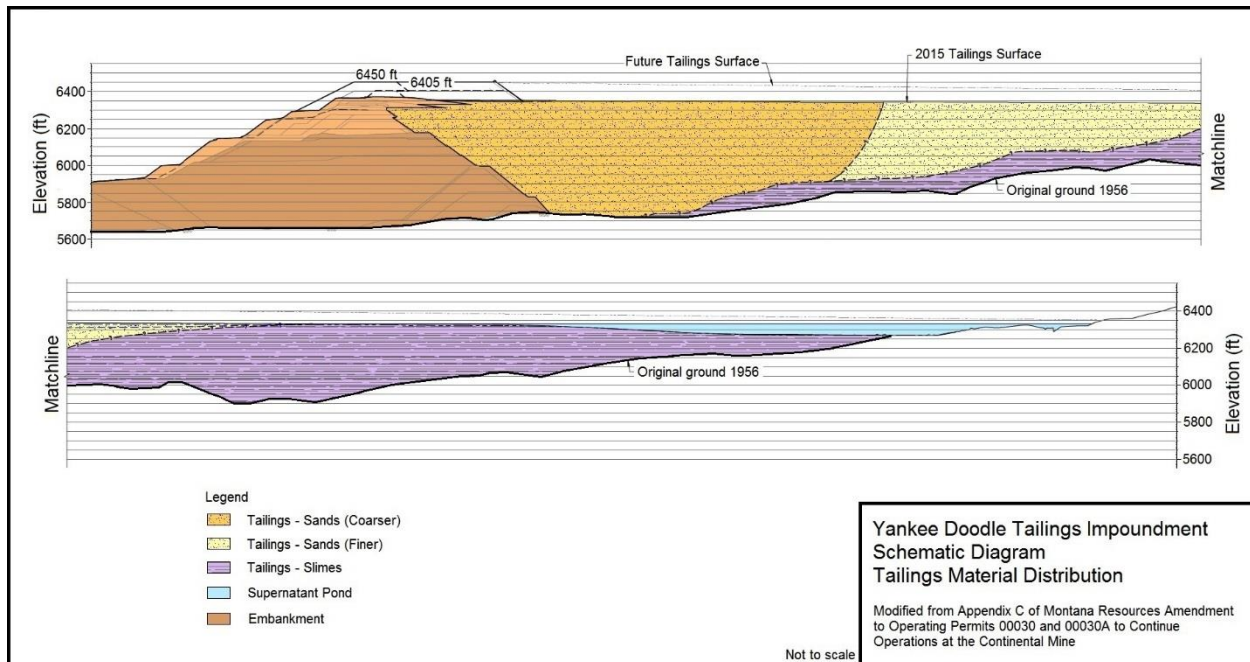
MGD Million gallons per day

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As described in detail in Appendix C of the Amendment Application (Montana Resources 2018b) (Schafer Limited LLC 2018), surface runoff from the tailings would continue to flow into the YDTI pool due to the northward sloping tailings beach. Seepage of process solution or excess meteoric water would flow downward and toward the south, driven by the draining effect of the embankment rockfill and the underlying natural topography. Near the embankment, excess water contained in tailings deposited on the beach would drain downward through a saturated zone within the tailings, through predominantly unsaturated embankment rockfill, and into a saturated zone in the lower portion of the embankment. The current distribution of tailings in the YDTI is shown on **Figure 2.3-2**. The seepage would then move to the Horseshoe Bend area in a series of prominent springs which surface near the Precipitation Plant. In tailings located further from the embankment, water would drain preferentially to the south toward the embankment within the tailings because of the low permeability slimes that occur at the base of the tailings and limit seepage to the foundation. Ground water movement in the shallow fractured bedrock and colluvium in the tailings foundation is also to the south toward Horseshoe Bend Springs. The WED may intercept a portion (about 20 percent) of the tailings seepage.

The primary water supply to the Butte Concentrator is reclaim water from the YDTI supernatant pond which is conveyed either directly to the Butte Concentrator or to a process water reservoir for storage prior to use. Flows from Continental Pit dewatering, YDTI seepage collected at Horseshoe Bend (post treatment in the HsB Water Treatment Plant), and surface runoff from catchments downstream of the YDTI also discharge into the Butte Concentrator process water reservoir. A potable water supply from Butte's municipal water supply and a freshwater makeup supply from Silver Lake are also used in the Butte Concentrator to meet specific processing water quality requirements.

The primary water consumptions in order of usage would continue to include: 1) water stored in pore spaces within the tailings mass, 2) evaporation from ponded water surfaces, 3) site dust control, 4) HsB Water Treatment Plant sludge discharge to the Berkeley Pit, and 5) water in concentrate shipped off site.



(Schafer Limited LLC 2018)

Figure 2.3-2. YDTI tailings material distribution.

2.3.4 Associated Mine Facilities, Materials, and Personnel

Under the No Action Alternative, no changes would occur to the associated facilities permitted under Operating Permits 00030, 00030A, 00041, and 00108. Access roads and pit haul roads would continue to be maintained for safe conditions. Haul truck traffic would continue to occur 7 days per week, 24 hours per day, 365 days per year.

Salvage of material for mine reclamation, including alluvium, leached cap overburden, and soil, has been contemporaneous with mining and would continue as those materials are encountered until mining ceases. Some alluvium is suitable for use as surface or sub-surface reclamation material, and some leached cap material is suitable for use as subsoil reclamation material. Existing stockpiles and capping materials to be salvaged from the mine would be utilized to meet the anticipated volume goals of capping for reclamation at the end of mining operations. Although most alluvium and leached cap to be mined in the near term in the Continental Pit would continue to be used for existing permitted embankment construction, reserves of alluvium in the Central Zone (including the McQueen alluvium borrow area) would need to be characterized and selectively excavated in order to be available for reclamation. This alluvium reserve is abundant and would be adequate for reclamation of mine components. A detailed discussion of capping materials is presented in the Mine Operations Plan (Montana Resources 2018a).

Salvage of topsoil and subsoil has been limited within the mine boundary because most of the active mine area was developed prior to soil salvage guidelines and regulations. Therefore,

recently salvaged soils and potential future salvage targets are generally limited to areas surrounding the YDTI. Soils and alluvium salvaged since 1972 from existing disturbances (pits, leach pads, waste rock dumps, YDTI, and other mine support facilities) have been used for concurrent reclamation or have been stockpiled at selected locations around the mine site.

Workforce levels would be expected to remain the same and operations would continue into approximately 2022. Although ore reserves would support operations beyond 2022, the mine life would not be extended because additional tailings storage capacity in the YDTI would not be available. Although MR's workforce may fluctuate on a seasonal and annual basis, the operation has typically employed between 350 and 400 employees and on-site contractors since 2010.

2.3.5 Reclamation and Revegetation

The following information about the existing reclamation plan for the current permitted mine operations is summarized from Knight Piesold Reclamation Overview document (Knight Piesold 2018b) and from MR Operations Plan (Montana Resources 2018a).

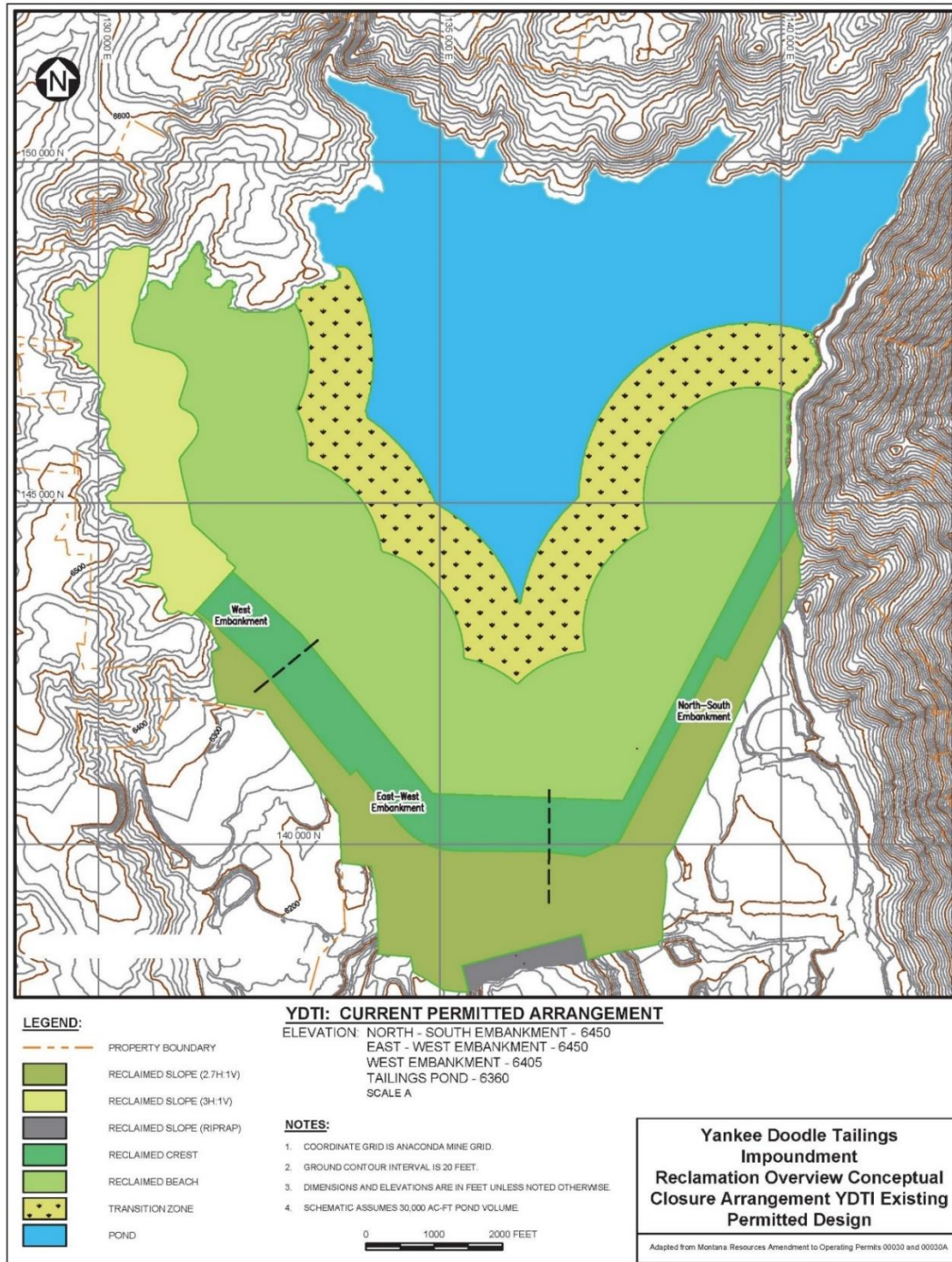
2.3.5.1 Reclamation Plan for YDTI

The No Action post-closure reclamation plan for the YDTI is described in the amendment application (Montana Resources 2018b). The existing permitted closure design is shown on **Figure 2.3-3**. Mining operations under the No Action Alternative would likely continue through 2022 and mine capacity, design, and processes would be limited to the current permits. Pond equilibrium for the No Action Alternative would be reached in approximately 2061 (Knight Piesold 2018b).

The reclamation plan for most of the tailings embankment would include regrading the downstream slopes to a ratio of 2.7 horizontal to 1 vertical (2.7H:1V), placing a 20-inch thick amended alluvium cap on the regraded surface, and revegetating the slope. The downstream slope of the northern portion of the West Embankment would be regraded to 3H:1V. The access road along the embankment crest would remain for post-closure monitoring. Ditches and swales would be constructed at 100-foot intervals on the regraded slopes to promote drainage and reduce erosion of the reclamation cap.

The section of the embankment adjacent to the Precipitation Plant would be reclaimed differently from the rest of the embankment. A cover of coarse rockfill (riprap) material would be placed on top of the constructed (steeper) slopes. The area of slope protected by riprap would be 2,000 feet long, 450 feet high, and 3 feet thick. The riprap material would be coarse (18-inch minus), durable, non-acid generating rock sourced from off-site. The reclaimed slopes would be revegetated using primarily native and introduced grasses and forbs. Species would be used that are locally adapted to a relatively wide range of cover material and conditions.

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Source: (Knight Piesold 2018b)

Figure 2.3-3. Reclamation overview and closure plan for the No Action Alternative.

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A 6-inch thick layer of rockfill would cover the tailings beach areas that are susceptible to wind erosion after completion of operations. The cover would be composed of rock, leached cap, or similar material and seeded for dust control if spreading of alluvium is not promptly conducted. Reclamation of the tailings beach areas would follow, including placement of a 28-inch thick amended alluvium cap and revegetation. A partial wet closure scenario is planned for the northern portion of the tailings impoundment consisting of a pond and adjacent wetland area, which would be periodically inundated as the seasonal pond water level fluctuates.

The alluvium used for reclamation would be excavated from the Central Zone area, located between the Berkeley and Continental Pits. The alluvium may need to be amended with lime for pH adjustment (to reduce acidity) and the addition of compost to increase the organic material content. The amount of amendment required would depend on the characteristics of the capping material and the quality of lime and organic material. Soil testing would be completed to confirm the required amendment specifications at the time of reclamation.

During closure, the tailings would be progressively reclaimed. Initially, the beach that is safely accessible would be reclaimed within 3 years of the end of operations. As the pool gradually recedes and the tailings stabilize, the beach surface more than 800 feet from the pool would be reclaimed. Remaining areas near the pool called the Transition Zone would remain without cover due to seasonal variation in pool stage. When saturated, the high-water content and low strength of the tailings would make cover placement hazardous (Knight Piesold 2018b).

Infiltration of water into the tailings from precipitation would vary between reclaimed and unreclaimed conditions. For unreclaimed tailings, 35 percent of precipitation water would be assumed to infiltrate whereas only 10 percent of precipitation water would be assumed to infiltrate for reclaimed conditions.

West Embankment Drain

The conceptual model developed for the water balance identifies separate sources and flowpaths for water entering the WED. Constant sources of inflow include ground water at 60 gallons per minute (gpm), runoff from the watershed area upgradient of the West Embankment at 24 gpm, runoff from the West Embankment at 14.8 gpm, and seepage through the surface of the West Embankment at 9.9 gpm (Schafer Limited LLC 2018). The remaining inflows to the WED would be variable and would include runoff, and about 20 percent of the seepage from the YDTI pool that would have otherwise traveled to the south and discharged at the Horseshoe Bend area. Seepage from the pool would include flow through the beach at 28 gpm and flow through the slimes at 0.010 gpm. Additional contributions to the WED would include infiltrating precipitation from beach sediments at 15.8 gpm and infiltration from slimes at 6.8 gpm (Schafer Limited LLC 2018). This volume would be expected to decrease when tailings slurry is no longer added to the YDTI and movement to more static conditions exist at closure.

2.3.5.2 Reclamation Plan for Associated Facilities

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. Materials, including the leached cap and alluvium, would be salvaged and stockpiled or excavated from the Central Zone for use during reclamation of the mine facilities.

2.4 PROPOSED ACTION ALTERNATIVE: ON-SITE TAILINGS STORAGE AND WATER CONTAINMENT

Montana Resources has submitted an amendment application proposing to raise the West Embankment of the YDTI to the 6,450-foot elevation in order to increase the impoundment capacity and extend the life of the Continental Mine. The proposed amendment also outlines modifications to waste RDSs, roads, reclamation material stockpiles, tailings lines, Moulton water pipeline replacement near the West Embankment, spillway, the WED, tailings discharge, and YDTI closure and reclamation.

2.4.1 Introduction to the Alternative

The Proposed Action would raise the West Embankment to match the presently permitted elevations of the East-West and North-South embankments. It would also extend the northern boundary of the impoundment, which would allow continued tailings deposition and extend operations at the Continental Mine. The West Embankment would be raised 45 feet from an elevation of 6,405 feet to 6,450 feet. As the pond fills to the increased capacity, it would extend the northern boundary of the tailings pond to an elevation of approximately 6,428 feet. A gravity controlled subsurface drain, known as the WED, would intercept seepage before it migrates west of the impoundment.

The total permitted area would increase by about 237 acres. Approximately 99 acres within the expanded Permit 00030A area would be disturbed to accommodate increased tailings storage, construction, topsoil storage, roads, and monitoring wells. There would be no additional disturbance within Operating Permit 00030.

Other associated facilities are proposed and would include additional non-ore storage areas developed in an existing RDS, a new RDS, stockpile areas for soil and alluvium, access roads, and long-term monitoring sites within Operating Permits 00030 and 00030A. A closure spillway has been conceptually designed to provide a system for releasing water from the tailings impoundment to the Continental Pit, which is assumed to develop a pit lake after closure, subject to the BMFOU requirements.

To achieve the geotechnical objectives for beach development, enhance embankment stability, and limit the potential for internal erosion, the practice of inundating the tailings beach with water to manage wind-blown dust would be phased out. The potential for tailings dusting would be managed using multiple discharge points or by other means to wet the beach by recycling water within the mine area during critical periods.

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Closure would include dewatering of the impoundment via seepage to the WED and Horseshoe Bend, as well as through evaporation. The tailings beach or dry area and a Transition Zone would be incrementally created by dewatering and subsequently reduce the supernatant pond. The tailings beach would remain dry and the Transition Zone would continue to retain water. The reclamation of the Beach and Transition Zone would include the incremental capping and revegetation as the areas become accessible. Final reclamation would include a partial wet closure with a reclaimed beach, Transition Zone, and a pond with a volume of approximately 1,000 acre-feet.

2.4.2 Disturbed Areas Description

The Proposed Action would increase the total YDTI acreage, including embankments, by 118 acres from 2,177 acres to 2,295 acres. The acreage associated with the mine facilities (which includes the North RDS, Great Northern RDS, and the New Reclamation Materials Stockpile) would change from 160 acres to 465 acres between the No Action Alternative and the Proposed Action. **Table 2.4-1** compares the disturbance components between the No Action and the Proposed Action. All of the acres associated with mine facilities fall within the existing permit boundary, and therefore do not contribute to new disturbances. The change in associated facility acreage does not necessarily equate to new disturbance, but the areas may be categorized differently for acreage accounting because these acreage changes occur within the current mine permit boundaries.

**Table 2.4-1
Acreages Associated with MR Operations – Currently Permitted Design (No Action) and
Proposed Action**

Location	No Action	Proposed Action	Change
	Area (Acres) ^a		
N-S and E-W Embankments			
Reclaimed Slope (2.7H:1V)	209	154	-55
Reclaimed Slope (2H:1V)	64	64	0
West Embankment			
Reclaimed Slope (3H:1V)	118 ^b	22	-96
Reclaimed Slope (2.5H:1V)	8 ^b	8	0
Slope above Precipitation Plant (Riprap)	14	14	0
Reclaimed Crest	166	229	63
Reclaimed Beach			
At Closure ^b	806	1,122	316
At Pond Equilibrium ^c	1,305	1,487	182
Transition Zone ^d			
At Closure ^b	232	220	-12
At Pond Equilibrium ^c	122	146	24
Pond			

**Table 2.4-1
Acreages Associated with MR Operations – Currently Permitted Design (No Action) and
Proposed Action**

	No Action	Proposed Action	Change
Location	Area (Acres) ^a		
At Closure ^b	560	462	-98
At Pond Equilibrium ^c	171	171	0
SUB-TOTAL YDTI	2,177	2,295	118
Associated Facilities (within existing permit boundary)			
North RDS ^e			
Reclaimed Slopes	-	163	163
Reclaimed Top/Benches	-	86	86
Great Northern RDS	133	152	19
Reclaimed Slopes			
Reclaimed Top/Benches			
New Reclamation Material Stockpiles			
Soil	27	40	13
Alluvium (temporary) ^f		24	24
SUB-TOTAL ASSOCIATED FACILITIES	160	465	305

Sources: (Montana Resources 2018b, Knight Piesold 2019b, Knight Piesold 2019a)

^aAreas are plan areas, not sloped areas; totals are ± 1 acre due to rounding. Numbers in this table are estimates based on the most recent 2018 KP Water Balance and 2019 KP Surface Modeling Tables.

^bClosure for the currently permitted design is 2022 and 2031 for the 6,450 design.

^cEquilibrium in the current permit is assumed at a pond volume of about 500 acre-feet. However, to facilitate comparison with the proposed amendment, acreages are provided for an approximate 1,000 acre-feet pond for both the No Action and the Proposed Action. Both the currently permitted design and the 6,450 design assume a freshwater input of 1 MGD.

^dThe Transition Zone is assumed to be about 800 feet wide along the beach and pond boundary.

^eThe North RDS covers about 92 acres of the embankment, primarily the previously permitted face of the North-South Embankment.

^fTemporary alluvium stockpiles are within the footprints of the North and Great Northern RDS.

^gIncludes areas disturbed by construction of the starter dike and WED.

Based on modeling of tailings deposition and filling schedule of the YDTI during operation, the total impounded area (i.e. tailings and pond) would increase from 1,598 to 1,804 acres and the pond volume would decrease from 20,000 acre-feet to 15,000 acre-feet. The beach area, which includes the beach and Transition Zone, is projected to be 1,342 acres when mining ceases, which is approximately 304 acres larger than the beach area under the No Action Alternative.

2.4.3 YDTI West Embankment and Water Management

The West Embankment would be raised to the proposed elevation of 6,450 feet to match the presently permitted elevations of the East-West and North-South Embankments. The storage

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capacity of the YDTI would be increased and closure would be extended until 2031. The West Embankment would include features to manage seepage from the YDTI. Some design features were developed in conjunction with a previous amendment for initial West Embankment construction under Amendment 9 to Permit 00030A (Knight Piesold 2017b). The design of the West Embankment for the 6,450-foot elevation and associated water management features were based on comprehensive, site-specific West Ridge resource inventories and analyses covering geology, hydrology, and geotechnical conditions.

The West Ridge hydrogeologic evaluation included numerous monitoring wells, drill holes, test pits, and trenches. The West Embankment design focused on depressed ground water elevations within a saddle in the central West Ridge, with the design goal of maintaining a ground water elevation similar to current conditions by using best available technology. This would limit potential migrations of seepage from the YDTI to the west of the permitted boundary. The West Embankment would be constructed to have a free draining upstream zone (i.e., the inner zone facing the tailings) and a less permeable downstream zone (the outer face of the embankment). The downstream zone would act as an impediment to drainage and horizontal migration of perched seepage flow towards the downstream face of the embankment, encouraging free draining to the more permeable zone for collection in the WED. This design would direct water into the drain (WED). The WED and West Embankment design are expected to control hydraulic heads. Hydrodynamic containment would occur along the western edge of the YDTI to prevent potential head increases related to the facility.

The WED is a gravity controlled subsurface collection system installed in the permeable upstream portion of the West Embankment. The WED is designed to intercept ground water flow before it moves into the lower permeable zone West Embankment and potentially migrates west of the YDTI. It is anticipated that the WED would be needed for about 20 years after closure to mitigate impacts to ground water west of the West Embankment. The WED is based on a conservative design to minimize the potential for water to move west of the Embankment. The design flow for the WED is 4,500 gpm which equates to the 98th percentile of the flow observed at HsB Water Treatment Plant since 2000. According to the IRP, the volume of water reporting to the WED during the closure period has not been quantified (IRP 2018). Estimated inflows from various sources are described in Section 2.3.5.1. Post-closure, the Extraction Pond and WED would be operated for long-term hydrodynamic containment or alternative water management scenarios, should they be needed.

Other components of the WED system include an Extraction Pond, Extraction Basin, drain pods, and Secondary Seepage Collection Drains. Each of these features would be connected hydraulically to the upstream side of the embankment.

The purpose of the 3.6 million-gallon Extraction Pond would be the gravity collection of the seepage water from the WED. It would be installed at the southern end of the WED, near a topographic feature known as Rocky Knob. The seepage would be pumped from the Extraction Pond back into the YDTI via pipeline. The pump system would have the capacity to collect and

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convey the water from the WED at any given time. The pipeline would convey flows from the pump system over the embankment, and the flow discharged onto the beach during operations. The pipeline would be buried on the crest of the embankment in areas of recurring traffic to prevent damage. Volumes in excess of the pond storage capacity would be directed to a spillway towards the Northwest Dumps area.

The Extraction Basin would be positioned within a topographic depression along the West Embankment. Pumping systems can be installed within the Extraction Basin to control water levels in the WED by pumping the captured flows back to the YDTI. The pumping systems for the Extraction Pond and Extraction Basin would be designed to manage full design flow of the WED and could operate independently or collaboratively if needed.

Two contingency drain pods would be positioned in topographic depressions along the West Embankment and would also be connected to the WED. They would serve as optional extraction areas that could be completed with pumping systems to augment the Extraction Pond and Extraction Basin, if needed.

The Secondary Seepage Collection Drains would consist of several finger drains placed in topographically low areas along the WED, perpendicular to the embankment alignment. They would connect the less permeable zone and the free draining zone boundary of the West Embankment to the WED.

2.4.4 Modifications to Associated Facilities

Modifications to associated facilities include the Great Northern RDS. Non-ore rock generated from the Continental Pit would be primarily used to construct the YDTI embankments. Non-ore rock not placed in the YDTI embankment or in the North RDS would be added to the existing Great Northern RDS. However, as access to the embankment is necessary when rock production exceeds the requirement for embankment construction, rock would be used to construct access ramps and the North RDS. No new disturbance is expected since the addition would be over the top of the existing disposal or in areas previously disturbed. However, construction of the North RDS would require the relocation of the current solid waste disposal site at some point between 2022 and 2031. The change would be addressed in a revision application to MR's operating permit prior to construction. The bottom of the Continental Pit was approved to an elevation of 4,720 feet, ACM datum, in the D-East Pushback Amendment in 2013. Based on current mine design planning for the Proposed Action, the extended timeframe for mining operations in the Continental Pit would lower the bottom elevation to 4,900 feet in year 2031. This would deepen portions of the Continental Pit that are already disturbed within Permits 00030A and 00041, and it would not expand the footprint of the pit or the permit boundaries. Mining below that depth, presumably beyond 2031, would be contingent upon MR developing additional tailings disposal capacity and amending the operating permits accordingly.

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Portions of the 16-inch Moulton water pipeline would be relocated due to the proposed expansion of the West Embankment, beach, and pond. Development of the West Embankment crest to an elevation of 6,450 feet would affect a portion of the pipeline, and tailings would encroach over part of the pipeline after 2022. MR would need to coordinate with Butte-Silver Bow City-County to relocate the pipeline segment that would be affected by the YDTI. Roads would be modified as necessary to meet operational objectives for construction and access. Modifications would include ramps to build embankment lifts, adjustment of the access road along the east side of the impoundment for reclamation, soil haulage roads, perimeter roads around the impoundment, and access roads to monitoring sites.

Volumes of capping materials required to reclaim the YDTI and associated facilities and stockpile area footprints would increase. Material would include alluvium and leached cap material which has been weathered and has been depleted of most sulfides and metals.

Salvaged soils would be transported to soil stockpile areas or placed on regraded sites. Soils stockpiled for over one year would be seeded for revegetation until used. Vegetation like aspens would be planted in stockpile areas along Moulton Road as a visual barrier.

As part of the wet closure design for the YDTI and to enhance dam safety, a closure spillway is conceptually designed to release water from the YDTI to the Continental Pit when the pond elevation exceeds the 6,430-foot elevation. The YDTI spillway would not be operated as a routine water discharge system. It would only convey flow if an unlikely sequence of storm events was to occur in combination with a starting pond volume equal to the 95th percentile (wet condition) steady-state pond volume (8,000 acre-feet). Release from the spillway would limit the maximum pond volume to below approximately 26,000 acre-feet following a 1 in 1,000-year, 30-day rainfall event, immediately followed by the Probable Maximum Flood (PMF) event (probable maximum precipitation plus snowmelt), which is then immediately followed by an additional 1 in 1,000-year, 24-hour rainfall event (Montana Resources 2018b). This spillway would ensure that the supernatant pond does not encroach on the embankment during extreme storm events.

2.4.5 Modifications to Reclamation Plan for the YDTI and Associated Facilities

Reclamation of the YDTI under the Proposed Action would be similar to the No Action Alternative but would incorporate additional acreage due to the tailings impoundment expansion. The current YDTI closure plan includes three reclamation components, the embankment, the tailings beach, and tailings pond.

Modifications to the current reclamation plan under the Proposed Action would include the construction of the West Embankment to a crest elevation of 6,450 feet, additional impoundment acreage, a closure spillway, and the WED decommissioning. Under the Proposed Action, reclamation would be expected to begin at the end of 2031 when mining operations cease.

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Reclamation of North RDS and Great Northern RDS would not change substantially from other permitted RDSs. Reclamation methods would include reducing slopes to gradients less than 2.7H:1V, regrading to mitigate water ponding, constructing benches or runoff collection ditches at 100-foot intervals on regraded slopes, redistribution of 20-inches of alluvium on slopes and 28-inches on tops and benches. The alluvium would be tested, and soil amendments would be added if necessary. Twenty-three tons per acre of organic matter would be incorporated if topsoil is not spread over the alluvium. Vegetation would be established, and weeds controlled. Final grading would be made with non-noxious, nonflammable, noncombustible solids.

Areas once serving as soil stockpiles would be reclaimed by ripping the surface to relieve compaction and revegetating. Areas used as alluvium stockpiles would either be reclaimed as part of the North RDS, or ripped if needed, capped, and seeded. Other areas would be ripped where compacted, covered with stockpiled or direct-haul material, and revegetated.

All roads not necessary for post-closure management would be regraded to blend with adjacent areas, ripped to relieve compaction, capped with 24-inches of alluvium, and revegetated. Stable road cuts in rock would not be regraded.

2.4.5.1 West Embankment Drain

At the time of reclamation, the discharge pipeline from the WED system Extraction Pond to the YDTI would be extended progressively as the closure pond retreats and the tailings beach is reclaimed. These pumpback flows would continue during the closure period for approximately 20 years to mitigate the potential ground water impacts to the west of the West Embankment through hydrologic control of the ground water and tailings seepage into the WED. Water that would be continually returned to the supernatant pond from the WED would eventually evaporate or seep out of the impoundment at Horseshoe Bend.

2.4.5.2 Embankment Reclamation

The modification to the embankment reclamation would include regrading downstream slopes flatter than current reclamation (2H:1V) with final regrading of 2.7H:1V. The lower portion of the North-South Embankment would be covered by the North RDS. A portion of the East-West Embankment located upstream of the Precipitation Plant would be constructed with a 2H:1V downstream slope. The West Embankment would be constructed with a final slope of 3H:1V except near the WED Extraction Pond. A small segment near the WED extraction pond would be graded to 2.5H:1V. Swales and ditches would be constructed at 100-foot intervals on the downstream, regraded slopes to reduce erosion and facilitate drainage of the reclaimed areas. Structures would include grass-lined swales, riprap lined ditches, and plunge pools at the lower reaches.

West Embankment capping would include 6 inches of soil over 36 inches of non-acid generating alluvium. The volume of the capping material for the West Embankment is estimated to be about 19,000 cubic feet. The East-West Embankment face would be capped with 20 inches of alluvium on 2.7H:1V slopes and 36 inches on 2H:1V slopes. Reclamation material amendments

would be based on testing during reclamation. The North-South Embankment would be covered and reclaimed with the North RDS. The embankment crest would be capped with 28 inches of suitable or amended alluvium unless mine scheduling allows for direct-haul of the final 28 inches of the crest using suitable leached cap. The embankment area covered by the North RDS would be reclaimed at a 2.7H:1V slope consistent with the North RDS reclamation and redistributing 20 inches of alluvium on the slopes.

2.4.5.3 YDTI Reclamation

A partial wet closure for the tailings pond is planned for the north portion under the current permits. Under the Proposed Action, closure of the YDTI would be expected to begin when mining ceases in 2031. A general arrangement plan for YDTI is shown in **Figure 2.4-1**. The impoundment would include a pond with an adjacent area that is periodically inundated with seasonal pond water level fluctuations. During closure activities, the YDTI pond would begin to retreat until the pond reaches equilibrium leaving a pond of approximately 1,000 acre-feet in 2062. An overview of reclamation at the equilibrium condition is shown on **Figure 2.4-2**.

Under the Proposed Action, an impoundment area would be created that is 13 percent larger than under the No Action Alternative. In addition, as described in Section 2.4.2, a larger beach area with a smaller pond area would be created under the Proposed Action than under the No Action Alternative.

Closure would include dewatering of the impoundment via seepage to the WED and Horseshoe Bend, as well as through evaporation. The tailings beach or dry area (approximately 1,122 acres) would be reclaimed in the first 5 years post-closure, and a Transition Zone would be incrementally exposed by dewatering and shrinking the supernatant pond. The tailings beach would remain dry and the Transition Zone would continue to retain water beneath the drying surface.

The Transition Zone resembles a mudflat and consists of tailings slimes that have settled out onto the bottom of the pond, rather than the coarser materials found in the beach tailings. Slimes are composed of finer silt and clay particles while the beach is composed of coarser-grained, sand-like particles. As the dewatering transitions, the slimes closest to the supernatant pond would remain saturated with water due to their inherent moisture holding capacity while the slimes nearest the beach would “crust” over as they dry. The beach, Transition Zone, and water level would be observed multiple times per day in accordance with the air quality permit to assess the potential for fugitive dust, and if dust is detected, MR would be required to implement its dust control plan.

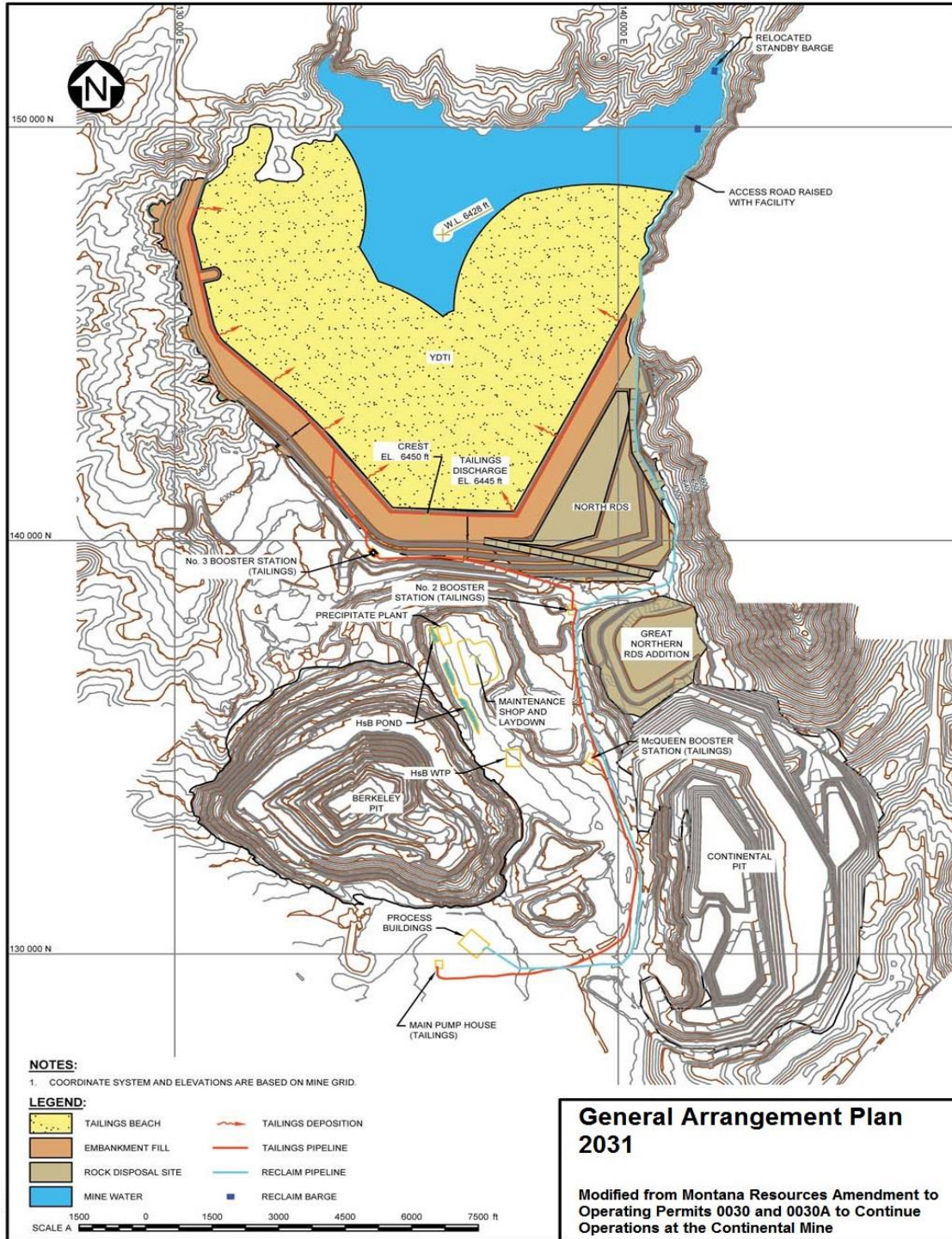


Figure 2.4-1. General arrangement plan for YDTI.

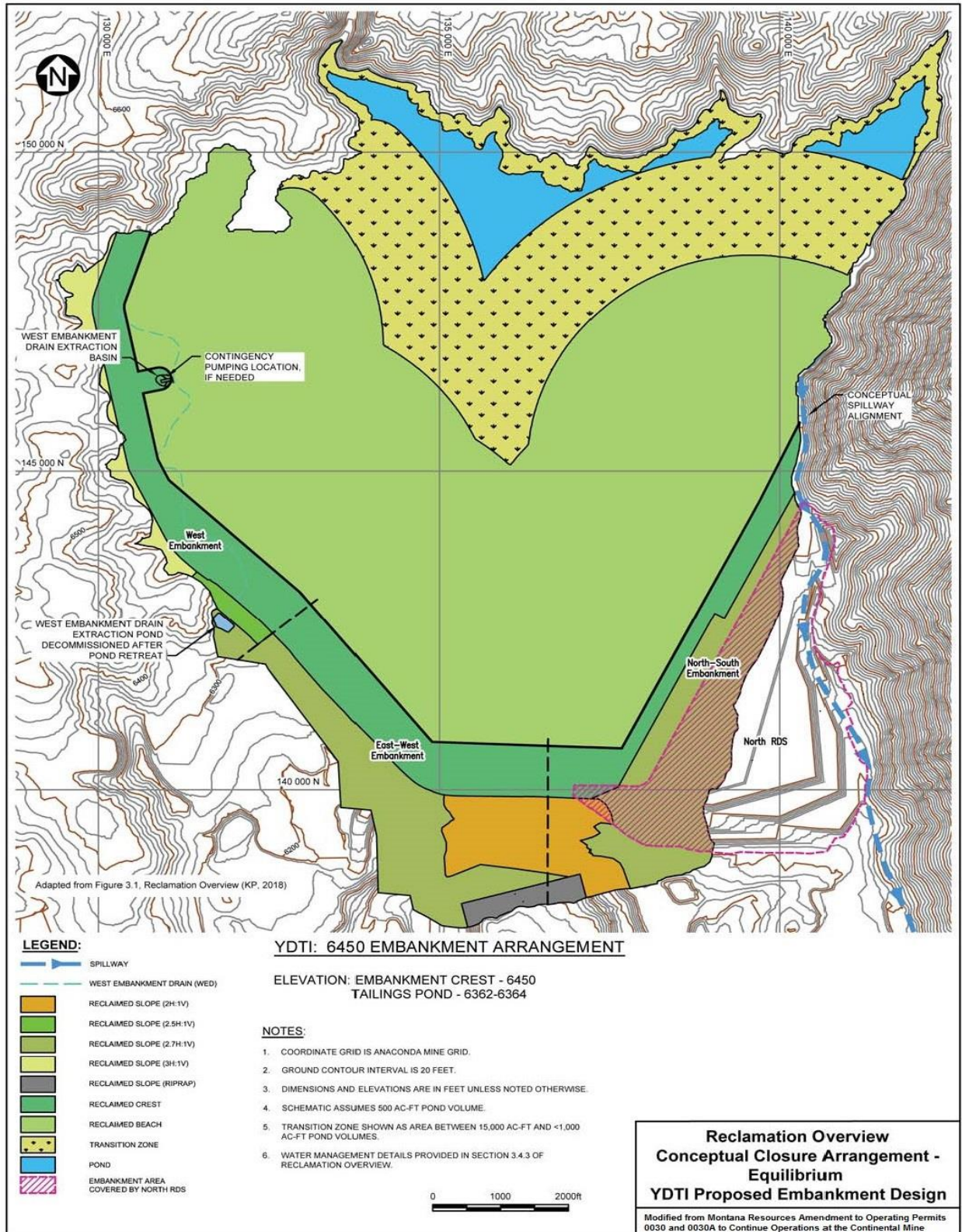


Figure 2.4-2. Overview of reclamation at closure and equilibrium.

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Further mitigations would include the placement of a 6-inch rock cover, leached cap (rock which used to contain sulfide ore but has since been depleted due to weathering), or similar material incrementally on the exposed beach as the water level drops, and placement of capping material and revegetation of the Transition Zone. The formation of dust on other areas could be controlled by maintaining and using rubber wheeled equipment to apply dust suppressant as needed.

The beach area would consist of drier tailings material that are susceptible to wind erosion. If alluvium cannot be spread promptly, the tailings beach areas would be covered with a 6-inch layer of rock, leached cap or similar material and seeded for revegetation. Reclamation of the tailings beach areas would be similar to the No Action Alternative, which includes placement of a 28-inch thick amended alluvium cap and revegetation. The quantity of available salvaged soil would provide a 6-inch upper soil layer for 731 acres of the permanent reclamation cap. Reclamation of the remaining 963 acres of beach would consist of placement of the 28-inch thick cap using alluvium with the top 6 inches amended as necessary followed by revegetation.

Application of soil amendments would be in accordance with the DEQ-approved 2002 Minor Amendment (MR- 02-001) for the Woodville Dump reclamation. Reclamation would be accomplished incrementally over an estimated 40-year period following mine closure as the tailings water recedes, exposing more Transition Zone for reclamation until the pond volume reaches approximately 1,000 acre-feet at equilibrium.

Water balance modeling results indicate that the YDTI supernatant pond volume will decrease and reach an equilibrium volume of approximately 1,000 acre-feet under average climatic conditions. The pond volume may be as high as approximately 2,500 acre-feet under wet climate conditions and as low as 500 acre-feet under dry climatic conditions (Knight Piesold 2018b). As shown on **Figure 2.4-3**, fluctuations in shoreline elevations total approximately 11 feet and range from a low of 6,363 feet to a high of 6,374 feet. Under wet climatic conditions, the pond would extend up onto the Transition Zone by about three-quarters of a mile compared to the pond under dry climatic conditions. Any alteration to the Transition Zone surface, if any, would be dependent upon the length of time it was inundated by water or exposed to the air.

2.4.5.4 Soils and Reclamation Cover Material

The mine site has an estimated 63 million tons of material known as leached cap, which is mineralized rock that has been depleted of most metals and sulfides due to weathering. Leached cap is a potential resource for permanent reclamation cover material (Montana Resources 2018b). An additional 275,000 cubic yards of soil is stored in the Moulton Road and Buntown stockpiles, and approximately 67,000 cubic yards of soils are yet to be salvaged from new disturbance areas. It is expected that shortages of soil needed for reclamation would be taken from the Central Zone Alluvium. A total of 609,000 cubic yards of soil would be used for primary reclamation of the West Embankment and a portion of the beach. Alluvium used for

reclamation would be sourced from areas between the Berkeley and Continental Pits. Leached cap would be sourced from the Continental Pit (Montana Resources 2018b).

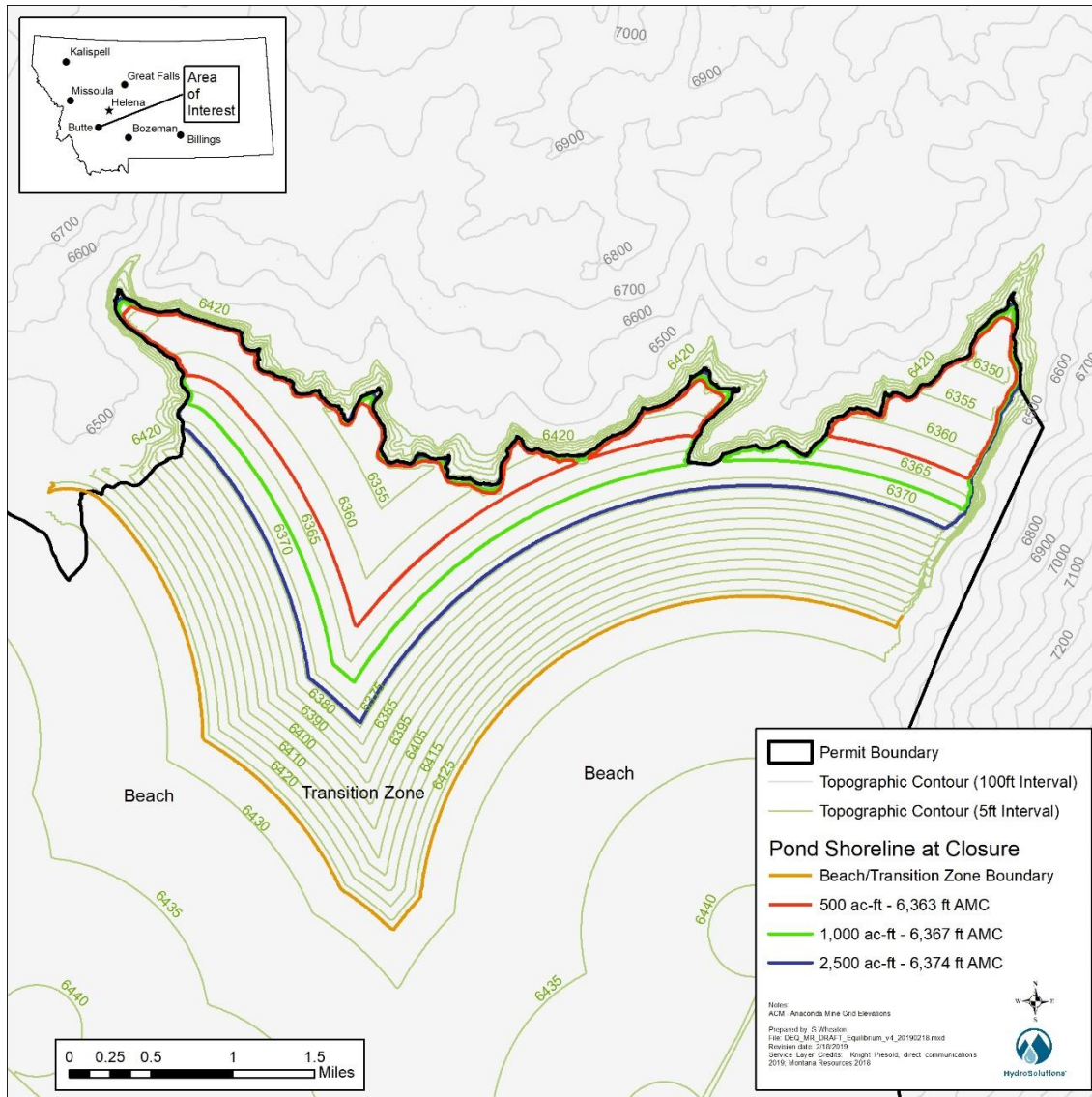


Figure 2.4-3. Approximate contours and extent of the supernatant pond under three post-closure volume conditions.

2.4.6 Post-Closure Management and Monitoring for the YDTI and Associated Facilities

At closure, input from the tailings and makeup water would cease with corresponding changes in output. Under the Proposed Action, water would only be removed from the impoundment through evaporation loss or seepage to Horseshoe Bend. The water management system for the YDTI would no longer be a closed loop, as treated water from the HsB Water Treatment

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Plant would no longer be used in the mill or utilized to convey tailings into the impoundment. The water would be treated and managed in accordance with the 2002 BMFOU Consent Decree. (See Section 1.3.3.1).

Prior to post-closure, a closure spillway would be constructed at the 6,430-foot elevation to maintain the maximum pond volume below 26,000 acre-feet. The spillway would be designed to handle an additional 1 in 1,000-year 24-hour rainfall event that occurs after the YDTI pond has reached the maximum volume (26,000 acre-feet), due to an unlikely sequence of storm and flooding events (See Section 2.4.4). This would ensure that the supernatant pond does not encroach on the embankment during extreme storm events. Limited spillway maintenance would be required in the long term, although periodic inspection would be necessary to verify the spillway is operational. The Conceptual Closure Spillway is shown on **Figure 2.4-4**.

Mass load models were run on the YDTI pool (supernatant pond) water under two scenarios. The probable case scenario assumed geochemical differences between current rock and tailings from the Continental deposit and the worst-case Berkeley Pit rock and included different assumptions for the tailings contact water quality under each scenario. The model accounted for contributions in flow and mass loading from the WED pumpback system.

For the probable case, the pool water would remain alkaline (high pH) throughout operations and closure and metals would remain low. Sulfate levels are anticipated to be 1,100 milligrams per liter (mg/L) with a total dissolved solids (TDS) concentration of 1,800 mg/L at closure and would gradually decline to about 250 mg/L with a TDS of 400 mg/L about 30 years post-closure.

However, for the worst-case scenario, the pool would gradually become slightly acidic (low pH) after closure with an increase in iron and aluminum of up to 36 mg/L and 16 mg/L, respectively. Sulfate levels would be around 1,100 mg/L with a TDS of 1,800 mg/L at closure. Sulfate and TDS are expected to decline 30 years post-closure to about 600 mg/L and 1,000 mg/L, respectively. If acidic conditions exist, lime could be added to the pool to maintain alkaline conditions and low metal concentrations. About 5,000 tons of lime would be required to maintain alkaline conditions throughout post-closure under the probable-case scenario, or about 150 tons per year throughout the 30-year post-closure period. Slightly more lime would be needed during the first 3 to 5 years after closure for the worst-case scenario. Also, the WED discharge could be limed prior to discharge into the impoundment during its post-closure operation while the WED would be needed for ground water control.

The WED system would provide long-term hydrodynamic containment of the tailings water from the YDTI. This would prevent tailings water from the YDTI from migrating west of the MR property and West Ridge and adversely affecting off-site water quality. The system may be used for alternative water management strategies should they arise. Operation of the WED pumpback system would continue as long as post-operational ground water conditions indicate it is necessary to maintain long-term ground water gradients toward the YDTI. Alternate

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mitigations such as augmented recharge have not been designed and approved. Timeframe for operation of the WED pumpback is expected to be within about 20 years post-closure.

Once the YDTI supernatant pond retreats sufficiently to no longer require that the WED function as a ground water elevation control, the Extraction Pond would be reclaimed either by removing or breaching the liner, capping as necessary, and seeding. The WED connection to the Extraction Pond would be decommissioned by grouting a section of the gravity drain.

After plugging, the WED would flood and no longer act as a drain, and water levels within the west tailings beach and ground water west of the West Embankment would re-equilibrate to approximate pre-WED conditions. Once ground water conditions re-equilibrate, the overall West Ridge ground water flow pattern would be similar to current flow conditions, flowing eastward from the West Ridge crest toward and into the impoundment.

Following the completion of the YDTI reclamation, the EOR would evaluate the existing closure monitoring plan which outlines site specific needs for monitoring, inspections, and review. The plan details the requirements and frequency of monitoring, and the required qualifications of monitoring personnel (Montana Resources 2018b). The frequency of monitoring may vary depending on the implementation and functionality of facility components after reclamation, and the EOR would prepare a post-closure monitoring program and schedule to account for variations accordingly.

Post-operational water, reclamation, and revegetation monitoring programs would be implemented, and conditions documented at the mine site and surrounding water resources. The current operational and residential well monitoring programs operated by MR could continue for future monitoring; however, the scope of monitoring, including monitoring sites, frequency and parameters may be modified in the future in conjunction with DEQ if ongoing data evaluation warrants. Monitoring would continue until all bonding release milestones are met.

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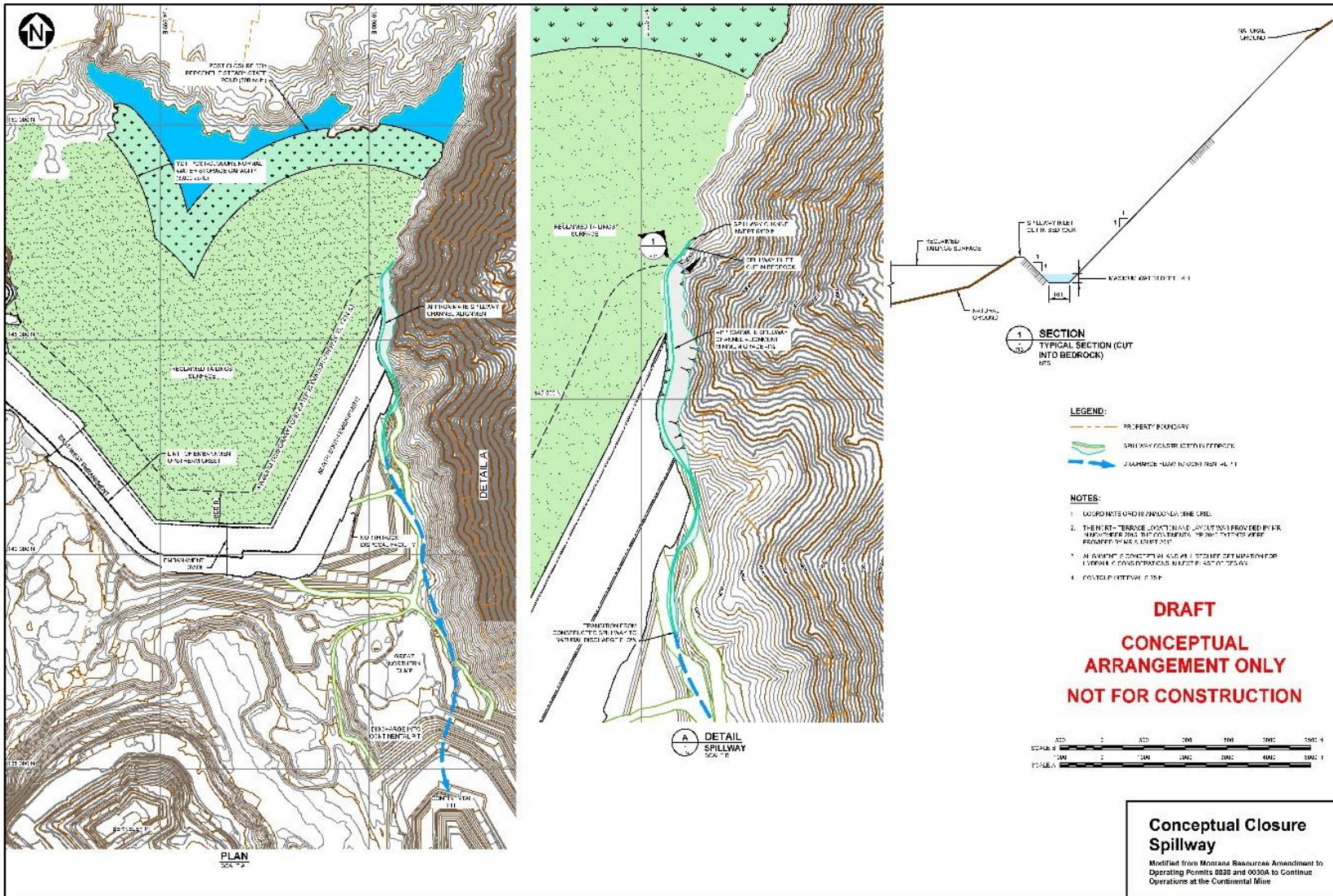


Figure 2.4-4. Conceptual closure spillway for the Yankee Doodle Tailings Impoundment at the Continental Mine.

2.5 ACCELERATED DRAWDOWN AT CLOSURE ALTERNATIVE

2.5.1 Introduction to the Alternative

Accelerating drawdown of the supernatant pond at closure would allow surface reclamation of previously saturated tailings or Transition Zone areas to happen more quickly than under the Proposed Action. Under the MMRA, all reclamation must be completed within two years after mining is completed, unless a longer period is allowed by DEQ (82-4-336, MCA). The Accelerated Drawdown at Closure Alternative would not achieve reclamation completion within two years, but it would be expected to significantly shorten the time to complete reclamation. Like under the No Action and Proposed Action alternatives, addition of saturated tailings to the YDTI would no longer occur at closure. By pumping water out of the tailings pond after mining ceases, a more rapid decrease in the pond level and hydraulic head in the YDTI would occur, tailings surfaces would be exposed more quickly, and seepage to the WED would be reduced at a faster rate than under the Proposed Action.

As previously described, the No Action Alternative anticipates closure in 2022. The Proposed Action Alternative would extend closure to 2031. Pond equilibrium for the No Action Alternative would be reached in approximately 2061 and in 2062 under the Proposed Action Alternative (Knight Piesold 2018b). The Accelerated Drawdown at Closure Alternative would not require a change to the design or function of the tailings impoundment during mine operations, but the pond would be reduced to the equilibrium volume more quickly following closure than under the No Action or Proposed Action alternatives.

Estimated Drawdown

The effect the Accelerated Drawdown at Closure Alternative would have on the reclamation timeframe was evaluated. This analysis represents a simplified quantitative estimate based on an initial pond volume at closure of 15,000 acre-feet and a remaining pond volume of approximately 1,000 acre-feet at equilibrium. These pond volumes were estimated to be the “normal case” through modeling, which is the 50th percentile condition in the water balance sensitivity analyses (Knight Piesold 2018a). Variables such as inflow from upstream watersheds, precipitation, evaporation, seepage loss through tailings, and water locked in pore spaces were either evaluated as a gain, loss, or not considered as part of the assessment. The incorporation of those variable and the values used for different time steps were consistent with the water balance submitted with the amendment application (Knight Piesold 2018a). A summary of assumptions used in calculating the accelerated drawdown at closure is shown in **Table 2.5-1** below.

Table 2.5-1.
Summary of assumptions used to calculate the time to reach equilibrium pond volume with accelerated drawdown.

Parameters		OPERATION (2031)	CLOSURE (2032)	POST-CLOSURE (2033 and beyond)
INFLOWS		MGD	MGD	MGD
Direct precipitation on pond/beach		0.8	0.7	0.5
Runoff from contributing catchment		0.7	0.6	0.6
Water in tailings slurry		22.0	0	0
Groundwater from West Ridge to WED		0.1	0.1	0.1
	Total Inflows	23.6	1.4	1.2
		OPERATION (2031)	CLOSURE (2032)	POST-CLOSURE (2033 and beyond)
OUTFLOWS		MGD	MGD	MGD
Evaporation		1.0	0.9	0.6
Losses to tailings voids		4.5	0	0
Seepage losses from impoundment		4.2	3.4	1.0
Reclaim water to process		16.5	0	0
	Total Outflows	26.2	4.3	1.6

Source: Table 3-2, (Montana Resources 2018b); Table C-1, (Knight Piesold 2018a)

MGD Million gallons per day

Based on the above input data, variable pumping rates were used to provide a range of accelerated drawdown rates. Existing mine equipment is expected to be used. **Table 2.5-2** summarizes the time in days and years to accelerate drawdown at different pumping rates.

As a maximum potential pumping rate, the current rate for pumping reclaimed water from the pond for use in milling operations was initially used (Knight Piesold 2018a). The average pumping rate for years 2012-2017 was estimated at 16.35 MGD. Additional decreased pumping rates were used to calculate a range of drawdown timelines (Table 2.5-2). Using drawdown rates between 16.35 MGD and 10 MGD, the pond could be reduced to the estimated equilibrium volume of 1,000 acre-feet in one year or less. Lower pumping rates may be utilized to balance the timeline of pond level reduction with the feasibility of reclaiming the exposed tailings surfaces. At pumping rates of 5 MGD, the equilibrium volume would be reached within 2 years. An accelerated drawdown rate of 1 MGD would be roughly equivalent to the assumed seepage rate at Horseshoe Bend under steady-state conditions, and the equilibrium pond volume would be reached in approximately 7 years. In comparison, the pond would take approximately 30 years to drain to equilibrium levels under the Proposed Action Alternative, which relies on evaporation and seepage to Horseshoe Bend to remove water from the facility.

Table 2.5-2.
Estimated pumping rates used to calculate drawdown time during accelerated drawdown.

Pumping rate (MGD)	Percent of Average Operational Pumping Rate	Days to Reach Equilibrium Volume	Years to Reach Equilibrium Volume
16.35 ^a	100%	237.0	0.65
10.0	61%	353.6	0.97
5.0	31%	675.8	1.85
2.0	12%	1520.6	4.17
1.0	6%	2606.7	7.14
0.5	3%	4054.9	11.11
0.25	1.5%	5614.5	15.38

MGD=Million gallons per day

^a Average operational pumping rate from Water Balance Report used in calculations

2.5.2 Alternative Components Different from the Proposed Action

During active mining, no differences between the Proposed Action and the Accelerated Drawdown at Closure Alternative would occur and based on estimated production rates, mine operations would continue through 2031. To support mine operations, approximately 16.5 MGD of reclaim water from the tailings impoundment pond, which includes contributing volumes from upstream tributaries and watersheds and water contained in the tailings slurry, would be pumped to the MR Concentrator and used in the mine process circuit. Tailings pond water would continue to drain as seepage through the impoundment and would be collected at Horseshoe Bend to then be managed and treated under BMFOU remedial plans (Knight Piesold 2018a). During operations, HsB Water Treatment Plant discharge and the water collected in the WED Extraction Pond would be pumped back to the YDTI pond (Knight Piesold 2018a).

2.5.2.1 Rate of Drawdown

Under the Accelerated Drawdown at Closure Alternative, like the No Action and Proposed Action alternatives, approximately 22.0 MGD of water contained in the tailings slurry would no longer discharge into YDTI when mining ceases. The assumed pond volumes for closure (15,000 acre-feet) and equilibrium (1,000 acre-feet) would be the same as under the Proposed Action. Under this alternative, the approximately 14,000 acre-feet of excess water would be pumped out of the supernatant pond to reduce the time necessary to reach the equilibrium volume. The potential pumping rates and drawdown timelines are shown in **Table 2.5-2**. As discussed in Section 2.5.5, the tailings and slimes surfaces would be able to support truck traffic approximately 5 to 9 years after being exposed by the receding pond. Similar to the Proposed Action, the initial 1,122 acres of beach would be reclaimed in the first 5 years following closure. Pumping the excess pond water within 1 year after closure (i.e. at an average rate ≥ 10 MGD) would allow the drying and consolidation process to begin for an additional 365 acres, while

reclamation is performed on the initially dry areas of the beach. Consequently, there would be a reduction in the volume of pond water that would eventually drain out as seepage through the impoundment, and the steady-state conditions at Horseshoe Bend anticipated under BMFOU remedial plans may be attained more rapidly.

2.5.2.2 BMFOU Coordination

Development of this Accelerated Drawdown at Closure Alternative recognizes USEPA's authority over long-term water management and treatment at the site under the BMFOU. Accelerated removal of the supernatant pond would be a component of the reclamation under the mine operating permits, and not required as a part of the remedy under Superfund. Water pumped from the YDTI would need to be stored and managed elsewhere on the site, like in the Continental Pit, or it would need to be treated directly at a water treatment plant prior to off-site discharge. Discussions and coordination with all parties in the 2002 Consent Decree would be needed to review the options and feasibility for handling and treating this water, the potential use of existing or upgraded water treatment facilities and infrastructure, and to amend their agreement accordingly. No matter which facility might potentially treat the water, it would need to meet water quality criteria and final off-site discharge performance standards as described in the 2002 Consent Decree prior to discharge (Consent Decree for the Butte Mine Flooding Site 2002).

Based upon the available information about the BMFOU water treatment pilot studies, the current polishing plant and HsB Water Treatment Plant do not appear to have available treatment or discharge capacity capable of handling additional water from the accelerated drawdown of the YDTI pond (Wood 2018). This alternative would be contingent upon the treatment or storage of the water pumped during accelerated drawdown, but the feasibility of treating additional flow at existing facilities cannot be determined without further information about process optimization from the pilot studies. Until further evaluation of treatment and discharge is possible through Superfund, the option to store the excess YDTI water on-site in the Continental Pit remains feasible, since accelerated drawdown would only commence when mining in the pit has ceased.

The available storage capacity for water in the Continental Pit was analyzed. At closure, inflows to the Continental Pit would include ground water and precipitation. The volume of the pit below the BMFOU critical water level (5,410 feet, USGS datum; 5,460.64 ACM) at closure would be approximately 124 million cubic yards (25 billion gallons). At the current estimate of inflow into the pit of 0.5 MGD, it would take approximately 137 years for the Continental Pit lake to reach the critical water level. The excess YDTI pond water to be diverted into the Continental Pit under this alternative (estimated to be 14,000 acre-feet, or 4.6 billion gallons) would fill approximately 18.3 percent of total capacity below the critical water level. This rapid increase in inflow would shorten the time to reach the critical water level by approximately 25 years. The addition of high-pH (more alkaline) YDTI water to the Continental Pit would raise the pH

and alkalinity of the initial pit lake and would flood exposed mineral surfaces, lowering the potential for sulfide oxidation and acid generation.

2.5.3 YDTI West Embankment and Water Management

During operation, the West Embankment and water management of the YDTI would remain the same under the Accelerated Drawdown at Closure Alternative as under the Proposed Action Alternative. Reclaim water would be pumped to the MR Concentrator for incorporation into the mill circuit, as would water treated in the HsB Water Treatment Plant.

Seepage to the WED would continue to be pumped back into the YDTI during both the operation and closure period. This alternative does not necessarily preclude the implementation of the WED Pumpback Elimination at Closure Alternative described in Section 2.6, but each closure alternative is evaluated independently here.

Water in the YDTI supernatant pond is of better quality than Horseshoe Bend seepage waters. Tailings pond water would be expected to remain alkaline and the concentration of metals would remain low (Montana Resources 2018b). However, water quality monitored when the mine was temporarily not operating (mid 2000 to 2003) and when Horseshoe Bend seepage was collected and pumped back into YDTI (1996-2000) indicated an increase in sulfate concentration and a slight decrease in pH. Mine process water was not added to the YDTI during the temporary closure, a scenario which may represent possible water quality conditions at final closure (Schafer Limited LLC 2018). When operations started again in mid-2003, freshwater, tailings slurry, and lime were again pumped into the YDTI. This adjusted the pH of the system and reversed some of the impacts to pond quality that were noted during the shutdown.

If the supernatant pond water becomes acidic after closure, lime would be mixed with the water collected in the WED Extraction Pond and pumped into the pond to maintain alkaline pH (Knight Piesold 2018a). Baseline information in the hydrology report indicates that pH levels in the three tributaries are all above 7 (Hydrometrics, Inc. 2018a). Lime would be added to maintain alkaline conditions of the remnant pond in order to attain the post-mine land use of wildlife habitat and watershed protection. Additionally, if changes to management of the water result in modified agreements under Superfund, the water quality of the pond would still be maintained at an alkaline pH. If this water remained in the YDTI and eventually drained out of the facility at Horseshoe Bend, it would have more contact time with acidic waste rock and tailings and could become more acidic, thus requiring more treatment to meet discharge standards.

Accelerated drawdown of the supernatant pond would allow for storage of the alkaline water elsewhere, precluding seepage and tailings reactions within the YDTI, or allow for the direct treatment of this water, which would presumably need less treatment than what is needed for Horseshoe Bend seepage. Accelerated drawdown would allow the equilibrium volume of the pond (approximately 1,000 acre-feet) to be reached considerably faster, reducing the hydraulic

head in the facility and the duration of seepage to the WED, and ultimately shortening the facility reclamation timeframe.

2.5.4 Modifications to Associated Facilities

The Accelerated Drawdown at Closure Alternative would not affect changes proposed to other associated facilities included in the Proposed Action. Existing pumps and pipelines would continue to be used, but water would be pumped or drained by gravity to on-site storage or treatment facilities and not into the mine circuit. The Accelerated Drawdown at Closure Alternative would not require a change to the design or function of the tailings impoundment during mine operations.

DEQ does not consider modification to drawdown rates at YDTI a significant change to the designs of the tailings impoundment, West Embankment, or WED and would not require reopening the IRP review. The Accelerated Drawdown at Closure Alternative would remove water more quickly from the tailings impoundment and allow for reclamation of the facility to occur at a faster rate. This alternative would be contingent upon the treatment or storage of the water pumped during accelerated drawdown. The feasibility of treating additional flow at existing water treatment facilities, or the need to modify those facilities, would need to be reviewed by BMFOU Consent Decree parties. No matter which facility might potentially treat the water, it would need to meet water quality criteria and final off-site discharge performance standards as described in the 2002 Consent Decree prior to discharge (Montana Resources and Atlantic Richfield Company 2018).

2.5.5 Reclamation

Under the Accelerated Drawdown at Closure Alternative, reclamation at the YDTI would be similar to the Proposed Action. No changes to the proposed reclamation plan, other than accelerated drawdown of water and an accelerated time frame for reclamation, would occur.

Reducing the time required to consolidate the tailings with the Accelerated Drawdown at Closure Alternative would allow reclamation at YDTI to be completed sooner. The Proposed Action indicates approximately a 30 to 40-year period following closure before reclamation of the tailings could be completed. Based on additional information provided by Montana Resources, the top 10 to 20 feet of tailings near the margin of the supernatant pond would likely consolidate in less than 1 year following rapid dewatering (Knight Piesold 2019c). It may take an additional 2 to 3 years of air-drying and freeze-thaw consolidation to develop a surface that would enable surficial tailings to become trafficable. In addition, 2 to 5 years may be required for very fine-grained slime tailings to consolidate and develop into a trafficable surface to facilitate capping (Knight Piesold 2019c). Therefore, the exposed surfaces would be able to support truck traffic approximately 5 to 9 years after closure under the Accelerated Drawdown Alternative.

Considering the rate of initial beach reclamation in the Proposed Action (1,122 acres in the first 5 years), consolidation of the tailings seems to be the limiting step for completing reclamation and not the equipment or soil placement rates. Therefore, rapidly drawing down the pond within 1 year following closure would expose an additional 365 acres of Transition Zone. This would allow the drying and consolidation process to commence while reclamation is performed on other areas of the beach that are already dry and accessible to equipment. The next phase of sequential reclamation on the exposed Transition Zone could begin shortly after the initial beach area is completed.

Proposed capping materials and methods of reclamation cap would not change but would be able to be added to the YDTI beach area sooner than would be possible under the Proposed Action. Dust controls would still be integral in the reclamation plan. Reclamation of areas other than the YDTI tailings beach and Transition Zone would be expected to begin at the end of 2031 when mining operations would cease.

2.6 ELIMINATION OF WEST EMBANKMENT DRAIN PUMPBACK AT CLOSURE ALTERNATIVE

2.6.1 Introduction to the Alternative

The Elimination of West Embankment Drain (WED) Pumpback at Closure Alternative would discontinue pumping water from the WED back into the YDTI as soon as mining and milling are completed. This would reduce inflow into the post-closure YDTI pond, and the reduction in time to reach the equilibrium volume (approximately 1,000 acre-feet) would speed up reclamation activities at the facility. The volume of water contributed to the WED at closure is estimated to be 160 gpm (Schafer Limited LLC 2018). The Elimination of WED Pumpback at Closure Alternative would eliminate pumping the potentially poor-quality seepage water collected in the WED Extraction Pond back to the tailings pond for approximately 20 years post-closure. MR predicts that much of the YDTI seepage reporting to the WED (i.e. contact water) would most likely have a pH of 7.5, a positive net alkalinity, and acid neutralization potential (Schafer Limited LLC 2018). However, in MR's worst-case model scenario, contact water to the WED is assumed to be more similar in composition to current Horseshoe Bend seepage, with a pH around 3, negative net alkalinity, and no acid neutralization potential (Schafer Limited LLC 2018).

When mining ceases, YDTI water would not be used in the mill process circuit, but it would continue to seep into Horseshoe Bend and be collected for treatment under Superfund. The WED is predicted to initially capture approximately 20 percent of tailings pond seepage, but seepage rates would decline as the pond level decreases. Under this alternative, water collected at the WED Extraction Pond would be diverted away from the YDTI to be stored elsewhere on-site or treated prior to discharge, whether by pumping or using gravity drainage. Under the Proposed Action Alternative, the WED would be grouted approximately 20 years post-closure. The WED would not be grouted under the Elimination of WED Pumpback at Closure Alternative and would provide a greater certainty to capture and contain any seepage

to the west. Discussions and coordination with all parties in the 2002 BMFOU Consent Decree would be needed to review the options and feasibility for handling and treating this water, the potential use of existing or upgraded water treatment facilities and infrastructure, and to amend their agreement accordingly.

2.6.2 Alternative Components Different from Proposed Action

During active mining, there would be no difference between the Proposed Action and the Elimination of the WED Pumpback at Closure Alternative. Based on estimated production rates, mine operations would continue through 2031. As described in the Proposed Action, reclaim water from the YDTI would continue to be pumped to the MR Concentrator and used in the mine process circuit. Seepage from the tailings impoundment into Horseshoe Bend would be treated in the HsB Water Treatment Plant and pumped to the MR Concentrator. Water collected in the WED Extraction Pond would be pumped back to the YDTI pond during operations.

Under the Elimination of WED Pumpback at Closure Alternative, like the Proposed Action closure scenario, water contained in the tailings slurry would no longer be an input to YDTI when mining and milling cease. Approximately 22 MGD of water in tailings slurry would no longer be pumped into the tailings impoundment. Water in the tailings pond would continue to seep through the impoundment and discharge at Horseshoe Bend, to then be managed and treated under BMFOU remedial plans. Under the Elimination of WED Pumpback at Closure Alternative, seepage collected in the WED Extraction Pond would not be pumped back to the tailings pond, and potentially treated with lime to control the acidity, for approximately 20 years post-closure. Instead, the seepage water in the WED Extraction Pond would be diverted away from the YDTI to a water treatment facility or to the Continental Pit for storage, whether by pumping or by gravity drainage. This alternative would expedite the dewatering of tailings, reduce long-term risks to ground water seepage out of the facility due to the WED remaining operational, and shorten the reclamation and closure timeframe of the YDTI. It would also reduce the potential for acidification or metal loading in the YDTI pond, and thereby reduce the amount of lime needed as mitigation.

The available storage capacity for water in the Continental Pit was analyzed and described in detail in Section 2.5.2.2. At closure, inflows to the Continental Pit would include ground water and precipitation. Under the Elimination of WED Pumpback at Closure Alternative, the estimated 160 gpm (0.23 MGD) of seepage to the WED Extraction Pond may be diverted to the Continental Pit. Each year, the increase in inflow would fill approximately 0.34 percent of the total capacity of the Continental Pit below the critical water level. To preclude acidification of the Continental Pit lake, WED seepage would be amended with lime if necessary to neutralize acidity before being stored in the pit.

2.6.3 YDTI West Embankment and Water Management

During operation, the West Embankment and water management of the YDTI would be the same as under the Proposed Action. Reclaim water would be pumped to the MR Concentrator,

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as would water treated in the HSB Water Treatment Plant and used in the milling process. MR predicts that much of the YDTI seepage reporting to the WED (i.e. contact water) would most likely have a pH of 7.5, a positive net alkalinity and acid neutralization potential. However, in MR's worst-case model scenario, contact water to the WED is assumed to be more similar in composition to current Horseshoe Bend seepage, with a pH around 3, negative net alkalinity and no acid neutralization potential (Schafer Limited LLC 2018). This scenario aligns better with water samples collected from the southern end of the WED, which had pH values ranging between 3.0 and 4.1 between March and August 2018. This may represent flushing of easily mobilized solutes from recently placed embankment rock fill, in which case WED seepage water quality may improve over years of flushing during operations. If WED seepage water quality remains degraded after mining ceases, or the tailings pond degrades due to WED seepage pumpback, MR would add lime in order to maintain neutral conditions in the pond. Under worst-case conditions, MR estimates that about 5,000 tons of lime would be required to maintain alkaline conditions throughout post-closure, or about 150 tons per year for three decades. Slightly more lime would be needed during the first 3 to 5 years after closure for the worst-case scenario (Montana Resources 2018b).

Based on the water balance model completed as part of the design documents, 60 gpm of ground water is predicted to flow into the WED for up to 20 years after closure (Schafer Limited LLC 2018) (Knight Piesold 2018d). The rate of YDTI seepage into the WED is not well quantified (IRP 2017), but the basic WED design can accommodate 4,500 gpm, placing an upper bound on the expected seepage component of flow into the WED. During current operation with the addition of tailings slurry input into YDTI, MR estimates approximately 500 to 600 gpm is captured in the WED and pumped backed into the impoundment. This volume would be expected to decrease when tailings slurry is no longer added to the YDTI and static conditions are approached after closure. As the YDTI pond drains naturally towards Horseshoe Bend and water levels drop, the hydraulic gradient would change from west and south to east and south, away from the WED. The elimination of pumping this collected seepage back into the YDTI for 20 years would reduce the amount of water in the YDTI pond by an estimated 160 gpm or 84.1 million gallons per year. Water balance modeling indicate that without WED pumpback, the equilibrium pond volume would be reached 7 years sooner than under the Proposed Action (Knight Piesold 2018b). As seepage into the WED decreases over time, less volume of water would be available for removal from the WED Extraction Pond.

This alternative would be contingent upon storage or treatment of the water collected in the WED Extraction Pond that would not be pumped back into the YDTI. Seepage would be stored in the Continental Pit or it would be sent directly to a water treatment facility like other impoundment seepage. Water would be pumped directly from the WED Extraction Pond or allowed to drain by gravity. The Proposed Action identifies grouting to seal off the WED after 20 years since the drain system would no longer be necessary to maintain the ground water elevation in the tailings at a lower level than that beneath the west ridge. However, the WED

would not be grouted under the Elimination of WED Pumpback at Closure Alternative and would provide a greater certainty to capture and contain any seepage to the west.

The Elimination of WED Pumpback at Closure Alternative presents a different scenario for YDTI water management at closure, which necessitates recognition of USEPA's authority over long-term water management and treatment at the site under the BMFOU. Discussions and coordination with all parties in the 2002 BMFOU Consent Decree would be needed to review the options and feasibility for handling and treating this water, the potential use of existing or upgraded facilities and infrastructure (e.g. HsB Water Treatment Plant), and to amend their agreement accordingly.

2.6.4 Modifications to Associated Facilities

The Elimination of WED Pumpback at Closure Alternative would not affect changes to other associated facilities included in the Proposed Action like the soil and alluvium stockpiles, rock disposal sites, or access roads. DEQ does not consider eliminating pumping water from the WED Extraction Pond into the YDTI a significant change to the designs of the tailings impoundment, West Embankment, or WED and would not require reopening the IRP review. The Elimination of WED Pumpback at Closure Alternative would eliminate adding approximately 84.1 million gallons per year of collected seepage water into the tailings impoundment and allow for reclamation of the facility to occur at a faster rate.

The feasibility of conveying and treating additional flow at existing water treatment facilities, or the need to modify those facilities, would need to be reviewed by all BMFOU Consent Decree parties. No matter which facility might potentially treat the water, it would need to meet water quality criteria and final off-site discharge performance standards as described in the 2002 Consent Decree prior to discharge (Montana Resources and Atlantic Richfield Company 2018).

2.6.5 Reclamation

Under the Elimination of WED Pumpback at Closure Alternative, reclamation at the YDTI would be similar to the Proposed Action. No changes to the proposed reclamation plan would occur, other than slightly accelerating the drawdown of water and the time frame for reclamation. Proposed capping materials and the methods of reclamation would not change, but it would be possible to cap the gradually exposed Transition Zone area approximately 7 years sooner than reclamation under the Proposed Action. Dust controls would still be integral in the reclamation plan. The reclamation is expected to begin at the end of 2031 when mining operations would cease.

2.7 ALTERNATIVE CAPPING METHODS

2.7.1 Introduction to the Alternative

The Alternative Capping Methods option focuses on accelerating tailings reclamation and reducing potential dust upon initial closure conditions. It incorporates the introduction of alluvial material to the mill for processing to create a modified alluvial material used for initial

capping of the tailings beach and transition zones. The material would be hydraulically placed rather than with equipment as outlined in the Proposed Action. This method of alluvium placement for reclamation would allow for directed discharge to areas of the impoundment prone to produce dust but not accessible to equipment due to tailings saturation and instability. Interim seeding of the hydraulically placed material in the Transition Zone would provide stability and limit dust generation during the period between hydraulic placement of alluvium and final capping / final revegetation. Physical placement of the remainder of the capping material and revegetation would follow this initial reclamation as outlined in the Proposed Action. This alternative could potentially accelerate reclamation of the YDTI tailings beach area.

Alluvial material stockpiled throughout the mine or contained within the Central Zone, located between the Berkeley and Continental Pits (See **Figure 3.3-2**), would be removed, transported to the mill, processed to meet hydraulic and reclamation specifications, and pumped through existing tailings lines to the YDTI. Like the No Action Alternative, the processed alluvial tailings would be directed to up to eight discharge locations on the tailings beach and spread to the required depth.

It is anticipated that the processed alluvial tailings would consist of 85 percent water to enable the material to be pumped through the existing tailings lines to the YDTI, using supernatant pond water. The selection of the alluvium source and mill specifications such as particle distribution and water content, would aid in achieving suitable capping material consistent with the Proposed Action. DEQ anticipates that the processed alluvial material would be less reactive and have lower metal concentrations than typical tailings. If necessary, to support temporary vegetative cover, the capping material may be amended with compost or other organic material consistent with Minor Revision MR 02-001 to Operating Permit No. 00108.

2.7.2 Alternative Components Different from the Proposed Action

This alternative differs from the Proposed Action through the methods of initial capping material placement. This alternative would include excavating alluvium from the Central Zone and transporting it to the mill, processing (modifying) the alluvium to a specified size, and adding sufficient water to create a pumpable slurry. The modified alluvium would be transferred through any one of the three tailings lines to the YDTI for discharge through the existing tailings discharge lines. The Proposed Action reclamation would progress over decades as the Tailings Beach and Transition Zone become stable for equipment to place the cap. It takes time for the materials placed in the YDTI to dry, settle, and become stable enough for trucks and equipment to move on the surface safely. This alternative would allow for hydraulic placement of some of the capping material to limit the potential for dust, before the YDTI surface can be accessed by equipment and fully reclaimed.

2.7.3 YDTI West Embankment and Water Management

The alluvial material selected for the cap would need additional water for processing at the mill and pumping into the YDTI. The water needed to slurry the modified alluvium would come from

the supernatant pond. DEQ estimates that the total beach and transition areas may encompass approximately 1,342 acres in 2031 at closure. The material would be used for initial capping of the Transition Zone, estimated to be about 220 acres at the start of closure, to accelerate reclamation and control dust in areas not accessible to wheeled equipment. Following the hydraulic placement of the material, the remainder of the cap would be placed. An initial capping depth of 6 inches was used to estimate material volumes.

2.7.4 Modifications to Associated Facilities

Modification to the mill may be necessary to process alluvial material because its characteristics are different from the ore currently processed. The tailings discharge points may need to be modified for direct placement of the modified alluvium to areas without promoting segregation of the materials. Segregation of the materials can lead to development of an uneven cap. Uniform distribution of the initial capping material may be accomplished through the installation of multiple discharge points exceeding the currently proposed eight lines for the Proposed Action. Source areas for the alluvium would be accessed and reclaimed as necessary.

2.7.5 Reclamation and Revegetation

Overall reclamation using the modified alluvium would be similar to the Proposed Action with the exception of hydraulic placement of an initial cap to the Transition Zone for accelerated reclamation and dust control. Placement of the modified alluvium cap would occur as the Transition Zone becomes exposed during the initial few months following cessation of mining, and as soon as the mill could be modified (if necessary) to process alluvium. MR projects that, under the Proposed Action, the Transition Zone would become progressively exposed over a period of about 30 years. Assuming current milling rates, 6 inches of initial cap material could be deposited over the entire tailings surface (beach, Transition Zone, and subaqueous zone) in about one month. The remainder of the cap and reclamation would be similar to the Proposed Action. This action would occur sooner in comparison to the Proposed Action Alternative.

Flow characteristic studies should be performed to evaluate the modified alluvium and segregation of the material as it is discharged as a cap to control adequate particle distribution and placement thickness. The settling of larger particles near the discharge point could affect the flow and deposition thickness of the cap by diverting flows. This may result in thickness variation and possible increased alluvial material requirements to achieve the desired capping thickness.

Following the dewatering of the modified alluvium to enable equipment access, it is anticipated that the same revegetation plan would be implemented as the Proposed Action. However, the benefit of this alternative is long-term dust control of the Transition Zone without the need to inundate it with pond water for short-term dust mitigation. Also, reclamation may be able to commence sooner if the modified alluvium can drain faster than the tailings in place and provide adequate support for the equipment. This would facilitate accelerated reclamation with respect to the Proposed Action.

2.8 COMPARISON OF ALTERNATIVES

The following table (Table 2.8-1) presents a comparison of the components of each of the alternatives.

**Table 2.8-1.
Comparison of Montana Resources LLP Proposed Amendment EIS Alternatives**

Alternative Component	No Action Alternative (Current Operations)	Proposed Action – On-Site Tailings Storage and Water Containment	Accelerated Drawdown at Closure	Elimination of West Embankment Drain Pumpback At Closure	Alternative Capping Methods
Alternative Description	<p>No increase in tailings storage capacity in the YDTI would occur, the northern boundary of the YDTI would not be expanded, disturbed acreage would not be increased, and revisions to the existing reclamation and closure plans would not be necessary.</p> <p>MR mining operations would continue into approximately 2022 and be limited to the current permits which include Operating Permits 00030, 00030A, 00041, and 00108, along with associated amendments, modifications, and revisions. A summary of all operating permits and components can be found in Montana Resources Continental Mine Operations Plan dated February 2017 and revised February 2018.</p>	<p>Increase in capacity of YDTI to allow for on-site storage of additional tailings. Extend the northern boundary of the impoundment, which would allow continued tailings deposition through 2031 as part of operations at the Continental Mine. Associated facilities to support continued operations include rock disposal sites, reclamation material stockpiles, access roads, monitoring sites, and a closure spillway.</p> <p>The West Embankment would be raised to match the presently permitted elevations of the other two embankments. The West Embankment would be raised 45 feet from the 6,405-foot to the 6,450-foot elevation and extend the northern boundary of the tailings pond.</p> <p>A gravity controlled subsurface seepage collection drain, known as the West Embankment Drain (WED), would intercept seepage before it migrates west of the impoundment. Water collected in the WED would be pumped back into the YDTI pond during operations and for approximately 20 years post-closure, after which time, MR proposes to grout the WED to prevent continued discharge.</p> <p>Reclamation of the YDTI is dependent on the gradual exposure and consolidation of tailings surfaces as the pond elevation decreases, which is estimated to be completed between 30- and 40-years post-closure.</p>	<p>The accelerated drawdown during the closure phase would involve pumping or diverting water from the supernatant pond, in order to reach the equilibrium volume more quickly than under the Proposed Action. Accelerated drawdown would lower the elevation of water in the pond and reduce the potential for ground water to move west. It reduces the timeframe for reliance on the WED for seepage collection and reduces the timeframe needed to access the Transition Zone for YDTI reclamation. It would also reduce the timeframe that tailings may react with water and degrade pond water quality.</p> <p>Water removed from the supernatant pond would need to be stored and managed elsewhere on the site, or treated directly, prior to off-site discharge. MR would need to have discussions and coordination with parties in the 2002 BMFOU CD.</p>	<p>Eliminating the pumpback of WED seepage to the YDTI during the closure phase would expedite the dewatering of tailings, by reducing flow inputs into the YDTI. This would help to reach the equilibrium pond volume more quickly than under the Proposed Action. Eliminating flow back into the YDTI would lower the elevation of water in the pond and reduce the potential for ground water to move west. It reduces the timeframe for reliance on the WED for seepage collection and reduces the timeframe needed to access the Transition Zone for YDTI reclamation. It would also reduce the potential for acidification or metal loading in the YDTI pond, and thereby reduce the need for lime addition as mitigation.</p> <p>Water from the WED Extraction Pond would need to be stored and managed elsewhere on the site, or treated directly, prior to off-site discharge. MR would need to have discussions and coordination with parties in the 2002 BMFOU CD.</p> <p>The WED would not be grouted post-closure but would be allowed to continue to flow.</p>	<p>The Alternative Capping Methods option would accelerate tailings reclamation. Immediately upon cessation of mining, alluvial material would be routed to the mill for processing and discharged as modified tailings material to cap the transition zone areas that would be susceptible to blowing dust and inaccessible to equipment.</p> <p>It would allow for capping in areas not accessible to equipment placement due to tailings saturation and stability. This initial cover would eventually be reclaimed to the full thickness (28 inches) when equipment access is possible. This alternative could potentially accelerate reclamation of the YDTI.</p>

**Table 2.8-1.
Comparison of Montana Resources LLP Proposed Amendment EIS Alternatives**

Alternative Component	No Action Alternative (Current Operations)	Proposed Action – On-Site Tailings Storage and Water Containment	Accelerated Drawdown at Closure	Elimination of West Embankment Drain Pumpback At Closure	Alternative Capping Methods
Permit Boundary/Disturbed Area	Permit boundary and disturbed area would remain the same as currently permitted. This includes 2,177 acres for the YDTI and 160 acres for associated facilities.	<p>The proposed amendment would increase the total area of Permit 00030A by approximately 237 acres, but only 99 of these acres would be disturbed to accommodate the West Embankment raise and YDTI expansion. Although the proposed amendment would affect mine facilities that are located within Operating Permit 00030, it would not authorize the disturbance of any additional land under Operating Permit 00030. All acreage changes would occur within the current MR mine permit boundary.</p> <p>Additional disturbances within Operating Permit 00030A would accommodate increased tailings storage, construction, topsoil storage, roads, and monitoring wells.</p>	No change to Proposed Action acreage.	No change to Proposed Action acreage.	No change to Proposed Action acreage.
YDTI West Embankment and Water Management	<p>Water management is expected to continue as permitted. MR monitors surface water quality at several sites within and adjacent to the mine. The Berkeley Pit and Horseshoe Bend monitoring sites are sampled as part of the BMFOU. The monitoring program continuously evolves with changes in the operation and site conditions. YDTI and treated HsB seepage reclaim water would continue to be used in the MR Concentrator until closure unless water management and treatment strategies change as a result of the BMFOU pilot study.</p> <p>The elevation of the West Embankment would remain at 6,405 feet and not be raised to the proposed elevation of 6,450 feet to match the presently permitted elevations of the East-West and North-South Embankments. Storage capacity of the YDTI would not be increased and current mining could only continue through 2022.</p> <p>The WED is a gravity controlled subsurface collection system installed in the permeable upstream portion of the West Embankment</p>	<p>The design of the West Embankment includes features to manage seepage from the YDTI. The WED Design Report incorporates these previous design elements with additional features to manage seepage. Design of the West Embankment to the 6,450-foot elevation and associated water management features were based on comprehensive, site-specific West Ridge resource inventories and analyses covering geology, hydrology, and geotechnical conditions.</p> <p>Other elements included as part of the WED system are an Extraction Basin, drain pods, and Secondary Seepage Collection Drains. Each of these would be connected hydraulically to the upstream side of the embankment.</p> <p>The purpose of the 3.6-million-gallon Extraction Pond would be the gravity collection of the seepage water from the WED. The seepage would be pumped from the Extraction Pond back into the YDTI during operations and for approximately 20 years post-closure. Potential acidification of the pond would be mitigated by the addition of lime.</p>	<p>Accelerating drawdown of the supernatant pond at closure would allow surface reclamation to happen sooner than proposed. As high flow rate estimates, the equilibrium pond volume could be achieved in one year or less, with a pumping rate between 10 and 16.35 MGD (the average reclaim water pumping rate during 2012-2017 operations). Lower pumping rates may be utilized to balance the timeline of pond level reduction with the feasibility of reclaiming the exposed tailings surfaces.</p> <p>During operation, no changes would be expected to the West Embankment and water management of the YDTI as presented in the Proposed Action. Reclaim water would be pumped to the MR Concentrator, as would water treated in the HsB Water Treatment Plant unless water management and treatment strategies change as a result of the BMFOU pilot study.</p> <p>At closure, water removed from the supernatant pond would be stored and managed elsewhere on the site, or treated</p>	<p>Eliminating WED pumpback at closure would reduce the pond elevation and allow surface reclamation to happen sooner than the Proposed Action, but not as quickly as the Accelerated Drawdown at Closure Alternative. It would also reduce the potential for acidification or metal loading in the YDTI pond, and thereby reduce the need for lime addition as mitigation.</p> <p>During operation, no changes would be expected to the West Embankment and water management of the YDTI as presented in the Proposed Action. Reclaim water would be pumped to the MR Concentrator, as would water treated in the HsB Water Treatment Plant unless water management and treatment strategies change as a result of the BMFOU pilot study.</p> <p>At closure, water from the WED Extraction Pond would be stored and managed elsewhere on the site, or treated directly, prior to off-site discharge. MR would need</p>	Similar to the Proposed Action. To preclude the incorporation of additional flow into the YDTI, water from the supernatant pond may be used to place the modified alluvium cover material during the initial phase of closure.

**Table 2.8-1.
Comparison of Montana Resources LLP Proposed Amendment EIS Alternatives**

Alternative Component	No Action Alternative (Current Operations)	Proposed Action – On-Site Tailings Storage and Water Containment	Accelerated Drawdown at Closure	Elimination of West Embankment Drain Pumpback At Closure	Alternative Capping Methods
	<p>which would intercept flow before migration to the lower permeable downstream zone and potentially migrating west of the YDTI. The WED was previously approved in Amendment 9 and has been constructed. Pumping water from the WED into the YDTI was approved during operations as a contingency for hydrodynamic containment, but was not anticipated beyond closure to maintain the ground water gradient.</p>		<p>directly, prior to off-site discharge. MR would need to have discussions and coordination with parties in the 2002 CD.</p>	<p>to have discussions and coordination with parties in the 2002 CD.</p>	
<p>Modifications to Associated Facilities, Materials, and Personnel</p>	<p>No changes would occur to the associated facilities permitted under Operating Permits 00030 and 00030A. Access roads and pit haul roads would continue to be maintained for safe conditions. Haul truck traffic would continue to occur 7 days per week, 24 hours per day, 365 days per year. Salvage of material for mine reclamation has been contemporaneous with mining since 1972. Some alluvium is suitable for surface or sub-surface reclamation material, and some leached cap material is suitable for subsoil reclamation material.</p> <p>Workforce levels would be expected to remain the same and operations would continue through 2022. MR's workforce may fluctuate on a seasonal and annual basis, but the operation has typically employed between 350 and 400 employees and on-site contractors since 2010.</p>	<p>Associated facilities proposed include additional area in an existing rock disposal site, a new rock disposal site, stockpile areas for soil and alluvium, access roads, and long-term monitoring sites within Operating Permits 00030 and 00030A. A closure spillway has been conceptually designed to provide a system for releasing water from the tailings impoundment and maintaining a safe water level during a major storm event.</p> <p>There would be no changes to personnel during operations, which would be extended through 2031. Some positions may then be reduced or reassigned during reclamation and post-closure management and monitoring.</p> <p>Under the Proposed Action, water would only be ultimately removed from the impoundment through evaporation loss or seepage to Horseshoe Bend. The water would be treated and managed in accordance with the 2002 BMFOU Consent Decree.</p>	<p>Associated facilities that support mine operation would be the same as the Proposed Action. There would be no changes to personnel during operations. Some positions may be reduced or reassigned during reclamation and post-closure management and monitoring, which would occur more quickly than under the Proposed Action.</p> <p>Modified plans to manage water and to pump directly from the supernatant pond would need to be developed. Water would be stored and managed elsewhere on the site, or treated directly, prior to off-site discharge. MR would need to have discussions and coordination with parties in the 2002 BMFOU CD.</p> <p>Use of existing infrastructure would be evaluated. Options for gravity drainage would be evaluated. Storage locations will be identified and may include the Continental Pit.</p> <p>Upgrades to water treatment facilities managed under Superfund may need to be considered. The water would be treated and managed in accordance with the 2002 BMFOU Consent Decree.</p>	<p>Associated facilities that support mine operation would be the same as the Proposed Action. There would be no changes to personnel during operations. Some positions may be reduced or reassigned during reclamation and post-closure management and monitoring, which would occur more quickly than under the Proposed Action.</p> <p>Modified plans to divert water away from WED Extraction Pond would need to be developed. New water lines may be needed to pump or divert water from the WED Extraction Pond. Locations of water lines would need to be placed to avoid interference with other ongoing reclamation.</p> <p>Upgrades to water treatment facilities managed under Superfund may need to be considered. Locations for discharge of treated water may need to be coordinated with other parties in the 2002 BMFOU CD and amendments to their agreement may be needed. The water would be treated and managed in accordance with the 2002 BMFOU Consent Decree.</p>	<p>Associated facilities that support mine operation would be the same as the Proposed Action. There would be no changes to personnel during operations. Following the initial placement of modified alluvium as cover material, the personnel needs during reclamation and post-closure management and monitoring would be more similar to the Proposed Action.</p> <p>Modification to the mill would be necessary to process alluvial material due to its different characteristics in comparison to ore.</p> <p>The tailings discharge points may need to be modified for direct placement of the modified alluvium to areas without promoting segregation of the materials. This may be accomplished through the installation of multiple discharge points exceeding the currently used eight lines for the Proposed Action.</p> <p>Tailings lines may need to be modified or replaced to handle the potential abrasive characteristics of the modified alluvium.</p>

**Table 2.8-1.
Comparison of Montana Resources LLP Proposed Amendment EIS Alternatives**

Alternative Component	No Action Alternative (Current Operations)	Proposed Action – On-Site Tailings Storage and Water Containment	Accelerated Drawdown at Closure	Elimination of West Embankment Drain Pumpback At Closure	Alternative Capping Methods
					Source areas for the alluvium would be accessed and reclaimed as identified in the Proposed Action.
Reclamation and Post-Closure Management for the YDTI and Associated Facilities	<p>The reclamation plan for most of the tailings embankment includes regrading the downstream slopes to 2.7H:1V, placing a 20-inch thick amended alluvium cap, and revegetation. The access road along the embankment crest would remain for post-closure monitoring. Ditches and swales would be constructed at 100 ft intervals on the regraded slopes to promote drainage and reduce erosion risk of the reclamation cap.</p> <p>WED construction was permitted by DEQ as part of Amendment 9. However, the operation of the WED identified a maximum operational supernatant pond elevation of 6,360 feet, and the WED was not required as a hydrodynamic containment feature. The WED would still effectively capture seepage moving west from the YDTI after closure, but at a lesser flow anticipated under the Proposed Action.</p> <p>Rockfill would cover the tailings beach areas susceptible to wind erosion after termination of operations. The cover would be comprised of leached cap material and seeded for dust control. Reclamation of the tailings beach areas would follow, which would include placing a 28-inch thick amended alluvium cap and revegetation. A partial wet closure scenario is planned for the northern portion of the tailings impoundment consisting of a pond and adjacent wetland area periodically inundated as the seasonal pond water level fluctuates.</p>	<p>Reclamation at the YDTI would be similar to the No Action Alternative but would incorporate additional acreage due to the tailings impoundment expansion.</p> <p>The WED system and Extraction Pond would be operated for hydrodynamic containment for approximately 20 years post-closure, until the pond elevation/saturated head is below the WED invert elevation. Potential acidification of the pond would be mitigated by the addition of lime.</p> <p>Reclamation methods for the rock disposal sites do not change substantially from methods for other permitted rock disposal sites. In general, reclamation includes reducing slopes steepness, constructing benches or runoff collection ditches; testing and amending alluvium. Soil stockpiles will be ripped to relieve compaction and revegetated. The spillway walls and bottom in the segment excavated in bedrock will be broadcast-seeded. The spillway segment traversing previously disturbed areas will be regraded, ripped, covered with 28 inches of alluvium, and seeded. Roads not necessary for post-closure management and monitoring will be reclaimed.</p>	<p>Reclamation at the YDTI would be similar to the Proposed Action Alternative, and no changes to the reclamation of associated facilities would occur. No changes to the proposed reclamation plan, other than accelerated drawdown of water and accelerated time frame for reclamation, are planned. Pumping rates should be utilized to balance the timeline of pond level reduction with the feasibility of reclaiming the exposed tailings surfaces.</p> <p>Proposed capping materials and methods of reclamation cap would not change. Dust controls would still be integral in the reclamation plan. The reclamation is expected to begin at the end of 2031 when mining operations cease.</p> <p>Reclamation methods for the rock disposal sites, soil stockpiles, spillway, and roads would be similar to the Proposed Action.</p>	<p>Reclamation at the YDTI would be similar to the Proposed Action Alternative, and no changes to the reclamation of associated facilities would occur. Eliminating WED pumpback at closure would reduce the pond elevation and allow surface reclamation to happen sooner than the Proposed Action, but not as quickly as the Accelerated Drawdown at Closure Alternative.</p> <p>Reclamation methods for the rock disposal sites, soil stockpiles, spillway, and roads would be similar to the Proposed Action.</p>	<p>Reclamation using the modified alluvium would be similar to the Proposed Action with the exception of hydraulic placement of modified alluvium as cover for some areas of the tailings beach and Transition Zone.</p> <p>Placement of the material would occur immediately after mining on areas that are susceptible to blowing dust and/or inaccessible to equipment due to tailings saturation and instability.</p> <p>Studies may need to be performed to evaluate the flow characteristics of the modified alluvium and segregation of the material as it is discharged as a cap to ensure adequate particle distribution and placement thickness.</p> <p>Reclamation methods for the rock disposal sites, soil stockpiles, spillway, and roads would be similar to the Proposed Action.</p>

**Table 2.8-1.
Comparison of Montana Resources LLP Proposed Amendment EIS Alternatives**

Alternative Component	No Action Alternative (Current Operations)	Proposed Action – On-Site Tailings Storage and Water Containment	Accelerated Drawdown at Closure	Elimination of West Embankment Drain Pumpback At Closure	Alternative Capping Methods
	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.				
Years after closure when reclamation of the Transition Zone could begin (Reduction in reclamation timeline)	30 to 40 years (No change)	30 to 40 years (No change)	5 to 9 years (25 to 31 years)	23 to 33 years (7 years)	28 to 38 (2 years)

2.9 ALTERNATIVES CONSIDERED BUT DISMISSED FROM FURTHER ANALYSIS

Under MEPA, a reasonable alternative is one that is practical, achievable under current technology, and economically feasible (EQC 2015). 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(C)(I), MCA). Pursuant to 75-1-220(1), MCA, an “alternatives analysis” under MEPA does not include an evaluation of an alternative facility or an alternative to the proposed project itself. In addition, 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 agency representatives and MR 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 is included.

2.9.1 Dry Closure of YDTI Through Upstream Diversions for Tributaries

Surface runoff from the upstream watershed flows directly into the YDTI supernatant pond via three perennial streams: Silver Bow Creek, Yankee Doodle Creek, and Dixie Creek (Knight Piesold 2018a). The total contributing watershed area is approximately 4,000 acres. The Moulton Reservoirs #1 and #2 store water for the town of Walkerville and limited utilization by Butte and are located in the upper reaches of the Yankee Doodle Creek watershed. The two reservoirs have an additional total catchment area of approximately 1,680 acres. The Moulton Reservoir dams are designed to facilitate the emergency spill of excess water into Yankee Doodle Creek, which then flows downstream to the YDTI supernatant pond.

Total inflow into YDTI include 3 percent (0.7 MGD) from runoff from the contributing catchment basin, 4 percent (0.9 MGD) from direct precipitation on the pond and beach, and 93 percent (22 MGD) from water in the tailings slurry.

Developing diversion systems to capture upstream ground water and surface water prior to flowing into YDTI was planned in the 1990s as part of the BMFOU. The diversion systems were found to be of limited benefit. Only 3 percent of the flow into YDTI is from runoff whereas the majority of inflow is from tailings slurry, which would be eliminated upon mine closure. Upstream capture systems would not appreciably speed reclamation.

2.9.2 Off-Site Tailings Storage

Locating a new tailings storage in a location outside of the currently permitted mine site was considered during development of the design documents (Knight Piesold 2017c). During the analysis, it was agreed that a newly developed tailings disposal facility could be identified,

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designed, permitted, and constructed to the north (upslope) of the existing YDTI. However, any of the off-site options have limitations imposed by the project location and surrounding development, including 1) the existing access into and out of the mine, 2) private property and federal property surrounding the mine, 3) construction and operation of a tailings pipeline crossing private lands, and 4) impacts to multiple stakeholders (Knight Piesold 2017c).

A new tailings facility located off-site would change the risk of tailings management. Any new site would add to the project risk portfolio and negate the long-term experience of operating the current facility. Land ownership and topographic constraints limit the possibility of development in most directions. The timeline to locate, investigate, design, permit and construct a new facility could easily exceed three years, which would likely lead to a temporary interruption of operations. It is possible that a new site would be difficult or even impossible to permit, or that the local site conditions would not be conducive for development of a suitable tailings facility (Knight Piesold 2017c).

Any new development would likely result in large scale disturbance of a previously undisturbed site and would require considerable increases to the area requiring reclamation following mine closure. The alternative is dismissed because it does not meet the purpose and need of the Proposed Amendment and is essentially proposing an alternative to the project itself. DEQ is acting on MR's proposal to expand the capacity for storing tailings by increasing the storage capacity of the YDTI.

2.9.3 Tailings Storage in Berkeley Pit

Although the Berkeley Pit is located within MR's permitted mine area, it is also located within the BMFOU to the Silver Bow Creek/Butte Area National Priorities List (NPL) Site and subject to USEPA jurisdiction and requirements. According to USEPA, the Berkeley Pit is the major feature in the BMFOU. That determination was made in compliance with CERCLA and is documented, along with other remedy requirements, in the 1994 Record of Decision (USEPA 1994). The use of the Berkeley Pit for tailings storage would require a change to both the BMFOU ROD and the 2002 Consent Decree (See Section 1.3.3.1). The use of the Berkeley Pit for tailings storage would also obstruct access and the potential for future exploration of a significant mineral resource. This alternative was dismissed because the use of the Berkeley Pit for tailings storage would not meet the purpose and need of this proposed amendment.

2.9.4 Alternative Tailings Management Strategies

Alternative tailings management strategies would consider options for dealing with the tailings slurry prior to deposition in the YDTI. Two options were considered, filtering the tailings and depositing them on existing disturbed areas, and changing the tailings process to create a thicker tailings material. More detail on the proposed processes is provided below. Neither of these alternative processes would meet the purpose and need for the proposed amendment. In

addition, analysis of these processes did not identify any benefit to operations or reduction in environmental effects (Knight Piesold 2017c).

2.9.4.1 Filtered Tailings

Modification of the tailings processing and distribution infrastructure to produce and stack filtered tailings within the currently disturbed mine site area was evaluated. A tailings thickener and filtration plant would need to be added at the back end of the process to produce filtered tailings. Tailings would then be distributed by conveyor or truck to the disposal area. A filter plant capable of dewatering tailings at the rate required for the project exceeds the current industry precedent (Knight Piesold 2017c).

The outer edge of the tailings pile would be compacted and armored with rockfill to reduce erosion, improve stability, and to facilitate reclamation. An area within the tailings stack would be designated for tailings that do not meet the required moisture content for optimum compaction in the structural areas, to allow ongoing placement during precipitation events and freezing conditions. The existing pond at the northern end of the YDTI would be maintained for additional reclaim water, storage of storm water, and storage of slurry tailings during upset conditions at the filtration plant. Water removed during filtration would be sent back the mill for reuse in processing. Water from the storage pond would be reclaimed for use in processing as a supplement to water recovered during filtration (Knight Piesold 2017c).

According to the EOR, there are many issues associated with the development of this alternative (Knight Piesold 2017c). Distribution using a truck fleet would at least double the existing truck fleet and the fuel needs. The risk of blowing dust would increase for this alternative compared to other alternatives. The closure objectives for the entire site would be fundamentally altered by pursuing this alternative. The ultimate size of the filtered tailings pile would substantially exceed any existing precedent by nearly an order of magnitude. The rate of rise in the maximum section would be on the order of 30 feet per year and would have the potential for development of saturated conditions and excess pore pressures due to the rapid rate of construction and due to water entrainment from snowfall or rainfall events. The entrainment of snow and/or excess pore pressure development could impact the stability of the pile in the short and long-term. The pile position adjacent to both open pits would add loading to the surface in these areas and could potentially impact pit wall stability. The seismicity of the area and the presence of the Continental Fault is also a consideration.

2.9.4.2 Thickened Tailings

Modification of the tailings processing to thicken the tailings slurry to the YDTI was evaluated. A tailings thickener would need to be added at the back end of the process. The tailings thickener would conceptually be located in the vicinity of the concentrator buildings. The tailings distribution system would be modified, and tailings would be deposited from multiple locations during the continued construction and use of the facility (Knight Piesold 2017c).

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The existing tailings distribution system pumps and pipelines would need to be replaced to distribute thickened tailings. The cost would be considerable without an offsetting benefit to balance the incremental capital and operating costs of the change. The reclaim water system is already in place, and therefore no offsetting benefit can be realized by reducing the size of that system. Tailings would segregate less during deposition; however, tailings beaches could still be developed. There would be no expected detriment or benefit to environmental attributes or closure objectives as a result of thickening the tailings. In addition, this operational change would not provide additional capacity in the YDTI. Therefore, it would not meet the purpose and need of the proposed amendment.

Alternative tailings management strategies would consider options for dealing with the tailings slurry prior to deposition in the YDTI. The current permitted operation would continue to manage tailings as has been done for years with proven and successful operational management techniques typically used for slurry tailings management. Alternative tailings management strategies have been evaluated in the options and have considered common and proven tailings slurry management techniques such as filtering or thicken tailings slurry.

2.9.5 Alternative Post-closure Topography

Post-closure topography could possibly be redesigned to minimize erosion or infiltration based on topographic features. However, any runoff would remain within the mine permit boundary and drain into Horseshoe Bend or Berkeley Pit where it would continue to be managed by MR and under the BMFOU. Changing the topography would not provide additional capacity at the YDTI and would not meet the purpose and need for the proposed amendment. The option of altering the topography during reclamation management to better address site conditions would be available to MR in consultation with DEQ.

2.10 SUMMARY OF IMPACTS AND ALTERNATIVES

A series of tables summarize the impacts for each alternative in Chapter 5. Descriptions and analyses of the types of impacts are provided by resource area and by alternative in Chapter 3, Environmental Consequences and in Chapter 4, Cumulative, Unavoidable, Irreversible, and Irretrievable Impacts.

2.11 PREFERRED ALTERNATIVE

ARM 17.4.617(9) requires an agency to state a preferred alternative in the draft EIS, if one has been identified, and to give its reason for the preference. DEQ has identified the West Embankment Drain (WED) Pumpback Elimination at Closure Alternative as the agency's preferred alternative.

Under the Proposed Action, the impoundment seepage captured by the WED would be pumped back into the impoundment after mining ceases (closure). It is estimated that this would occur for approximately 20 years, or until the tailings pond level decreases to the point that the West Embankment Drain no longer captures impoundment seepage. Pumping the impoundment seepage captured by the WED back into the impoundment would maintain a closed loop so that water only permanently exits the facility through evaporation or through seepage at Horseshoe Bend, where it is captured and treated under the Superfund remedy. Because the impoundment seepage captured by the WED is anticipated to be acidic with elevated ion and metal concentrations, the seepage would be treated with lime to limit the acidification of the remnant tailings pond. When the WED ceases to capture impoundment seepage, it would be grouted to prevent continued discharge. The rate of reclaiming the surface of the impoundment is contingent upon safe access to dry tailings, which relies on draining the tailings pond to a steady state ("equilibrium").

Under the WED Pumpback Elimination at Closure alternative, the impoundment seepage captured by the WED would be diverted to the Continental Pit for storage (i.e. within the previously approved closure pit lake) or to the Horseshoe Bend Treatment Plant for treatment and discharge under the Superfund remedy. If the WED effluent is routed to the Continental Pit for storage, it would first be treated, if necessary, to eliminate acidity and maintain alkaline conditions in the Continental Pit lake. This would eliminate the need to maintain pumpback systems for decades post-closure, and the need to lime the impoundment seepage captured by the WED to mitigate acidification of the tailings pond. Furthermore, water balance modeling indicates that draining the tailings pond to a steady state would be accelerated by approximately 7 years by eliminating the return of tailing seepage back to the pond. As a result, the schedule for reclaiming the exposed tailings surfaces would be accelerated. Finally, the WED would not be grouted at some point after cessation of tailings disposal in the impoundment, but would be allowed to continue to function as a drain. This would maintain a more robust groundwater divide between the tailings impoundment and groundwater resources to the west of the West Ridge. For these reasons, the WED Pumpback Elimination at Closure alternative was selected as the agency's preferred alternative.

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 the permit amendment application contains all necessary information and whether the proposed amendment satisfies the substantive requirements of the MMRA.

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DEQ determined that MR's permit amendment application was complete and compliant on August 31, 2018 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 even though DEQ believes that there is environmental benefit to the WED Pumpback Elimination at Closure Alternative. However, if after the public comment period, DEQ still prefers the WED Pumpback Elimination at Closure alternative, the applicant and BMFOU parties could voluntarily agree to the alternative.

The WED Pumpback Elimination at Closure Alternative presents a different scenario for YDTI water management at closure, which necessitates recognition of USEPA's authority over long-term water management and treatment at the site under the BMFOU. Discussions and coordination with all parties in the 2002 BMFOU Consent Decree would be needed to review the options and feasibility for handling and treating this water, the potential use of existing or upgraded facilities and infrastructure (e.g. HsB Water Treatment Plant), and to amend the agreement accordingly.

3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

The affected environment section provides a baseline of information from which to analyze and compare the effects of the alternatives. 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 Continental Mine permit boundary, but some may cover larger areas relevant to the potential for impacts. With several narrow exceptions, an environmental review conducted under 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), MCA).

3.1 LOCATION DESCRIPTION AND STUDY AREA

The permit footprint of the Continental Mine facilities, including the YDTI and Berkley Pit, is approximately 4.9 miles long by 2.8 miles wide at the furthest points and covers approximately 5,890 acres of which approximately 4,632 acres are currently disturbed (WESTECH 2018a). The mine permit area is adjacent to the city of Butte and near the intersection of Interstates 15 and 90 (**Figure 1.3-1**). As mentioned previously, the Continental Mine is part of the Butte Mining District and is located within Operable Units subject to Superfund oversight (See Sections 1.3 and 1.5).

In order to maintain consistency with the proposed amendment application materials, maps and figures related to the Continental Mine presented in this EIS reference the site coordinate system known as the Anaconda Mine Grid established by the ACM in 1957. The Anaconda Mine Grid is based on a vertical datum established in 1915. Elevations in this EIS are generally stated in Anaconda Mine Grid coordinates with respect to the ACM Vertical Datum, which is typically 52.6 feet higher than the U.S. Geological Survey (USGS) datum (slight variations in the elevation correction factor occur around the mine). Information on areas outside of the mine or provided by sources other than MR are presented in the USGS datum or elevation above mean sea level (AMSL).

The YDTI is located in the upper portion of the Silver Bow Creek drainage in steep mountainous terrain (**Figure 1.3-1**). The impoundment is bounded to the east by the East Ridge or Rampart Mountain, to the west by the relatively low-lying West Ridge, and to the north by the Silver Bow Creek and Yankee Doodle Creek headwaters. South of the YDTI are historic and current mining facilities including the Berkeley Pit, Continental Pit, MR processing facilities, and the HsB Water Treatment Plant.

Elevations in and around the YDTI range from about 6,340 feet AMSL at the current tailings pond, to over 7,800 feet on Rampart Mountain to the east. The elevation of the West Ridge ranges from approximately 6,470 to 6,550 feet AMSL. Daily precipitation data are available

from the Bert Mooney Airport weather station (USC00241320), located approximately six miles south of the YDTI at an elevation of 5,600 feet AMSL, about 800 feet lower than the impoundment. For the period 1990 through 2016, annual precipitation averaged 12.8 inches per year, ranging from 8.63 inches in 2000 to 19.96 inches in 1997 (**Figure 3.1-1**) (Montana Resources 2018b). Schafer (2016) developed an adjustment factor for the Bert Mooney Airport precipitation data to address the higher elevation YDTI. Based on this adjustment, annual precipitation in the YDTI and West Ridge area is estimated to be 15.9 inches per year (Montana Resources 2018b).

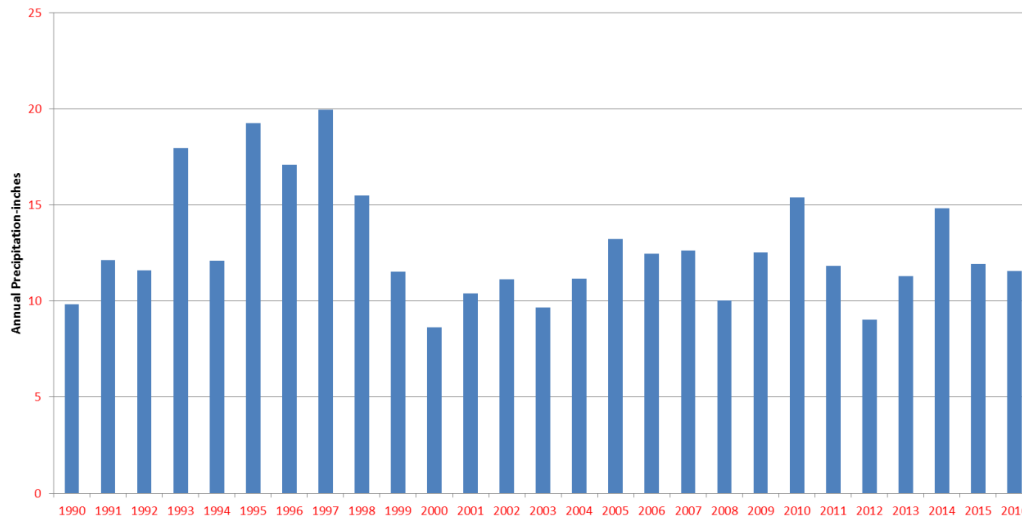


Figure 3.1-1.

Annual precipitation for the period of record 1990 to 2016 as measured at the Bert Mooney Airport Weather Station (USC00241320), Butte Montana.

3.2 ISSUES CONSIDERED BUT NOT STUDIED IN DETAIL

The interdisciplinary team reviewed resource areas and associated issues and determined there would be no impacts or minimal impacts to several resources. Therefore, these resources will not be analyzed in detail in the EIS. **Table 3.2-1** lists resources that were eliminated from detailed analysis and the rationale for why they will not be analyzed in detail.

**Table 3.2-1
Resources Eliminated from Detailed Analysis for the YDTI Expansion**

Resource	Determination	Rationale
Environmental Justice	Not Present	Impacts would not be disproportionately high or adverse. No alternative considered in this analysis resulted in any identifiable impacts or issues specific to any minority or low-

**Table 3.2-1
Resources Eliminated from Detailed Analysis for the YDTI Expansion**

Resource	Determination	Rationale
		income population or community as defined in Executive Order 12898. The number of people in Silver Bow County living in poverty in 2017 was 15.5 percent and the minority populations were 10.6 percent (US Census Bureau 2018) .
Land Use	Negligible Impacts	All of the lands affected by the proposed amendment are held privately by MR. There is no public access to the site, nor would there be access in the absence of the mine activity.
Paleontological	Not present	No paleontological resources have been found in over 100 years of mining, nor would these resources be expected to occur within the prevalent intrusive igneous rocks.
Recreation	Negligible impacts	The Continental mine and MR’s surface facilities including the YDTI would not affect recreational access or opportunities in the area. Vehicle and public access is already restricted within the mine. Access to areas surrounding the mine would not be affected.
Safety	No impacts	The Continental Mine and MR is regulated by MSHA. This issue was not analyzed as it is outside of the scope of MEPA review.
Transportation	No Impacts	Transportation effects are not expected because the proposed amendment would not affect the total employment by MR nor would it affect transportation of mine inputs or outputs.
Species listed under the Endangered Species Act (ESA)	No impacts	Individual grizzly bear (<i>Ursus arctos</i>) (threatened), Canada lynx (<i>Lynx canadensis</i>) (threatened), or wolverine (<i>Gulo gulo</i>) (proposed threatened) could occasionally move through the area during exploratory or dispersal movements but none are expected to be permanent residents.

**Table 3.2-1
Resources Eliminated from Detailed Analysis for the YDTI Expansion**

Resource	Determination	Rationale
Wetlands and Waters of the US	No Impacts	A Jurisdictionality Determination was completed by the US Army Corps of Engineers (USACE) for the waterways tributary to the YDTI. The waters were determined to be isolated, non-jurisdictional waterways because they lack a connection with a water of the US (USACE 2018).
Wastes (Hazardous or Solid)	No Impacts	Spill plans are in place.

Impacts are analyzed at a level commensurate with the likelihood that a resource would be affected. 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 intensity of the impacts is evaluated using the following categories:

- No impact: No change from current conditions, the issue should be dismissed from detailed consideration.
- 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.

3.3 GEOLOGY AND MINERALS

The Proposed Action and project alternatives have the potential to affect geology and minerals in the Project area. This section provides a description of the general and YDTI-specific geologic setting and affected environment, as well as a discussion of environmental consequences related to geology and minerals.

The Butte Mining District, located near the southern portion of the Boulder Batholith, covers an area of approximately 25 square miles (Czehura 2006). Large quantities of copper, silver, gold, manganese, zinc, lead, and molybdenum have been mined from underground mines and the Berkeley Pit. Although large-scale underground mining has ceased in the District, current

operations at the Continental Mine continue to develop a 500 million-ton geologic resource. (Czehura 2006).

3.3.1 Analysis Methods

3.3.1.1 Analysis Area

The geology analysis area is confined to the MR mine permit boundary and the proposed amendment boundary.

3.3.1.2 Methods of Analysis

The full site characterization report (Knight Piesold 2017a) is presented in the Design Document and is summarized in part below. The site characterization report describes:

- The physiography, site geology, and known faults in the vicinity of the YDTI;
- The properties and distribution of surficial material (alluvium) underlying the YDTI;
- The geotechnical and hydrogeological conditions along the West Ridge;
- The foundation conditions for the existing rockfill embankment;
- The geotechnical properties and hydrogeological conditions for the existing rockfill embankment;
- The geotechnical properties and hydrogeological conditions of the tailings contained in the YDTI; and
- The instrumentation monitoring network.

Along with the site characterization report, information used in the analysis of the existing geologic conditions and environmental concerns was found in the proposed amendment to Operating Permits 00030 and 00030A and accompanying documentation (Montana Resources 2018b). MR completed a geotechnical and hydrogeological site investigation program throughout 2015 and 2016 to support the design and permitting of increased storage capacity within the YDTI (Montana Resources 2018b). The findings of this site investigation work were integrated with previous site investigation work completed during the design and construction of the YDTI between 1962 and the present.

3.3.2 Affected Environment

The geology of Butte has been described in numerous publications and is summarized in MR's mine operations plan (Montana Resources 2018a), the proposed amendment (Montana Resources 2018b), and the YDTI Site Characterization Report (Knight Piesold 2017a). Three geologic units are present within the mine permit area and include 1) granitic bedrock associated with the Boulder Batholith, 2) Lowland Creek Volcanics (LCV), and 3) unconsolidated valley fill deposits. A general description of the geologic units and structures in the vicinity of the YDTI is summarized below.

3.3.2.1 Geologic Setting and Formations

The local geology is dominated by the Butte Quartz Monzonite (BQM) phase of the Boulder Batholith. The BQM is a hard, crystalline granitic bedrock with very low primary porosity and

permeability. It consists of medium grained hornblende-biotite-quartz monzonite, forming the oldest and most common rock type in the district (Houston 2001). The aplite and granoaplite units identified on **Figure 3.3-1** are cogenetic (formed at the same time) sills and dikes intruded into the BQM. These units are typically very hard and subject to fracturing which can lead to enhanced ground water flow through these features.

The Boulder Batholith bedrock is mechanically homogeneous where intact, but jointing has created dominant planes of weakness that control rock behavior near the surface. The dominant joint sets are vertical and north-south trending, but other orientations exist (Montana Bureau of Mines and Geology 2009). A summary of geologic map units found in the project area is shown in **Table 3.3-1**. A geologic map of the YDTI and immediately surrounding the proposed amendment area is shown on **Figure 3.3-1**.

A distinct zone of highly weathered and altered bedrock occupies the upper few feet to tens of feet of BQM through most of the study area. The weathered bedrock typically consists of relatively fresh, quartz-rich BQM clasts within an iron stained matrix of weathered and altered plagioclase and potassium feldspar minerals (Knight Piesold 2017a).

Tertiary Lowland Creek Volcanics (LCV) unconformably overlie BQM just north and west of the project area (**Figure 3.3-1**). LCV units present in the general area include the Basal Unit (Tlt) comprised of a basal ash tuff and detritus-rich conglomerate, and an overlying quartz-latite welded ash-flow tuff (Tlw). The LCV deposits are up to 700 meters thick north of the YDTI (Houston 2001). The LCV typically are not considered to be significant water-bearing units due to their general lack of primary porosity.

Quaternary unconsolidated alluvium and colluvium material occurs within drainage bottoms and on some hillslopes between ridge outcrops of BQM. Alluvial deposits within Silver Bow and Yankee Doodle creeks upstream of the YDTI are thin and narrow in lateral extent and are not considered to be significant water-bearing units. Beneath the YDTI however, these unconsolidated deposits reach thicknesses of 40 feet or more along the east side of the impoundment beneath the tailings.

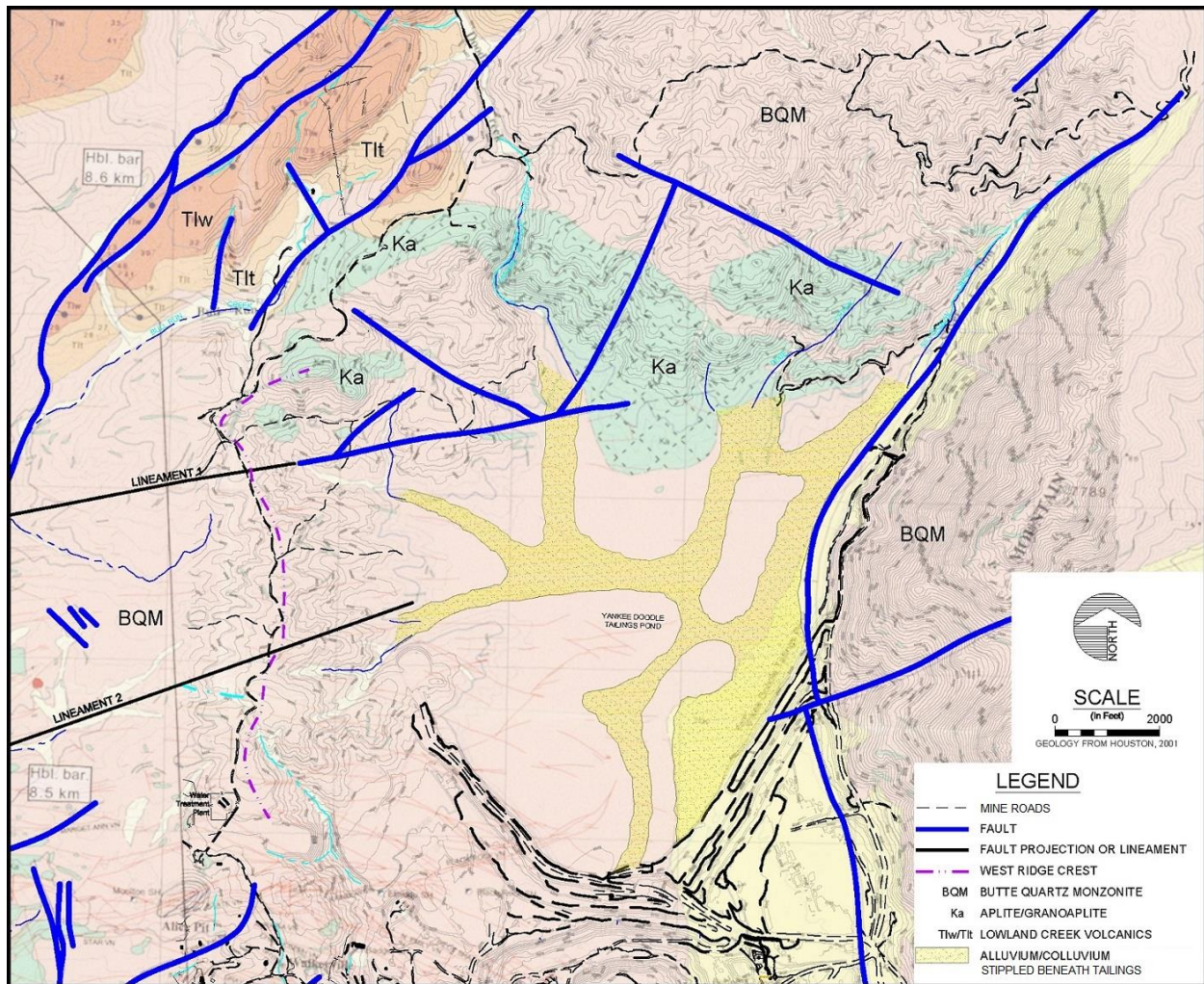
Table 3.3-1
Summary of Geologic Map Units Listed from Youngest to Oldest for the Area near the Yankee Doodle Tailings Impoundment, Butte, Montana

Formation	Lithology	Period
Alluvium of modern channels and flood plains	Unconsolidated deposits of alluvium and colluvium; dense silty sand; silt and sand, up to cobble-size materials.	Quaternary
Lowland Creek Volcanics (LCV)	Includes Basal Unit (Tlt) comprised of a basal ash tuff and detritus-rich	Early Tertiary 48 to 50 m.y.

Table 3.3-1
Summary of Geologic Map Units Listed from Youngest to Oldest for the Area near the Yankee Doodle Tailings Impoundment, Butte, Montana

Formation	Lithology	Period
	conglomerate, and an overlying quartz-latite welded ash flow tuff (Tlw).	
Butte Quartz Monzonite (BQM)	Medium-grained hornblende-biotite quartz monzonite	Late Cretaceous 68 to 78 m.y.

m.y.= million years



Source: (Houston 2001)

Figure 3.3-1. Geologic map of the YDTI and area immediately surrounding the site.

3.3.2.2 Geologic Structure

Numerous geologic faults are found throughout Silver Bow County, some of which date back to Precambrian time. Faults located close to the proposed amendment area are shown on **Figure 3.3-1**. Most faults have seen little to no movement for hundreds of millions of years. However, a few faults have exhibited evidence of movement more recently and could be considered to have the potential for movement again. The faults demonstrating more recent movement generally trend northeast and displace Quaternary sediments (Knight Piesold 2017a). These recent faults typically cut the north-south trending Rocker Fault and possibly the Continental Fault and are associated with the broad northeast-southwest belt of faults associated with the Great Falls Tectonic Zone (Knight Piesold 2017a). The faults that created Rampart Mountain, Elk Park, and the East Ridge include the Continental Fault, Klepper Fault, and the East Ridge Fault and generally strike in a north-south direction (Montana Bureau of Mines and Geology 2009). All three are normal faults. The Continental Fault and Klepper Fault intersect the Continental Pit located south of the YDTI. The Continental Fault runs along the eastern edge of the YDTI below the North-South Embankment. These and other faults were included in the seismic hazard source models completed for the YDTI design documents (Knight Piesold 2018c)

Important to the YDTI geologic evaluation is the presence of two east-west trending geologic structures (lineaments) within the bedrock and traced through the area of the West Embankment. BQM has a low primary porosity and permeability with ground water flow controlled by secondary features such as fractures, joint sets, mineralized veins, and faults. The location of these structures is relevant to understanding ground water flow along the west side of YDTI.

Lineament 1

Lineament 1 is the northern most lineament identified on **Figure 3.3-1**. It extends from the northwest portion of the YDTI (where an east-west oriented fault has previously been identified), westward to the head of Bull Run Creek drainage. Based on the east-west trending fault previously mapped in the northwest portion of the impoundment, and its general alignment with the head of Bull Run Creek drainage, it appears likely that the fault extends westward through the West Ridge.

Besides the mapped fault on the east end and the aligned drainage on the west end of the apparent lineament, other indications of a cross-ridge bedrock structure include a topographic low or saddle where the lineament crosses the ridge crest, and “gray decomposed clay” noted in a well log from a private water well located near the westward lineament projection (Montana Resources 2018b). A low point or saddle in a ridge line typically indicates an area of increased bedrock erodibility, caused either by a change in lithology or the presence of a bedrock structure. Lacking a change in lithology in the immediate area, the topographic saddle may indicate a structural feature trending through the area (Montana Resources 2018b). In addition, ground water level monitoring conducted during the West Ridge evaluation shows that ground water levels are shallower and have significantly greater seasonal fluctuation north

of Lineament 1 than to the south. These water level trends are consistent with the presence of a low permeability geologic structure coinciding with Lineament 1 and restricting southward ground water flow.

Lineament 2

Lineament 2 extends from the west impoundment abutment westward to the head of Oro Fino Gulch drainage. Lineament 2 is located south of Lineament 1 and also trends northeast to southwest as shown on **Figure 3.3-1**. Although no fault or other significant bedrock structures are identified on the geologic maps in this area, the strong linear pattern of upper Oro Fino Gulch drainage suggests the drainage pattern may be structurally controlled. The drainage is oriented approximately North 50° East, which closely parallels the general northeast-southwest trending fault set present in the impoundment area (Montana Resources 2018b). In addition, the alluvium deposit that is mapped in a linear orientation extending northeast beneath the YDTI tends to agree with a structural control of the pre-YDTI drainage.

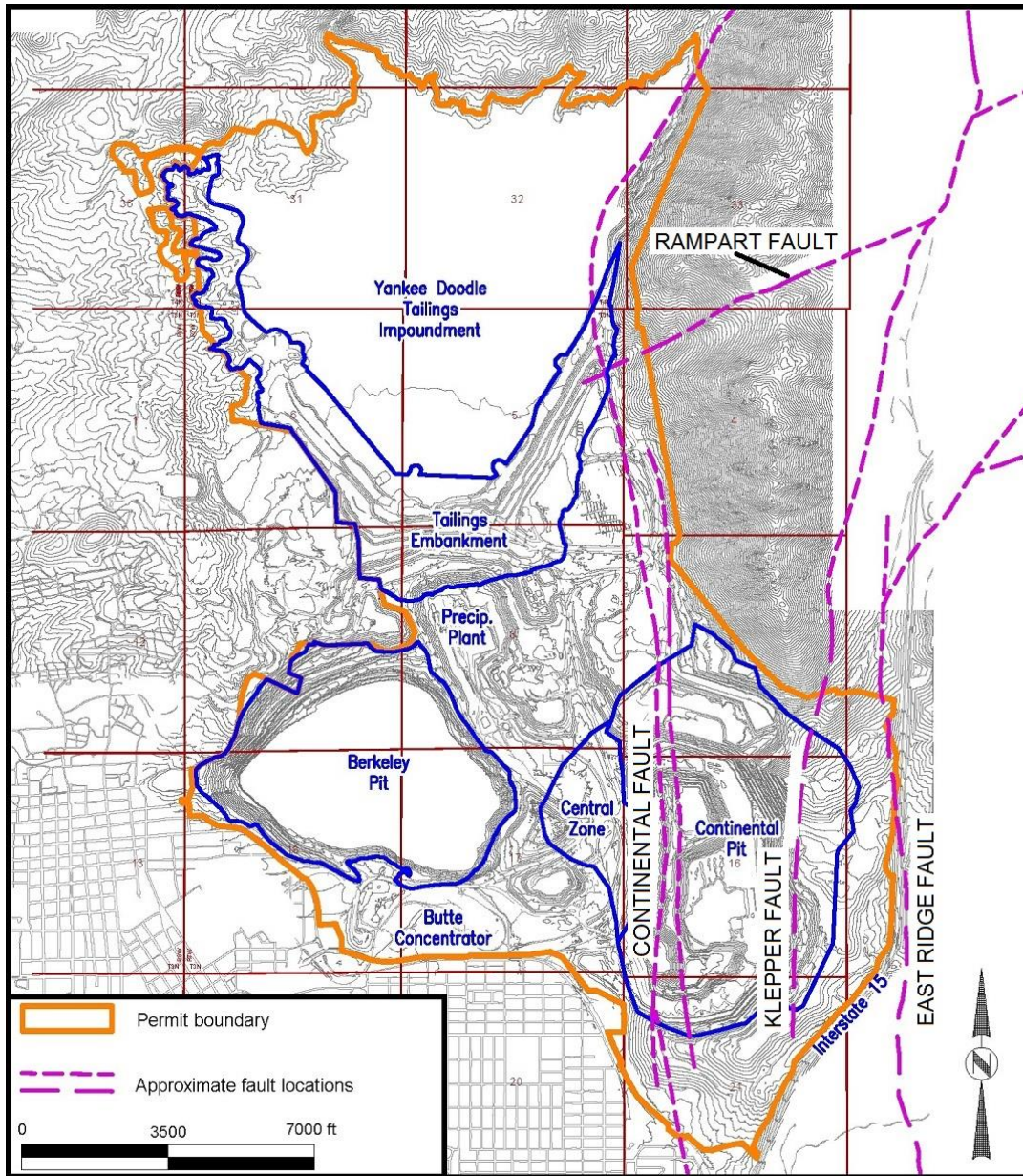
Numerous other structures of varying size and characteristics have been identified through the West Ridge hydrologic evaluation as well as prior regional studies. For the West Ridge hydrogeology, potentially significant features include aplite dikes, which tend to fracture under stress and could act as potential conduits, and numerous, predominantly east-west oriented shear zones. The shear zones are typically associated with moderately to highly altered bedrock envelopes which restrict ground water flow (Montana Resources 2018b).

3.3.2.3 Mining and Mineral Development

The Continental orebody is being mined by ongoing operations at the Continental Pit. The locations of the mine permit boundary and associated facilities are shown on **Figure 3.3-2**.

Continental Pit

In the Continental area, 160 to 200 feet of Leached Cap and overburden overlie a massive copper-molybdenum orebody bounded on the west by the Continental Fault and on the east by the Klepper Fault. The deposit is a typical porphyry copper system except that the enriched zone is less pronounced than is commonly observed. Continental Primary Zone copper occurs as chalcopyrite in interlacing veinlet swarms and as disseminations in the BQM. Continental Primary Zone molybdenum occurs in younger subparallel veinlet swarms and slicks that offset the early copper veinlets. More recent mesothermal (moderate temperature and pressure) veins overprint the early mineralization, but these contain mostly iron, lead, and zinc. Continental Primary Zone copper immediately below the Leached Cap is weakly enriched by surface weathering where secondary chalcocite occurs as coatings on pyrite and chalcopyrite (Montana Resources 2018a).



Source: (Montana Resources 2018a)

Figure 3.3-2. Montana Resources Mine complex and general location.

Central Zone

The Central Zone orebody is situated between the Berkeley Pit and the Continental Pit and is bounded on the east by the Continental Fault. This major, north-south trending basin and range fault dips steeply to the west and offsets the Continental orebody by some 3,500 feet.

Porphyry-style mineralization has been intercepted in the hanging wall of the Continental Fault at that depth and mapped in underground workings at elevations of 2,000 feet AMSL, beneath

the bottom of the Berkeley Pit. As in the Berkeley Pit and in the Continental Pit, mesothermal veins overprint the early mineralization. In localized areas, shear couples have developed “horsetail ore zones” of minor importance compared to those along the Leonard-Belmont axis that were exploited by underground mining and ultimately mined out in the Berkeley Pit (Montana Resources 2018a).

Ore and Pit Rock

Ore from the Continental Pit is geochemically different when compared to Berkeley Pit ore. Continental Pit ore consists of lower copper and higher molybdenum grades, lower pyrite content, and higher calcite content. Berkeley Pit deposit ore consisted of higher-grade metals, higher sulfide content, and lower carbonate content (Montana Resources 2018a).

Approximately 296 million tons of waste material will be mined through the planned mine life with the majority of rock comprised of Continental Primary Zone waste (163 million tons) and Continental Leached Cap material (63 million tons). A significant amount of material in the rock disposal sites will also be re-located (31 million tons). The leached cap along with the 6 million tons of alluvium represent an important resource that will be used in dam construction and reclamation of the mine facilities. Most of this leached cap and alluvium material will be mined in two phases, including 2016 to 2020 and again from 2025 to 2030. Most material to be mined near the end of mine life will be Continental Primary Zone waste (Montana Resources 2018a).

3.3.3 Environmental Consequences

This section presents environmental consequences associated with the Proposed Action and other alternatives. Consequences unique to each alternative are discussed under separate headings.

3.3.3.1 No Action Alternative

Under the No Action Alternative, the proposed Amendment would not be approved and MR would continue to operate under its existing operating permits. Mining would continue until approximately 2022 when the YDTI would reach capacity. During this time, mining at the Continental Pit would continue, ore processing would continue at the MR Concentrator, tailings would continue to be pumped into the YDTI, and waste rock would continue to be placed on the approved waste rock storage sites. Reclamation would begin following mining and include incremental dewatering of the tailings, development of beach and Transition Zones, and a reduction in the size of the supernatant pond. Impacts to the geology and mineral resources would not change from what has been previously permitted for the mine, such as removal of ore and rock from the Continental Pit and placement of tailings in the YDTI to the currently approved elevation.

3.3.3.2 Proposed Action

Under the Proposed Action, the crest elevation of the West Embankment would be increased to 6,450 feet, with a proposed maximum water surface elevation for the supernatant pond of approximately 6,428 feet. Mining would continue until the YDTI reaches a pool elevation of

6,428 feet. During mining, tailings would continue to be deposited in the YDTI and waste rock would continue to be placed on the YDTI embankment. Once the YDTI embankment crest elevation is raised to an elevation of 6,450 feet, waste rock that would not be needed for the YDTI embankment would be stored in the North RDS and the Great Northern RDS (Montana Resources 2018b).

Disturbance to the West Embankment geology and minerals during construction as part of the Proposed Action would occur. Surficial alluvium would be buried beneath the tailings as the supernatant pond size increases to the north. Drainages entering the pond would also be impacted by sediment and pond water. Mining would continue to remove rock from the Continental Pit, but the footprint (disturbed acres) would not change. Impacts to the geotechnical and hydrogeological conditions along the West Ridge and of the tailings contained in the YDTI, and the foundation conditions for the existing rockfill embankment, are described in Sections 3.4.3, 3.5.3, and 3.6.3.

3.3.3.3 Accelerated Drawdown at Closure Alternative

No aspect of the Accelerated Drawdown at Closure Alternative would affect the amount or extent of excavation at the Continental Pit or the design or placement of materials along the embankments. If water is diverted to the Continental Pit for storage, it would occur after mining has ended. The impacts to the geology resources under this alternative would be similar to the Proposed Action, except for the potential reduction in time for reclamation to be completed.

3.3.3.4 Elimination of West Embankment Drain Pumpback at Closure

No aspect of the Elimination of the WED Drain Pumpback Alternative would affect the amount or extent of excavation at the Continental Pit or the design or placement of materials along the embankments. If water is diverted to the Continental Pit for storage, it would occur after mining has ended. The impacts to the geology resources under this alternative would be similar to the Proposed Action, except for the timing of the reclamation.

3.3.3.5 Alternative Capping Methods

No aspect of the Alternative Capping Methods Alternative would affect the amount or extent of excavation at the Continental Pit or the design or placement of materials along the embankments. The impacts to the geology resources under this alternative would be identical to the Proposed Action, except for the potential reduction in time for reclamation.

3.4 GEOTECHNICAL ENGINEERING

The Proposed Action and project alternatives have the potential to affect geotechnical design and stability of YDTI. This section provides a description of the affected environment in relation to the YDTI, as well as a discussion of environmental consequences related to its development.

The technical aspects of the YDTI design for geotechnical considerations were reviewed and accepted by the IRP, with the results of their review documented within their final report (IRP

2017) and updated report (IRP 2018). The IRP was involved with the review of the YDTI embankments design throughout the design process, that included detailed reviews of each component of the design. The IRP's final report addresses each component of the design individually, and provides an overview of the regulatory requirements, their assessment and observations of the design, and their concurrence with each design component. The IRP states that they agree with the analysis provided by KP and Hydrometrics and that the design was reviewed in accordance with the regulatory requirements outlined in 82-4-377, MCA. As stated by the IRP, "In the view of the Independent Review Panel, the design document for expansion of the Yankee Doodle Tailings Impoundment addresses all MCA requirements. Based on the selection of the appropriate parameters and sound technical evaluations, the IRP accept the adequacy of this design" (IRP 2017). The following summary is provided for informational purposes only.

3.4.1 Analysis Methods

3.4.1.1 Analysis Area

The analysis area for geotechnical engineering includes the YDTI storage facility embankment and impoundment, the waste rock storage areas, and adjacent improvements and undeveloped land in the MR permit area.

3.4.1.2 Information Sources

Information used in the analysis of the existing geotechnical engineering conditions and environmental concerns was found in the proposed amendment to Operating Permits 00030 and 00030A.

3.4.1.3 Methods of Analysis

The primary requirements for the design and evaluation of tailings dams in Montana have been set forth in 82-4-375 through 82-4-381, MCA. These statutes require that any modifications or design for tailings dam storage facilities as defined in 82-4-303, MCA be completed by an EOR. The EOR must have at least 10 years of direct experience with the design and construction of tailings storage facilities. The design must be reviewed by an IRP consisting of three independent review engineers who are experts in the design and construction of tailings storage facilities. The IRP is charged with reviewing the design document, underlying analysis, and assumptions including the practical application of current technology within the design. The detailed level of design and review required for applicable tailings storage facilities in Montana is intended to provide for the design, operation, monitoring, and closure of tailings storage facilities such that they (a) meet state-of-practice engineering design standards, (b) use applicable, appropriate, and current technologies and techniques that are practicable given site-specific conditions and concerns, and (c) provide for the protection of human health and the environment. The primary intent of the legislation is to provide for expert design and review of the tailings storage facility to limit the risk of failure. The results of the IRP review can be found within their final report (IRP 2017).

Geotechnical engineering concerns were analyzed to assess the stability of the existing YDTI storage facility embankment and waste RDS under both static and seismic loading conditions. Computer software included SLOPE/W, a subset of the Geostudio software platform developed by Geo-Slope International Ltd. and was used to estimate the stability that would result from increasing the height of the YDTI embankment. This computer program provided an estimate for a factor of safety against a large-scale failure of the upstream and downstream embankments during operation, closure and equilibrium conditions. The minimum factor of safety of 1.5 for both operational and post-closure conditions used in the analysis is consistent with stability objectives required by Montana legislation and accepted at other large-scale mining operations.

3.4.2 Affected Environment

This section describes the affected environment in terms of geotechnical engineering concerns for the YDTI and waste rock storage areas.

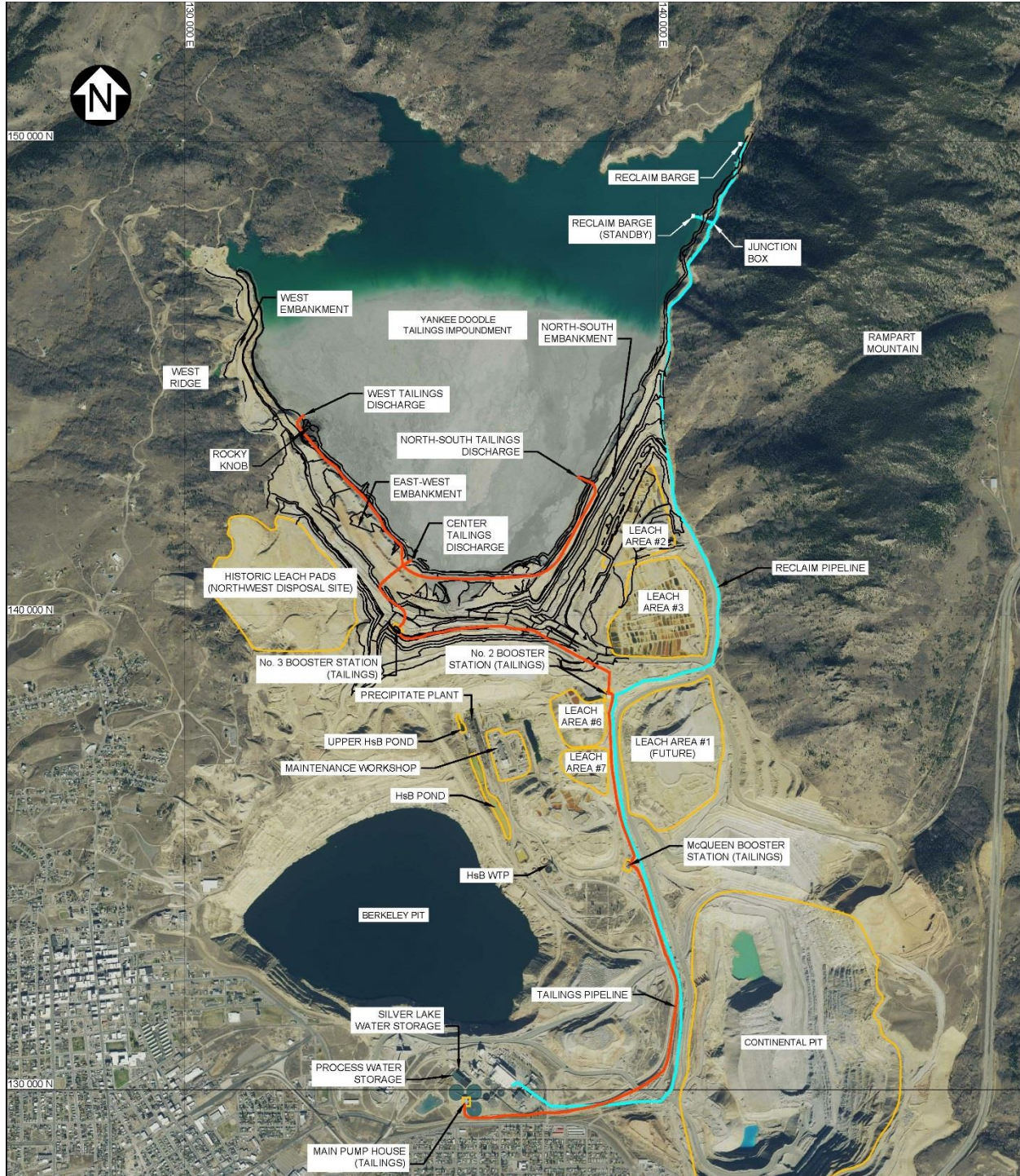
3.4.2.1 YDTI and Embankments

The YDTI and its embankments are currently permitted to cover a total of 2,295 acres and the YDTI is designed to contain approximately 750.2 million cubic yards of tailings. The YDTI embankment was originally constructed in 1963 to facilitate mining operations from the Berkeley Pit. The YDTI embankment has been expanded since that time to an elevation of 6,405 feet with waste rock from the Berkeley Pit (1963 to 1982) and from the Continental Pit (1986 to current). A plan view showing the current layout of the YDTI facility is shown on **Figure 3.4-1**. The YDTI embankment consists of a valley-fill impoundment created by dumping waste rock from the mining process in 30 to 100-foot lifts to form the free-draining embankment fill. The waste rock lifts were typically traffic compacted with haul trucks to consolidate the material. The embankment has been modified to incorporate a zone of fine-grained alluvial material on the upstream face of the dam to limit tailings migration into the embankment fill (Knight Piesold 2017a). For discussion purposes, MR has delineated the YDTI embankment into three segments, as follows (**Figure 3.4-1**):

- North-South Embankment - Located at the base of Rampart Mountain and forms the eastern portion of the YDTI embankment. The North-South Embankment is approximately 7,300 feet long and is oriented north to south and forms the eastern boundary of the MR mine site. The current crest elevation of the North-South Embankment is approximately 6,400 feet (Montana Resources 2018b).
- East-West Embankment - The East-West Embankment is approximately 4,800 feet long, is oriented east to west, and forms the southern and southwestern limb of the YDTI. The current crest elevation of the East-West Embankment is approximately 6,400 feet. The East-West Embankment is constructed upstream of Horseshoe Bend and the Berkeley Pit (Montana Resources 2018b).
- West Embankment – The West Embankment is approximately 7,000 feet long and is oriented north to south along the western side of the YDTI. The current crest elevation

Chapter 3: Affected Environment and Environmental Consequences

of the West Embankment is approximately 6,405 feet. The West Embankment is constructed along the West Ridge area between Moulton Road and the tailings impoundment (Montana Resources 2018b).



Source: Knight Piesold, Ltd.

Figure 3.4-1. Current YDTI facility layout.

Historically, tailings have been discharged at a single discharge point located at the center of the East-West Embankment. Tailings are combined with water at the mill to form a slurry, which is then pumped via a pipeline to the YDTI. Coarse solids settle out first to form beaches, and the finer tailings fraction settles toward the center and northern end of the tailings storage facility. The practice of discharging at a single location was recently changed to a multiple discharge point system at various points around the impoundment to facilitate the reclamation process and improve the stability of the YDTI embankments. The multiple point discharge system was implemented to provide a larger tailings beach area that increases the distance between the embankment and the supernatant pond. The increased distance results in developing a larger dry beach between the embankment and pond that limits the risk of failure of the embankment, as water directly against the embankment can lead to failures. This change was made to produce a more stable tailings mass suitable for reclamation following the completion of mining (Montana Resources 2018b).

3.4.2.2 Waste Rock Disposal Sites (RDS)

The primary waste RDS lay to the south and west of the YDTI facility. The existing waste RDS were originally designed to be constructed using 50-foot lifts. There have been no waste RDS slope stability problems to date.

3.4.3 Environmental Consequences

This section presents environmental consequences associated with the Proposed Action and other alternatives. Consequences unique to each alternative are discussed under separate headings.

3.4.3.1 No Action Alternative

Under the No Action Alternative, operations at the mine would continue until the YDTI reaches a full pool elevation of 6,360 feet, per the current mine permits. During this period, tailings would continue to be deposited in the YDTI and waste rock would continue to be placed on the approved waste rock storage sites.

YDTI and Embankments

After mining operations cease, the downstream slope of the existing embankment would be regraded to a 2.7H:1V slope or greater except for the area near the Precipitation Plant. The slope in this area would be reclaimed by covering the steep slopes with a coarse rockfill-material consisting of 18-inch minus riprap that would be a durable and non-acid generating rock, sourced from off site. The remainder of the embankment slopes would be capped with a 20-inch thick alluvial material and revegetated (Montana Resources 2018a).

The resulting impoundment would consist of a tailings beach, seasonal Transition Zone, and remnant pond. The tailings beach would be reclaimed by covering the beach areas that are susceptible to erosion and blowing dust with a 6-inch thick layer of rock. The entire beach would be reclaimed with the placement of a 28-inch thick alluvial material cap and revegetated. Reclamation of the Transition Zone and remnant pond would include a partial wet closure with

a seasonal Transition Zone that would be periodically inundated with seasonal water level fluctuations and an open water area (pond) (Montana Resources 2018a). Under the No Action Alternative, there would be no adverse impacts to the YDTI facility or to embankment stability.

Waste Rock Disposal Sites

Under the No Action Alternative, the waste rock generated from approved mining activities would be added to either the existing waste RDS or, more likely, added as a buttress against the downstream slope of the YDTI. Adding material as a buttress against the downstream slope of the YDTI would act to increase the stability of the YDTI embankment.

After mining operations cease, the existing waste RDS would be reclaimed using methods included in the approved operating permit. These methods would include reducing the slopes to no steeper than 2.7H:1V, regrading to keep water from ponding on the RDS, constructing benches or runoff collection ditches at 100-foot interval on regraded slopes, placement of 20 inches of alluvial material on the slopes and 28 inches of alluvial material on the tops and benches, placement of organic matter and/or topsoil at a rate of 23 tons per acre, and revegetation of the sites (Montana Resources 2018a).

Under the No Action Alternative, there would be no geotechnically adverse impacts to the YDTI, the embankment, or the RDS areas' stability.

3.4.3.2 Proposed Action

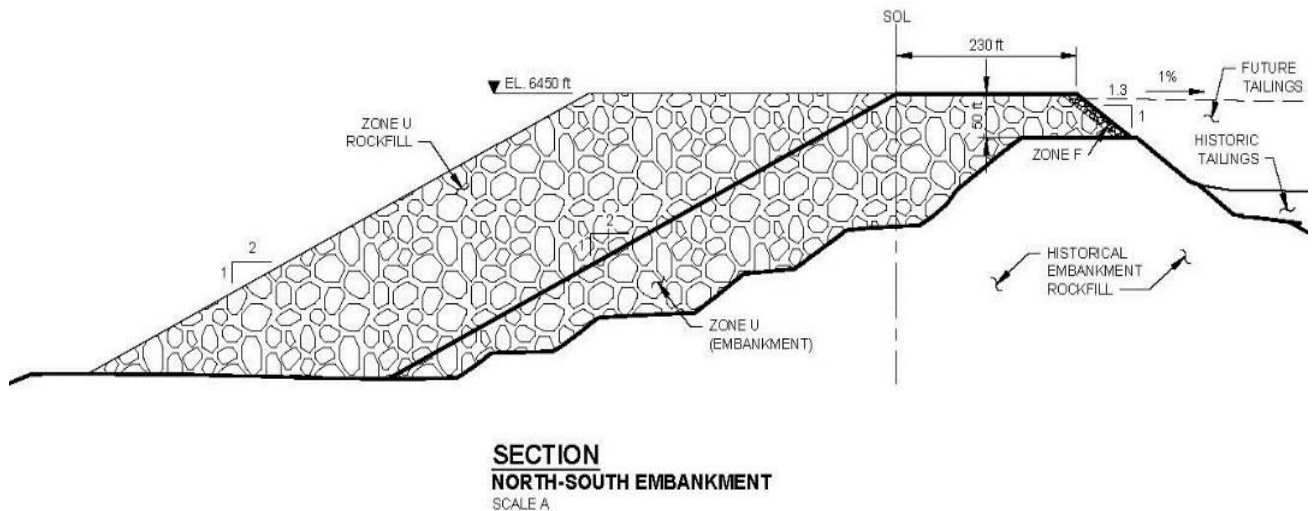
Under the Proposed Action, the crest elevation of the West Embankment would be increased to 6,450 feet, with a proposed maximum water surface elevation of 6,428 feet. The primary purpose of the Proposed Action is to increase YDTI West Embankment height to facilitate continued mining operations at the Continental Pit. Under the Proposed Action, mining would continue until the YDTI reaches a pool elevation of 6,428 feet. During mining, tailings would continue to be deposited in the YDTI and waste rock would continue to be placed on the YDTI embankment. Once the YDTI embankment crest elevation is raised to 6,450 feet, waste rock that would not be needed for the YDTI embankment would be stored in the North RDS and the Great Northern RDS (Montana Resources 2018b).

YDTI Facility and Embankments

The crest elevation of the YDTI West Embankment would be raised incrementally using similar techniques, equipment, and construction methodologies previously evaluated and permitted. Waste rock from the Continental Pit would be transported with haul trucks and dumped to construct most of the embankment. The proposed YDTI embankment construction would be performed during ongoing mining operations. The proposed increase in the crest elevation of the West Embankment to 6,450 feet is scheduled for completion within approximately four years. As discussed previously, the YDTI embankment is divided into three segments that include the North-South Embankment, the East-West Embankment, and the West Embankment. A description of the recent and proposed modifications to each of these embankment segments to support the Proposed Action is as follows:

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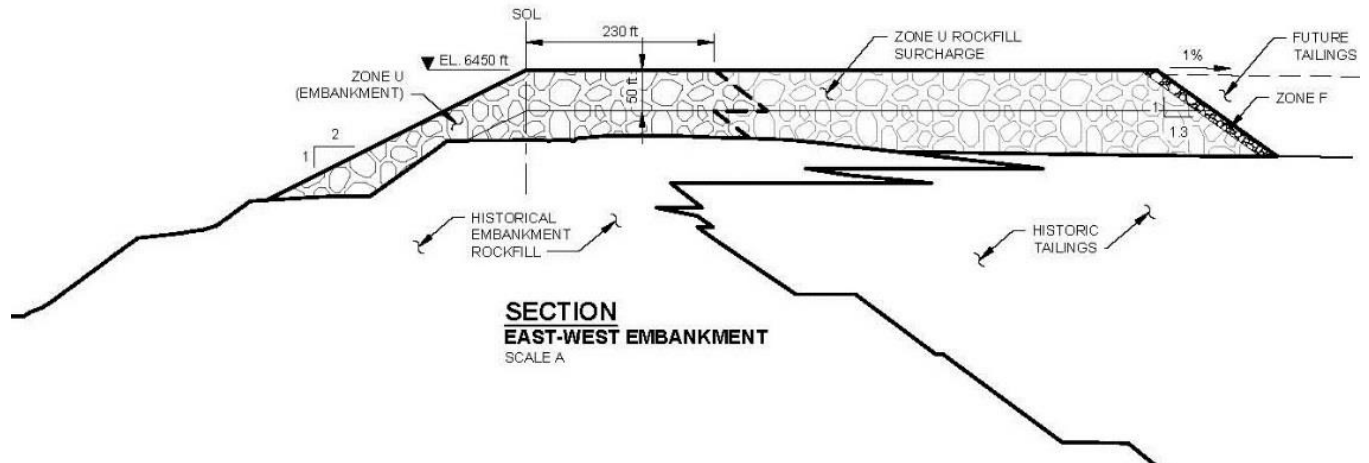
- **North-South Embankment:** This portion of the embankment is currently permitted with a crest elevation of 6,450 feet (**Figure 3.4-2**). The most recent 50-foot raise to an elevation of approximately 6,400 feet was performed by downstream construction method where rockfill was added to the downstream face of the embankment. The downstream construction method consists of the placement of the initial embankment in upstream areas with subsequent lifts placed on the downstream slope. The upstream slope has been constructed at the angle of repose (natural slope of the material after dumping) of the waste rock material (about 1.3H:1V). The downstream slope has been constructed to a slope of approximately 2H:1V and the crest has a minimum width of 230 feet (KP 2017b). No additional increase to the crest elevation (above what is permitted) would be included in the Proposed Action.



Source: (Knight Piesold 2017b)

Figure 3.4-2. North-South embankment section.

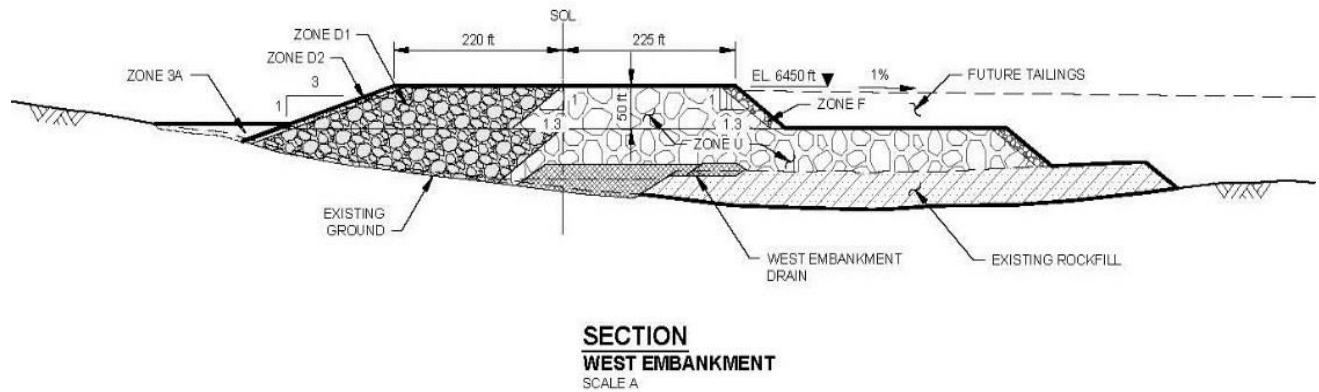
- **East-West Embankment:** This portion of the embankment is currently permitted to an elevation of 6,450 feet (**Figure 3.4-3**). The most recent 50-foot raise was performed by the centerline construction method where rockfill was added to the upstream and downstream faces to an elevation of approximately 6,400 feet. The upstream slope, downstream slope, and crest width are the same as the North-South Embankment (Knight Piesold 2017b). No increase to the crest elevation (above what is permitted) would be included in the Proposed Action.



Source: (Knight Piesold 2017b)

Figure 3.4-3. East-West embankment section.

- West Embankment: This portion of the embankment is currently permitted to an elevation of 6,405 feet. The proposed embankment raise would be performed in a single 45-foot lift. The upstream slope would be constructed at the angle of repose of the waste rock material (about 1.3H:1V) and the downstream slope would be 3H:1V, or flatter. The minimum crest width would be 230 feet and alluvial material would be placed on the upstream face (Zone F on **Figure 3.4-4**) to limit tailings migration into the rockfill. The West Embankment includes a design feature to manage ground water levels in the embankment through the construction of the West Embankment Drain (WED). The WED is a gravity-control subsurface seepage collection drain located at the upstream toe of the West Embankment that is intended to intercept seepage flow that may migrate west of the YDTI. The WED is approximately 7,000 feet long and extends nearly the entire length of the West Embankment. The drain directs the gravity flow of intercepted seepage from the YDTI to a lined extraction pond where it will be pumped back into the YDTI, if necessary. The WED generally consists of a subsurface aggregate filter drain underlain with a non-woven geotextile material capable of collecting up to 4,500 gpm. The WED was constructed with multiple redundant features including a secondary extraction basin, drain pods, and secondary seepage collection drains to serve as a backup for seepage collection in the event that the WED is not effective (Knight Piesold 2017b). The West Embankment configuration is shown on **Figure 3.4-4**.



Source: (Knight Piesold 2017b)

Figure 3.4-4. West embankment section.

The proposed West Embankment raise would comprise the following rockfill zones that are shown on the **Figures 3.4-2 through 3.4-4**:

- Zone U material would be waste rock hauled from the Continental Pit. This material would be free-draining to facilitate water movement through this zone. The material would be hauled from the Continental Pit and end-dumped by 240-ton haul trucks. As this material is placed (50-foot lifts), finer-grained materials would be expected to accumulate near the top of the lifts while cobbles and boulders roll down the slope and accumulate at the toe.
- Zone F material would be an alluvial material placed along the upstream face of the embankment to prevent migration of the tailings in the impoundment into the Zone U rockfill.
- Zone D1 material would be rockfill used to construct the downstream portion of the West Embankment to limit horizontal migration and allow seepage water to collect within the WED. The Zone D1 material would be made up of rock with a relatively low acid potential (AP).
- Zone D2 material would be an alluvial material placed on the downstream slope of the West Embankment to facilitate runoff of surface water around the West Embankment. The alluvial material would be finer grained material that would act to discourage the migration of surface water into the West Embankment.
- Zone 3A material would be a rockfill material placed along the toe of the downstream slope of the West Embankment to facilitate the infiltration of runoff to the toe of the embankment.

Engineering Assessment

Knight Piesold Ltd. (KP) performed an evaluation of the proposed West Embankment geometry to assess the foundation and embankment stability, the potential for overtopping of the embankment crest, and the potential for internal erosion and/or piping within the embankment.

The slope stability evaluation was performed on four segments of the West Embankment. The most critical slip planes that represent the weakest portions of the embankment were found for both the upstream and downstream slopes. Material properties for the various portions of the embankment were selected based on past site investigations. Various material strengths were selected for portions of the foundation and the embankment based on industry standard design criteria. Analyses were performed to determine an estimate of the embankment crest settlement and deformation during the Maximum Credible Earthquake (MCE) condition. The seismic hazard analysis used a magnitude 6.5 earthquake on the Richter scale as the MCE

The results of the stability evaluation showed that the weakest portion of the embankment would occur through the downstream embankment rockfill. However, the results showed that the proposed YDTI embankment would be stable, with a factor of safety of 2.0 or greater, which exceeds the legislative requirement of having a factor of safety of 1.5 or greater for normal operations. The stability evaluation showed that the factor of safety values for the upstream cases would typically be more than 5.0 for normal operations.

The analysis of the liquefaction potential that could occur during earthquake conditions showed that, although saturation of a portion of the tailings could occur, the rockfill surcharge from the embankment would effectively mitigate any potential movement of this material. The impact of earthquake-induced strength loss would be largest in the upstream portion of the embankment. However, the factor of safety in the upstream embankment even during the MCE exceeds 3.0 and the embankment would be stable. The evaluation also considered the potential for continuous layers of saturated overburden and rockfill in the base of the embankment with lower strength materials, which indicated that the embankment would remain stable under these conditions. The earthquake deformation analysis showed that the maximum embankment deformation caused by an earthquake would be within design tolerance for the proposed YDTI embankment. The results of the stability evaluation suggest that the continued expansion of the YDTI West Embankment pursuant to the proposed embankment design criteria to an elevation of 6,450 feet would not reduce the stability of the embankment (Knight Piesold 2018c). **Table 3.4-1** provides a summary of the risk ratings, by failure mode, and the design criteria for risk management related to the proposed YDTI embankment work.

One of the primary takeaways from the stability evaluation was the need to develop larger drained tailings beaches that push the supernatant pond (water lying above deposited tailings) as far to the north away from the embankments as possible. The drained tailings beaches would

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reduce the pore pressures within this material to increase stability. Strategic placement of the excess rockfill material generated from mining operations along the downstream slopes would provide for increased stability both during operations and through equilibrium conditions.

The post-closure pond would be positioned at the furthest north portion of the YDTI. The maximum available pond storage of the post-closure pond would be 26,000 acre-feet, which is controlled by the elevation of the closure spillway.

**Table 3.4-1
Summary of Risk Ratings by Failure Mode, and Design Criteria for Risk Management**

Failure Mode	Loading Condition	Likelihood		Consequences	Risk Management Design Criteria
		Probability of Loading Conditions	Probability of Coincident Failure		
Foundation and Slope Instability	Normal Operating Conditions	Likely	Very Low	Moderate	-Maintain overall downstream embankment slope angles of 2H:1V or flatter; -Maintain minimum embankment crest width of 200 feet; -Monitor pore pressures/water levels.
	Earthquake Events	Very Rare	Very Low	Moderate to Major	
	Flood Events	Very Rare	Very Low	Moderate to Catastrophic	
Overtopping	Normal Operating Conditions	Certain	Not Credible	-	-Maintain ≥ 15 feet of elevational difference between tailings discharge and pond; -Maintain minimum freeboard above tailings discharge ≥ 5 feet; -Operate tailings and reclaim pipelines at design flow rates and pressures; -Construct spillway channel at 6430-foot elevation at closure.
	Pipeline Rupture	Likely	Not Credible	-	
	Earthquake Events	Very Rare	Very Low	Moderate to Major	
	Flood Events	Unlikely	Very Low	Catastrophic	
		Very Rare	Very Low	Catastrophic	
Internal Erosion and Piping	Normal Operating Conditions	Certain	Not Credible	-	-Face upstream slope of embankment with alluvium to limit tailings migration; -Maintain pond elevation ≥ 15 feet below tailings discharge elevation ⁵ ; -Keep pond more than 200 feet
	Tailings Stream Leakage	Likely	Moderate	Minor to Moderate	

**Table 3.4-1
Summary of Risk Ratings by Failure Mode, and Design Criteria for Risk Management**

Failure Mode	Loading Condition	Likelihood		Consequences	Risk Management Design Criteria
		Probability of Loading Conditions	Probability of Coincident Failure		
	Earthquake Events	Very Rare	Very Low	Minor to Moderate	from embankment during operations by managing spigotting; -No ponded water within 800 feet of the embankment following closure. Monitor pore pressure/water levels.
	Flood Events	Unlikely	Low	Catastrophic	
		Very Rare	Moderate	Catastrophic	

Source: (Montana Resources 2018b)

The stability evaluation suggested that the impacts from internal erosion and/or piping could be primarily mitigated through construction of a free-draining embankment. The free-draining embankment would allow seepage water to move through the embankment without building up head pressure, which would decrease the saturation of the embankment (keeping materials drier) and increases the embankment stability. The evaluation also showed that internal erosion and piping would be limited by reducing the amount of seepage from the impoundment area by maintaining a pond elevation of greater than or equal to 15 feet below the tailings discharge, keeping the pond area more than 200 feet from the embankment during operations, lining the upstream face of the embankment slope with alluvial material to limit tailings migration, and pushing the pond edge back greater than 800 feet away from the embankment following closure (Knight Piesold 2018c).

The technical evaluation showed that effects from overtopping could be mitigated by maintaining greater than or equal to 15 feet of elevation difference between the tailings discharge and the pond water level, maintaining a minimum freeboard of 5 feet above the tailings discharge, and providing for an emergency spillway at closure. A closure spillway would be constructed to provide for dam safety (preventing overtopping) at equilibrium conditions. The closure spillway is designed to flow only in extreme runoff conditions. The closure spillway would have an invert elevation of 6,430 feet. The maximum supernatant pond elevation is 6,428 feet, which provides for the storage of approximately 26,000 acre-feet of water between the pond water surface elevation and the crest of the closure spillway. Thus, the closure spillway would only spill during an extreme runoff event.

The sequence of storm events required to activate spillway discharge would need to generate a runoff volume larger than 26,000 acre-ft, which is equivalent to a 1 in 1,000 year 30-day storm event and the post-closure Probable Maximum Flood (PMF) event occurring consecutively

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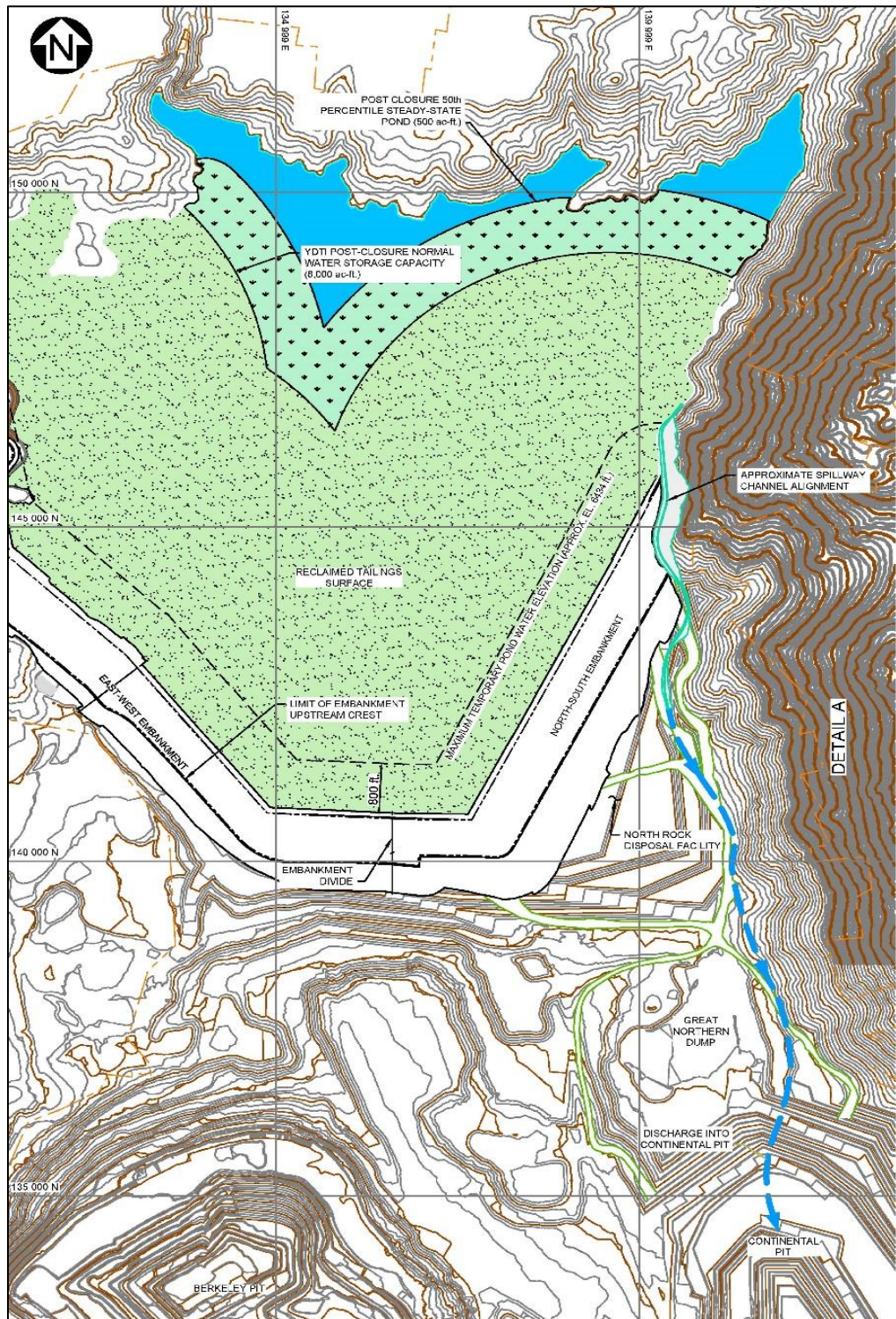
(Knight Piesold 2018b). The PMF was determined to be a combination of the 24-hour probable maximum precipitation (PMP) amount and the complete melt of a 1 in 100-year snowpack, in addition to the full failure of the upstream Moulton reservoirs. The calculated PMF runoff volume equates to 19,000 acre-feet. The spillway would not be required to discharge the PMF event, but only if an additional rainfall event were to immediately occur. The spillway is sized with sufficient capacity to pass flows from storms exceeding the 1 in 1,000 year, 24-hour rainfall event. The start of the closure spillway at the upstream end would be cut into bedrock to promote stability and would extend past the toe of the North RDS to a point where the regraded topography would flow to the Continental Pit (Knight Piesold 2018a). The Continental Pit (when no longer pumped to allow mining) will eventually contain a larger pit lake, which will need to be pumped/managed for water level compliance (below 5,410 feet AMSL or 5,460.4 feet ACM) and water treatment under BMFOU. The closure spillway would be approximately 13,000 feet in length, as shown on **Figure 3.4-5**.

The equilibrium volume of the post-closure pond would be approximately 1,000 acre-feet at an elevation of 6,363 feet. The post-closure pond elevation would fluctuate annually depending on precipitation amounts and runoff to the pond (Knight Piesold 2017b).

The technical aspects of the YDTI design for geotechnical considerations were reviewed and accepted by the IRP, with the results of their review documented within their final report (IRP 2017). The IRP was involved with the review of the YDTI Embankments design throughout the design process, that included detailed reviews of each component of the design. The IRP's final report addresses each component of the design individually, and provides an overview of the regulatory requirements, their assessment and observations of the design, and their concurrence with each design component. The IRP states that they agree with the analysis provided by KP and Hydrometrics and that the design was reviewed in accordance with the regulatory requirements outlined in 82-4-377, MCA. As stated by the IRP, "In the view of the Independent Review Panel, the design document for expansion of the Yankee Doodle Tailings Impoundment addresses all MCA requirements. Based on the selection of the appropriate parameters and sound technical evaluations, the IRP accept the adequacy of this design" (IRP 2017).

Reclamation of the YDTI Embankment would generally follow the currently approved YDTI reclamation plan. The face of the North-South Embankment would be covered by the North RDS. Swales would be constructed every 100 feet along the regraded West Embankment downstream slopes and would consist of grass-lined swales in the upper reaches that would transition to riprap-lined ditches and plunge pools in the lower reaches. The function of the swales would be to facilitate the transport of runoff water in a non-erosive manner. Final grading of the downstream North-South and East-West Embankment slopes would result in a slope of 2.7H:1V, except for the East-West Embankment just upstream of the Precipitation Plant that would be constructed to a 2H:1V slope.

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Source: (Montana Resources 2018b)

Figure 3.4-5. Proposed YDTI closure spillway location and alignment.

The West Embankment downstream slope would be constructed at a 3H:1V slope with the exception of a small area near the WED extraction pond that would be constructed to a 2.5H:1V slope. The minimum embankment crest width would be 200 feet, and an access road would be retained along the crest for post-closure use. The West Embankment downstream slope would be capped with 6 inches of soil placed over 36 inches of non-acid generating alluvial material. The East-West Embankment downstream slope would be capped with 20 inches of alluvial material on the 2.7H:1V slopes and 36 inches on the 2H:1V slopes. The embankment crest would be capped with 28 inches of alluvial material or suitable leached cap from mining operations (Knight Piesold 2017a).

The final YDTI impoundment area under the Proposed Action would increase from 1,598 acres to 1,804 acres. This alternative provides for a larger beach area and smaller pond area. The total beach area (beach and Transition Zone) is proposed to be approximately 1,342 acres, which is 304 acres larger than under the No Action Alternative. The beach area would be covered with a total of 28 inches of alluvial material with the top 6 inches amended as necessary to be an approved soil material to promote the growth of revegetation and limit percolation through the tailings. The final beach configuration would slope away from the embankment north toward the final pond. Final surface shaping may be necessary to account for material settling (Knight Piesold 2017a).

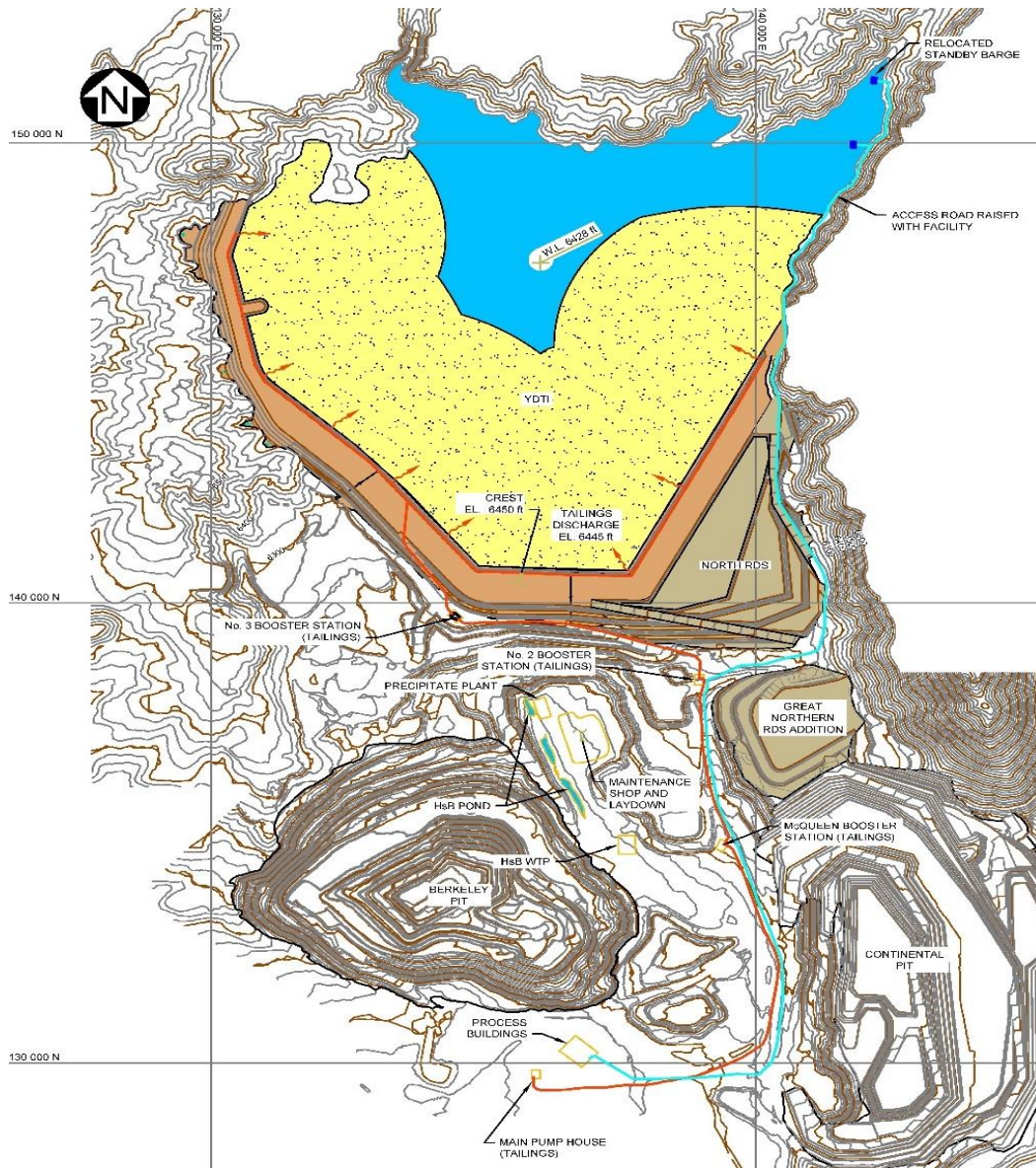
Based on this analysis, no adverse geotechnical impacts from the YDTI expansion under the Proposed Action are anticipated.

Waste Rock Disposal Sites

Waste rock that would not be needed for construction of the YDTI embankment would be used to construct access ramps and/or the North RDS and Great Northern RDS. The North RDS would be constructed adjacent to the North-South Embankment to overlay existing leach dumps and facilitate ramp construction to the new embankment crest. The current projection for the amount of waste rock to be placed in the North RDS is approximately 140 million tons. **Figure 3.4-6** shows the location and configuration of the North RDS (MR 2018).

Additional waste rock generated from mining activities would be placed in the existing Great Northern RDS. It is anticipated that approximately 15 million tons of waste rock would be added to the existing Great Northern RDS. No new disturbance would result from adding waste rock to the Great Northern RDS as the additional material would be added on top of the existing RDS and slightly to the east, on previously disturbed ground (Montana Resources 2018b). The proposed expansion of the Great Northern RDS is shown on **Figure 3.4-6**.

After mining operations cease, the waste RDS would be reclaimed as described in the No Action Alternative. Based on past experience with waste RDS in this area, no adverse geotechnical impacts are anticipated.



Source: (Montana Resources 2018b)

Figure 3.4-6. Proposed expansion of the YDTI.

3.4.3.3 Accelerated Drawdown at Closure Alternative

Accelerating the drawdown of the supernatant pond at closure would allow surface reclamation to happen sooner than under the Proposed Action (see Section 2.5.5). Water contained within the YDTI under the Proposed Action would be allowed to passively drain through the embankment to the HsB Water Treatment Plant. Additionally, water collected within the WED would be pumped back up into the YDTI. Water pumped from the YDTI under this alternative would need to be stored and managed elsewhere on the site, possibly in the

Continental Pit, or treated directly, prior to off-site discharge. Discussions and coordination with all parties in the 2002 Consent Decree would be needed to review the options and feasibility for handling and treating this water, the potential use of existing or upgraded water treatment facilities and infrastructure, and to amend their agreement accordingly. This alternative is contingent upon storage or treatment of the water pumped during accelerated drawdown. No matter which facility might potentially treat the water, it would need to meet DEQ water quality criteria and final off-site discharge performance standards as described in the 2002 Consent Decree prior to discharge (Consent Decree for the Butte Mine Flooding Site 2002).

YDTI and Embankments

The impacts of the Accelerated Drawdown at Closure Alternative to the YDTI facility and embankment would be the same as under the Proposed Action.

Waste Rock Disposal Sites

The impacts of the Accelerated Drawdown at Closure Alternative to the waste RDS would be the same as under the Proposed Action.

3.4.3.4 *Elimination of West Embankment Drain Pumpback at Closure*

This alternative is similar to the Accelerated Drawdown at Closure Alternative but would only include elimination of the WED pumpback to the YDTI at Closure. The Proposed Action would include pumping water collected from the WED at the Extraction Pond back into the YDTI until hydraulic head in the YDTI declines below the WED invert elevation, which is anticipated to be approximately 20 years. Under the Elimination of WED Pumpback at Closure Alternative, water contained in the tailings slurry would no longer be an input to YDTI when mining and milling cease. Approximately 22 MGD of water would no longer be available to be pumped into the tailings impoundment. Water in the tailings pond would continue to seep through the impoundment and discharge at Horseshoe Bend, to then be managed and treated under BMFOU remedial plans. Under the Elimination of WED Pumpback at Closure Alternative, seepage collected in the WED Extraction Pond would not be pumped back to the tailings pond. Instead, the seepage water in the WED Extraction Pond would be diverted away from the YDTI to be stored elsewhere on-site or treated prior to discharge, whether by pumping or by gravity drainage.

YDTI and Embankments

The impacts of the Elimination of West Embankment Drain Pumpback at Closure Alternative to the YDTI facility and embankment would be the same as under the Proposed Action.

Waste Rock Disposal Sites

The impacts of the Elimination of West Embankment Drain Pumpback at Closure Alternative to the waste RDS would be the same as under the Proposed Action.

3.4.3.5 *Alternative Capping Materials*

This alternative would provide for the mining of alluvium from the mine site, transport of the alluvial material to the mill, processing of the alluvial material to a specified size and water content, and then pumping the modified alluvial material through any one of the three tailings lines to the YDTI for discharge through the multiple discharge line system to cover the tailings beach. The Proposed Action would provide for the physical placement of the cap with equipment, requiring the tailings beach to be dewatered and stable enough to allow equipment access. This alternative provides for the hydraulic placement of approximately 6 inches of capping material immediately following mining and at an earlier date than the Proposed Action. The remainder of the 28-inch cap would be placed with equipment consistent with the Proposed Action.

YDTI and Embankment

The impacts of the Alternative Capping Materials Alternative to the YDTI facility and embankment would be the same as under the Proposed Action.

Waste Rock Disposal Sites

The impacts of the Alternative Capping Materials Alternative to the waste RDS would be the same as under the Proposed Action.

3.5 SOILS AND RECLAMATION

The baseline study methods and results for the Proposed Action are described in the following sections. The regulatory framework for federal and state requirements is identified.

3.5.1 Analysis Methods

The soils area included as part of the YDTI Proposed amendment was surveyed and described by WESTECH Environmental Services, Inc. and included in Appendix A-4 of the proposed amendment (Montana Resources 2018b). Soil profile descriptions and soils sampling were completed in October 2015. Soils scientists traversed the study area on foot and placed soil sample sites in representative areas, based on geomorphic and topographic position, slope gradient, slope exposure, and vegetation community. Shovels and hand augers were used to excavate soils to a depth of 60 inches or to auger refusal (usually due to bedrock). Soil characteristics such as the depth and thickness of soil horizons and dominant characteristics were described at each site. The extent of each soil type was mapped in the field on aerial photo base maps. These data were then digitized in GIS to establish the boundaries and acreages of each soils mapping unit. Physical and chemical soil properties were determined using a combination of field-based and laboratory analyses. The latter were conducted by Energy Laboratories of Helena, Montana, using standard protocols and analytical methods. The study area for the soils survey is shown on **Figure 3.5-1**.

3.5.2 Affected Environment

YDTI was originally constructed in the 1960s for the Anaconda Copper Mine's operations. Tailings from ore processing have been deposited in the YDTI since its construction in the

1960s, and more recently under Operating Permits issued by DEQ. The tailings impoundment is located north of the mining operation and consists of the embankment, impoundment (tailings and open water components), discharge and pumpback systems, and related infrastructure. Existing facilities including the Continental Pit, Butte Concentrator, Precipitation Plant, leaching facilities, and other rock disposal sites are not the subject of this proposed amendment and will continue to operate as previously permitted.

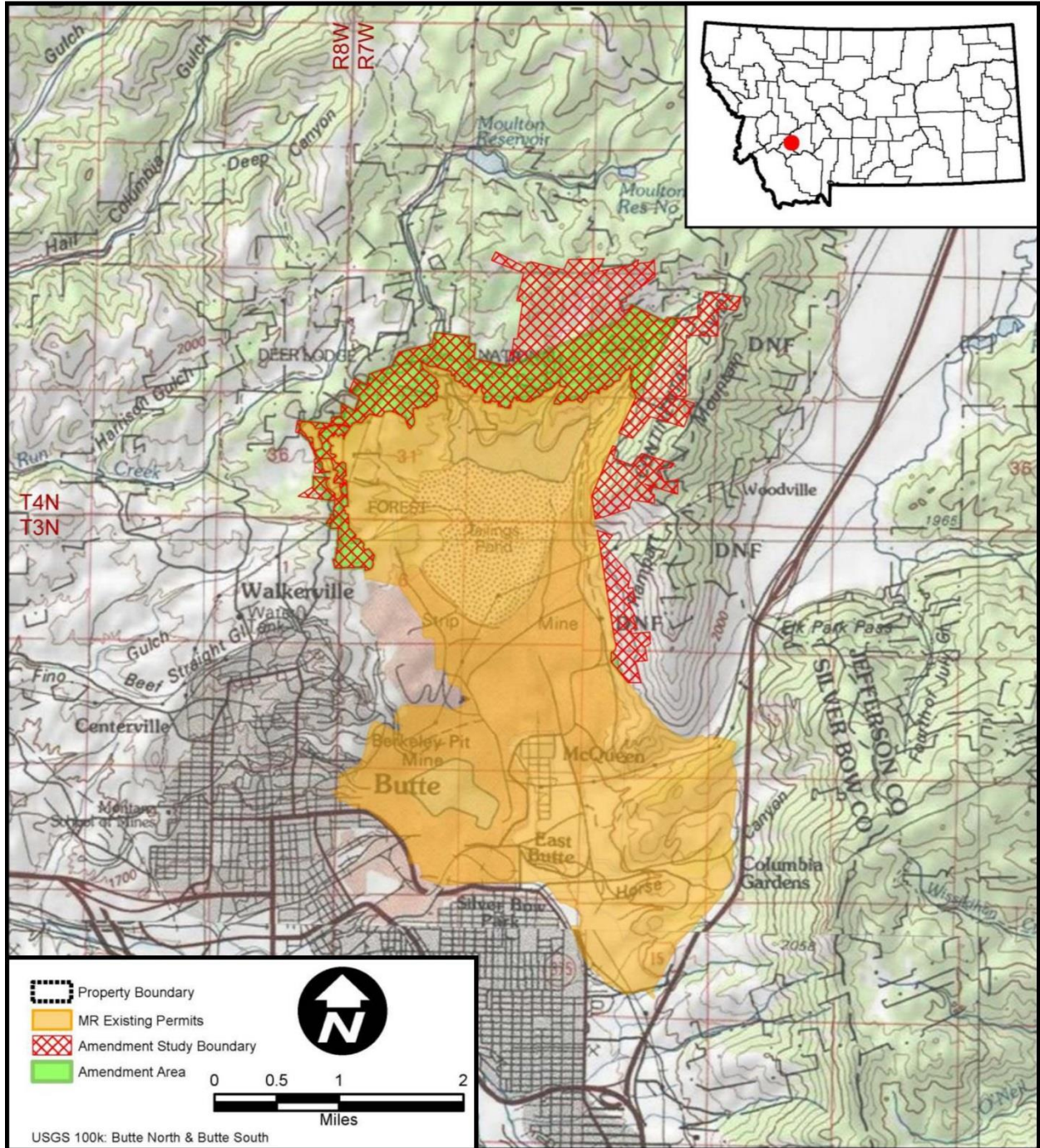
3.5.2.1 General Soil Types

Soils are predominantly coarse-grained, reflecting their derivation from granitic parent material. Steep slopes and high coarse fragment content are the two primary factors that may limit salvage and reclamation potential of some soils; these and other factors such as topsoil depth, soil texture and organic matter content are considered when developing guidelines for soil salvage plans for future disturbances.

The area is located on the Boulder Batholith at elevations between approximately 6,300 and 7,600 feet above mean sea level. Soils in the area are predominantly shallow soils formed on steep slopes and ridges. Moderately deep to deep soils are located in some of the larger swales and along drainage features. Gravel-to boulder-sized coarse fragments are common in soil profiles throughout the area. Extensive areas of exposed bedrock are also common. In general, the soils are well drained and have low moisture holding capacity. This is particularly true of shallow soils where coarse sands and weathered bedrock are near the surface. Deeper soils are more likely to have loamy soil textures, with moderate drainage and moisture holding capacity. These deeper soils typically formed as a result of alluvial deposition on top of granitic colluvium or residuum (Montana Resources 2018b).

Soils within the study area are heavily influenced by their granitic parent material, typically exhibiting characteristics such as coarse textures, slightly acidic pH, and widespread distribution of coarse fragments. Soils along the eastern portion of the study area are on slopes exceeding 50 percent and consist of very shallow soils between large areas of rock outcrop. The northern and western portions of the study area have rolling hills with scattered alluvium-influenced soils in depressions, with some steep slopes dominated by shallow soils between granite outcrops. Coarse fragments ranging in size from large boulders and stones to smaller cobbles and gravels are common in most soil types, with the exception of deep, alluvial soils (Montana Resources 2018b).

The topsoil horizons in most area soils have loamy or sandy loam textures and organic matter concentrations in excess of 2 percent, to a depth of about 6 inches. Deep, alluvial soils such as Silas, Pitchstone, and Peeler soil types exhibit greater topsoil depths averaging 8 to 12 inches. In all soil types, subsoil horizons typically exhibit coarse sandy loam soil textures and organic matter content of less than 1 percent.



Source: (Montana Resources 2018b)

Figure 3.5-1. Soils survey study area completed for YDTI Proposed amendment.

3.5.2.2 Soil Descriptions

Soil map units identified in WESTECH's soil survey are described below. The variable topography and resulting diversity of soil depths and development within the study area result in some soil map units that are complexes of multiple soil series. Some map units depict non-soil areas such as rock outcrops or open water. The acreage of mapped soil units within the YDTI baseline study area completed in 2015 is provided in **Table 3.5-1**. A soils map for the area in the vicinity of the YDTI is shown on **Figure 3.5-2**.

BoPe-c : Bobowic-Peeler sandy loams, 15 – 35 percent slopes

These soils consist of moderately deep to deep soils that formed in swales, toe slopes and depressions on granitic hills and slopes. Bobowic soils are moderately deep to bedrock and commonly exhibit soil textures of sandy loams or coarse sandy loams. These soils formed in colluvium or residuum from granite bedrock and contain between 20 – 50 percent coarse fragments. Peeler soils are deep, with overall depths to parent material in excess of 40 inches, loamy soil textures and coarse fragment contents less than 30 percent.

Other soils in this map unit include Pitchstone soils that formed in alluvial deposits on north-facing slopes. Stecum and Zonite soils are present on slopes and hills along the edges of swales and surface depressions; these soils are described below for the ZoSt-e map unit.

CpRj-c : Caseypeak-Rockerjohn coarse sandy loams, 15 – 35 percent slopes

Soils in this map unit consist of alternating shallow Caseypeak soils and deep Rockerjohn soils on undulating hills. Caseypeak soils are located on south-facing hills, ridges and convex slopes. Rockerjohn soils are found on north-facing slopes and depositional areas such as swales and toeslopes. Both of these soils are derived from granitic parent materials, although Rockerjohn soils are influenced by alluvial deposits overlying the granitic bedrock or colluvium. Coarse fragments are prevalent in these soils and range from a maximum of 30 percent in Rockerjohn soils to greater than 60 percent in Caseypeak soils.

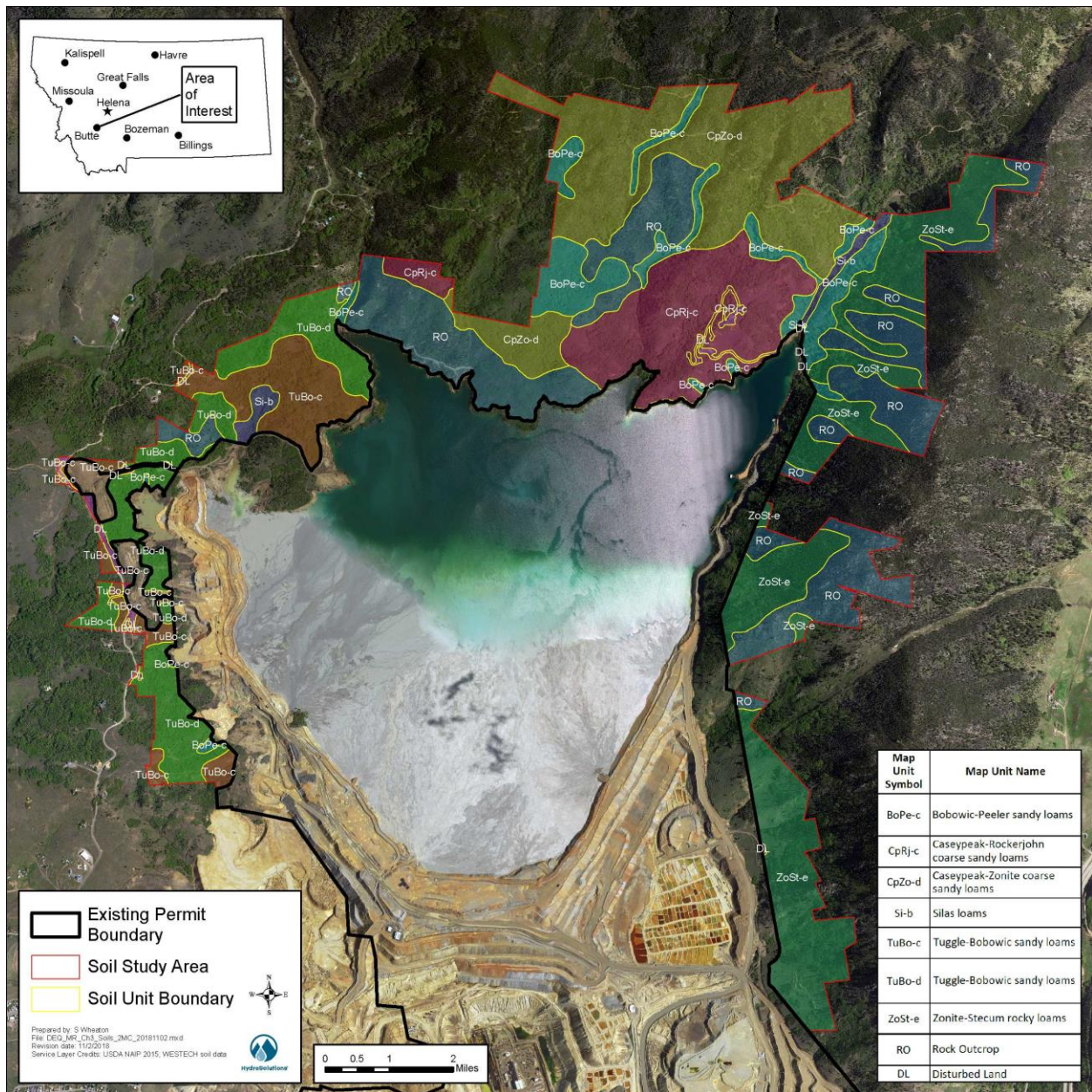
Other soils in the map unit include Bobowic and Peeler soils, which are granitic-derived soils found on swales, slopes, and small terraces.

**Table 3.5-1
Acreage of Mapped Soil Units Within the YDTI Baseline Study Area Completed in 2015**

Map Unit Symbol-Slope Class	Map Unit Name	Slope ^a (%)	Soil Salvage (in)	Components and Proportions (%)	Acres in Study Area	Percent of Study Area
BoPe-c	Bobowic-Peeler sandy loams	15-35	36	Bobowic 40% / Peeler 40% / Pitchstone 10% /Stecum 5% / Zonite 5%	122.0	7.3
CpRj-c	Caseypeak-Rockerjohn coarse sandy loams	15-35	24	Caseypeak 60% / Rockerjohn 30% / Bobowic 5% /Peeler 5%	205.5	12.4
CpZo-d	Caseypeak-Zonite shallow coarse sandy loams	35-50	12	Caseypeak 40% / Zonite 45% / Stecum 10% / Rock Outcrop 5%	322.6	19.4
Si-b	Silas loams	8-15	48	Silas 80% / Peeler 10% / Pitchstone 10%	19.3	1.2
TuBo-c	Tuggle-Bobowic sandy loams	15-35	36	Tuggle 50% / Bobowic 40% / Caseypeak 5% /Stecum 5%	111.7	6.7
TuBo-d	Tuggle-Bobowic sandy loams – steep	35-50	12	Tuggle 60% / Bobowic 20% / Caseypeak 10% /Stecum 5% / Rock Outcrop 5%	164.6	9.9
ZoSt-e	Zonite-Stecum rocky loams – very steep	50+	0	Zonite 60% / Stecum 30% / Rock Outcrop 10%	325.2	19.6
RO	Rock Outcrop	NA	0	Rock Outcrop 80% / Zonite 10% / Caseypeak 10%	370.8	22.3
DL	Disturbed Land	NA	0	Disturbed Land 100%	20.1	1.2
Total					1,662.0	100

Source: (Montana Resources 2018b)

^aSlope Classes: a = 0-8%, b = 8-15%, c = 15-35%, d = 35-50%, e = 50+%



Source: (Montana Resources 2018b)

Figure 3.5-2. Soils map for the area in the vicinity of the Proposed Action.

CpZo-d : Caseypeak-Zonite shallow coarse sandy loams, 35 - 50 percent slopes

This map unit contains shallow, coarse-textured soils that formed in granite residuum and colluvium. These soils are located on hills, slopes, and ridges associated with granite spires and exposures of decomposed granite. Zonite soils occupy the ridges and steep slopes while Caseypeak soils are most commonly found on terraces and hills. Coarse fragments are

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commonly in excess of 60 percent in both of these soils and consist of gravels, cobbles, stones, and boulders.

Other soils in the map unit include Stecum soils in swales, depressions, and toeslopes. Rock outcrops occur on the tops of hills, ridges, and slopes, and as collections of large dislodged boulders at the base of slopes.

Si-b : Silas loams, 8 - 15 percent slopes

Silas soils are very deep soils that formed in alluvial deposits on terraces and depressions within relatively broad drainages and floodplains. Silas soils typically exhibit loam and silt loam textures in both topsoil and subsoil horizons. These soils contain relatively few, small-diameter coarse fragments within the soil profile and contain some widely scattered boulders and stones.

Other soils in this map unit include the more coarsely textured Peeler and Pitchstone soils along toeslopes at the edges of floodplains and drainages.

TuBo-c : Tuggle-Bobowic sandy loams, 15 – 35 percent slopes

Soils in this map unit include shallow, dark Tuggle soils located on slopes and hills in a complex with the slightly deeper Bobowic soils located on toeslopes and swales. Both of these soils formed in granite residuum or colluvium and exhibit coarse sandy textures with gravels and cobbles. Contact with lithic or paralithic granitic bedrock is typically between 10 to 20 inches in Tuggle soils and 20 to 40 inches in Bobowic soils.

Other soils in the map unit include Caseypeak and Stecum soils, which are both found on slopes and hills near granitic rock outcrops or colluvial deposits, such as large boulders.

TuBo-d : Tuggle-Bobowic sandy loams - steep, 35 - 50 percent slopes

Soils in this map unit are similar to the TuBo-c map unit; however, this map unit represents steeper slopes, shallower soils and higher rock content. The dominant soils are Tuggle soils on slopes and hills and Bobowic soils on toeslopes and swales. These soils formed in granite residuum or colluvium and exhibit coarse sandy textures and coarse fragments in sub-surface horizons. Coarse fragments of all size classes are common in these soils, with total coarse fragment content ranging from 15 to 60 percent. Contact with lithic or paralithic granitic bedrock is typically between 10 to 20 inches in Tuggle soils and 20 to 40 inches in Bobowic soils.

Other soils in the map unit include Caseypeak and Stecum soils, which are both found on slopes and hills near granitic rock outcrops or colluvial deposits, such as large boulders.

ZoSt-e : Zonite-Stecum shallow, skeletal sandy loams – very steep, greater than 50 percent slopes

This map unit represents the very steep slopes and mountains on the eastern portion of the study area. Zonite soils are very shallow and consist of coarse sandy loams and weathered parent material from granitic residuum on ridges and slopes. Stecum soils are slightly deeper soils, also consisting of coarse sands and gravels that formed in granitic residuum and colluvium on concave slopes. Coarse fragments are prevalent in these soils, ranging from 40 to 100 percent. Depth to bedrock is typically 5 to 10 inches in Zonite soils and 20 to 40 inches in Stecum soils.

Rock outcrops are common in this map unit, consisting of lithic bedrock outcrops as well as large boulder colluvium that has dislodged from bedrock outcrops.

DL: Disturbed Lands

This map unit denotes areas of prior disturbance that remain in use as part of mining operations or road construction.

RO: Rock Outcrop

These areas are dominated by outcrops of granitic bedrock, exposures of weathered bedrock ridges or concentrations of dislodged boulder- and stone-sized colluvium. Small areas of Zonite or Caseypeak soils can occur around outcrops and other rock deposits.

SS: Soil Stockpile

This map unit designates areas that currently hold salvaged topsoil or subsoil.

3.5.2.3 Soil Protection

Prior to permanent reclamation, a 6-inch layer of suitable rocky material (rockfill cap) will be placed, as necessary, over tailings beach surface areas that are susceptible to wind erosion and erodibility. Placement will occur soon after the deposition of tailings and water into the impoundment has stopped.

3.5.2.4 Suitability for Reclamation

Soils within the proposed amendment disturbance area will be salvaged and stockpiled, or directly hauled and replaced on sites that have been prepared for reclamation (such as the West Embankment downstream face). Soil salvage depths were derived from data collected as part of the soil inventory (Montana Resources 2018b) . Soil salvage depths were determined in consideration of soil horizons with organic matter in excess of 1 percent, coarse fragment content less than 50 percent by volume, and depth to bedrock. Other considerations included soil texture, salvage restrictions on slopes greater than 2H:1V, and geographical grouping of soils to facilitate effective salvage.

Soils will be salvaged in a single lift following vegetation clearing and prior to major surface-disturbing activities. Soil will not be salvaged from soil storage areas. Soils will be protected using salvage techniques and timing that minimize erosion, contamination, degradation, and compaction.

Soil salvage depths range from 0 inches in soils on steep slopes and ridges dominated by bedrock outcrops, to 48 inches in depositional areas such as alluvial plains and broad swales. Estimated soil stockpile volumes include a 12 percent swell factor. Actual salvage volumes will vary due to the presence of large coarse fragments and intermittent rock outcrops within many salvage areas. Limitations imposed by coarse fragments and bedrock will be most evident in shallow to moderately deep soils on ridges, slopes, and in incised drainages.

3.5.2.5 *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 extreme properties of saturation percent, texture, or rock fragment content. Slope and organic matter are not used to exclude a soil from salvage; however, they are useful for planning salvage strategy.

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 plant growth; however, it could be good for shrubs by reducing competition with cool season grasses.

Thirty-five sample sites were evaluated during the soil survey traverse completed by WESTECH (Montana Resources 2018b). Field data collected from test pits and soil horizons included color, texture, structure, percent of coarse fragments, presence of roots, and potential to effervesce. Soil characteristics are described above.

Sixty-nine samples from 21 of the 35 sample sites were collected from the test pits and submitted to a certified laboratory for analysis of percent fragments, texture, pH, organic matter, and nitrates. Laboratory results reported pH ranging from 4.7 to 7.3. Organic matter content was relatively low in the 1 to 3 percentage range, but up to 5 to 6 percent at a few locations. A complete description of physical and chemical characteristics of the soils associated with the proposed amendment area is found the baseline soils survey report (Montana Resources 2018b).

In general, area soils are predominantly coarse-grained, reflecting their derivation from granitic parent material. Steep slopes and high coarse fragment content are the two primary factors that may limit salvage and reclamation potential of some soils in the study area. These and other factors such as topsoil depth, soil texture, and organic matter content will be considered when developing soil salvage plans for future disturbances within the study area.

3.5.2.6 Prime Farmland

There is no prime farmland within the project boundary.

3.5.3 Environmental Consequences

This section evaluates the potential effects of the Proposed Action and alternatives on the soils which 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 include slope and coarse fragment content. Other less influential considerations include organic matter content and soil texture.

3.5.3.1 No Action Alternative

Impacts to native soils include soil salvage and stockpiling ahead of construction and tailings inundation. The No Action Alternative affects no new soil. Current permits allow for mining, and thus soil salvage and stockpiling, to continue into approximately 2022. At that time, closure and reclamation would occur.

3.5.3.2 Proposed Action

The purpose of this Proposed Action is to raise the elevation of the West Embankment to 6,450 feet to match the presently permitted elevations of the North-South and East-West Embankments and extend the northern boundary of the impoundment to allow for continued operation of the Continental Mine. Impacts to the native soils include soil salvage and stockpiling ahead of construction and tailings inundation. Approximately 85 acres of the 1,662 total acres in the YDTI baseline study area will be disturbed (Montana Resources 2018b). Soil mapping units acreage affected by the Proposed Action and limitations for potential salvage within the baseline soils study area are provided in **Table 3.5-3**.

**Table 3.5-3
Summary of Soil Map Unit Disturbance Acreages and Potential Soil Salvage Limitations**

Soil Map Unit Symbol^a	Map Unit Name	Potential Salvage Limitations	Total Disturbance Per Soil Map
BoPe-c	Bobowic-Peeler sandy loams	Steep slopes, coarse fragment content	7.3
CpRj-c	Caseypeak-Rockerjohn coarse	Steep slopes, coarse fragment content	15.6
Si-b	Silas loams	NA	10.2
TuBo-c	Tuggle-Bobowic sandy loams	Steep slopes, coarse fragment content	14.0
TuBo-d	Tuggle-Bobowic sandy loams	Steep slopes, coarse fragment content	11.9

**Table 3.5-3
Summary of Soil Map Unit Disturbance Acreages and Potential Soil Salvage Limitations**

Soil Map Unit Symbol^a	Map Unit Name	Potential Salvage Limitations	Total Disturbance Per Soil Map
ZoSt-e	Zonite-Stecum rocky loams	Extremely steep slopes, coarse fragment	0.1
RO	Rock Outcrop	NA	23.0
SS	Soil Stockpiles ^b	NA	NA
DL	Disturbed Land	NA	3.3
TOTAL			85.4

Source: (Montana Resources 2018b)

^aSee Soils Baseline Inventory (Appendix A-4).

^bSoil will not be salvaged in soil storage areas (total of 13.3 acres).

NOTE:

Some totals are not exact due to rounding.

NA Not applicable

Reclamation of the YDTI would be essentially the same as previously permitted. The reclamation plan includes grading, capping, and revegetation of the embankment and beach; and wet closure of the open water component and associated facilities. Pertinent proposed changes to reclamation would include:

- Additional reclaimed embankment acreage;
- Concurrent reclamation of the West Embankment from the bottom up;
- Additional reclaimed impoundment area acreage;
- Revised post-closure topography;
- Additional required quantities of reclamation capping material;
- Revised revegetation mixtures;
- Modified reclamation schedule;
- Interim and/or permanent reclamation of long-term monitoring sites previously permitted under Exploration License 00711; and
- Updated post-operation management and monitoring plans.

The reclamation plan for the YDTI system describes post-closure land use, summarizes existing reclamation assumptions contained in DEQ's 5-year bond review (DEQ 2015), and identifies procedures to reclaim new or altered facility components. Only YDTI facilities that are within the scope of the Proposed Action are addressed in this EIS.

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The currently permitted reclamation design for the YDTI includes the embankment, beach, and a wet closure pond. MR is not proposing to change the basic reclamation design and retains these three basic components incorporating reclamation assumptions from DEQ's 2015 bond calculations. This plan references the reclamation overview report prepared for MR by Knight Piesold (Knight Piesold 2018b).

Post-closure land uses would include watershed protection and wildlife habitat. In addition to these land uses, the post-closure YDTI will be within the BMFOU boundary and subject to any land management conditions of that program.

A partial wet closure scenario would be planned for the northern portion of the tailings impoundment, consisting of a pond and adjacent area that would be periodically inundated with seasonal pond water level fluctuations.

Reclamation capping materials include alluvium, leached cap, and soil. In 2002, MR developed capping recommendations for the Woodville Dump, which were adopted in DEQ's 5-year bond assumptions (see Section 9.0 of MR's Operations Plan). MR would use non-acid producing alluvium or leached cap, or, if suitable alluvium or leached cap is not available when needed, lime-amended alluvium or leached cap would be used. For the most part, redistribution depths and material testing would not change from assumptions in the 2015 bond calculations.

Changes under the Proposed Action include:

- Additional capping material would be needed due to an increase in the disturbance area;
- Capping material would be placed concurrently with lift completion on the West Embankment;
- Additional capping material stockpile locations are identified;
- Reclamation capping material would be stockpiled for the YDTI Transition Zone to cover the exposed beach area as the post-closure pond recedes; and
- Soil previously salvaged and stockpiled and soil to be salvaged would be used for reclamation of a portion of the YDTI disturbance area.

Capping would be distributed on the 3H:1V portion of the West Embankment concurrently with lift completion. Six inches of soil would be placed over 36 inches of non-acid generating alluvium. The topsoil volume needed for resoiling the slope to the 6,450-foot elevation is estimated to be approximately 19,000 cubic yards.

The East-West Embankment face would be capped with 20 inches of alluvium on the 2.7H:1V slopes and 36 inches on the 2H:1V slopes. Alluvium would be amended as necessary to support revegetation based on laboratory test results at the time of reclamation.

The embankment crest would be capped with 28 inches of suitable or amended alluvium unless mine rock scheduling allows the direct-haul of the final 28 inches of the crest to be constructed of suitable leached cap.

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Raising the YDTI West Embankment elevation to 6,450 feet is projected to increase the beach area (internal extent of the YDTI not including the embankment footprints) by about 13 percent - from 1,598 acres to approximately 1,804 acres. The proposed design at closure would produce a larger beach area and smaller pond area compared to the No Action Alternative. The total tailings beach area is projected to be approximately 1,342 (beach and Transition Zone) acres at closure in 2031 under the Proposed Action Alternative, which would be approximately 304 acres greater than the tailings beach under the No Action Alternative. The volume of the closure pond under the Proposed Action would be approximately 15,000 acre-feet compared to approximately 20,000 acre-feet under the No Action Alternative.

If acidic conditions were to develop after closure, lime would be added to maintain alkaline conditions. An estimated five-thousand tons of lime would be needed over the 30-year post-closure period, or about 150 tons per year. If the closure pond begins to degrade in water quality, the WED discharge into the pond would be limed in a mix box prior to discharge into the pond.

The tailings Transition Zone would be exposed as water levels drop. Subaqueous coversoil material placement is not proposed under this alternative, so coversoil would be placed incrementally on exposed beach as the water level drops. A 6-inch cover of rock, leached cap, or similar material would be placed as necessary for dust control concurrently with beach exposure. Alluvium would be spread to a depth of 28 inches as pond levels drop. The ability to place this material would be dependent on a sufficient area being available and equipment being able to operate on the surface. Beach and Transition Zone areas would need to settle and consolidate before they could support large equipment, which may require several years during which the areas would remain exposed.

Roads not necessary for post-closure management and monitoring would be reclaimed. Reclamation would consist of grading to blend into adjacent areas, ripping compacted surfaces, capping with 24 inches of alluvium, and revegetating. Stable road cuts in rock would not be graded. Grading would be conducted to minimize surface flow over fill slopes, and with non-noxious, nonflammable, noncombustible solids. Access roads associated with long-term monitoring sites in the proposed amendment area would be used for operational and post-closure monitoring of wells and drillholes. As such, these roads would be long-term features that have been graded and stabilized per ARM 17.24.104 and would be seeded using the road seed mix. Once all wells and drillholes have been plugged, and well pads graded and stabilized, access roads would be reclaimed per ARM 17.24.107(3) by grading to a stable slope approximating original contours, ripping compacted surfaces, installing drainage structures as necessary, and seeding the sites using the Road seed mix. Reclaimed roads would be closed to access using locked gates, Kelly humps, dips, or other effective methods.

Previous YDTI development resulted in salvage of about 275,000 cubic yards of soil currently stored in the Moulton Road and Bumtown stockpiles (Montana Resources 2018b). About 67,000 cubic yards are yet to be salvaged from the Amendment 9 disturbance area.

Additionally, about 267,000 cubic yards of soil would be salvaged from the new disturbance area. This total of about 609,000 cubic yards would be used primarily for reclamation of the West Embankment and a portion of the beach.

Soil Amendments

No changes to the use of amendments described in the approved permit conditions are proposed, except that they may not be necessary on sites where soil is respread, depending on the outcome of soil tests. Where indicated by sampling and testing, MR would utilize lime, organic matter, and fertilizer to support revegetation. MR has developed seed mixes emphasizing species that are adapted to expected capping material chemical and physical properties.

Reclamation activities would be completed not more than two years after closure in 2031 or upon abandonment of the operation, with the exception of 1) the pond, spillway, and WED Extraction Pond, which would remain after closure, 2) the YDTI Transition Zone, which would be reclaimed incrementally over an estimated 40-year period following closure, and 3) long-term monitoring sites (monitoring wells, drillholes, pads, and associated access roads) which would be permanently reclaimed at such time as the rest of the mine is determined by DEQ to be fully reclaimed.

3.5.3.3 Accelerated Drawdown Alternative

The soils and the reclamation methods and procedures under this alternative are identical to the Proposed Action, except for the timing of the reclamation. Using drawdown rates between 16.35 MGD and 10 MGD, the pond could be reduced to the estimated equilibrium volume of 1,000 acre-feet in one year or less. Lower pumping rates may be utilized to balance the timeline of pond level reduction with the feasibility of reclaiming the exposed tailings surfaces. In comparison, the pond would take approximately 30 years to drain to equilibrium levels under the Proposed Action Alternative, which relies on evaporation and seepage to Horseshoe Bend to remove water from the facility.

Reducing the time required to consolidate the tailings with the Accelerated Drawdown at Closure Alternative would allow access and reclamation at YDTI to occur sooner. The Proposed Action indicates approximately 30- to 40-year period following closure before reclamation of the tailings can be completed. Based on additional information provided by Montana Resources, the top 10 to 20 feet of tailings near the margin of the supernatant pond would likely consolidate in less than 1 year following rapid dewatering. It may take an additional 2 to 3 years of air-drying and freeze-thaw consolidation to develop a surface that would enable surficial tailings to become trafficable. In addition, 2 to 5 years may be required for very fine-grained slime tailings to consolidate and develop into a trafficable surface to facilitate capping (Knight Piesold 2019c).

Considering the rate of initial beach reclamation in the Proposed Action (1,122 acres in the first 5 years), consolidation of the tailings seems to be the limiting step for completing reclamation

and not the equipment or soil placement rates. Therefore, rapidly drawing down the pond within 1 year following closure would expose an additional 365 acres of Transition Zone. This would allow the drying and consolidation process to commence while reclamation is performed on other areas of the beach that are already dry and accessible to equipment. The next phase of sequential reclamation on the exposed Transition Zone could begin as soon as 5 to 9 years after closure, shortly after the initial beach area is completed.

3.5.3.4 *Elimination of West Embankment Drain Pumpback at Closure*

The soils and the reclamation methods and procedures under this alternative are identical to the Proposed Action, except for the timing of the reclamation. The Elimination of WED Pumpback at Closure Alternative would eliminate adding approximately 84.1 million gallons per year of collected seepage water into the tailings impoundment and allow for reclamation of the facility to occur at a faster rate. Proposed capping materials and the methods of reclamation would not change, but it would be possible to cap the gradually exposed Transition Zone area approximately 7 years sooner than reclamation under the Proposed Action.

3.5.3.5 *Alternative Capping Methods*

This alternative would not allow for even placement of the alluvial material. By trying to place the alluvial material via the eight discharge locations, the material would segregate during the discharge process. Uniform distribution of well-graded material necessary for minimizing infiltration and providing an acceptable surface for revegetation would be compromised. However, this alternative only involves initial placement of 6-inches of the total reclamation cover. An additional 22-inches of material would be placed over this layer via conventional means before final revegetation occurs.

3.6 GROUND AND SURFACE WATER RESOURCES

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

- The Federal Clean Water Act
- The Montana Water Quality Act (75-5-101, *et seq.*, MCA)
- Nondegradation Rules (ARM 17.30.701, *et seq.*)
- Montana Metal Mine Reclamation Act (82-4-301, *et seq.*, MCA)
- Montana Pollutant Discharge Elimination System (MPDES)
- Montana Nonpoint Source Management Plan
- CERCLA

In the case of the BMFOU, the 2002 Consent Decree may supersede other Montana rules and regulations.

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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 *et seq.*). The USEPA delegated most of the implementation of the Clean Water Act (CWA) 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 the pollution of water. In addition, the reclamation bond that a mine operation must submit before DEQ issues a permit or approves a permit amendment must be sufficient to ensure compliance with the Montana Water Quality Act (WQA), which provides a regulatory framework for protecting, maintaining, restoring and improving the quality of water for beneficial uses. Pursuant to the WQA, DEQ has 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. Some of the more pertinent state laws and administrative rules related to surface and ground water resources are briefly summarized above.

3.6.1 Analysis Methods

Analysis methods for understanding the existing surface water and ground water environments at the Continental Mine included review of the proposed operating permit amendment and supporting documentation provided by MR, including the hydrologic baseline study conducted by Hydrometrics, Inc. (Hydrometrics, Inc. 2018a). Specifically, the primary resources reviewed and relied upon for this section include:

- Montana Resources Application to Amend Operating Permits 00030 and 00030A to Continue Operations at the Continental Mine, Revised May 2018 (Montana Resources 2018b)
- Water Management Report Rev. 3, prepared for MR by Knight Piesold Consulting Ltd. (March 14, 2018) (Knight Piesold 2018a)
- Baseline Hydrology Report for the Yankee Doodle Tailings Impoundment (Hydrometrics, Inc. 2018a).

3.6.2 Affected Environment

The affected environment includes both ground water and surface water resources on and around the Continental Mine permit area. The YDTI is located in mountainous terrain of the upper Silver Bow Creek drainage. The YDTI is bounded to the north by the Silver Bow Creek and Yankee Doodle Creek headwaters, to the east by the East Ridge (Rampart Mountain), and to the west by the West Ridge (**Figure 3.6-1**). The following sections describe the affected environment for surface water and ground water.

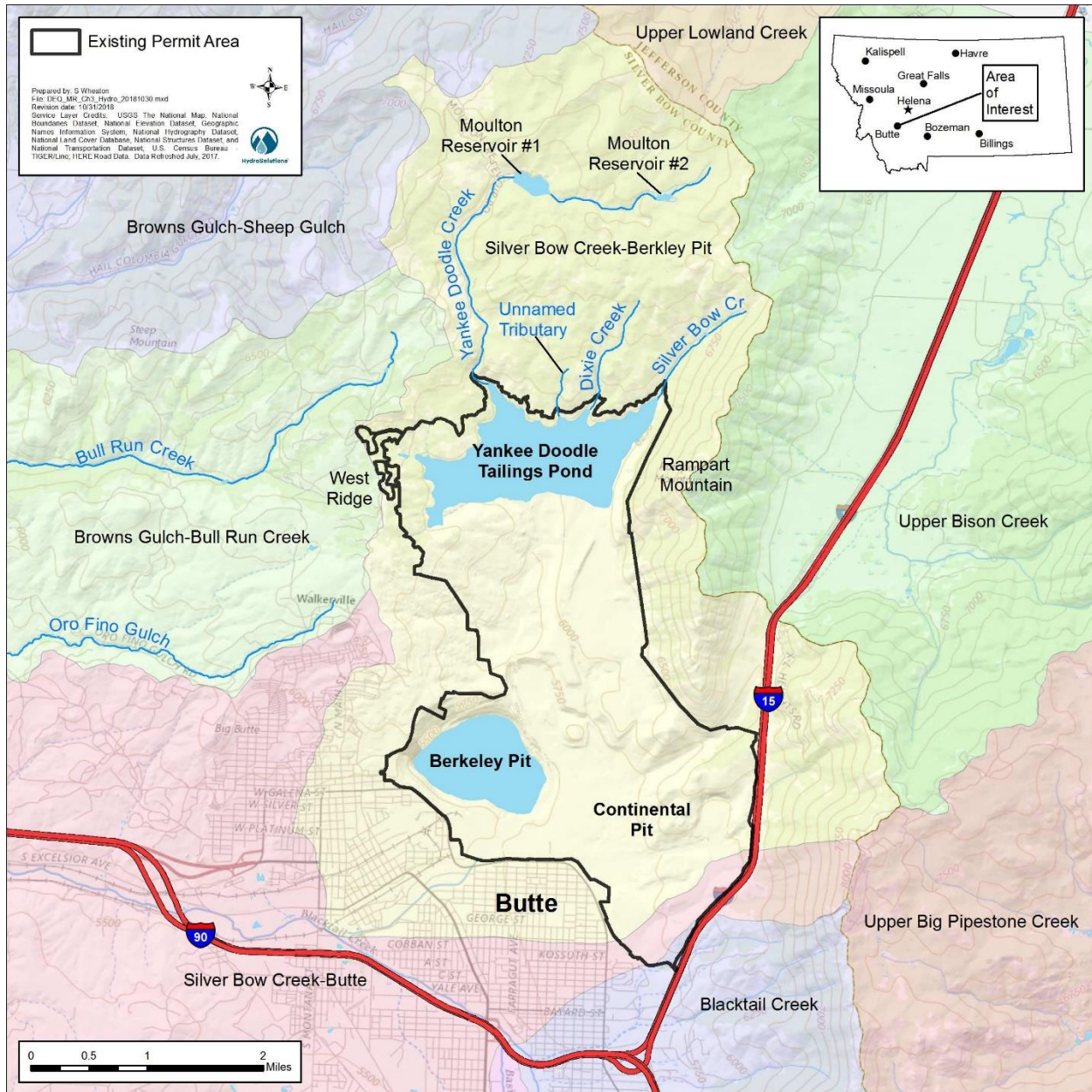


Figure 3.6-1. Hydrologic features and subbasins near the Continental Mine.

3.6.2.1 Surface Water

The YDTI is a valley-fill style impoundment that was constructed in 1963 for tailings storage. The YDTI intercepts surface flows from portions of Silver Bow Creek, Yankee Doodle Creek, Dixie Creek, and an unnamed tributary drainage to the north. Other streams in the area include Bull Run Creek and Oro Fino/Beef Straight Gulch, which are located to the west of the YDTI but are separated from the YDTI catchment by the West Ridge (Figure 3.6-1). All of these streams are perennial, with the exception of Oro Fino Gulch, which is classified as intermittent. Two on-stream reservoirs, Moulton Reservoir #1 and #2, are located on the upper reaches of Yankee

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Doodle Creek above the YDTI and supply water to the Butte/Silver Bow municipal water system. A limited number of secondary surface water features are also present in the YDTI catchment, including springs, seeps, and minor ephemeral drainages (Hydrometrics, Inc. 2018a).

The current YDTI tailings pond level is 6,340 feet, equating to a volume of about 25,000 acre-feet. Current inflows to the YDTI include precipitation, runoff from the contributing catchments, and water in tailings slurry. Outflows include evaporation, losses to tailings voids, seepage losses from the impoundment, and reclaim water used at the mill. Seepage through the south embankment is captured and treated at the HsB Water Treatment Plant. Along with 14,000 GPM of reclaim water pumped from the YDTI, treated Horseshoe Bend seepage is circulated through the mill before returning to the YDTI as tailings slurry (Montana Resources 2018b) (Hydrometrics, Inc. 2018a).

A surface water monitoring program was undertaken to characterize baseline hydrologic conditions on area streams, the YDTI pond, and selected springs and seeps in the vicinity of the YDTI. Surface monitoring points are shown on **Figure 3.6-2**. Surface water monitoring began in the West Ridge area in 2012 and the northern drainages were incorporated into the program in 2015. Baseline data from the monitoring program was supplemented by data collected from MR's operational monitoring program.

Surface water flow was measured at various points (including springs) in the major drainages surrounding the YDTI. Measurement locations and flow summaries are shown on **Figure 3.6-2**. Both the highest and lowest stream flows were reported on Yankee Doodle Creek (1,102 GPM and 0.12 GPM). Minimum flows on other streams ranged from about 1 to 35 GPM and maximum flows ranged from about 35 to 162 GPM.

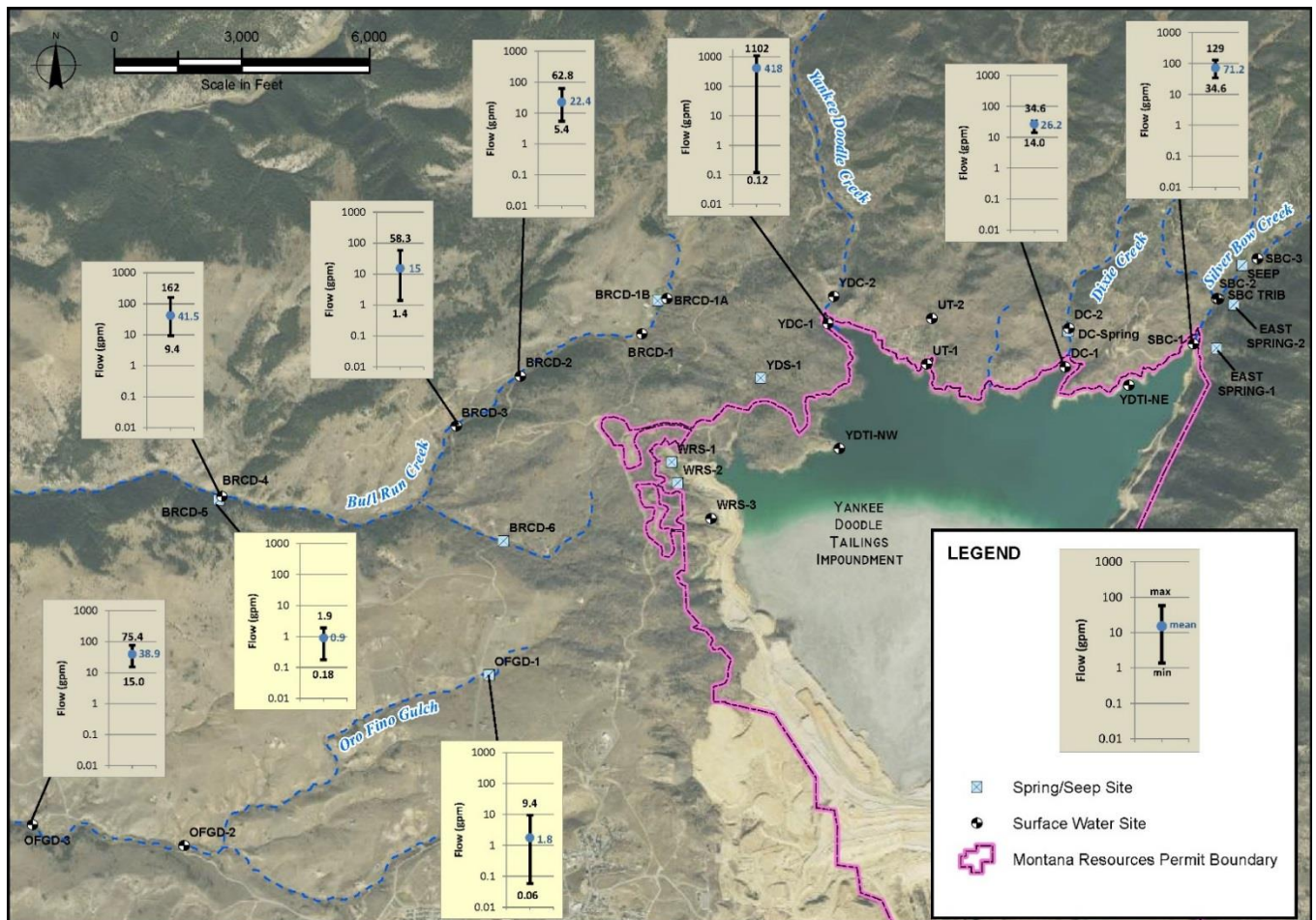
Surface water quality was sampled at selected sites shown on **Figure 3.6-2**, including on streams and from two locations on the YDTI. Field parameters were recorded and laboratory analyses were completed for major ion concentrations, total recoverable metals, and dissolved aluminum. A summary of surface water field parameter and common ion results by drainage is shown in **Table 3.6-1** and a summary of dissolved metals concentrations is shown in **Table 3.6-2**.

For the most part, surface water chemical compositions are unremarkable and are classified as either calcium sulfate type, calcium bicarbonate type, or on a continuum between the two types. Oro Fino Gulch and several sites between the YDTI and the West Ridge ("WRS-" prefixes in **Figure 3.6-2**) had somewhat elevated total dissolved solids (TDS) and common ion concentrations compared to the other monitored drainages, which may be related to ground water contributions to these surface waters (Hydrometrics, Inc. 2018a).

At the request of DEQ, MR compared surface water quality to water quality standards at a limited number of sites upstream of the YDTI. This evaluation was intended to characterize surface water quality above the YDTI in areas near but not directly affected by mine operations. The evaluation consisted of comparing results from Silver Bow Creek site SBC-1, Yankee Doodle

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Creek site YDC-1, and Dixie Creek site DC-1 to the lowest applicable Montana numeric surface water quality standard. Results from a total of 29 samples collected at these sites from 2012 to 2016 were evaluated. A total of eight water quality standard exceedances were identified in 5 of the samples, with all exceedances occurring in either 2013 or 2014. Specifically, concentrations of thallium, cadmium, copper, and selenium were identified in excess of either the human health standard or the chronic and/or acute aquatic standards set forth in DEQ Circular DEQ-7 (DEQ 2017). As these exceedances were detected upgradient of the mine, they are likely indicative of the natural water quality associated with mineralized bedrock.



Source: Baseline Hydrology Report (Hydrometrics, Inc. 2018a)

Figure 3.6-2. Map showing surface water monitoring sites and flow measurement summaries.

Table 3.6-1
Summary of Baseline Surface Water Monitoring Results by Drainage for the YDTI Proposed Amendment Area

		Bull Run Cr Drainage	Oro Fino Gulch Drainage	Drainages North of YDTI	WRS Sites West of YDTI	All SW	YDTI
pH -Field	n	41	16	59	6	122	7
	min	6.53	6.33	4.10	6.29	4.10	9.56
	max	8.48	7.82	8.23	6.81	8.48	10.57
	avg	7.56	7.3	7.6	6.6	7.5	10.1
SC - Field	n	41	16	59	6	122	7
	min	114	459	104	240	104	2079
	max	1059	892	311	590	1059	2317
	avg	283	598	229	407	306	2166
TDS	n	28	15	35	6	84	6
	min	113	291	60	160	60	1890
	max	693	681	195	443	693	2040
	avg	220	428	145	287	230	1955
Calcium	n	28	15	35	6	84	6
	min	15	59	7	28	7	391
	max	114	129	39	79	129	446
	avg	34	85	28	49	42	419
Magnesium	n	28	15	35	6	84	5
	min	5	12	1.7	7	1.7	1
	max	25	28	8	17	28	8
	avg	9	18	6	11	9	3
Sodium	n	28	15	35	6	84	6
	min	6	10	3.6	8	3.6	83
	max	26	23	9	17	26	94
	avg	10	18	7	12	10	87
Potassium	n	28	15	34	6	83	6
	min	4	5	1.8	3	1.8	34
	max	19	9	9.3	16	19	39
	avg	6	6	3	8	5	36
Bicarbonate	n	28	15	35	6	84	4
	min	43	86	36	35	35	3
	max	160	220	150	130	220	13
	avg	80	167	100	71	103	9
Chloride	n	28	15	22	6	71	6
	min	3	3	0.49	1	0.49	8
	max	33	24	4	3	33	10
	avg	9	11	1	2	6	10
Sulfate	n	28	15	35	6	84	6
	min	15	110	6	18	6	1180
	max	370	420	31	270	420	1280
	avg	61	171	17	131	67	1232

Source: Adapted from Baseline Hydrology Report Table 3-5 (Hydrometrics, Inc. 2018a)

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A limited review of metals data summarized in **Table 3.6-2** and in Appendix B of the Baseline Hydrology Report (Hydrometrics, Inc. 2018a) suggests that some other instances of Human Health Standard or aquatic standard exceedances were recorded during the baseline monitoring period. Notably, concentrations of arsenic in excess of the Human Health Standard was detected in all the basins and with relatively high frequency. However, there are no documented instances of MR operations leading to water quality standards being exceeded outside of their permit boundary.

**Table 3.6-2
Summary of Selected Total Recoverable Metals Concentrations^a by Drainage**

Drainage Name	Constituents (DEQ Human Health Standard, Chronic Aquatic Standard (mg/l))					
	Arsenic (0.01, 0.15) ^b	Copper (1.3, 0.00285)	Manganese (NE)	Molybdenum (NE)	Strontium (4.0, NE)	Zinc (7.4, 0.037)
WRS sites (east of West Ridge)	0.010–0.040	0.002–0.714	0.071–1.27	<0.001–0.006	0.15–0.36	<0.008–1.05
Oro Fino Gulch	0.002–0.078	<0.001–0.007	0.01–21.7	<0.001–0.0069	0.33–0.83	<0.008–0.042
Bull Run Creek	0.007–0.079	0.002–0.084	0.008–0.74	0.0003–0.0071	0.10–0.68	<0.008–0.099
Drainages North of YDTI (Silver Bow, Dixie, Yankee Doodle & Unnamed Trib.)	0.001–0.031	<0.001–0.026	0.007–0.17	0.0009–0.0059	0.057–0.255	<0.008 or <0.01

Source: Baseline Hydrology Report (Hydrometrics, Inc. 2018a).

Notes:

^a-All concentrations in milligrams per liter (mg/l).

^b-DEQ Human Health Standard, Chronic Aquatic Standard (mg/l) (DEQ 2017) shown in parenthesis beneath constituent name for general reference. Copper and zinc Chronic Aquatic Standards are for 25 mg/l hardness; values reported in table would require hardness correction for meaningful comparison to these standards.

-NE=not established.

Water quality in the YDTI supernatant pond is characterized in an attachment to the Water Management Report (Knight Piesold 2018a). This characterization relied on samples collected biannually from 2002 through 2014 from site WQ-9A, located near the reclaim water pump station. Characteristics of YDTI supernatant pond water quality include:

- High hardness, with a median hardness of 1,065 mg/l;
- A pH ranging from 7.7 to 11 with a median of 10 and alkalinity ranging from 20 mg/l to 134 mg/l with a median of 40 mg/l;
- High TDS, with a median of 1,706 mg/l;
- Elevated concentrations of some common ions compared to local surface waters, namely potassium, sodium, calcium, magnesium, sulfate, and chloride;
- Calcium and sulfate as dominant ions, averaging 403 mg/l and 1,080 mg/l, respectively;

- Moderate total phosphorus and low to moderate nitrogen-based nutrient concentrations; and
- Detection of aluminum, cadmium, copper, iron, lead, manganese, nickel, selenium, silicon, and strontium metals in most samples. These metals were generally present at concentrations similar to local surface water. However, nickel and strontium concentrations tended to be uniformly higher in the supernatant pond than in other surface waters, and iron and zinc concentrations were in some cases higher in the supernatant pond compared to surface waters.

3.6.2.2 Ground Water

Ground water baseline investigations and monitoring for the Amendment Application were undertaken by MR beginning in 2012. Activities included installation of 24 ground water monitoring wells around the YDTI (19 located in the West Ridge area), installation of 19 bedrock boreholes, installation of 73 piezometers, a residential well inventory, ground water level monitoring, aquifer testing, and ground water quality monitoring in project monitoring wells and nearby domestic water supply wells (Hydrometrics, Inc. 2018a). The ground water monitoring network is shown on **Figure 3.6-3**. The remainder of this section will present existing ground water conditions in terms of the hydrogeologic setting, ground water levels, flow, quality, and a conceptual model as reported in MR's Baseline Hydrology Report.

Hydrogeologic Setting

Ground water hydrogeology at and around the YDTI is influenced by structurally complex fractured bedrock geology that underlies the area. The YDTI area is dominated by the Butte Quartz Monzonite (BQM), a granite-like bedrock unit with very low primary porosity but substantial secondary porosity in the form of fractures and other structural (deformation-related) features. Other units present in the area include Lowland Creek Volcanics and unconsolidated alluvium and colluvium, although these units play comparatively minor roles in YDTI area hydrogeology. In the West Ridge area, MR differentiated a main bedrock ground water system and a deep isolated fracture ground water system (both BQM-hosted) (Hydrometrics, Inc. 2018a).

Ground Water Levels and Flow

Under present hydrogeologic conditions, ground water to the east, north, and west of the YDTI flows towards the impoundment, affecting hydrodynamic containment of the YDTI supernatant pond. At the south end of the impoundment, ground water flows south and away from the impoundment, manifesting as springs and seeps in the Horseshoe Bend area, which are captured and treated. Together, the YDTI-directed ground water flow from the west, north, and east, along with capture and treatment in the Horseshoe Bend area, results in complete containment of the YDTI supernatant pond under current conditions.

Ground water levels around the West Ridge were identified as an important control on hydrologic containment of YDTI pond seepage, and therefore received substantial attention

during the baseline investigation. The West Ridge is a ground water divide, so ground water on the west side of the ridge flows to the west, whereas groundwater on the east side of the ridge flows towards the YDTI, helping to contain pond seepage. Ground water levels beneath the West Ridge are highest at its northern and southern ends and lowest in between, forming a comparatively low ground water elevation saddle near the middle of the West Ridge. Seasonal ground water level fluctuations of 3.5 to 20 feet were observed during 2016 and 2017 in West Ridge area wells.

To the east and north of the YDTI, ground water flows through low-permeability BQM bedrock towards the YDTI at variable but relatively steep gradients ranging between 0.05 to 0.2 feet/foot.

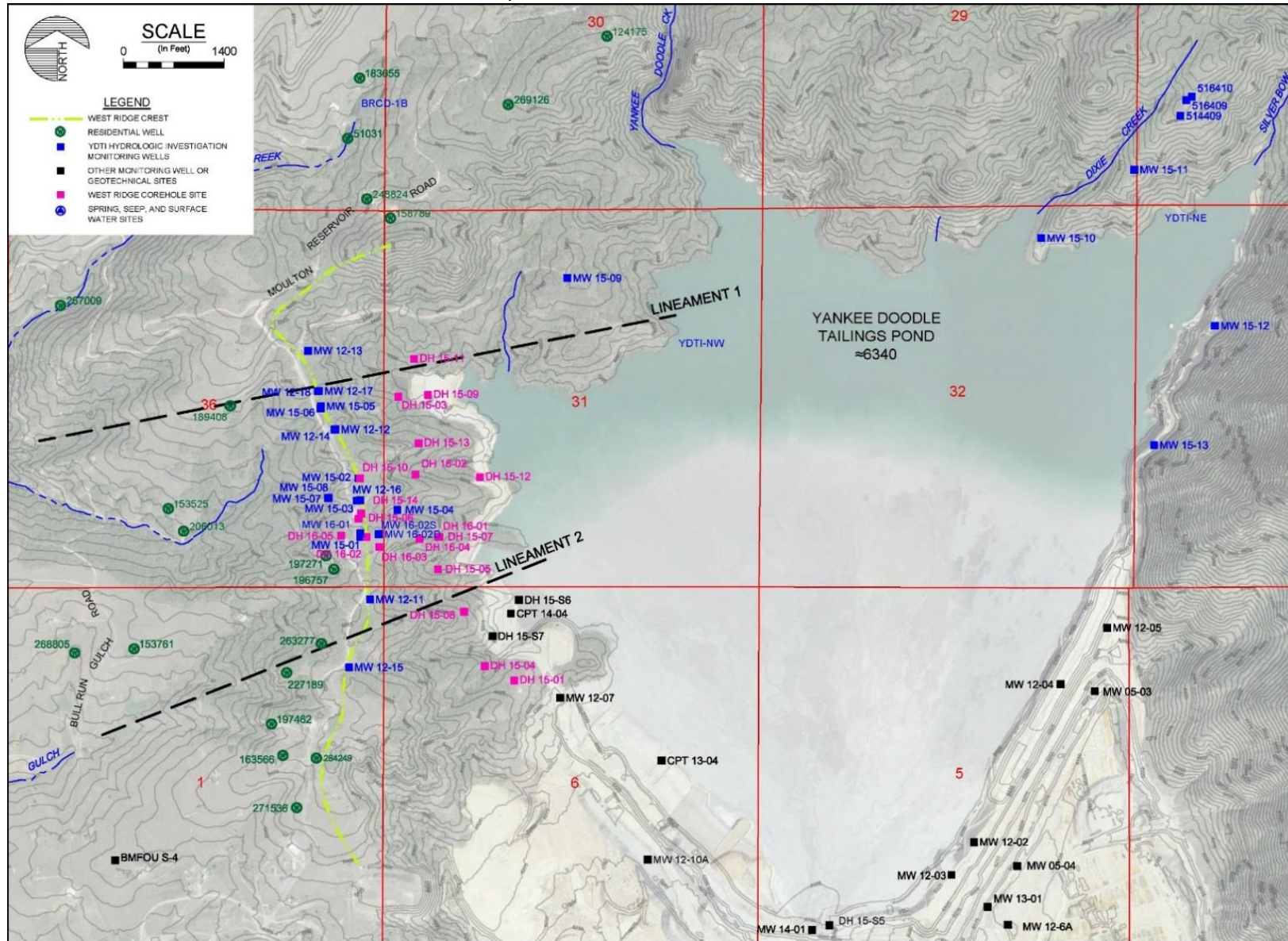
Vertical hydraulic gradients were examined using pairs of wells with different screened intervals. Paired wells were located at six locations in the West Ridge area. Observed gradients ranged from downward to neutral (0 to -0.29 feet/foot). Some wells exhibited apparent seasonal variation over the three measurements collected, with gradients typically higher in the spring than in the fall. Hydraulic heads in the shallow bedrock ground water system are typically higher than those in the deep fracture system, suggesting a downward gradient toward the deep fracture system.

Aquifer Testing

Aquifer testing was conducted on wells completed in the fractured bedrock aquifer in the West Ridge area to characterize physical properties of the aquifer. Constant rate aquifer tests on wells MW15-01, MW15-02, and MW12-18 resulted in estimated hydraulic conductivities of 0.03 to 1.39 feet/day. Tests on seven additional West Ridge area wells yielded similar estimated hydraulic conductivities ranging from 0.07 to 1.62 feet/day. A 14-day variable-rate pumping test was also conducted by pumping MW16-02D (completed in the deep fracture system) and monitoring 14 surrounding wells and angled boreholes, resulting in estimated hydraulic conductivity of 0.4 to 1.2 feet/day and storage coefficients of 8.0×10^{-4} to 1.7×10^{-5} (Hydrometrics, Inc. 2018a).

Results of the West Ridge aquifer testing program indicate that the deep fracture system had the overall highest permeability, the bulk BQM bedrock an intermediate permeability, and altered shear zones the lowest permeability, each separated by about one order of magnitude. The deep fracture system appeared to have some indirect connectivity to the main bedrock system, as evidenced by delayed responses during the long-term test. Taken together, the West Ridge bedrock aquifer system was determined to be a semi-confined double-porosity system (Hydrometrics, Inc. 2018a). Essentially this means that water can move through the rock via cracks or through the structure (pore space) of the rock itself and that the water level in the aquifer is near the top boundary of the aquifer.

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Source: Baseline Hydrology Report (Hydrometrics, Inc. 2018a)

Figure 3.6-3. Ground water monitoring network.

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Infiltration tests indicated a hydraulic conductivity of unconsolidated alluvium and colluvium is on the order of 3 to 50 feet/day. Hydraulic conductivity of tailings material was estimated based on soil behavior and pore pressure dissipation, and ranged from 0.17 to 0.3 feet/day for sands and 0.0009 to 0.0026 feet/day for fine-grained slimes (Montana Resources 2018b, Hydrometrics, Inc. 2018a)

Ground Water Quality

Baseline ground water conditions were documented from 2012 to 2016 with samples from 21 monitoring wells and 28 domestic wells located in and around the Proposed amendment area, primarily for the purpose of comparison to future ground water quality as the tailings pond level rises. Major ion and general characteristics of ground water in the Proposed amendment area, and particularly the West Ridge are summarized as follows:

- West Ridge area wells had low to moderate TDS and major ion concentrations (calcium, magnesium, sodium, potassium, bicarbonate, chloride, and sulfate). TDS averaged approximately 220 mg/l for both monitoring and domestic wells. Specific conductance averaged 329 and 325 $\mu\text{mhos/cm}$ for monitoring and domestic wells, respectively.
- Calcium is the dominant cation in area ground water. Ground water in the majority of wells was classified as calcium-bicarbonate type, with a minority of wells falling under the calcium-sulfate classification.
- Overall average pH of monitoring wells was 7.4, with average pH of individual wells ranging from 6.1 to 8.4. Overall average pH of domestic wells was 7.4, with individual well averages of 6.2 to 8.3.
- Major ions, pH, and TDS varied little with seasons and over the baseline monitoring period.
- Sulfate and TDS concentrations tend to be higher at the south end of the West Ridge, where ground water tends towards calcium-bicarbonate-sulfate type. Still, sulfate and TDS concentrations in the pond are substantially higher than in these ground water samples. Specifically, the YDTI pond has elevated sulfate and TDS concentrations (typically 1,080 mg/l and 1,706 mg/l, respectively; Section 3.6.2.1) and calcium-sulfate type water.

Major ion and general chemistry of ground water was distinct compared to YDTI pond water, which had an average pH of 10.2, an average specific conductance of 2,141 $\mu\text{mhos/cm}$, and is classified as calcium-sulfate type. Furthermore, the calcium-bicarbonate classification and average TDS of YDTI-area ground water is consistent with published data on regional ground water, suggesting that the baseline water quality data provide a reasonable representation of local ground water characteristics (Hydrometrics, Inc. 2018a).

Dissolved metals in baseline ground water samples were particularly low considering the proximity to mineralized bedrock and the YDTI. Dissolved metals baseline results included:

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- Molybdenum, rubidium, strontium, and uranium were the most commonly detected metals, present in over 95 percent of all ground water samples, and 100 percent of domestic well samples. Arsenic was detected in 80 percent of monitoring well samples and 99 percent of domestic well samples.
- Average concentrations of commonly detected metals in monitoring wells were 0.0038 mg/l for molybdenum, 0.0012 mg/l for rubidium, 0.22 mg/l for strontium, and 0.0133 mg/l for uranium.
- Average concentrations of these metals in domestic wells were 0.0037 mg/l for molybdenum, 0.0010 mg/l for rubidium, 0.39 mg/l for strontium, and 0.0199 mg/l for uranium.
- Strontium concentrations did not exceed the DEQ-7 Human Health Standard (HHS; 4 mg/l) but uranium concentrations exceeded the HHS of 0.03 mg/l in 19 of 98 domestic well samples.
- Arsenic and antimony concentrations also exceeded DEQ-7 HHS in some samples. Arsenic concentrations in 14 monitoring well samples and 38 domestic wells samples exceeded the HHS of 0.010 mg/l. Antimony exceeded the HHS of 0.006 mg/l in 4 domestic well samples.
- Lithium, silver, and vanadium were not detected in any samples.
- Concentrations of other metals were generally low.

Four chemical constituents were identified as possible indicators of potential YDTI tailings pond leakage in the future: sulfate, fluoride, rubidium, and tungsten. Concentrations of these constituents in the YDTI supernatant pond are one or more orders of magnitude higher than in surrounding ground water and surface waters. Potassium and sodium are also potentially useful parameters for distinguishing YDTI pond water from ground water.

3.6.3 Environmental Consequences

This section presents environmental consequences associated with the project alternatives. Consequences unique to each alternative are discussed under separate headings. The alternatives do not affect water resources during mine operations. Thus, this section focuses on how each alternative will affect water resources during the closure and post-closure periods.

As part of the EIS process, technical memoranda have been prepared that evaluate potential impacts to ground water and surface water resources under different alternatives in detail. Specifically, these memoranda are:

- *West Embankment Ground Water Contaminant Review Technical Memorandum for the Proposed Amendment to Permits 00030 and 00030A for the Continental Mine: Changing Operations at the Yankee Doodle Tailings Impoundment* (HydroSolutions Inc 2018a)
- *Closure Pond Water Balance and Quality Impacts Technical Memorandum for the Proposed Amendment to Permits 00030 and 00030A for the Continental Mine: Changing Operations at the Yankee Doodle Tailings Impoundment* (HydroSolutions Inc 2018b)

These memoranda are part of the Administrative Record for this EIS. The following impacts analysis draws upon the conclusions of these memoranda. For a detailed treatment of the technical foundations of the following impacts analysis, the reader is directed to these memoranda.

3.6.3.1 No Action Alternative

Under the No Action Alternative, mining would continue under the current operating plan into approximately 2022, at which point reclamation activities would commence. As discussed in the technical memorandum (HydroSolutions Inc 2018b), MR presented limited results of a water balance model run for this scenario but did not present water quality model results specific to the No Action Alternative.

Ground Water

Under the No Action Alternative, ground water quality impacts to the west, north, and east of the YDTI will continue to be mitigated by limiting the tailings pond elevation to ensure the existing YDTI-directed ground water gradient remains in place. Water quality monitoring indicates that this YDTI-directed ground water gradient has effectively contained supernatant pond water in the YDTI. Additionally, the West Embankment Drain (WED; **Section 2.3.3**), which has already been constructed, will capture seepage and some ground water from the YDTI in the West Ridge area, further ensuring West Ridge area seepage containment.

Under the No Action Alternative, pumpback of WED water after closure was not anticipated (DEQ 2014). Poor quality seepage emanating in the Horseshoe Bend area to the south of the YDTI will continue to be collected and treated at the HsB Water Treatment Plant, per current operating practices and through post-closure under the requirements of BMFOU.

Surface Water

Water balance modeling presented by MR indicates that under the No Action Alternative, following completion of mining operations, the YDTI supernatant pond volume will decrease and reach an equilibrium volume approximately seven years later than the timeframe predicted under the Proposed Action. The pond volume, approximately 37 years after closure, is predicted to be approximately 1,000 acre-feet under average climate conditions, and in the long-term may range up to approximately 2,500 acre-feet under wet climate conditions. (Knight Piesold 2018d, HydroSolutions Inc 2018b).

MR's water quality model was not specifically run for the No Action Alternative; however, the Technical Memorandum concluded that the initial iteration of the MR water quality model (Schafer Limited LLC 2017) provided an indication of potential water quality under this alternative (HydroSolutions Inc 2018b). Specifically, the lack of ongoing WED pumpback to the supernatant pond under the No Action Alternative reduces the likelihood of adversely impacting the supernatant pond with poor-quality WED water. This is borne out in the initial water quality model (Schafer Limited LLC 2017), which concluded that the supernatant pond water's chemical composition should be similar to local surface runoff within about 20 years of

closure without WED pumpback occurring (Schafer Limited LLC 2017). Thus, under the No Action Alternative, MR's water quality modeling suggests supernatant pond water quality could approximate natural conditions more rapidly than under most other alternatives.

3.6.3.2 Proposed Action

Under the Proposed Action, YDTI closure would be initiated in 2031. MR has proposed extensive ground water management mitigations as well as water balance and water quality modeling results for the Proposed Action, which are discussed in the following sections.

Ground Water

Prior to closure, the supernatant pond water level will have surpassed the ground water elevation of about 6,380 feet at the West Ridge ground water depression (Hydrometrics, Inc. 2018a). Without mitigation, this elevated supernatant pond level could lead to a loss of hydrodynamic containment of the pond water, and seepage of supernatant pond water away from the YDTI and into the local ground water system.

Therefore, MR has proposed several mitigation measures to ensure continued hydrodynamic containment of supernatant pond seepage. These mitigation measures are discussed in detail in (Hydrometrics, Inc. 2018a, Knight Piesold 2017a, Montana Resources 2018b, HydroSolutions Inc 2018a), and are summarized as follows:

- Operation of a subsurface seepage interceptor drain under the West Ridge area called the West Embankment Drain (WED). The purpose of the WED will be to lower ground water elevations immediately adjacent to the YDTI in the West Ridge area in order to maintain a hydraulic gradient from the West Ridge towards the YDTI and to collect and convey seepage from the YDTI. The ground water component of flow in the WED is anticipated to be 60 GPM (Hydrometrics, Inc. 2018b).
- Conservative design of the WED including a drain capable of conveying 4,500 GPM, a lined extraction pond, an extraction basin, and "pod" locations where additional contingency pumps can be installed if unanticipated flows are encountered in the WED. Excluding the capacity of the pod locations, the system will have a pumping capacity of 9,000 GPM, approximately twice the maximum seepage rates observed at Horseshoe Bend.
- Design of the West Embankment was optimized to promote drainage of pond seepage into the WED.
- A time lag between installation of the WED and the supernatant pond filling to a critical elevation above West Ridge ground water elevations will allow for a period of time to assess the performance of the WED and make modifications if necessary, before hydrodynamic containment at the West Ridge becomes a concern.
- Deposition of the tailings beach in a way that "pushes" the supernatant pond approximately 3,500 feet away from the West Embankment would maximize the

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resistance to seepage between the supernatant pond and the depressed ground water levels at the West Ridge.

- The potential for “augmented recharge” of West Ridge aquifers: Tests conducted indicated that water levels in the West Ridge aquifer could be raised by injecting water at low rates. This approach could be used to augment the hydrodynamic containment affected by the WED if an (unanticipated) need were to arise.
- Ongoing water quality monitoring in the West Ridge area and around the YDTI would focus on indicator parameters associated with YDTI water but not local ground water.

Evaluation in the West Embankment Technical Memorandum determined that despite a lack of operational data with an elevated supernatant pond level, the conservative nature of the West Embankment Drain design coupled with the contingency plans in place resulted in a prudent strategy for maintaining hydrodynamic containment of the YDTI along the West Ridge (HydroSolutions Inc 2018a).

Ultimately, due to the mitigations proposed, the Proposed Action is not anticipated to impact area ground water quality compared to existing conditions. Furthermore, impacts to ground water elevations outside the immediate YDTI area are anticipated to be minimal because the WED is only expected to intercept existing ground water flows that were already discharging to the YDTI.

Surface Water

MR’s water balance model predicts that under average climate conditions, the supernatant pond will reach an equilibrium volume of about 1,000 acre-feet. The rate and trajectory of supernatant pond drawdown would be generally similar between the Proposed Action and the No Action alternatives. Pond volumes under different climatic scenarios are presented in greater detail in MR’s modeling report and in the Water Balance and Quality Technical Memorandum (Knight Piesold 2018d, HydroSolutions Inc 2018b).

Water quality modeling indicates that during post-closure, supernatant pond water quality is largely dependent on whether seepage collected by the WED and pumped back into the supernatant pond becomes acidified or remains alkaline (Schafer Limited LLC 2018, HydroSolutions Inc 2018b). However, MR’s operating permit states that “If acidic conditions were to develop [in the WED or in the supernatant pond] after closure, lime would be added to maintain alkaline conditions and low metals” (Montana Resources 2018b). Thus, the possibility of supernatant pond acidification during closure raised by the water quality model is addressed by MR’s commitment to control the pond water chemistry through the application of lime. Based on the modeled “worse case” seepage chemistry, MR estimates approximately 150 tons of lime would need to be added to the YDTI per year during the 30-year post-closure period (Schafer Limited LLC 2018). For perspective, a typical hopper railcar can carry approximately 100 tons of material.

3.6.3.3 Accelerated Drawdown Alternative

Reclamation under this alternative would be similar to that described under the Proposed Action but would increase the YDTI supernatant pond drawdown rate in comparison to the Proposed Action. The water pumped from the YDTI would be treated and discharged or stored in the Continental Pit. In either case, the water would be managed in accordance with the 2002 BMFOU Consent Decree (see Section 1.3.3.1).

Ground Water

Under this alternative, protection of West Ridge ground water from YDTI seepage would still require the WED as in the Proposed Action; however, the WED would need to function for a shorter time. Faster reduction in the supernatant pond volume would result in lowering the pond below the critical West Ridge ground water elevation sooner than under the Proposed Action. Once below the critical West Ridge ground water elevation, the WED would no longer be necessary to maintain hydrodynamic control of YDTI seepage and seepage rates would decline until the hydraulic head in the YDTI is below the invert elevation for the drain. The previous West Ridge ground water gradients toward the YDTI would likely be re-established.

Surface Water

The MR water balance model was not run for this scenario, although estimates of the timeframe for accelerated drawdown are presented on **Table 2.5-2** of this document (Knight Piesold 2019c). Generally speaking, this alternative has the potential to substantially expedite drawdown of the supernatant pond and shorten the time required for it to reach its equilibrium volume compared to the Proposed Action.

Shortening the lifecycle of the supernatant pond would allow more rapid placement of cover material, thus reducing infiltration and possibly reducing the risk of continued tailings acidification compared to the Proposed Action. Furthermore, faster pond drawdown would lead to a faster reduction in seepage to the WED, which would reduce the input of potentially poor-quality pumpback water to the pond. Improved supernatant pond water quality would likely require the addition of less or no lime as compared to the Proposed Action.

3.6.3.4 Elimination of West Embankment Drain Pumpback at Closure

The ultimate result of this alternative would be to accelerate the drawdown of the supernatant pond, a similar effect to the Accelerated Drawdown Alternative, although achieved by a different mechanism (elimination of WED pumpback). Reclamation under this alternative would occur similarly to reclamation for the Proposed Action and Accelerated Drawdown Alternative.

Under the Elimination of West Embankment Drain Pumpback at Closure Alternative, the YDTI supernatant pond is anticipated to reach equilibrium approximately 7 years faster than under the Proposed Action Alternative (Knight Piesold 2018d), as detailed in **Section 2.6.3**. This time to equilibrium would be faster than the Proposed Action but slower than the Accelerated Drawdown Alternative. The water would be managed in a manner in compliance with the 2002 Consent Decree. The Consent Decree would ensure the water would meet applicable water

quality and quantity criteria if the water were to be discharged off-site. On-site storage of the water in the Continental Pit would also have to be approved within the framework of the Consent Decree process.

Ground Water

Operation of the WED for hydrodynamic containment would still be required under this alternative as described in the Proposed Action; however, under this alternative it would not be grouted and would continue to maintain hydrodynamic containment of the YDTI seepage. Impacts to ground water under this alternative would thus be similar to those described for the Proposed Action, but shorter in duration, as described for the Accelerated Drawdown Alternative.

Surface Water

A water balance model was run that partially accounts for this alternative. Specifically, the initial water balance modeling effort did not account for an estimated 60 GPM of WED ground water seepage being pumped back into the supernatant pond (Knight Piesold 2018a). This, in effect, is equivalent to modeling a partial elimination of WED pumpback (specifically, elimination of 60 GPM of WED pumpback). Groundwater seepage makes up a little more than a third of the overall WED pumpback volume at closure (estimated to be 160 GPM (Schafer Limited LLC 2018)), so this model result in all likelihood underestimates the rate at which the supernatant pond would contract under this alternative.

Depending on the amount of make-up water required by the Mill during mine operations, this model predicts a supernatant pond volume of approximately 1,000 acre-feet with 2 MGD of make-up water 30 years after mine closure. The equilibrium pond volume is estimated to be approximately 1,000 acre-feet and will be reached 7 years earlier under this alternative than under the Proposed Action (Knight Piesold 2018d). With respect to water quality, expediting supernatant pond drawdown would have the same benefits described for the Accelerated Drawdown Alternative.

3.6.3.5 Alternative Capping Methods

This alternative differs from Accelerated Drawdown and the Elimination of WED Pumpback at Closure Alternatives in that it does not attempt to expedite reclamation by means of altering the water balance. Use of water from the YDTI to make slurry and return it back to the YDTI beach would maintain a closed loop system, meaning impacts to the water balance and pond chemistry would likely be minimal.

Ground Water

In order to mitigate potential impacts to ground water, operation of the WED to collect seepage would be required under this alternative as described for the Proposed Action, but it would not be pumped back to the YDTI.

Surface Water

Processing, transport, and placement of the alluvial cap slurry material is not anticipated to require water from an external source (make-up water) for the mill (**Section 2.7**). Since all tailings processing and slurry water can be sourced from the supernatant pond, a closed loop can be maintained (excepting minor losses anticipated at the mill), which would likely result in a similar or slightly expedited supernatant pond drawdown profile compared to the Proposed Action.

If cap particle distribution and other issues could be adequately controlled resulting in a consistent, low permeability cap, the additional capping proposed under this alternative could theoretically reduce or stop tailings acidification that may occur under other alternatives. However, MR's stated intent to control supernatant pond alkalinity through application of lime, if needed (Montana Resources 2018b), limits the utility of this alternative from a water quality perspective.

3.7 VEGETATION AND WETLANDS

This section describes the vegetation, wetlands, and ecological conditions within the Continental Mine permit boundary and the vegetation survey area (**Figure 3.5-1**). The baseline information, coupled with a review of reclamation literature, is used to quantify potential impacts of the alternatives and implications for reclamation plans related to the vegetation resources in the area.

3.7.1 Analysis Methods

The majority of lands within the Continental Mine permit boundary is actively mined or used for mine-related activities such as water treatment, equipment storage and maintenance, and material processing. The area affected by the proposed amendment is limited to a fringe along the northern perimeter of permit 00030A (**Figure 1.3-1**). Pedestrian vegetation surveys were conducted in 2011 and 2015 as part of the permit amendment application studies (WESTECH 2017a). The survey areas for vegetation, wetlands, and soils were the same (**Figure 3.5-1**) (WESTECH 2017a). This EIS relies on the data collected in those surveys, electronic searches of the Montana Natural Resources Information System (NRIS) and the Montana Natural Heritage Program (MNHP), and a windshield survey of the site conducted on October 4, 2018 during the site tour.

3.7.1.1 Vegetation Classification

Pedestrian surveys of the inventory area were completed during the periods September 22-23 and October 5-14, 2011 and October 15-20, 2015 (WESTECH 2017a). Biologists surveyed the study area on foot, noting vegetation types on 1 inch = 500 feet aerial photo base maps and listing plant species that occurred in each type encountered. Species not recognized in the field were collected for identification in the office. Potential habitat for plant Species of Concern (SOC) was searched more intensively than areas with low potential to harbor SOC. Noxious

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weeds listed by Montana were noted on field maps as they were encountered. Photos were taken using digital cameras.

Vegetation classification was based generally on (Culwell, et al. 1987) the classification of Montana vegetation types developed for the MNHP. Vegetation community types were defined by, and named for, dominant and co-dominant plant groups or species.

3.7.1.2 *Special Status Species and Noxious Weeds*

Special status plant species are afforded additional levels of protection through law, regulation, or policy by state and federal agencies. Special status species are identified based upon agency reviews of their known occurrences, changes in historic range, and potential threats to persistence such as competition with invasive species, reduction in available habitat, or large disturbance events.

Identified species are ranked by state (Montana Fish, Wildlife and Parks) or federal (US Fish and Wildlife Service) regulatory agencies. Special status plant species were researched based on their presence on current lists of species pursuant to Section 7 of the Endangered Species Act (ESA) and Montana's list of species of concern.

Weeds are classified as "noxious" by the Montana Department of Agriculture as described in the Montana County Weed Control Act. There are currently (effective February 2017) 35 noxious weeds in Montana that are divided into four categories based on management objectives (Montana Department of Agriculture 2017). The four categories are:

- **Priority 1A:** weeds not present in Montana; eradication required if detected;
- **Priority 1B:** weeds with limited presence in Montana; eradication or containment and education required;
- **Priority 2A:** weeds common in isolated areas; eradication or containment required where less abundant, under prioritization by local weed districts; and
- **Priority 2B:** weeds abundant and widespread in many counties; eradication or containment required where less abundant, under prioritization by local weed districts.

A fifth category of Priority 3 plants was created in 2010. Priority 3 plants are regulated plants, but not Montana-listed noxious weeds. MR has a Weed Control Plan on-file with the Butte Silver-Bow Weed Control District.

3.7.1.3 *Wetland Methods*

WESTECH (2016a) conducted wetland surveys and delineations in 2015 as part of the vegetation survey referenced above. MR subsequently conducted a wetland delineation of the area after the embankment expansion approved under Amendment 9 to Permit 00030A. The wetlands and waterbodies survey area boundary was identical to the soils and vegetation survey areas (**Figure 3.5-1**) (WESTECH 2016a). However, the wetland field surveys focused on areas with potential for wetlands and waterbodies based on review of high-resolution aerial

photos and publicly available survey records such as the National Wetlands Inventory (NWI). The wetland delineation followed the methods prescribed in the 1987 US Army Corps of Engineers (USACE) Manual that identifies wetlands based on vegetation, soils, and supporting hydrology (WTI 2003) and the (USACE 2010).

Under the authority of Section 404 of the Clean Water Act, USACE permits are required for the discharge of fill material into waters of the United States. Waters of the US include the area below the ordinary high-water mark of stream channels and lakes or ponds connected to the tributary system, and wetlands adjacent to these waters. Isolated waters and wetlands, as well as man-made channels and ditches, may be waters of the U. S. in certain circumstances, which must be determined on a case-by-case basis. The USACE reviews wetland surveys and makes a determination as to whether a wetland or waterway is connected to or influenced by a water of the US This jurisdictional determination or “JD” identifies whether a project will be subject to requirements under Section 404. The 2018 JD for the YDTI area is described in Section 3.7.2.8.

3.7.2 Affected Environment

The vegetation study area is located in the Middle Rockies Level III Ecoregion at elevations between approximately 6,300 and 7,600 feet AMSL. The majority of the mine permit area falls within the Dry Intermontane Sagebrush Valley Level IV Ecoregion (17aa) and the proposed amendment expansion of the YDTI extends into the Boulder Batholith portion of the Elkhorn Mountains-Boulder Batholith Level IV Ecoregion (17ai) as described by Woods *et al.* (Woods, et al. 2002, Plant Maps 2018). Ecoregions are areas where ecosystems and the type, quality, and quantity, of environmental resources, including the vegetation, are generally similar. Ecoregions are delineated based on similar geologic, climatic, and biological characteristics.

WESTECH (2017a) assessed the vegetation communities in and around the proposed amendment area. The major vegetation communities recorded included deciduous forest, coniferous forest, sage-shrublands, grasslands, willow-alder, and wet meadows. Potential natural vegetation within the area along the north and eastern edges of the permit boundary is coniferous forest dominated by Douglas-fir (*Pseudotsuga menziesii*) on lower, drier slopes or subalpine fir (*Abies lasiocarpa*) on higher, mesic (moderately wetted) slopes and drainages (WESTECH 2017a). The summaries below are excerpted from the WESTECH (2017a) Baseline Vegetation Survey.

3.7.2.1 Deciduous Forest

Quaking aspen (*Populus tremuloides*) forest occurs on variable slopes and aspects throughout the study area. Canopy cover measures how much of an area a plant’s branches and leaves cover or shade the ground beneath. Aspen stand canopy cover varied from approximately 15 percent in relatively open stands with stunted trees, to approximately 65 percent in dense stands with more robust trees. Diameter at breast height (dbh) of the trees observed typically varied from four to eight inches.

Understory cover varies with site conditions. Primary shrub species in the vegetation survey area include common juniper (*Juniperus communis*), Canada buffaloberry (*Shepherdia canadensis*), and bitterbrush (*Purshia tridentata*). Primary herbaceous species include pinegrass (*Calamagrostis rubescens*), Kentucky bluegrass (*Poa pratensis*), Sandberg's bluegrass (*Poa secunda*), elk sedge (*Carex geyeri*), bluebunch wheatgrass (*Agropyron spicatum*), Richardson's needlegrass (*Stipa richardsonii*), and numerous forbs.

As vegetation communities mature, the species composition of an area can change as one community replaces another in response to changing canopy cover (affecting sunlight availability) and soil conditions. This is called "succession". Most aspen stands included at least one species of seedling or sapling conifer present such as Douglas-fir, lodgepole pine (*Pinus contorta*), or Engelmann spruce (*Picea engelmannii*), indicating that the forest succession would likely lead to more conifer-dominant forest.

3.7.2.2 Coniferous Forest

Coniferous forest was observed primarily on north, east, and west-facing slopes, and this vegetation community was most extensive on the eastern portion of the study area on steep slopes above the tailings impoundment (WESTECH 2017a). Scattered, smaller stands were present north and west of the YDTI. Douglas-fir and lodgepole pine were more common in this vegetation type. Engelmann spruce was a minor component in some areas, with greater abundance in drainage bottoms and on slopes with higher moisture content due to aspect and/or soil type. Tree size and density varied considerably in this type throughout the study area, although most stands appeared immature.

Higher elevation lodgepole pine stands included an understory dominated by grouse whortleberry (*Vaccinium scoparium*). Pinegrass and/or elk sedge were also common understory dominants on drier sites.

3.7.2.3 Grasslands

Grassland communities occurred within quaking aspen stands, intermixed with sagebrush stands, and along ridge-tops. Most grassland types within the study area have been invaded by non-native grasses and forbs such as Canada bluegrass (*Poa compressa*), Kentucky bluegrass, and spotted knapweed (*Centaruea maculosa*). These non-native species are often the dominant species within grasslands below about 6,600 feet AMSL. The level of non-native species indicates a greater level of past disturbance such as logging. Grassland types above 6,600 feet elevation were more typically dominated by native species such as bluebunch wheatgrass or muttongrass (*Poa fendleriana*). Some small areas are dominated by rough fescue (*Festuca campestris*), primarily on cooler aspects and in areas with deeper soils. Associated native grasses that occur within each type include Richardson's needlegrass, prairie junegrass (*Koeleria macrantha*), and Sandberg's bluegrass. Forbs are common in the grassland type. Scattered rubber rabbitbrush (*Chrysothamnus nauseosus*) and common juniper occur within most grasslands.

3.7.2.4 Sagebrush-Shrubland

Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) was observed interspersed with grasslands in relatively small areas within the vegetation study area. Sagebrush shrubland occurred primarily on ridges, in swales, and on slopes with a generally south-facing aspect. Soils were typically deeper and more well-developed than in adjacent grassland or aspen stands.

Sagebrush canopy cover was generally high (40 to 60 percent) with understory composition varying with site conditions. Bluebunch wheatgrass was observed on drier sites, while muttongrass occurred on more mesic sites. Kentucky bluegrass and Canada bluegrass are also common herbaceous associates within sagebrush stands. Forb diversity is relatively high and includes species such as Virginia strawberry (*Fragaria virginiana*), yarrow (*Achillea millefolium*), Missouri goldenrod (*Solidago missouriensis*), and sulphur-flower buckwheat (*Eriogonum umbellatum*).

3.7.2.5 Riparian and Wet Meadow Areas

The three perennial streams that flow into the YDTI had associated riparian vegetation. The willow-alder community was observed in association with perennial streams, intermittent drainages, and sidehill seeps within the study area. This type often forms a mosaic with the wet meadow type. Woody vegetation was dominated by Bebb willow (*Salix bebbiana*), thinleaf alder (*Alnus incana*) and Geyer willow (*S. geyeriana*), with occasional sandbar willow (*S. exigua*) and Booth willow (*S. boothii*).

Quaking aspen typically occurred as a forested fringe around the margins of some stands and was only occasionally found growing within the interior of riparian or wetter areas. Other common shrubs within the type include northern black currant (*Ribes hudsonianum*), Wood's rose (*Rosa woodsii*), and red osier dogwood (*Cornus sericea*). The herbaceous plants recorded in and around the willow-alder community included several wetland-adapted species such as rushes (*Juncus* spp.) and sedges (*Carex* spp.). Wet meadows were interspersed within the willow/alder type and as larger mosaics apart. Many wet meadows were located near old beaver ponds but also occurred within, and adjacent to, drainage bottoms, streams, and seeps. A full list of all species recorded in the vegetation survey area can be found in the Appendix A-3 of the Amendment Application (Montana Resources 2018b).

3.7.2.6 Weeds and Invasive Plants

The 2011 and 2015 WESTECH surveys observed occurrences of four noxious weed species, spotted knapweed (*Centaurea maculosa*), Dalmatian toadflax (*Linaria dalmatica*), yellow toadflax or butter-and-eggs (*Linaria vulgaris*), and Canada thistle (*Cirsium arvense*), and one regulated plant, cheatgrass (*Bromus tectorum*) (WESTECH 2017a). The four state-listed weed species are all classified as Priority 2B on the Montana Noxious Weeds List. Priority 2B noxious weeds are weeds that are abundant in Montana and widespread in many counties. These weeds are capable of rapid spread and render land unfit or greatly limit beneficial uses. Management criteria requires containment and suppression where 2B species are abundant

and widespread, and eradication or containment, prevention, and education where less abundant. Management would be prioritized by the local weed district.

Cheatgrass is managed as a regulated plant (Priority 3) and as such it may not be intentionally spread or sold (except as a contaminant in agricultural products such as non-certified feed). Cheatgrass has the potential to have significant negative effects on native vegetation communities because of its invasive spread and the way that it can intensify grassland fire when it becomes widespread.

Spotted knapweed occurred throughout much of the study area; it was particularly common in grassland, disturbed areas, and sagebrush shrubland but also occurred in more open forest stands, in rocky areas, and on disturbed sites with bare soil (WESTECH 2017a). Dalmatian toadflax and yellow toadflax were more restricted within the vegetation study area. Dalmatian toadflax occurred primarily near roads and other disturbed areas, while yellow toadflax was widely scattered (WESTECH 2017a). Canada thistle was observed at isolated areas within a few forested types but was most common within and adjacent to wetlands. Cheatgrass was observed in limited areas, primarily within grassland and sagebrush shrubland vegetation types.

3.7.2.7 Disturbed Areas

Overall, the entire permit footprint of the Continental Mine facilities, including the YDTI and Berkley Pit, is approximately 4.9 miles long by 2.8 miles wide at the furthest points and totals approximately 5,890 acres of which approximately 4,632 acres are currently disturbed (WESTECH 2018a).

Disturbed areas include the YDTI embankment, waste rock dump, roads and associated facilities, topsoil stripping and storage areas, reclaimed sites, and the impoundment itself. Most disturbed areas do not support vegetation and were not included in the vegetation surveys. However, the reclaimed area is dominated by intermediate wheatgrass (*Agropyron intermedium*), spotted knapweed, and sheep fescue (*Festuca ovina*). Widely scattered quaking aspen and lodgepole pine occur on portions of the waste rock dump and within some areas of older disturbance.

3.7.2.8 Wetlands

A wetland delineation and waterbody survey of the survey area identified 24.1 acres of wetlands and ponded areas, and 11,408 linear feet of stream within the survey boundary (**Figure 3.5-1**) (WESTECH 2016a, USACE 2018, WESTECH 2018a). Streams in the survey area are relatively small; most are perennial and all flow into the YDTI (See also Section 3.6). Wetland areas within the survey area were found primarily in drainages and swales, at hillside seeps, and in or near disturbed areas along the west side of the tailings pond. A few recently formed ponds were surveyed on disturbed ground along the western and southwestern margin of the YDTI (WESTECH 2016a). These ponds have unconsolidated bottoms and would not be considered wetlands because they do not support wetland soils or vegetation as they are a result of recent excavation in uplands.

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The wetlands identified in the survey area were found almost exclusively outside of the proposed expansion of Permit 00030A at elevations well above the proposed full pool YDTI water surface of 6,428 feet (WESTECH 2016a). The majority were vegetated wetlands dominated by palustrine emergent (grassy or herbaceous marsh-type) or palustrine scrub-shrub (marsh-type wetlands with shrubs present) vegetation (WESTECH 2016a). No forested wetlands were observed, although some wetlands had minor tree cover along the margins.

Streams and wetlands in the YDTI area have been isolated from the remainder of Silver Bow Creek and other waters since mining the Berkeley Pit began in 1955. The YDTI embankment and other mining facilities create a physical barrier of about two miles between the wetlands and streams within the survey area and any other waterbody. Consequently, there is no physical or hydrologic connection between the wetlands and streams above the YDTI and any downstream waterbody. Therefore, the USACE determined that the wetlands that would be impacted by the Proposed Action would not be considered jurisdictional under the Clean Water Act (USACE 2018).

Based on the submitted report and mapping, and on-site reviews, the USACE completed an approved JD. It was determined that the aquatic resources within the defined study area (3.1 acres of pond, 21 acres of wetland, and 11,408 linear feet of stream channel), are isolated, non-jurisdictional waters (USACE 2018). Discharges of dredged or fill material into non-jurisdictional waters do not require authorization from the USACE; therefore, the activities in the proposed amendment would not require such authorization.

3.7.2.9 Special Status Species

Only one Montana plant SOC was identified as having potential to occur in the vicinity of the YDTI (MNHP 2018b). Dense-leaf draba (*Draba densifolia*) is a mat-forming perennial with leaf rosettes at the ends of numerous rootcrown branches, which are clothed with old leaf bases. It is adapted to arid conditions and is generally found on gravelly, open soil of rocky slopes and exposed ridges in the montane to alpine zones. No occurrences of dense-leaf draba were found during the 2011 or the 2015 vegetation survey. Areas identified as potential habitat were searched more intensively for this species, but none were observed. **Table 3.7-1** presents a summary of vegetation community characteristics described in WESTECH 2017a.

**Table 3.7-1
Summary of Acreage and Percent Cover for Vegetation Community Types within the Vegetation Baseline Survey Area and the Proposed Disturbed Area**

Code from Exhibit 1 (Appendix A-3)	Vegetation Community Type	Acres in Vegetation Study Area	Percent Cover in Vegetation Study Area	Acres in Proposed Amendment Disturbance Area	Percent Cover in Proposed Amendment Disturbance Area
GR	Grassland	55.4	4.4	2.7	2.7
DF	Deciduous Forest	132.1	10.5	69.0	70
CF	Coniferous Forest	301.9	24	0.6	<1
D-CF	Deciduous-Coniferous Forest	264.2	21	12.0	12.2
S-G	Sagebrush-Shrublands	402.5	32	5.6	5.7
WA	Willow-Alder	52.8	4.2	4.2	4.3
WM	Wet Meadow	49.1	3.9	1.3	1.3
	Subtotal (not disturbed)	1,258	100		
D	Disturbed/ Open Ground	4,632	74.1	3.3	3.3
	Total Acres^a	5,890	100%	98.7	100%

Source: (WESTECH 2017a, WESTECH 2018a)

- a. Total acreage in the permit and disturbance areas is slightly less (<1 percent difference) than reported in the amendment application due to rounding and polygon overlap.

3.7.3 Environmental Consequences

The reclamation plan states that the post-closure land uses for the areas to be reclaimed are watershed protection and wildlife habitat. The revegetation plan is integral to both land uses. The seed mixes and planting described in the reclamation portions of the current operations plan and the proposed amendment include locally prevalent and native plants with a predominance of herbaceous (grassland) plants and some forbs and shrubs. This vegetation composition would change the character of the wildlife habitat from the mix of deciduous forest and grassland that was present historically (pre-YDTI) and currently along the northern edge of the YDTI. However, it would also vegetate the lands exposed as the YDTI recedes and the large, currently open water area shrinks to the equilibrium pond. Vegetating the area would secure soils in place, reduce erosion potential, and decrease airborne dust, which would protect the watershed. This EIS is focused on the lands subject to the proposed amendment and discussion of the larger areas to be reclaimed after closure is limited to the cumulative effects analysis in Chapter 4.

3.7.3.1 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.

3.7.3.2 Proposed Action

Under the Proposed Action, as the pond fills to the increased capacity, it would extend the northern boundary of the tailings pond to an elevation of 6,428 feet. The total permitted area would increase by about 237 acres. However, the disturbance area within Operating Permit 00030A would only increase by about 99 acres to accommodate increased tailings storage, construction, topsoil storage, roads, and monitoring wells. As the tailings pond fills to the higher elevation, water would inundate shoreline acres and riparian areas near the mouths of the three tributary streams. The inundation would replace shoreline habitat with open water and would likely displace vegetation. **Figure 3.7-1** illustrates the approximate shape and location of the area that would be inundated when the YDTI reaches the proposed full pool level for the portion of the YDTI shoreline between the mouths of Yankee Doodle and Silver Bow creeks. This provides a better frame of reference for the impacts discussion of the habitat and lands that would be affected.

Most of the area that would be directly affected by the proposed disturbance is forested (**Table 3.7-1**). Approximately 82 percent of the 99 acres is classified as either deciduous or mixed coniferous-deciduous forest. Inundation would cause many of these trees to die off because the soils around their root systems would be saturated with water, and these species are not adapted to long-term anaerobic (low oxygen) soil conditions. Most trees can survive a few days of flooding during the growing season, but they cannot adapt to consistent inundation (Jackson 2004). Damage is generally greater for trees with standing water around them than trees in

saturated (wet) soil. Damage is also greater on trees where the foliage (leaves) is submerged and tends to increase as more foliage is covered with water (Jackson 2004).

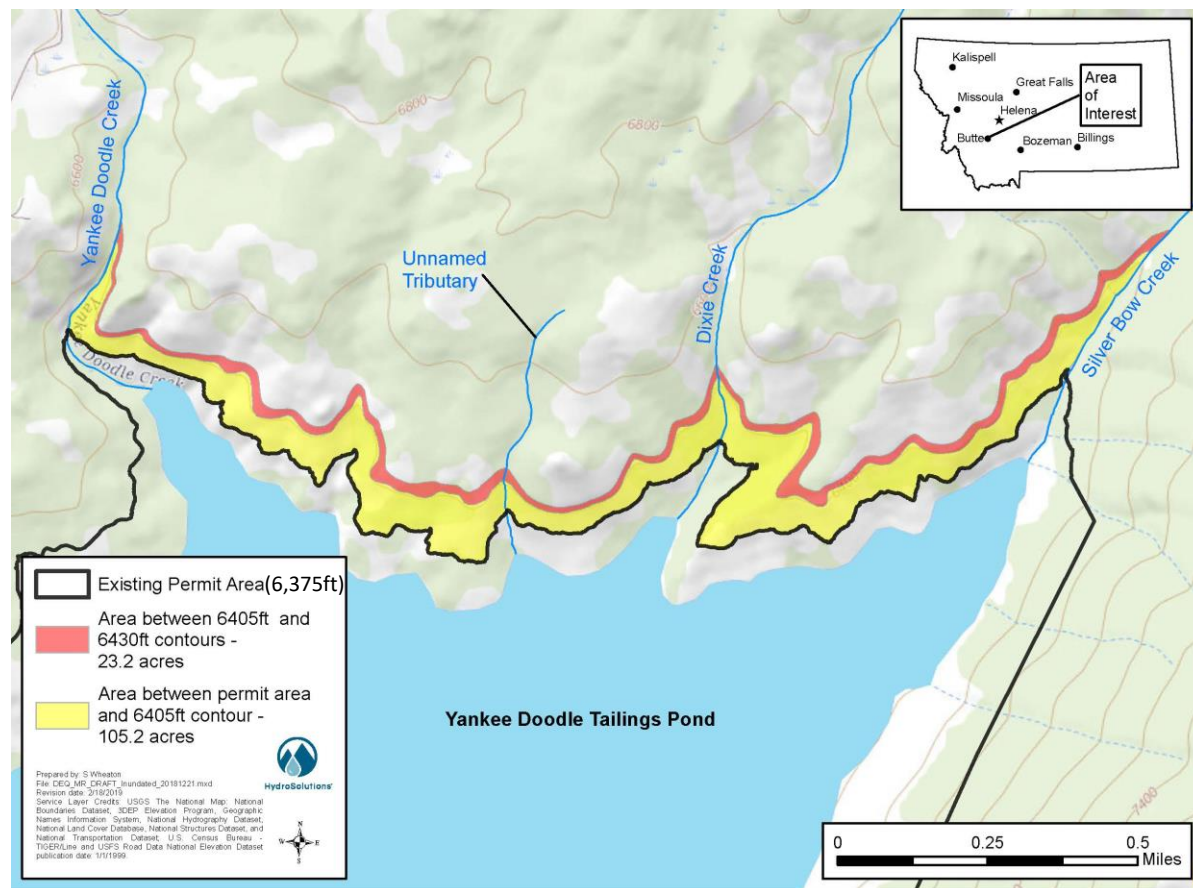


Figure 3.7-1. Illustration of the areas to be inundated as the pool level rises in the YDTI from the 6,405-foot contour line to the proposed full pool level of 6,430 feet. The orange shaded area would gradually be covered by water as the YDTI approaches full pool.

Riparian-adapted species such as quaking aspen, willow, and alder; and more vigorous, mature trees may survive, particularly those nearest to the new shoreline area where water is shallow or only seasonally present. However, areas where water accumulates at depth, essentially areas farther from the new shoreline, are likely to experience vegetation die off for the duration of the project.

The other vegetation types present in the proposed disturbance areas (**Table 3.7-1**) such as grassland and sage-shrubland are classified as upland plants. Upland plants are adapted to well-drained soils and typically cannot persist in consistently or seasonally saturated soils (Lichvar, et al. 2012). Upland plants would also experience die off for the duration of the project if their surrounding soils are inundated. Areas where the inundation would recede after reclamation would be able to support reseeding and tree planting once the soils dry out after closure.

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Transition Zone and Beach Area

The Transition Zone, or area exposed as the pond retreats after closure, would be reclaimed and reseeded as the surface conditions allow. These areas are currently open water and do not support vegetation. The proposed amendment estimates that the pond water level would drop approximately two feet per year after closure, but would be variable with changing annual runoff, pond surface area, and other factors influencing the annual water budget.

The rate of water level drop in conjunction with slope in the pond area would likely preclude establishment of a broad wetland zone along the Transition Zone edge. Some wetland vegetation may naturally establish temporarily; however, water level drop would result in a fairly rapid conversion of any narrow wetland zone to upland vegetation. The expanding beach zone would be revegetated with upland species. The proposed species mix includes native and locally prevalent herbaceous species and some forbs and shrubs such as sagebrush (*Artemisia tridentata*), yarrow (*Achillea millefolium*), and silver buffaloberry (*Shepherdia argentea*) which would provide high-quality wildlife habitat once established. Wetland plants would be likely to invade the equilibrium remnant pond perimeter since wetland species are present in upstream drainages and beaver ponds.

Soil Stockpiles, Rock Dumps, and Temporary Roads

Other aspects of the proposed amendment such as changes to the size and extent of the West Embankment and the rock dumps would not affect existing vegetation as these areas are not currently vegetated. Reclamation methods for the North RDS and Great Northern RDS would not change substantially from methods for other previously permitted rock disposal sites (Montana Resources 2018b). The reclamation plan for these areas would not differ from that under the No Action except that it would be initiated nine years later if the proposed amendment is approved.

In order to reduce short-term erosion and sedimentation, certain disturbances such as soil stockpiles and road cut and fill slopes may be temporarily stabilized with an interim revegetation mixture, a cover crop, soil binder and/or mulch (Montana Resources 2018b). Sites to be stabilized prior to final reclamation may also include areas subject to extreme wind or water erosion that cannot be permanently revegetated due to seasonal considerations, delays in reclamation scheduling, or during construction shutdowns.

Wetlands

As noted above, the wetlands identified in the baseline surveys were predominately located outside of the area that would be affected by the YDTI expansion. The wetland report identified 24.1 acres of wetlands and 11,000 feet of stream channel in the survey area (**Figure 3.51**) (WESTECH 2016a). WESTECH's analysis found that approximately 4.6 acres of willow-grey alder wetland near the Bumtown Road would be filled as part of the West Embankment work, and no portion of the stream channels would be filled under the Proposed Action (Beaver 2018).

The remaining 19.5 acres of wetlands are located at elevations above 6,450 feet (WESTECH 2016a). Because of their location with respect to the YDTI, changes in its pool level would be unlikely to affect the supporting hydrology of the remaining 19.5 acres of wetlands, and the potential for impacts to these wetlands would be negligible. In conclusion, the Proposed Action would remove approximately 4.6 acres of wetlands for the term of the project.

In addition, the USACE jurisdictionality determination regarding all of the wetlands and waterbodies in the wetland survey area was that these are not Waters of the US because they lack a connection to a traditionally navigable water (USACE 2018). Therefore, they are not subject to regulation under the Clean Water Act.

3.7.3.3 Accelerated Drawdown Alternative

The Accelerated Drawdown Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by as much as 20 to 30 years (**Table 2.8-1**). The final reseeding and vegetation reestablishment plan would not be altered, but establishing vegetation decades sooner after closure would allow a greater level of vegetation succession to occur than under the Proposed Action. The reestablishment of vegetation is integral to the post-closure land uses identified, namely wildlife habitat and watershed protection. This alternative may allow these land uses to be achieved as much as two to three decades sooner, which may be substantial in terms of vegetation succession, overall land appearance, and wildlife use.

No aspect of this alternative would affect the extent of the areas to be inundated. Therefore, the potential for primary impacts to vegetation would be the same as described for the Proposed Action, but because reseeding and vegetation reestablishment would be initiated sooner under this alternative, the time when areas would be useable as wildlife habitat would also occur much sooner.

3.7.3.4 Elimination of West Embankment Drain Pumpback at Closure

Although the Elimination of the WED Pumpback at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by approximately 7 years, the final reseeding and vegetation reestablishment plan would not be altered. No aspect of this alternative would affect the extent of the areas to be inundated. Therefore, the potential for primary impacts to vegetation would be the same as described for the Proposed Action, but because reseeding and vegetation reestablishment would be initiated sooner, the time when areas would be useable as wildlife habitat would also occur sooner. However, the amount of time gained under the Elimination of the WED Pumpback would be substantially less than what would be predicted under the Accelerated Drawdown Alternative.

3.7.3.5 Alternative Capping Methods

Although the Alternative Capping Methods Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by approximately 2 years, the final reseeding and vegetation reestablishment plan would not be altered. No aspect of this alternative would

affect the extent of the areas to be inundated. Therefore, the potential for primary impacts to vegetation would be the same as described for the Proposed Action, but because reseeding and vegetation reestablishment would be initiated sooner, the time when areas would be useable as wildlife habitat would also occur sooner. However, the amount of time gained under the Alternative Capping Methods Alternative would be substantially less than what would be predicted under the Accelerated Drawdown Alternative.

3.8 WILDLIFE

This section describes applicable wildlife regulations, the affected environment, and the evaluation of potential impacts on wildlife within the wildlife study area (WSA). The WSA includes the Amendment application area and a one-mile buffer (**Figure 3.8-1**). The regulatory framework protecting wildlife resources in Montana includes both state and federal laws and is described below.

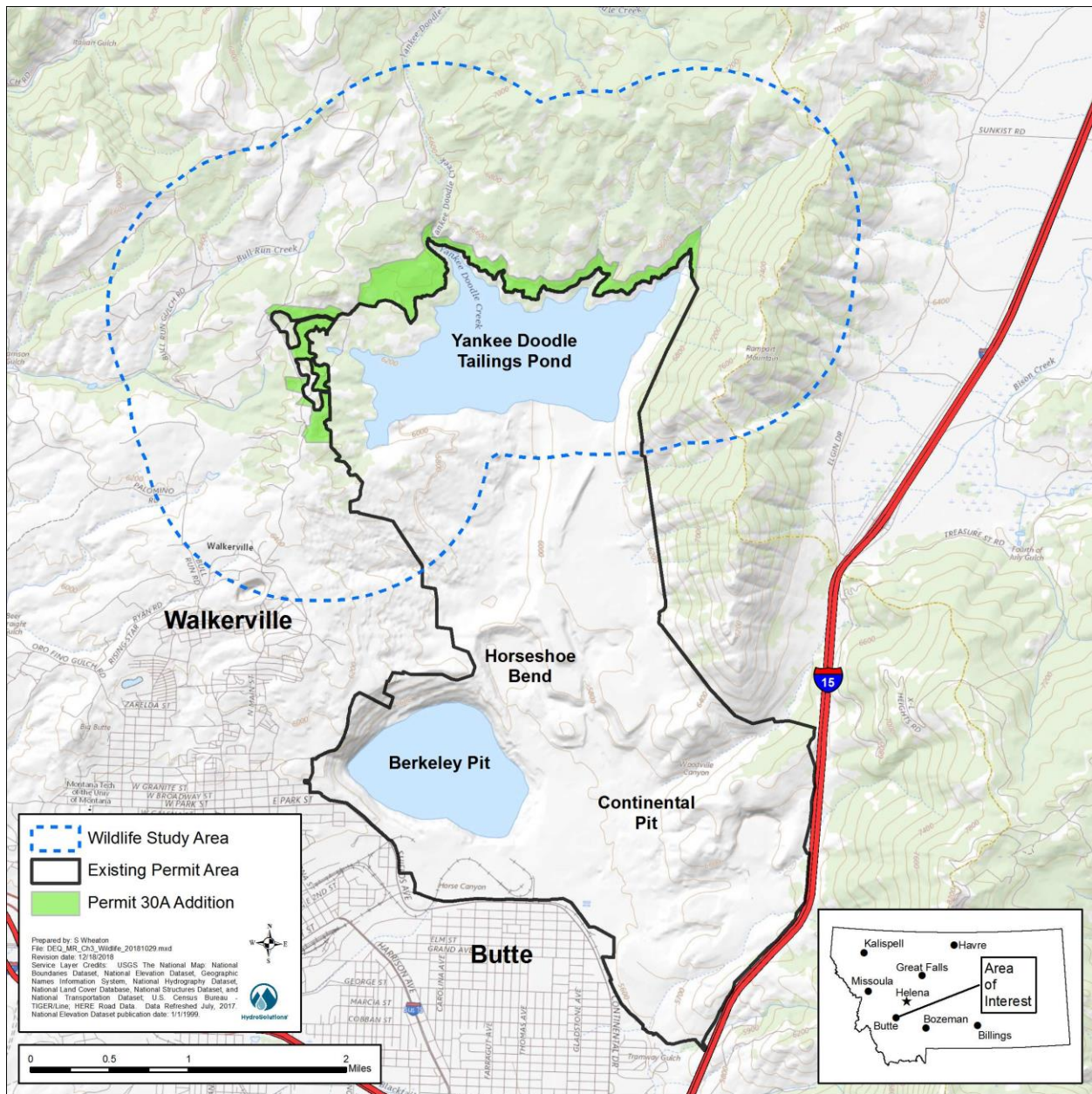
3.8.1 Federal Regulations

3.8.1.1 *Endangered Species Act (ESA)*

The ESA directs the US Fish and Wildlife Service (USFWS) to identify and protect endangered and threatened species and their critical habitat, and to provide a means to conserve their ecosystems. Among its other provisions, the ESA requires the USFWS to assess civil and criminal penalties for violations of the ESA or its regulations. Section 9 of the ESA prohibits 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 U.S.C. 1532). The term “harm” includes significant habitat alteration which kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 CFR 17.3).

3.8.1.2 *Migratory Bird Treaty Act (MBTA)*

The MBTA is the cornerstone of migratory bird conservation and protection in the United States. The statute’s language states that a “taking” or possession (permanent or temporary) of a protected species, in the absence of a USFWS permit or regulatory authorization, is a violation. The MBTA states, “Unless and except as permitted by regulations ... it shall be unlawful at any time, by any means or in any manner, to pursue, hunt, take, capture, kill ... possess, offer for sale, sell ... purchase ... ship, export, import ... transport or cause to be transported ... any migratory bird, any part, nest, or eggs of any such bird ...” (16 U.S.C. 703). The word “take” is defined by regulation as “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 protected by the MBTA at 50 CFR 10.13. This list includes over one thousand species of migratory birds, including eagles and other raptors, waterfowl, shorebirds, seabirds, wading birds, and passerines.



Source: WESTECH 2017b

Figure 3.8-1. The Wildlife Study Area for the Montana Resources Baseline Fish and Wildlife Study

3.8.1.3 Bald and Golden Eagle Protection Act (BGEPA)

Under authority of the BGEPA (16 U.S.C. 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 U.S.C. 668). The BGEPA also defines take to include “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb,” 16 U.S.C. 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).

3.8.1.4 State Management

Montana Fish, Wildlife and Parks (MFWP) sets the state policies for the protection and management of the state’s wildlife (game and non-game, 87-1-301, MCA). MFWP and the MNHP identify species of concern based on their vulnerability to extinction in Montana.

3.8.2 Analysis Methods

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

- Montana Resources Application to Amend Operating Permits 00030 and 00030A to Continue Operations at the Continental Mine (MR 2018a; revised May 2018) including:
 - Appendix A-2-Baseline Fish and Wildlife Survey; Montana Resources Yankee Doodle Tailings Impoundment; Application to Amend Operating Permits 00030 and 00030A (WESTECH 2017b), and
 - Appendix A-3-Baseline Vegetation Survey; Montana Resources Yankee Doodle Tailings Impoundment; Application to Amend Operating Permits 00030 and 00030A (WESTECH 2017a)
- Montana Natural Heritage Database Search (October 2018; MNHP 2018a)
- USFWS Information for Planning and Consultation (IPaC) search (October 2018; (USFWS 2018a))
- USFWS Endangered Species in Silver Bow and Jefferson counties database search (October 2018; (USFWS 2018b)).

3.8.3 Affected Environment

Elevation in the WSA ranges from 5,762 to 7,784 feet AMSL. Deciduous forest dominated by quaking aspen is the dominant vegetation type followed by deciduous-coniferous forest (quaking aspen, lodgepole pine), and Douglas fir (see Section 3.7). **Table 3.7-1** shows the acreage of each vegetation type that would be disturbed by the Proposed Action.

Aquatic habitat in the WSA includes open water (provided by the northern portions of the tailings impoundment) and perennial or intermittent streams (Silver Bow, Dixie, and Yankee Doodle creeks). Beaver (*Castor canadensis*) dams, both active and inactive, provide pond habitat in the drainages, and beaver have been observed in the YDTI pond (W. Jepson, Pers. com. 2019). Waterfowl such as Canada goose (*Branta canadensis*), mallard (*Anas platyrhynchos*), and American coot (*Fulica americana*) were observed in the aquatic habitat, as well as raccoon (*Procyon lotor*) and mule deer (*Odocoileus hemionus*). Rock outcrops occur throughout the Proposed amendment area providing habitat for small mammals such as

golden-mantled ground squirrel (*Callospermophilus lateralis*), red squirrel (*Tamiasciurus hudsonicus*), and chipmunk (*Tamias* spp.). There are no outcrops of suitable size for nesting raptors (WESTECH 2017b).

In August, September, and October 2011 and October 2015, WESTECH (2017b) conducted wildlife surveys in the Proposed amendment area and slightly beyond. Forty-four wildlife species were recorded by direct sight or by sign (tracks, scats, feathers, and/or hair). All of the species recorded during the reconnaissance would be considered seasonal or year-long residents of the area except one immature golden eagle (*Aquila chrysaetos*) that was probably a migrant (2011 record). More intensive surveys were conducted in the Proposed amendment area in the 1970s and 1990s, also by WESTECH, during times that included migration periods. These earlier surveys provide contextual information on wildlife presence and movements. When these results were added to the 2011 and 2015 surveys, a total of 80 wildlife species (2 amphibians, 0 reptiles, 21 mammals, and 57 birds) have been recorded in the vicinity of the proposed amendment area.

3.8.3.1 Special Status Species

Federally Listed Species

The proposed amendment area is not within any federally designated critical habitat (USFWS 2018a). One threatened species (grizzly bear [*Ursus arctos horribilis*]) has been confirmed in the WSA. Canada lynx (*Lynx canadensis*, threatened) and wolverine (*Gulo gulo luscus*, proposed threatened) may occur within the WSA based on habitat, range, and occurrence records (USFWS 2018a, MNHP 2018b). The species descriptions below provide more detail.

Canada lynx

The lynx is a medium-sized cat with long legs, large, well-furred paws, long tufts on the ears, and a short, black-tipped tail. The distribution of lynx in North America is closely associated with the distribution of North American boreal forest. Within these general forest types, prime habitat where lynx are most likely to persist are areas that receive deep snow and have high-density populations of snowshoe hares (*Lepus americanus*), the principal prey of lynx. Canada Lynx west of the Continental Divide generally occur in subalpine forests between 4,000 and 7,050 feet elevation in stands composed of pure lodgepole pine but also mixed stands of subalpine fir (*Abies lasiocarpa*), lodgepole pine, Douglas fir, grand fir (*Abies grandis*), western larch (*Larix occidentalis*), and hardwoods (Ruediger and et al. 2000).

MNHP has no records of Canada lynx from the WSA, but they do have observations from Silver Bow County. In the winter of 2017-2018, MFWP had a confirmed photo of a lynx from the north end of the Pintler Mountains, about 15-20 air miles from the WSA (V. Boccadori pers. comm.). Lynx have home range sizes large enough that they could travel to the WSA from where they were photographed (V. Boccadori pers. comm.). The USFWS Information for Planning and Consultation (IPaC) system identifies lynx as a species potentially affected by activities in the

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WSA area (USFWS 2018a). Transient lynx may occasionally move through the WSA but the area is not considered to have resident lynx (Zelinack 2019).

Grizzly bear

Adult grizzly bears weigh from 400 to 1,500 pounds and their coloring ranges from blond to deep brown or black depending on geographic area. The grizzly has a large hump over the shoulders, a large head, and concave facial profile. Grizzly bears are habitat generalists but in Montana primarily use meadows, seeps, riparian zones, mixed shrub fields, closed timber, open timber, sidehill parks, snow chutes, and alpine slabrock habitats.

Until recently, grizzly bears were not known from Silver Bow County (where the proposed amendment is) but only from the northern part of neighboring Jefferson County (MNHP 2018b, USFWS 2018a). The WSA includes a small section of Jefferson County across the Continental Divide. However, the range of the grizzly bear is expanding into Silver Bow County (V. Boccadori pers. comm.). In 2017 there was a confirmed grizzly bear sighting (tracks) at YDTI along with concurrent confirmed tracks a few miles west at Rocker, and to the east at Elk Park (Boccadori 2018).

Wolverine

The wolverine resembles a small bear with a bushy tail. It has a round, broad head, short, rounded ears, and small eyes. Males can weigh up to 40 pounds, and females up to 26 pounds (USFWS 2018a). Wolverines are limited to alpine tundra, and boreal and mountain forests (primarily coniferous) in the western mountains, especially large wilderness areas. However, dispersing individuals have been found far outside of usual habitats. In the Northern Rocky Mountains, wolverines are associated with fir, pine, and larch, and also use aspen stands and cottonwoods in riparian areas (MNHP 2018b).

In addition to being proposed for listing by the USFWS as threatened, wolverine are also a Montana SOC. Wolverines have been confirmed in Silver Bow County within the past 15 years (MNHP 2018b). MNHP identifies the WSA as a “confirmed area of occupancy” for wolverine (MNHP 2018a). This determination is supported by “recent (post-1980), nearby (within 10 kilometers) observations of adults or juveniles” (MNHP 2018a). The wolverine was considered a species potentially affected by activities within the WSA by the USFWS Information for Planning and Consultation (IPaC, USFWS 2018a). In the winter of 2017-2018 MFWP confirmed photos of wolverine from the north end of the Pintler Mountains, about 15-20 air miles from the WSA (V. Boccadori pers. comm.2018). Wolverines have home range sizes large enough that they could travel to the WSA from where they were photographed (V. Boccadori pers. comm.2018).

3.8.3.2 Montana State Species of Concern

Table 3.8-1 lists Montana SOC not already discussed under federally listed species that have been documented in the WSA or may occur based on habitat (WESTECH 2017b, MNHP 2018a, MNHP 2018b, USFWS 2018a). Species of Concern are native animals breeding in the state that are considered to be at risk due to declining population trends, threats to their habitats, and/or

restricted distribution. Designation as a Montana SOC is not a statutory or regulatory classification; the designation is intended to help resource managers make proactive decisions regarding species conservation and data collection priorities.

Table 3.8-1 also indicates if bird species that are protected by the federal MBTA, BGEPA, or are listed on the USFWS Birds of Conservation Concern (BCC) list (species that without additional conservation actions are likely to become candidates for listing under the federal ESA).

Three mammal species, 10 avian species, and one amphibian Species of Concern have been documented or may occur in the proposed amendment area (**Table 3.8-1**; (WESTECH 2017b, MNHP 2018a, USFWS 2018a).

3.8.3.3 Big Game

MFWP ranks most of the WSA as highest value class, primarily because of big game winter habitat (MNHP 2018a). Evidence of elk (*Cervus canadensis*) was found throughout the WSA in 2011 and 2015, with areas east of Yankee Doodle Creek having more sign (WESTECH 2017b). Previously rare, moose (*Alces americanus*) were considered relatively common in the WSA by 1998 (WESTECH 2017b). Evidence of moose was found throughout the WSA and the area is considered moose winter range. Mule deer (*Odocoileus hemionus*) are also considered common in the WSA and were recorded in all habitats (WESTECH 2017b). While considered winter range, WESTECH found mule deer to be more common in other seasons. Black bear (*Ursus americanus*) sign was also recorded throughout the WSA.

3.8.3.4 Raptors

Raptors were not common in the WSA on the surveys conducted by WESTECH (2017a) in all years (1970s, 1990s, 2011, and 2015). Most raptors recorded were considered migrants as they were reported outside of the nesting season. No raptor nests were found inside MR claim blocks.

**Table 3.8-1
Special Status Species with Potential to Occur in the Wildlife Study Area (WSA)**

Common Name	Scientific Name	Status		Habitat Requirements/Potential to Occur in WSA
		USFWS ^a	Montana ^b	
Mammals				
Preble’s shrew	<i>Sorex preblei</i>	None	SOC	Sagebrush-grassland habitats. Not documented in WSA, but suitable habitat present.
Hoary bat	<i>Lasiurus cinereus</i>	None	SOC	Forested areas in summer. Not documented in WSA, but suitable habitat present. Documented 6-7 miles from WSA.
Little brown myotis	<i>Myotis lucifugus</i>	None	SOC	Habitat generalist. Not documented in WSA, but suitable habitat present.
Birds				
Northern goshawk	<i>Accipiter gentilis</i>	MBTA	SOC	Mature, large-tract conifer forests with a high canopy cover (69%), relatively steep slope (21%), and little to sparse undergrowth. Not documented in WSA but suitable habitat present.
Golden eagle	<i>Aquila chrysaetos</i>	BGEPA; MBTA; BCC	SOC	Uses cliffs and large trees, occasionally power poles for nesting, and hunts over prairie and open woodlands. One migrant recorded in WSA but suitable nesting habitat not present.
Great gray owl	<i>Strix nebulosa</i>	MBTA	SOC	Lodgepole pine/Douglas fir forest. Not documented in WSA, but documented within 5 miles and suitable habitat present.
Olive-sided flycatcher	<i>Contopus cooperi</i>	MBTA, BCC	SOC	Post-fire habitat, forest openings (clear cuts and other disturbed forested habitat), and forest edges near natural meadows, wetlands, or canyons. Not documented in WSA but habitat may be present.

**Table 3.8-1
Special Status Species with Potential to Occur in the Wildlife Study Area (WSA)**

Common Name	Scientific Name	Status		Habitat Requirements/Potential to Occur in WSA
		USFWS ^a	Montana ^b	
Clark’s nutcracker	<i>Nucifraga columbiana</i>	MBTA	SOC	Conifer forest. Documented in the WSA and many records in the vicinity.
Veery	<i>Catharus fuscescens</i>	MBTA	SOC	Willow thickets and cottonwood stands along streams and lakes. Not documented in WSA, but marginal nesting habitat present.
Green-tailed towhee	<i>Pipilo chlorurus</i>	MBTA	SOC	Typically occurs along the ecotone, or edge, of sagebrush communities and other mixed-species shrub communities. Not documented in WSA but marginal nesting habitat occurs.
Brewer’s sparrow	<i>Spizella breweri</i>	MBTA, BCC	SOC	Sagebrush averaging 16 inches high. Possible but not likely in WSA – patch sizes of sagebrush are likely too small.
Cassin's finch	<i>Haemorhous cassinii</i>	MBTA, BCC	SOC	Every forest type, especially drier coniferous forests. Not documented in WSA but marginal nesting habitat present.
Evening grosbeak	<i>Coccothraustes vespertinus</i>	MBTA	SOC	Mixed-conifer, spruce-fir, and deciduous forests. Not documented in WSA but marginal nesting habitat present.
Reptiles and Amphibians				
Western toad	<i>Anaxyrus boreas</i>	None	SOC	Ponds, reservoirs, streams, marshes, lake shores, potholes, wet meadows, and marshes. Documented in WSA.

Source: WESTECH 2017b, MNHP 2018a, USFWS 2018a.

- a. BGEPA: Bald and Golden Eagle Protection Act; MBTA: Migratory Bird Treaty Act; BCC: Birds of Conservation Concern.
- b. SOC: Species of Concern

3.8.4 Environmental Consequences

3.8.4.1 No Action Alternative

Under the No Action Alternative, the permit amendment would not be approved and the tailings storage capacity in the YDTI would remain unchanged, the northern boundary of the YDTI would not be expanded, disturbed acreage would not be increased, and revisions to the existing reclamation and closure plans would not be necessary. MR mining operations would continue through 2022 as currently permitted, but not beyond.

Impacts to wildlife resources under the No Action Alternative are those that are ongoing from activities approved under the existing permits. Haul truck traffic occurs 7 days per week, 24 hours per day, 365 days per year (Montana Resources 2018a). There is an ongoing risk of roadkill from existing construction traffic. 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 years (construction of the YDTI began in 1963), 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.

3.8.4.2 Proposed Action

The Proposed Action would raise the West Embankment, thus extending the northern boundary of the impoundment to allow continued tailings deposition and extend operations at the Continental Mine until the year 2031. Disturbed land within Operating Permit 00030A would increase by about 99 acres to accommodate increased tailings storage, construction, topsoil storage, roads, and monitoring wells. The Proposed Action would increase the YDTI acreage from 2,177 acres to 2,295 acres (118 acres) (See Section 2.4.2 and **Table 2.4-1**). These areas encompass the impoundment and include the beach, Transition Zone, and the embankments. Reclamation under the Proposed Action would produce a 13 percent larger impoundment area, a larger beach area, and a smaller pond area than under the No Action Alternative (Knight Piesold 2018b).

The primary impact to wildlife from the Proposed Action would be the habitat loss associated with the 99 acres inundated by the expanded YDTI (**Table 3.7-1**). The greatest habitat loss would be the deciduous forest habitat type (69 acres). Wildlife species using this habitat are diverse and include western toad (*Anaxyrus boreas*, a Montana Species of Concern), mountain cottontail (*Sylvilagus nuttallii*), chipmunks (*Tamias* spp.), porcupine (*Erithizon dorsatum*), game species (mule deer, moose, elk, ruffed grouse [*Bonasa umbellus*]) and a variety of birds, most of which are protected under the MBTA. Habitat loss would occur gradually until 2031 as the YDTI expands to its full pool level. During reclamation, wildlife may be able to occupy the disturbed areas. At the completion of reclamation, grassland, wetland, and open water pond habitats would be available to wildlife, but the loss of forest and shrublands would be permanent. Wildlife species that would benefit from the reclaimed habitats include Columbia spotted frog (*Rana luteiventris*), northern pocket gopher (*Thomomys talpoides*), American crow (*Corvus*

brachyrhynchos), mountain bluebird (*Sialia currucoides*), and brewer's blackbird (*Euphagus cyanocephalus*).

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

The Proposed Action would prolong the period local wildlife would be subject to disturbance and displacement from mine activities (by an estimated 9 years under current production levels). Under the Proposed Action, pond equilibrium (when reclamation is considered complete) would occur from 30 to 40 years after closure (Knight Piesold 2019c). The Proposed Action would not likely cause population-level effects for any wildlife species but would cause local impacts through the loss of habitat and temporary displacement.

3.8.4.3 Accelerated Drawdown Alternative

The Accelerated Drawdown Alternative would have the same primary impacts to wildlife as described for the Proposed Action during operations. The difference would be that based on the tailings surface consolidation modeling, reclamation of the YDTI Transition Zone could begin between 5 to 9 years after closure rather than 30 to 40 years as anticipated under the Proposed Action (Knight Piesold 2019c). This represents a substantial reduction in the time to reclamation and vegetation reestablishment in the Transition Zone. Therefore, the temporal impact of wildlife disturbance from reclamation activities would be less and the reclaimed habitat would be available sooner.

3.8.4.4 Elimination of West Embankment Drain Pumpback at Closure

The Elimination of West Embankment Drain Pumpback at Closure Alternative would have the same primary impacts to wildlife as described for the Proposed Action during operations. The difference is it would be possible to cap the gradually exposed Transition Zone area approximately 7 years sooner than reclamation under the Proposed Action. Therefore, the amount of time that wildlife would continue to be disturbed or avoid the area because of reclamation activities would be shortened by the same amount. Reclamation could begin approximately 23 to 33 year after closure as compared with 30 to 40 years under the Proposed Action. In contrast, the reclamation schedule under the Accelerated Drawdown Alternative could begin as soon as 5 to 9 years after closure.

3.8.4.5 Alternative Capping Methods

The Alternative Capping Methods Alternative would have the same primary impacts to wildlife as described for the Proposed Action. The difference is the YDTI may be reclaimed as much as 2 years sooner than under the Proposed Action. If reclaimed sooner, the temporal impact of wildlife disturbance from reclamation activities would be less.

3.9 AQUATICS

The information provided is focused on data most relevant to assessing and addressing the likely impacts of the alternatives being considered on the aquatic species inhabiting the watershed that flows into the YDTI. The area of analysis for aquatic resources includes the Silver Bow Creek- Berkeley Pit watershed upstream of the YDTI (**Figure 3.6-1**). The YDTI and the waters contained within it are not included because the water is not capable of supporting aquatic species present in the tributaries such as trout or freshwater macroinvertebrates. In addition, the USACE found that the waters upstream of the YDTI area have no surface connection with the lower watershed and have been disconnected for many years (USACE 2018).

3.9.1 Analysis Methods

In addition to the field survey described below, the MNHP, the USFWS, MFWP's Fisheries Information System (FishMT), and the DEQ Ecological Data Application System (EDAS) databases were queried for information on special status species, prior surveys, and results from the general area.

No fisheries sampling was conducted as part of the baseline wildlife surveys. No macroinvertebrate samples were conducted, nor were any publicly available macroinvertebrate sampling data available. Therefore, the assessment of fisheries habitat was based on FishMT queries, consultation with MFWP biologists, and professional evaluation of the material presented in the vegetation, wetland, and wildlife surveys.

3.9.2 Affected Environment

Three perennial creeks contribute water to the YDTI: Yankee Doodle Creek, Silver Bow Creek, Dixie Creek (**Figure 3.6-1**). A smaller ephemeral unnamed tributary drains a watershed just under 400 acres between the Yankee Doodle Creek and Dixie Creek watersheds. Historically, these drainages converged to form Silver Bow Creek until sometime between 1966 and 1970, when rising waters retained by the YDTI inundated the confluence at a point now buried beneath the impoundment (WESTECH 2018a). This EIS will focus on the waters that flow into the YDTI because no waterways currently flow out of the YDTI or connect to waterways downstream of the YDTI (USACE 2018). Therefore, the environment that would be affected by the Proposed Action or alternatives would be limited to the mouths of tributaries that would be inundated and any effects that would be perceptible upstream of the mouths.

3.9.2.1 Water Quality Related to Aquatic Resources

Detailed information on the physical properties and water quality of these creeks is presented in Section 3.6 Surface and Ground Water. This section will focus on the biological systems in these creeks including fisheries and will limit repetition of water quality and stream characteristics to information relevant to the biological function of the streams.

Aspects of the water quality in the YDTI relevant to aquatic life include the overall pH, which ranges from 9.5 to 10.5; the TDS levels, which range between 1,890 and 2,040 mg/L; and the

conductivity (SC), which ranges from 2,079 to 2,317 $\mu\text{S}/\text{cm}$ (**Table 3.6-1**). Although these parameters do not exceed lethal limits for trout or macroinvertebrates, the tributary waters discussed below (Drainages North of YDTI in **Table 3.6-1**) often display readings as much as 90 percent lower than those measured in water in the YDTI (Hickman and Raleigh 1982). As an example, Specific Conductance (SC) which measures the ions in water (usually salts), ranges from 100 to 300 $\mu\text{S}/\text{cm}$ in the tributaries and from 2,079 to 2,317 $\mu\text{S}/\text{cm}$ in the YDTI. Rainbow trout (*Oncorhynchus mykiss*) have been shown to actively avoid waters with SC values of 645 to 688 $\mu\text{S}/\text{cm}$ (Little, Wells and Clafee 2006). Freshwater organisms are particularly affected by waters with higher SC than their blood or bodily fluids as this affects their ability to maintain their internal water balance. Fish and other aquatic life that live in freshwater (low-conductivity) are hyperosmotic, which means these organisms maintain higher internal ionic concentrations than the surrounding freshwater (Fondriest Environmental 2016). In addition, the high conductivity of the waters in the YDTI may also reduce the total dissolved oxygen available (Fondriest Environmental 2016). Although some tolerant species may be able to exist there, it is highly likely that most fish and macroinvertebrates would avoid the waters in the YDTI for these reasons.

3.9.2.2 Yankee Doodle Creek

Yankee Doodle Creek drains the largest watershed in the affected area. The total length of Yankee Doodle Creek is about 5.4 miles long, with about 2.3 miles flowing from downstream of Moulton Reservoir #1 to the YDTI (MFWP 2018a). The channel is very high gradient with steep slopes on either bank and large cobble and boulder substrate (WESTECH 2018a). Channel width is three to five feet immediately upstream of the YDTI.

Based on seasonal flow measurements recorded each spring and fall from 2015 through 2017, the Yankee Doodle Creek flow immediately upstream of the YDTI has ranged from less than 0.1 cubic foot per second (cfs) to 2.45 cfs (WESTECH 2018a).

Vegetation along Yankee Doodle Creek is typically dominated by deciduous/ coniferous forest including quaking aspen and lodgepole pine. The wetland delineation and waterbody survey (WESTECH 2016) identified limited willow/gray alder wetland communities along portions of Yankee Doodle Creek within the wildlife study area. Based on aerial photography, more extensive willow/gray alder communities occur farther upstream on Yankee Doodle Creek.

3.9.2.3 Dixie Creek

Dixie Creek flows perennially, but the 2015 to 2017 seasonally measured flows peaked at about 0.77 cfs (WESTECH 2018a). Channel width is two to five feet immediately upstream of the YDTI. The wetted width of Dixie Creek is typically one to two feet or less at the confluence with the YDTI. Wetland communities identified in the wetland delineation and waterbody survey were emergent plants, primarily beaked sedge (*Carex utriculata*) communities (WESTECH 2018a). The low flow and small size of Dixie Creek would limit its potential as fisheries habitat.

3.9.2.4 Upper Silver Bow Creek

The headwaters of Silver Bow Creek above the YDTI are isolated from the portion of Silver Bow Creek tributary to the Clark Fork River. Although FishMT includes data on this lower portion, no publicly available fisheries data exist for the portion included in the affected environment relevant to this EIS (MFWP 2018b). Perennial flow in Silver Bow Creek typically begins about 3,000 feet upstream (north) of the YDTI. The flow steadily increases as the stream descends to the impoundment with seasonally measured flows peaking at about 0.3 cfs (WESTECH 2018a). Channel width is five to fifteen feet immediately upstream of the YDTI. The wetted width of the creek is typically one to three feet wide at the confluence with the YDTI. Given the low amount of flow and lack of connection with other surface waters, it is unlikely that this portion of Silver Bow Creek supports trout species. Smaller sculpin may persist.

Similar to Yankee Doodle Creek, vegetation along Silver Bow Creek is typically dominated by quaking aspen and lodgepole pine.

3.9.2.5 Special Status Species: Westslope Cutthroat Trout

The Westslope Cutthroat Trout (*Oncorhynchus clarki lewisii*) is one of two subspecies of native cutthroat found in Montana. Together, they have been designated Montana's state fish. The Westslope Cutthroat Trout's historical range was all of Montana west of the Continental Divide as well as the upper Missouri River drainage. This fish has been seriously reduced in its range by two primary factors: hybridization with Rainbow (*Oncorhynchus mykiss*) and/or Yellowstone Cutthroat Trout (*O. clarki bouvieri*), and habitat loss and degradation (MNHP 2018b).

MFWP surveyed Yankee Doodle Creek above and below Moulton Reservoir #2 in 2014. Species encountered included Westslope Cutthroat Trout (*Oncorhynchus clarki lewisii*) above the reservoir and Brook Trout (*Salvelinus fontinalis*) and Slimy Sculpin (*Cottus cognatus*) below the reservoir (MFWP 2018a). MFWP fisheries biologist noted that the Westslope Cutthroat Trout collected in Yankee Doodle Creek appeared to be hybridized (Lindstrom, J. Pers. Comm., October 30, 2018). (Lindstrom 2018). As noted in Section 3.6, the streams tributary to the YDTI are isolated from any downstream waters; therefore, the fish inhabiting Yankee Doodle Creek are year-round residents and reproduce solely within the creek. The waters in the YDTI would not be hospitable to trout because of the alkaline pH, elevated SC and TDS, lack of food sources (macroinvertebrates), and lack of cover.

3.9.3 Environmental Consequences

3.9.3.1 No Action Alternative

Under the No Action Alternative, the permit amendment would not be approved, and ongoing land uses would continue. Tributary streams would not be affected beyond the level of YDTI increase that has already been permitted. Impacts to aquatic resources directly related to the proposed amendment would not occur under this alternative.

3.9.3.2 Proposed Action

Under the Proposed Action, as the YDTI fills to the increased capacity, it would extend the northern boundary of the tailings pond to an elevation of 6,428 feet. The total permitted area would increase by about 237 acres. However, the disturbed areas within Operating Permit 00030A would only increase by about 99 acres to accommodate increased tailings storage, construction, topsoil storage, roads, and monitoring wells. As the YDTI fills, it would inundate shoreline acres and riparian areas near the mouths of the three tributary streams.

A GIS was used to model the water levels in the YDTI using the information in the amendment application. The predicted amount of each stream channel inundated by raising the YDTI embankments as measured from water levels on October 28, 2017 is listed in **Table 3.9-1**.

Table 3.9-1
Approximate lengths of stream channel that would be inundated by the proposed water level increase in the YDTI at maximum pool (6,428 feet)

Waterbody	Approximate Measure (feet)	Approximate Measure (miles)	Percent of total Stream Length
Yankee Doodle Creek	226	0.04	<1
Dixie Creek	121	0.02	< 1
Silver Bow	312	0.06	<1
Totals	659	0.12	NA

The water quality in the YDTI would not be expected to change during operations. The higher fill level is meant to accommodate more tailings, but MR would monitor acidity in the YDTI and add lime to maintain the attributes and water chemistry of the waters used to move the tailings to the YDTI. Therefore, the Proposed Action would not change water quality conditions to allow resident fish from Yankee Doodle Creek to use the YDTI pond. Reducing the total length of habitat in Yankee Doodle Creek would potentially reduce the total number of fish in the creek and may impact individuals. However, a loss of <1 percent of the length is not likely to have long-term effects on the population of hybridized Westslope Cutthroat Trout.

Macroinvertebrates that live in the lower reaches would be likely to be displaced as inundation changes the habitat from creek bottom to lakeshore and the hospitable waters of the creeks are replaced by YDTI waters.

Dixie Creek and the upper reaches of Silver Bow Creek are unlikely to support fish because of their flow rates and channel characteristics. Therefore, the inundation of their mouths is not likely to affect any fish, but it would affect macroinvertebrate populations in the lower reaches. No macroinvertebrate sampling has occurred in the three tributary creeks, so it is not possible to assess species or community specific potential impacts. However, the most likely response would be for macroinvertebrates to move upstream into acceptable habitat as inundation progresses. Instream habitat availability is not likely to limit the number or composition of macroinvertebrates present (Whitmore, et al. 2017). Again, the short stream lengths affected,

the rate of the water rise, and the availability of adjacent, more hospitable habitat would all reduce the overall effect on the macroinvertebrate and fish communities.

3.9.3.3 Accelerated Drawdown Alternative

Although the Accelerated Drawdown Alternative has the potential to reduce the total time to complete reclamation of the YDTI area, the water management plan would not be altered in a way that would affect the final pond volume (estimated at approximately 1,000 acre-feet) or pool level (estimated at 6,362 to 6,364 feet). Therefore, the potential for primary impacts to aquatics would be the same as described for the Proposed Action.

3.9.3.4 Elimination of West Embankment Drain Pumpback at Closure

Although the Elimination of WED Drain Pumpback at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area, the water management plan would not be altered in a way that would affect the final pond volume or pool level. Therefore, the potential for primary impacts to aquatics would be the same as described for the Proposed Action.

3.9.3.5 Alternative Capping Methods

Although the Alternative Capping Methods Alternative has the potential to reduce the total time to complete reclamation of the YDTI area, the water management plan would not be altered in a way that would affect the final pond volume or pool level. Therefore, the potential for primary impacts to aquatics would be the same as described for the Proposed Action.

3.10 CULTURAL RESOURCES

This section addresses potential impacts to known cultural resources within the proposed MR YDTI permit boundary (**Figure 1.3-1**). Cultural resources consist of locations and remnants of prehistoric and historic human activity, occupation, or use. Cultural resources encompass a wide range of human use sites that contain features, structures, objects, surface, or buried cultural remains, and/or landscapes that may have important archaeological and historic value. These include prehistoric and historic Native American campsites and properties of religious, ceremonial, and cultural significance, including Traditional Cultural Properties (TCPs), that might still be recognized by tribal communities today.

Under guidelines of the National Register of Historic Places (NRHP), typically applied to evaluate the significance of cultural resources, any site of human activity older than 50 years may be considered as a potential cultural resource. Historic properties that meet the criteria for significance and maintain sufficient integrity are considered to be eligible for listing on the NRHP, and therefore are considered significant resources that warrant special consideration and historic preservation efforts.

This assessment was prepared to fulfill the requirements of MEPA and MMRA, with the State of Montana DEQ acting as lead agency. Since this proposed amendment would only involve private land and would not require federal permits or approvals, federal cultural resource

protection legislation relating to the consideration of historic properties, including Section 106 and Section 110 of the National Historic Preservation Act (NHPA), would not apply. Similarly, since state lands would not be impacted under this proposed amendment, the guidelines of the Montana Antiquities Act would not be applicable. Nonetheless, as a state agency, DEQ is required to consult with the Montana State Historic Preservation Office (SHPO) under MEPA considering its efforts to assess impacts to historic properties. The SHPO issues guidance for conducting cultural resource investigations based on the requirements of NEPA and NHPA (SHPO Planning Bulletin 2). Therefore, the terminology and guidelines established by SHPO are adhered to for investigations administered by state agencies that do not fall under the direct auspice of federal or state cultural resource protection legislation.

3.10.1 Overview and Study Area

The purpose of this section is to identify and assess impacts to cultural resources from the proposed amendment to Operating Permits 00030 and 00030A. The Proposed Action would authorize the disturbance of approximately 99 additional acres adjacent to the YDTI and would expand the permitted area designated in the existing operating permits. The area of potential effect (APE) for cultural resource consideration is the expanded permit boundary of approximately 237 acres, which includes the enlarged disturbance area.

3.10.2 Analysis Methods

A Cultural Resource Information System (CRIS) search was conducted at the Montana SHPO on October 26, 2018 (Phair 2018). The search identified 20 previously recorded cultural resources within a broad search area surrounding the proposed amendment area. Using GIS shapefiles of the revised operating permit boundary and SHPO site location GIS data, a total of ten documented cultural resources were found to be recorded within the revised 237-acre operating permit boundary. In addition, one previous cultural resource inventory has been conducted in the permit area (Ferguson 2012). A discussion and evaluation of the cultural resource survey and affected cultural resource sites follows.

3.10.2.1 Field Surveys

In 2012, MR funded an intensive cultural resource inventory by GCM Services to support Amendment 9 to Operating Permit 00030A that was approved by DEQ on February 17, 2015 (Ferguson 2012). The survey covered an irregularly shaped 1,400-acre parcel of MR land that extended north and west of the current YDTI, generally below the 6,600-foot contour interval on the north, to a point east of the discharge station on the east, and west to the property boundary roughly following Moulton Road. Field survey was conducted by pedestrian transects following the contour terrain. At the time of the survey, the reservoir shoreline was at approximately 6,200 feet. The 2012 cultural resource inventory covered the entire land area under consideration for the Proposed Action.

The GCM Services inventory recorded twenty cultural resources and 65 Minimal-Activity-Loci (MALs). A MAL is a small site of minimal human use that typically contains few if any artifacts and little to no information about its period of use or function. The vast majority of cultural

resources and MALs documented during the survey were associated with historic mineral prospecting activities dating from the late 1870s through the 1930s. Cultural resources that were recorded as MALs primarily consist of isolated prospect excavations such as trenches, small adits, pits, and undeveloped claim markers. Mining sites that were concentrated, extensive, or associated with structural remains were documented on Montana CRIS forms and issued a SHPO trinomial site number. In addition to the mining features, two prehistoric lithic scatters were documented by GCM Services.

Of the 20 properties recorded during the 2012 cultural resource inventory, only the W.A. Clark Municipal Waterline (24SB940), an 1880s water system pipeline, was recommended as eligible for NRHP listing. The cultural resource survey was completed in a manner that satisfies the Secretary of Interior's standards for Archaeology and Historic Preservation (48 FR 44716) and state of Montana Cultural Resource Inventory Guidelines (Rennie 2002). DEQ submitted the GCM inventory report to the SHPO for compliance review on January 2, 2019. The SHPO concurred with DEQ's determination that expansion of the YDTI will have No Adverse Effect on site 24SB940 and that the proposed permit amendment will not impact significant cultural resources (Strait 2019).

3.10.3 Affected Environment

The Butte area has been a nationally recognized center of hard rock mining operations since the mid-1870s when silver mines were developed in the local vicinity. Expanding from a small mining camp in the mid-1860s, Butte grew quickly as a mining center due to the abundance and high quality of the rich silver and copper ore veins in the Boulder Batholith formation. By the 1870s a large influx of miners arrived attracted by work opportunities available at the large underground mines operating on what became known as the "Richest Hill on Earth." As the town expanded, a mixed community of immigrants including Irish, Eastern European, Italian, and Chinese settled the area and gave Butte a reputation as a wide-open and diverse town.

By 1879, local mining magnate William A. Clark erected Butte's first smelter to process ore thereby facilitating a rapid expansion of copper mining. At about the same time, Marcus Daly established the Amalgamated Copper Mining Company ACM. In 1881, the Utah and Northern Railroad arrived in Butte connecting it with major industrial centers thereby allowing improved access to heavy mining machinery to expand underground mining to an industrial scale. By the late 1880s, Butte had a population of 25,000, became the largest city in Montana, and was the largest producer of copper in North America. In 1899, Daly's ACM controlled all mining operations in Butte (Montana Resources 2012a). As a growing and active mining community, and with the consolidation of mining resource ownership by ACM, Butte became a center for labor disputes between the large mining corporation and miners' unions adding to its rich, colorful, and sometimes violent history through the turn of the 20th century.

From the early to mid-20th century, mining in Butte transitioned to open pit mining as it was more economical and less dangerous than underground mining. Mining operations by ACM began at the Berkeley Pit in July of 1955. ACM merged with AR in 1977, and open pit mining at

the Berkeley Pit continued until its closure in 1982. Over that time, it swallowed several historic Butte neighborhoods and it currently is one of the largest open mining pits of its kind, one mile long by half a mile wide and over 1,780 feet deep. The MR property under consideration is located approximately 2.65 miles north of the Berkeley Pit. The gulches and hills surrounding the MR YDTI contain abundant evidence of Butte's past mining history in the form of mineral testing trenches, pits, adits and associated features and structures.

3.10.3.1 Documented Cultural Resources

This section discusses the known cultural resources located within the MR YDTI amended permit boundary. **Table 3.10-1** provides a summary of previously recorded cultural resources identified in the SHPO records search. Ten cultural resources have been recorded in the area. Nine of these sites consist of small mining operations that contain pit and trench features, structural remains and/or historic debris scatters associated with Butte's mining history. Similar mineral exploration sites are ubiquitous throughout the landscape in and around the MR property. According to the GCM Services evaluation and assessment, these sites offer no significant information value, contain few artifacts, and lack historic context. As such, the sites are recommended to be ineligible for listing on the NRHP.

The W.A. Clark water pipeline (24SB940), a historic municipal waterline, was recommended as eligible for NRHP listing for its contribution to community development and as an example of engineering and design technology of the period (Ferguson 2012). This buried linear site was originally built by mining magnate William A. Clark in the 1880s to supplement the municipal water supply of Walkerville and for industrial mining purposes. Water from Moulton Reservoir was piped through 17,200 feet of 16-inch steel pipe and 5,700 feet of wooden pipe wrapped with steel wire to residential Butte. The total length of the pipeline segment that lies within the project area is about 3,200 feet. The pipeline intersects the permit boundary in two places. The first intersection point runs for approximately 720 feet and the second location for a distance of approximately 2,500 feet, both following along the northern boundary of the amended permit area.

The segment of 24SB940 observed in Yankee Doodle Canyon includes 16-inch steel pipe and 12-inch diameter wood pipe. The pipeline contours from the northern property boundary near Yankee Doodle Creek at about 6,530 feet and drops to about 6,490 feet near Moulton Road. Where exposed, the pipe below the canyon maintains its original construction features, a 12-inch diameter pipeline made of wood staves wrapped with a coil of heavy gauge wire. The pipeline grade is about 8 feet wide, was clearly dug by hand, and includes spans of carefully stacked rockwork and possibly some boring through rock outcrops within the Yankee Doodle Canyon.

Table 3.10-1
Summary of Previously Recorded Cultural Resources Identified in the SHPO Cultural Resources Inventory Records Search

Site Number	Description	GCM Services Recommended NRHP Eligibility
24BS931	Little Dixie and Carpathia Lodes	Not Eligible
24BS933	Beehive Lode	Not Eligible
24BS934	Bluebird Lode 1	Not Eligible
24BS935	North Star Lode	Not Eligible
24BS938	Bluebird Lode II	Not Eligible
24BS940	W.A. Clark Water Pipeline	Eligible under Criteria A and C
24BS942	J356 Prospect Cluster	Not Eligible
24SB943	Bumtown	Not Eligible
24SB944	J413 Trenches and Prospects	Not Eligible
24SB945	J508 Dump and Prospects	Not Eligible

In places, subsequent replacement pipe line has crossed the original route and disturbed the integrity of the older pipeline. The pipeline route is overlain by subsequent pipelines conveying water from Moulton Reservoir to a Water Treatment Plant for the city of Butte. Evidence of a second, more or less parallel pipeline was observed in places, and may represent subsequent upgrades to the system or a replacement. The pipeline grade has been impacted and becomes hard to discern as it nears Moulton Road and it may be destroyed in this area. Given the structural changes and replacement of the original steel-wrapped wooden pipeline with steel and PVC pipe construction materials, the historic integrity of the pipeline has been impacted.

3.10.4 Environmental Consequences

For the purpose of assessing environmental consequences, it is typically the case that only “historic properties”, that is, cultural resources determined to be eligible for listing on the NRHP, are evaluated for impacts. Cultural resources that have been determined ineligible for NRHP listing are normally eliminated from the assessment of effect. Impacts to NRHP-eligible historic properties are typically evaluated by applying the criteria of “adverse effect” as outlined in Section 106 of the NHPA. Actions that directly or indirectly impact the historical integrity of historic properties are considered to be an “adverse effect.” Actions that would minimally impact a site’s historic integrity, or would avoid impacts altogether, would be classified as “no adverse effect” or “no effect”, respectively. There is no record of SHPO review and consensus to the determinations of eligibility provided in the GCM Services inventory report (Murdo 2018).

Based on the results of cultural resource investigations and the recommendations provided by GCM Services, nine of the ten cultural resources documented in the proposed MR YTI amended boundary are ineligible for NRHP listing because they lack sufficient historical integrity and the significance necessary to warrant further historic preservation efforts. One site, the W.A. Clark Waterline (24SB940), was recommended eligible for listing on the NRHP by GCM Services

(Ferguson, 2012:6-53). For an analysis of environmental consequences for the Proposed Action, cultural resources located within the MR YDTI permit boundary expansion area will be evaluated based solely upon GCM Services' inventory report recommendations, and these findings will form the basis for the environmental consequences analysis for each of the alternatives.

3.10.4.1 No Action Alternative

Under this alternative, the mine would continue to operate within the existing Operating Permit 00030 and 00030A boundary. There would be no additional impacts or effects to cultural resources.

3.10.4.2 Proposed Action

Based on current available information about the Proposed Action to raise the elevation of west embankment of the YDTI from 6,405 to 6,450 and to extend the northern boundary of the tailings pond from 6,375 to the 6,428-foot elevation contour, the action would have no significant impact to the nine cultural resources determined to be ineligible for NRHP listing. The W.C. Clark pipeline (24SB940), that is mostly buried but exposed in some areas, runs along the northernmost perimeter of the permit boundary. The Proposed Action would have "no effect" on site 24SB940 as it lies outside of the West Embankment construction zone and sits at an elevation of from 50 to 80 feet higher than the YDTI's proposed maximum water level and modification zone. Exposed areas of the pipeline that maintain historic integrity should be avoided as sites for rock disposal, reclamation material stockpiles and roads. Under these conditions, the Proposed Action would result in no significant impacts to cultural resources.

3.10.4.3 Accelerated Drawdown Alternative

The consequences for the Accelerated Drawdown Alternative would be the same as for the Proposed Action. There would be no significant impacts to cultural resources under this alternative.

3.10.4.4 Elimination of West Embankment Drain Pumpback at Closure

The consequences for the Elimination of WED Pumpback at Closure Alternative would be the same as for the Proposed Action. There would be no significant impacts to cultural resources under this alternative.

3.10.4.5 Alternative Capping Methods

The consequences for the Alternative Capping Methods Alternative would be the same as for the Proposed Action. There would be no significant impacts to cultural resources under this alternative.

3.11 SOCIOECONOMICS

This section presents the existing conditions and potential impacts of each alternative to the socioeconomics of the ROI, Silver Bow County, Montana.

3.11.1 Analysis Methods

Most of the information in this section was sourced from the MR Amendment Application Appendix A-5 (WESTECH 2017c) and updated from the original sources as available. WESTECH (2017c) collected data from federal and state sources, including the US Office of Management and Budget, US Census Bureau (USCB), US Bureau of Labor Statistics (USBLS), US Bureau of Economic Analysis (USBEA), Montana Department of Labor & Industry (MDLI), University of Montana’s Bureau of Business and Economic Research, and the Butte-Silver Bow Government. This information was collected for Silver Bow County, which was considered the region of influence (ROI) for socioeconomic resources including population, employment, and income. Because there would be no changes in mine employment as a result of the Proposed Action, housing, schools, and government and community services were not addressed.

3.11.2 Affected Environment

3.11.2.1 Population

The Butte area has been a nationally recognized center of hard rock mining operations since the mid-1870s when silver mines were developed in the local vicinity. In the second half of the 19th century, there was a huge influx of Euro-Americans, attracted by gold, silver, and copper. Silver Bow County population peaked around 1920, but Butte remained the largest city in Montana until World War II. Butte is now Montana’s fifth-largest city, and Silver Bow County is the eighth largest county in terms of population (USCB 2015 as cited in WESTECH 2017c).

The estimated population in Silver Bow County in 2017 was 34,602 a 1.1 percent increase since 2010 (US Census Bureau 2018). This compares to a population increase in the State of Montana of 6.2 percent and a national population increase over the same time period of 5.5 percent (US Census Bureau 2018). Essentially, the population of Silver Bow County has remained stable since about 1990. The City of Butte accounts for 98 percent of the population of the county (WESTECH 2017c).

The Silver Bow County population in 2017 was nearly 94 percent white, somewhat less diverse than the State of Montana and substantially less diverse than the United States as a whole (**Table 3.11-1**). The percentage of persons of Hispanic or Latino origin was slightly higher than in the State of Montana, but considerably lower than in the United States overall.

**Table 3.11-1
Ethnicity and Income Characteristics for Silver Bow County, Montana, and the United States
in 2017**

Ethnicity	Silver Bow County	Montana	United States
White alone, percent	93.8%	89.1%	76.6%
Black or African American alone, percent	0.7%	0.6%	13.4%
American Indian and Alaska Native alone, percent	2.3%	6.7%	1.3%

Table 3.11-1
Ethnicity and Income Characteristics for Silver Bow County, Montana, and the United States
in 2017

Ethnicity	Silver Bow County	Montana	United States
Asian alone, percent	0.8%	0.8%	5.8%
Native Hawaiian and Other Pacific Islander alone, percent	0.1%	0.1%	0.2%
Two or More Races, percent	2.3%	2.8%	2.7%
Hispanic or Latino, percent	4.4%	3.8%	18.1%
White alone, not Hispanic or Latino, percent	90.4%	86.2%	60.7%
Income	Silver Bow County	Montana	United States
Median household income in 2016 dollars	\$39,580	\$48,380	\$55,322
Per capita income in past 12 months (2012-2016) in 2016 dollars.	\$25,583	\$27,309	\$29,829
Percent of persons in poverty	15.5%	12.5%	12.3%

Source: (US Census Bureau 2018)

Household income measures the income of all persons living in a household, whether related or not. The ROI's median household income in 2017 was 72 percent of the United States median and 82 percent of the overall Montana value (US Census Bureau 2018). Per capita income (PCI) is the total personal income of an area divided by that area's population. The ROI's per capita income of \$25,583 represented 86 percent of the United States PCI and 94 percent of Montana's PCI (US Census Bureau 2018). With 15.5 percent of its population below the poverty level, Silver Bow County has higher rates of poverty than Montana (12.5 percent) and the United States (12.3 percent) (US Census Bureau 2018).

3.11.2.2 Employment

Employment (the number of jobs) within the ROI has remained fairly steady from 2014 to 2017, with 15,751 jobs in 2017 representing less than a one percent increase over 2014 statistics (USBLS 2018).

The USBEA and MDLI reports employment by industrial sector; these data allow an understanding of an area's economic diversity and its ability to withstand downturns in any one sector. **Table 3.11-2** illustrates the employment and average pay by industry in Silver Bow County (WESTECH 2017c). The sector of natural resources and mining is the highest paid in the county.

Table 3.11-2
Silver Bow County Employment and Average Pay by Industry Sector, 2013

Industry	Employment	Average Annual Pay
Trade, transportation and utilities	3,506	\$40,045
Education and health services	3,470	\$35,312
Leisure and hospitality	2,274	\$13,525
Professional and business services	1,260	\$49,000
Manufacturing	672	\$53,357
Other services	495	n/a
Construction	495	\$40,364
Financial activities	465	\$40,045
Natural resources and mining	460	\$84,878
Information	241	\$40,000

Source: (WESTECH 2017c)

The top private employers in Silver Bow County by size class are shown on **Table 3.11-3**. Montana Resources is in the second largest size class (MDLI 2018), currently employing 364 people (McGivern 2018).

Table 3.11-3
Top 20 Private Employers in Silver Bow County, 2017

Business Name	Type of Service	No. Employees
Northwestern Energy	Utilities	500-999
Acadia Montana	Health Services	250-499
Advanced Silicon Materials	Manufacturing	250-499
St. James Healthcare	Health Services	250-499
Montana Resources	Mining	250-499
Town Pump	Retail/Fuel Services	250-499
Wal-Mart	Retail	250-499
Aware Inc.	Human Services	100-249
BSW Rehabilitation Facility	Retail/Human Services	100-249
Community Counseling & Correctional Service	Adult Social Services	100-249
Community Health Center	Health Services	100-249
Easter Seals – Goodwill	Human Services	100-249
Fairmont Hot Springs Resort	Hospitality	100-249
Lady of the Rockies Rehab and Living Center	Health Services	100-249
Montana Independent Living Project	Social Services	100-249

**Table 3.11-3
Top 20 Private Employers in Silver Bow County, 2017**

Business Name	Type of Service	No. Employees
Montana Precision Products	Manufacturing	100-249
Safeway	Retail	100-249
Butte Adult Mental Health Center	Mental Health Services	50-99
Human Resources Council Dist XII (Headstart)	Human Resources	50-99
McDonalds	Hospitality	50-99

3.11.2.3 Tax Revenue and Community Contributions

MR’s tax contribution to the State of Montana and Silver Bow County is shown in **Table 3.11-4**. Because MR is one of the Washington Companies, profits made by Montana Resources contribute to the Dennis and Phyllis Washington Foundation, a major philanthropic organization. Since April 2017, the Foundation contributed over \$4 million to the community (McGivern 2018).

**Table 3.11-4
Montana Resources Economic Contributions to Silver Bow County**

	Tax Year/Fiscal Year				
	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019
Total Assessed Taxable Value	\$11,000,459	\$11,633,863	\$10,281,484	\$10,945,904	\$12,657,902
% of Total Assessed Value	17.63%	17.46%	15.73%	23.78%	26.78%
Rank by Principal Property Tax Payers	1	2	2	2	2
Property tax revenue, gross proceeds tax, fees, and assessments ^a	\$8,892,603	\$8,705,417	\$6,653,813	\$7,354,067	\$8,927,579
Metal Mines license tax paid to Hard Rock Trust Account held by Butte-Silver Bow ^b	\$538,547	\$388,052	\$391,167	\$625,200	\$306,187
Metal Mines license tax paid to Butte-Silver Bow	\$261,017	\$162,451	\$207,936	\$314,075	\$170,104
Metal Mines license tax paid to School District #1	\$522,034	\$324,902	\$415,872	\$628,150	\$340,208
Total Metal Mines License Tax allocated to Butte-Silver Bow and School District #1	\$1,321,598	\$875,405	\$1,014,975	\$1,567,424	\$816,499
Additional Contributions Contributions to Woodstove Change Out Program	\$27,926	—	—	—	\$110,074

Source: (Gleason 2018)

Notes:

^a Includes the total property taxes paid to Butte-Silver Bow, School District #1, State Mills, and other Entities and Districts. It also includes the Special Improvement District fees for Lighting, Street Maintenance, and Fire Hydrants and the services fees for Landfill, Metro Sewer and Stormwater.

^b The Metal Mines license tax for fiscal year 2019 includes payments as of November 13, 2018.

3.11.3 Environmental Consequences

3.11.3.1 No Action Alternative

The No Action Alternative assumes that MR would continue all activities approved under its current permit; therefore, the No Action Alternative is a “status quo” approach. Impacts to overall socioeconomic conditions in the area would be minimal and short term under the No Action Alternative. If all of the 364 jobs at MR ended at mine closure, that would represent a 2 percent reduction in the context of the county employment of 15,750 jobs. However, MR currently supports approximately 364 of the 460 natural resources and mining jobs in Silver Bow County (**Table 3.11-2**). Under the No Action Alternative, mine is projected to cease mining operations in 2022. Although MR has not projected changes to employment during reclamation and after reclamation is complete, it is likely that some mine-related jobs would be eliminated or revised.

3.11.3.2 Proposed Action

The Proposed Action would allow the mine to operate for another nine years beyond 2022. Therefore, the jobs provided by MR would be available for this time period. No new jobs would be created by the Proposed Action, and the Proposed Action would not affect housing vacancies or school or infrastructure capacity. The state and county would benefit from tax revenue derived from MR beyond 2022. It can be assumed (although not known for certain) that the philanthropic giving to the ROI by the Dennis and Phyllis Washington Foundation would continue. Essentially, the status-quo would be maintained under the Proposed Action for an additional nine years. Although MR has not projected changes to employment during reclamation and after reclamation is complete, it is likely that some mine-related jobs would be eliminated or revised.

3.11.3.3 Accelerated Drawdown Alternative

The socioeconomic impacts from the Accelerated Drawdown Alternative would be similar to those under the Proposed Action during operations. Because reclamation would be completed more quickly under the Accelerated Drawdown Alternative, jobs created or positions converted as result of reclamation would end sooner than under the Proposed Action.

3.11.3.4 Elimination of West Embankment Drain Pumpback at Closure

The socioeconomic impacts from the Elimination of WED Pumpback at Closure Alternative would be similar to those under the Proposed Action during operations. Reclamation under the Elimination of WED Alternative would be completed in a time frame between the Proposed Action and the Accelerated Drawdown alternatives. Therefore, jobs created as result of reclamation would end sooner than under the Proposed Action but would be in place longer than under the Accelerated Drawdown Alternative.

3.11.3.5 Alternative Capping Methods

The socioeconomic impacts from the Alternative Capping Methods Alternative would be similar to those under the Proposed Action during operations. Reclamation may be completed more

quickly than under the Proposed Action. If so, jobs created as result of reclamation would end sooner than under the Proposed Action.

3.12 LAND USE

The following sections present a brief discussion of land uses of the Continental Mine permit area. The amendment application provides additional land use information including history of use in the permit area.

3.12.1 Analysis Methods

The MR operating permit, and various on-line databases were reviewed to evaluate land use at and near the Continental Mine. **Figure 3.12-1** presents a map of land ownership.

3.12.2 Affected Environment

Land use involves the management and modification of natural environments into built or manipulated environments such as settlements, arable fields, pastures, and managed woods.

3.12.2.1 Land Ownership and Use

The lands that would be added to the permit area are currently undeveloped and their use is best characterized as wildlife habitat adjacent to industrial and residential use. The areas to the west of the Moulton Reservoir Road which provides public access to lands closest to the permit area is a mix of private acreages with dispersed homes and some US Forest Service lands. The general character of the lands adjacent to the southern mine permit boundary is urban, while the remaining three sides are primarily rural. There are no agricultural lands adjacent to the mine permit area.

MR owns approximately 8,070 acres of land in and around the current mine permit boundary. Approximately 5,800 acres of MR lands fall within the current mine permit boundary and the proposed expansion (**Figure 3.12-1**). Lands within Permit 00030 are either actively mined or part of the industrial facilities that the mine operates. Lands within Permit 00030A are also predominantly actively used for mining and associated work, but some of the lands fall along the shore of the YDTI are largely undeveloped.

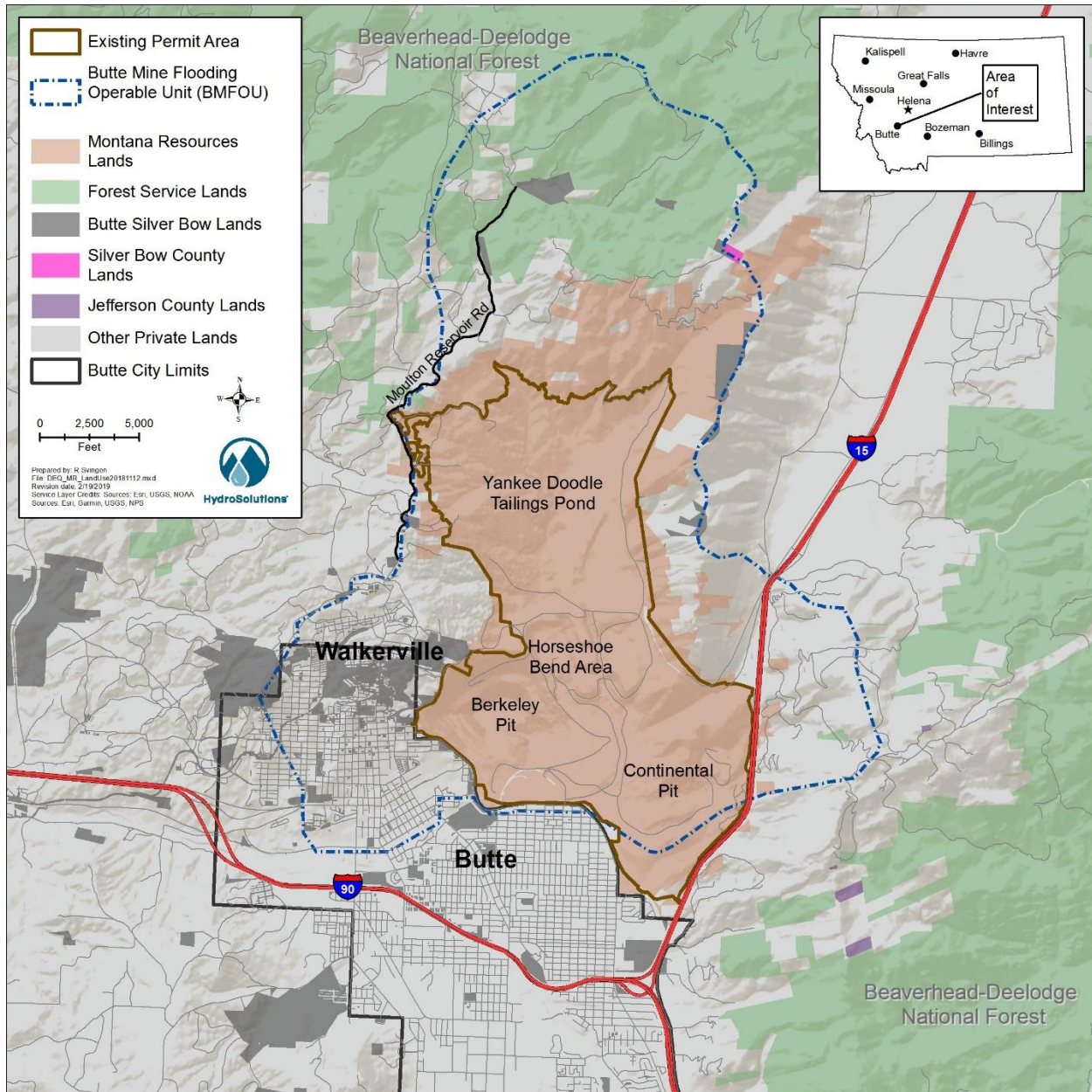


Figure 3.12-1 Map showing land ownership for the area near the Continental Mine and the Butte Mine Flooding Operable Unit, Silver Bow County, Montana.

3.12.3 Environmental Consequences

Post-closure land uses would include watershed protection and wildlife habitat. In addition to these land uses, the post-closure YDTI will be within the BMFOU boundary and subject to any land management conditions of that program. The vegetation composition planned for reclamation would change the character of the wildlife habitat from the mix of deciduous forest and grassland what was present historically (pre-YDTI) and currently along the northern edge of the YDTI. However, it would also vegetate the lands exposed as the YDTI recedes and the large,

currently open water area shrinks to the equilibrium pond. Vegetating the area would secure soils in place, reduce erosion potential, and decrease airborne dust, which would protect the watershed. This EIS is focused on the lands subject to the proposed amendment and discussion of the larger areas to be reclaimed after closure is limited to the cumulative effects analysis in Chapter 4.

3.12.3.1 No Action Alternative

The No Action Alternative assumes that MR would continue all activities approved under its current permit; therefore, the No Action Alternative is a “status quo” approach. Impacts to land use and ownership in the area would be negligible under the No Action Alternative.

3.12.3.2 Proposed Action

Under the Proposed Action, the total permit area would be increased by 237 acres. However, only 99 of those acres would be disturbed. Therefore, changes in land use would be limited to these 99 acres. MR owns all lands within the current permit boundary and the lands to be added to it under the proposed amendment. The area proposed for addition is adjacent to active mine operations in the YDTI. The lands that would be inundated by the increased YDTI capacity are currently undeveloped. The predominant use of this land is as wildlife habitat. The primary impact of the Proposed Action would be the conversion of the 99 acres from wildlife habitat to use in the mine activities until after closure and final reclamation.

Although there are also some proposed changes to land use for Permit 00030, that permit area is currently industrial. The proposed amendment may change the specific use of a site, but it would not change the general classification or potential use. Land use within permit 00030 would remain industrial. Some of these areas would continue to be used for post-closure administration and BMFOU related management for the foreseeable future (Montana Resources 2018b).

3.12.3.3 Accelerated Drawdown Alternative

No aspect of the Accelerated Drawdown at Closure Alternative would affect the amount or extent of disturbance to lands or the design or attributes of the proposed land uses. The impacts to land use under this alternative would be identical to the Proposed Action, except for the potential reduction in time for reclamation. The reestablishment of vegetation is integral to the post-closure land uses identified, namely wildlife habitat and watershed protection. This alternative may allow these land uses to be achieved as much as two to three decades sooner, which may be substantial in terms of vegetation succession, overall land appearance, and wildlife use.

3.12.3.4 Elimination of West Embankment Drain Pumpback at Closure

No aspect of the Elimination of WED Pumpback at Closure Alternative would affect the amount or extent of disturbance to lands or the design or attributes of the proposed land uses. The impacts to land use under this alternative would be identical to the Proposed Action, except for

the potential reduction in time for reclamation of approximately 7 years. If this alternative expedites reclamation, then lands would be useable as wildlife habitat sooner.

3.12.3.5 Alternative Capping Methods

No aspect of the Alternative Capping Methods Alternative would affect the amount or extent of disturbance to lands or the design or attributes of the proposed land uses. The impacts to land use under this alternative would be identical to the Proposed Action, except for the potential two- year reduction in time for reclamation. If this alternative expedites reclamation, then lands would be useable as wildlife habitat sooner.

3.13 VISUAL RESOURCES

Visual resources are the visible physical features on a landscape such as geologic features, water, structures, vegetation, or other natural or cultural features. These components contribute to the overall scenic and aesthetic quality of a landscape.

3.13.1 Analysis Methods

In 2018, WESTECH Environmental Services prepared a visual resource assessment for the MR Application to Amend Operating Permits 00030 and 00030A (WESTECH 2016b). The study defined the existing landscape character, scenic integrity, landscape visibility, and modeled anticipated visual changes that would result from the Proposed Action. Those findings are summarized below and form the basis of the visual resource analysis.

The objective of the visual resources approach is to identify and describe important visual resources that may be affected by proposed activities. Visual resources include landscapes that are visible to the public during activities such as travel, daily activities, or recreation.

Other sources of information reviewed:

- USGS Topographic Maps
- Google Earth Imagery
- Field visit

3.13.2 Affected Environment

The area of impact for the Proposed Action lies within the Middle Rockies Ecoregion, an ecoregion characterized by steep, high elevation mountains and intermontane valleys that covers much of central North America. More specifically, the area of impact is located on the southern part of the Boulder Mountains and just west of the Continental Divide in Silver Bow County, Montana. The typical vegetative landcover in this region is coniferous forest with a mosaic of riparian species. However, the area of impact has minimal coniferous forest cover due to significant impacts of historic and ongoing mining activities. Currently, sparse quaking aspen, conifers and bare mineral soils dominate the area, resulting in a distinct landscape character dominated by mining impacts.

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Scenic integrity of a landscape indicates whether a visual landscape is perceived by an average viewer as whole or intact. A high degree of integrity is typified by an ecologically intact and largely undisturbed natural landscape, while a low degree of integrity is associated with unnatural cultural alterations of the landscape. The scenic integrity of the area of impact is considered low due to significant effects from historical and current mining activity and the presence of multiple public and private roads and fences (WESTECH 2018b). The current visual setting for the area is illustrated in **Figure 3.13-1**.



Figure 3.13-1. Current visual setting of the West Embankment of YDTI from Moulton Reservoir Road.

3.13.3 Environmental Consequences

3.13.3.1 *No Action Alternative*

Under the No Action Alternative, the YDTI would not be expanded and the West Embankment elevation would remain unchanged. Similarly, the Great Northern RDS would not be expanded and the Northern RDS would not be constructed. The No Action Alternative would result in unchanged and unaffected visual resources and landscape.

3.13.3.2 *Proposed Action*

The primary components of the Proposed Action that may affect visual resources are discussed below.

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The raising of the West Embankment from 6,405 to 6,450 feet elevation is one component of the Proposed Action that would impact visual resources. However, in terms of landscape visibility, the YDTI and particularly its West Embankment occupy a topographic depression surrounded by rolling hills on all sides. This topographic configuration limits the visibility of the area of impacts to the public. The Moulton Reservoir Road offers the only public access that has views of the area of impact. The WESTECH (2018b) visual resource analysis focused on the Moulton Reservoir Road and established four viewpoints along its length to assess the visibility of the area of impact. All four viewpoints established offered only partial and short duration views of the West Embankment (WESTECH 2018b) The distance zones associated with the viewpoints fall largely within the foreground (within ½ mile from viewer) and middle foreground (up to 4 miles from viewer) classification. Three other viewpoints were established outside of Moulton Reservoir Road to assess the visual impacts to the landscape from prominent public viewing areas. These were the Granite Mountain Memorial, the Interstate 15 Scenic Overlook and the Top of the World trailhead. The West Embankment was not visible from any of these three viewpoints (**Figure 3.13-2**) (WESTECH 2018b).



Figure 3.13-2 Change to the visual setting from raising of West Embankment, viewed from Moulton Reservoir Road.

A second component of the Proposed Action would involve the creation of soil stockpiles for the planned reclamation and revegetation of the YDTI. Since 2015, these have been placed along the Moulton Reservoir Road and they serve to minimize foreground views of the West Embankment to the public. These stockpiles would be contoured and revegetated as part of the

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Proposed Action, which would mitigate visual impacts in terms of line, form, texture and color to make their appearance more closely aligned to the natural character of the surrounding landscape.

A final component of the Proposed Action would be the construction of the Northern RDS and expansion of the existing Great Northern RDS. The North RDS would be developed on the northeast facing downhill slope of the North-South Embankment of the YDTI and would overlay existing leach dumps. The existing Great Northern RDS would be expanded to accommodate additional waste rock not used in the Northern RDS or construction of the West Embankment. Both RDS features would be visible from points south of the YDTI unlike the West Embankment. Prominent public viewing areas include but are not limited to the Granite Mountain Memorial, Top of the World Trailhead and Continental Drive to the south.

The foreground and middle foreground views from these areas are dominated by large scale mining related features that provide pronounced visual contrast compared to the background views of Rampart Mountain and the Boulder Range (**Figures 3.13-3 and 3.13-4**). As such, the expansion of the Great Northern RDS and construction of the Northern RDS represent only an incremental increase to the existing visual impacts from mining activity. The planned reclamation and revegetation of the Embankments and RDS features following mine closure would mitigate the minor visual impacts caused by their expansion.

The visual impacts that would result from the Proposed Action would not be significant or lasting. Instead, the impacts represent incremental increases to existing visual impacts from the current YDTI and Great Northern RDS. The Northern RDS would similarly represent only an incremental increase to the visual impacts already in place from the North-South Embankment, as it will be constructed on its downward slope. These minor visual impacts are occurring in an area with low scenic integrity resulting from current and historic mining activity, so they would provide little additional visual contrast to a landscape that is already dominated by mining impacts. Finally, the planned reclamation and revegetation of the surface of these features following mine closure would mitigate the visual impacts caused by their expansion. The mitigation would alter the appearance of these features in terms of line, form, texture and color to more closely match the natural character of the surrounding landscape. Therefore, the Proposed Action would only cause minor and temporary impacts to visual resources in the landscape.

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Figure 3.13-3 Views of Great Northern RDS from Continental Drive via Google Street View.



Figure 3.13-4 Views of North-South Embankment and Great Northern RDS from Granite Mountain Memorial via Google Street View.

3.13.3.3 Accelerated Drawdown Alternative

The Accelerated Drawdown Alternative only deviates from the Proposed Action in the timing of closure and reclamation. As such, the impacts to visual resources would be the same as discussed in the Proposed Action.

3.13.3.4 Elimination of West Embankment Drain Pumpback at Closure

The Elimination of West Embankment Drain Pumpback at Closure only deviates from the Proposed Action in the timing of closure and reclamation. As such, the impacts to visual resources would be the same as discussed in the Proposed Action.

3.13.3.5 Alternative Capping Methods

The Alternative Capping Methods Alternative only deviates from the Proposed Action in the timing of closure and reclamation. As such, the impacts to visual resources would be the same as discussed in the Proposed Action.

3.14 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 are dependent on several variables, including distance and ground cover between the source and receiver and atmospheric conditions. Perception of noise is affected by intensity, frequency, pitch, and duration.

3.14.1 Analysis Methods

Noise levels are quantified using units of decibels (dB). Humans typically have reduced hearing sensitivity at low frequencies compared with their response at high frequencies. The “A-weighting” of noise levels, or A-weighted decibels (dBA), closely correlates to the frequency response of normal human hearing (250 to 4,000 hertz [Hz]). Noise levels typically decrease by approximately 6 dBA every time the distance between the source and receptor is doubled, depending on the characteristics of the source and the conditions over the path that the noise travels. The reduction in noise levels can be increased if a solid barrier or natural topography blocks the line of sight between the source and receptor.

For environmental noise studies, noise levels are typically described using A-weighted equivalent noise levels, L_{eq} , during a certain time period. The L_{eq} metric is useful because it uses a single number, similar to an average, to describe the constantly fluctuating instantaneous noise levels at a receptor location.

The 90th percentile-exceeded noise level, L_{90} , is typically considered the ambient noise level. The L_{90} is a single number that represents the noise level exceeded during 90 percent of a measurement period. Therefore, it is also an indication of the residual noise level and among the lowest noise levels during a measurement period. It typically does not include the influence of discrete noises of short duration, such as dog barks, backup alarms, vehicle pass-bys, a single blast, etc. If a continuous noise is audible at a measurement location, such as an engine,

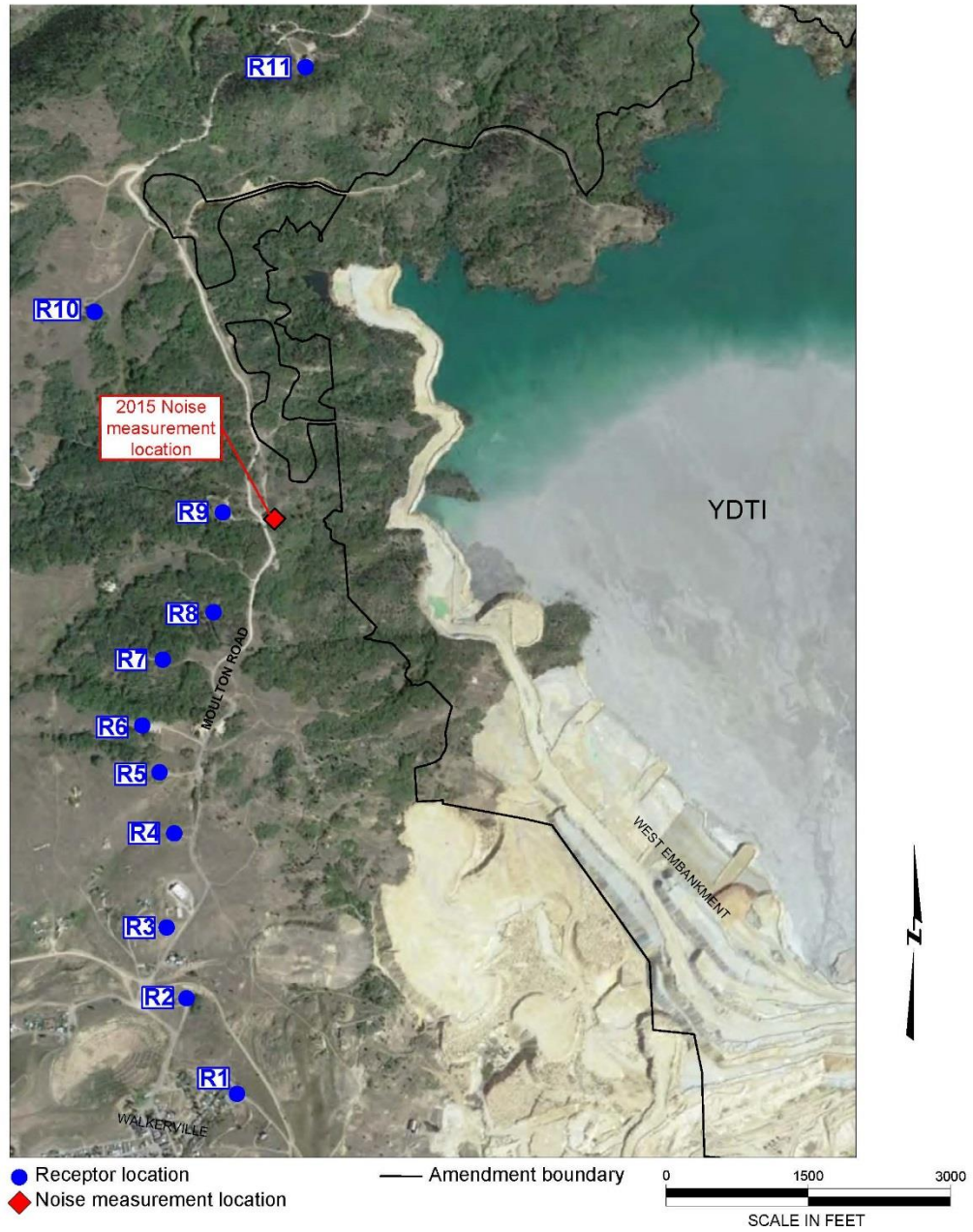
typically it is that noise that determines the L_{90} of a measurement period even though other noise sources may be briefly audible and occasionally louder than the equipment. The L_{max} metric denotes the maximum instantaneous sound level recorded during a measurement period.

The day-night average noise level, L_{dn} , is a single number descriptor that represents the constantly varying sound level during a continuous 24-hour period. The L_{dn} can be determined using 24 consecutive one-hour L_{eq} noise levels or estimated using measured L_{eq} noise levels during shorter time periods. The L_{dn} includes a 10-decibel penalty that is added to noises that occur during the nighttime hours between 10:00 p.m. and 7:00 a.m., to account for people's higher sensitivity to noise at night when the background noise level is typically low.

3.14.2 Affected Environment

Existing man-made noise sources near the residential structures within the West Ridge area, the residential structures nearest to the proposed Amendment area, include intermittent traffic on Moulton Road, large diesel-powered equipment working the existing YDTI operations, residential activities, dogs, and aircraft flyovers. Natural sound sources include wind, wildlife, birds, insects, and precipitation. As shown on **Figure 3.14-1**, there are 12 rural single-family residences located adjacent to Moulton Road, at areas southwest, west, and north of the West Embankment. Moulton Road is generally located on top of a ridge, with the West Embankment east and topographically downgradient (20 to 80 feet lower) than the residences.

In December 2015, a baseline noise study was completed to measure noise levels at one location east of Moulton Road (**Figure 3.14-1**). The location was selected to be close to the residence nearest to the West Embankment of the YDTI (R9) and within direct line of sight of the impoundment.



Source: Big Sky Acoustics, 2018

Figure 3.14-1. 2015 Noise Measurement Location and Residences Along Moulton Road.

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Over the 96-hour study period, the 1-hour L_{eq} ranged from 21 to 47 dBA, the one-hour L_{90} ranged from 18 to 39 dBA, and the calculated L_{dn} was 44 dBA. The measured L_{eq} , L_{90} and L_{dn} noise levels were found to be typical for lightly-populated rural areas (Harris 1998). Additional details of the noise study are included in the report completed by Big Sky Acoustics (2018).

In July 2017, noise level measurements were conducted for the Applicant's loaded and unloaded haul trucks as they passed by on a dirt haul road and also when dumping a load. The noise level study was conducted in accordance with methods described in the study completed by Big Sky Acoustics (2018). The measured noise levels were L_{max} 84 dBA at 50 feet for the haul truck pass-by and L_{eq} 72 dBA at 130 feet for the load dumping operation. The 2-minute load dumping operation included the haul truck backing up, raising the bed, slowly pulling forward to spread material as it falls out of the bed, lowering the bed, and pulling away from the dump area.

Current noise levels were predicted for each of the 12 residences (**Figure 3.14-1**) using the Cadna-A Version 2017 noise prediction software from DataKustik. The model used noise level measurements from the July 2017 noise study and the following assumptions:

Existing Ambient Noise Levels:

Day/Night Average: L_{dn}	44 dBA
Nighttime L_{eq}	26 dBA

Haul Trucks: Transport soil to the West Embankment and soil stockpiles

Average speed	25 mph
Pass-by frequency	every 3 minutes
Operating Hours	24 hours/day, 365 days/year

The results of the model are presented in **Table 3.14-1** and show that the predicted noise levels are near the L_{dn} and L_{eq} background noise levels of 44 dBA and 26 dBA, respectively.

Table 3.14-1
Current Noise Predictions at 12 Residential Receptors near the Continental Mine

Residential Receptor^a	Predicted 2018 L_{dn} (dBA)	Predicted 2018 L_{eq} (dBA)
R1	39	32
R2	41	34
R3	42	35
R4	43	36
R5	44	37
R6	44	37
R7	45	38
R8	45	38
R9	44	37
R10	45	38
R11	35	28
R12	45	38

^a Residential receptors as labeled on Figure 3.14-1

3.14.3 Environmental Consequences

3.14.3.1 No Action Alternative

Under the No Action Alternative, noise levels similar to those measured in July 2017 and estimated in the noise model (**Table 3.14-1**) would continue while noise impacts would not occur on the additional acreage that would be disturbed under the Proposed Action or other action alternatives. Currently approved operations and associated noise impacts would continue under Operating Permits 00030 and 00030A.

3.14.3.2 Proposed Action

To evaluate noise impacts, a significance criterion was developed based on existing federal, state, and county noise regulations, ordinances and guidelines. **Table 3.14-2** lists the identified applicable noise guidelines.

The Federal Transit Administration (FTA) has developed guidelines for assessing short-term (1-hour) and long-term (8-hours) construction activities. Assessment of construction noise includes evaluating the existing ambient noise environment, the absolute noise levels due to

construction activities, the duration of construction, and the noise-sensitivity of the adjacent land use. **Table 3.14-3** summarizes the FTA construction noise guidelines at adjacent land uses.

**Table 3.14-2
Project Noise Regulations and Guidance**

Regulatory Authority	Regulations and Guidelines	Citation
Environmental Protection Agency	Outdoor day-night average noise level (L_{dn}) less than or equal to 55 dBA are sufficient to protect public health and welfare in residential areas and other places where quiet is a basis for use.	Noise Control Act of 1972, 42 U.S.C § 4901 et seq.
State of Montana and Butte-Silver Bow County	Every motor vehicle shall at all times be equipped with a muffler in good working order and in constant operation to prevent excessive or unusual noise.	61-9-403, MCA Code of Ordinances 10.64.100
State of Montana	A person may not operate a motor vehicle with an exhaust system that emits a noise in excess of 95 dB, as measured by the Society of Automotive Engineers' standard j1169 (May 1998).	69-9-435, MCA

Sources: B-SBC 2018, USEPA1978, MCA 2017

**Table 3.14-3
FTA Construction Noise Guidelines**

Adjacent Land Use	Short Duration Noise Guidelines (1-hour)		Moderate Duration Noise Guidelines (8-hours)	
	Daytime L_{eq}	Nighttime L_{eq}	Daytime L_{eq}	Nighttime L_{eq}
Residential	90 dBA	80 dBA	80 dBA	70 dBA
Commercial	100 dBA	100 dBA	85 dBA	85 dBA
Industrial	100 dBA	100 dBA	90 dBA	90 dBA

Noise impacts were assessed by comparing background noise levels with projected noise levels. The noise level predictions for the Proposed Action were calculated using the noise model described above in Section 3.14.2. Assumptions used for the model were as follows:

Equipment and Noise Level (L_{max} at 50 feet in dBA):

Caterpillar 793 Haul Truck 240-ton	84 dBA
Crawler Dozer	85 dBA
Motor Grader	85 dBA
Water Truck	88 dBA

Westbank Embankment/Stockpile Construction

Haul truck load dumping operation	2 minutes
Haul truck dumping noise level	L_{eq} 72 dBA at 130 feet
1-2 crawler dozers, motor graders, and/or road water trucks also operating simultaneously, as needed	
Westbank Embankment construction	50-foot lifts
Stockpile construction	concurrent, as warranted
Operating Hours	24 hours/day, 365 days/year

The model determined that under the Proposed Action the L_{dn} noise levels at the residences would increase 0 to 6 dBA and the L_{eq} would increase 0 to 8 dBA. The highest increase in noise would be at residence (R9), located closest to the West Embankment, and residence (R10), located closest to the soil stockpile. The model confirmed that none of the modeled noise levels at the residences would exceed the USEPA L_{dn} 55 dBA guideline or the FTA L_{eq} 90 dBA nighttime guideline. Noise predictions are presented in **Table 3.14-4**.

**Table 3.14-4
Amendment Design Year Noise Predictions at 12 Residential Receptors near the Continental Mine.**

Residential Receptor	Predicted 2022 L_{dn} (dBA)	Predicted 2022 L_{eq} (dBA)
R1	46	33
R2	46	36
R3	47	37
R4	48	38
R5	48	39
R6	49	39
R7	50	41
R8	50	42
R9	52	44
R10	54	46
R11	45	33
R12	48	39

Based on the results of the model potential noise impacts are expected to be minimal since the predicted noise levels would be below the USEPA and FTA guidelines. **Table 3.14-4** shows that at residence R10, the noise levels would be close to the L_{dn} guideline. Since this residence is near the soil stockpile it is likely that noise impacts should be short-term. These stockpiles would be comprised of salvaged soil that would comply with the mitigation measures described in the Reclamation Plan.

Following construction of the West Embankment to the 6,450-foot elevation, noise levels may increase due to the decrease in topographic relief (i.e., the West Embankment would be close

to the same elevation as Moulton Road). The increase in noise levels would persist through the life of the YDTI.

3.14.3.3 Accelerated Drawdown at Closure

The impacts on noise from accelerated drawdown at closure would not be appreciably different than those from the Proposed Action and would not exceed USEPA or FTA guidelines.

3.14.3.4 Elimination of West Embankment Drain Pumpback at Closure

The impacts on noise from Elimination of West Embankment Drain Pumpback at Closure would not be appreciably different than those from the Proposed Action and would not exceed USEPA or FTA guidelines.

3.14.3.5 Alternative Capping Methods

The impacts on noise from Alternative Capping Methods would not be appreciably different than those from the Proposed Action and would not exceed USEPA or FTA guidelines.

3.15 AIR QUALITY

The Proposed Action would occur under a Montana Air Quality Permit (MAQP) #1749-12 issued by DEQ's Air Resources Management Bureau on January 8, 2004 (DEQ 2004). Sources of potential air quality impacts exist at the mine site where a majority of the activities occur.

3.15.1 Analysis Methods

Analysis methods for understanding the existing air quality within the mine permit as well as regional air quality environments at the Continental Mine included review of the proposed operating permit amendment and supporting documentation provided by MR. Specifically, the primary resources reviewed and relied upon for this section include:

- Proposed Amendment to Operating Permits 00030 and 00030A to Continue Operations at the Continental Mine, Revised May 2018 (Montana Resources 2018b)
- Montana Resources Continental Mine Operation Plan, Revised February 2018 (Montana Resources 2018a)
- Air Quality Permit #1749-12, January 8, 2004 (DEQ 2004)
- Montana Resource's 2017 Emission Inventory Detail, Airs Number 093-0009 (DEQ Air Resources Management Bureau 2017)
- Butte Montana PM 2.5 Source Apportionment Research Studies, 2013 and 2014 (Ward 2013, Ward 2014)
- An Assessment of Ambient Particulates in Butte, Montana, 2014 (Ganesan 2014)

The air quality of a region is primarily controlled by the type, magnitude and distribution of pollutants and may be affected by regional climate. Transport of pollutants from their source areas are affected by topography and meteorology.

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The primary indicator for air quality management of dust includes particulate matter less than 10 microns in size (PM₁₀) and particulate matter less than 2.5 microns in size (PM_{2.5}) from fugitive road dust and construction activities. The most common sources for particulate matter are fly ash, carbon black soot, smoke, and fugitive dust from unpaved roads and construction sites (DEQ 2018).

The amount of particulate dust associated with vehicle travel and construction activities varies. For vehicle travel, particulate dust generation varies with 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 particulate matter, vehicle speed, local weather as it relates to precipitation and evaporation, and duration of the operation. Both source control and work practices can limit dust emissions from disturbed soils and unpaved roads. Dust abatement operations such as fugitive dust control on material transfer, and stabilization of stockpiles or disturbed soils, dust suppression agents for road surfaces and disturbed areas including tailings, and controlling speed of vehicle/equipment travel, can greatly decrease the generation of particulate matter.

Ultimately, dust particles could contribute to water quality in conjunction with storm water erosion through depositional loading of sediment over the long-term.

The amounts of carbon dioxide (CO₂), nitrogen dioxide (NO₂), and methane (CH₄) emitted from ore haul trucks and mine related traffic emissions are regulated. The USEPA regulates emission for on-road and non-road vehicles and engines by regulating fuel and sets emission standards on the amount of pollution a vehicle or engine can emit. This ensures that the vehicles meet federal and corporate average fuel economy standards (USEPA 2017); therefore, on-road and non-road vehicle related engine emissions are expected to meet regulations and were not addressed further in this evaluation.

3.15.1.1 Spatial Boundary

Air quality for the project area was described as part of the MAQP #1749-12 and MR's proposed operating permit amendment application which incorporates regional climate and areas of concern, emission sources, types (fugitive or point source), quantities, and a projected ambient air quality analysis. According to the permit, Butte is a secondary nonattainment area for total suspended particles (TSP) and a Group 1 nonattainment area for PM₁₀. (Nonattainment refers to areas that have not met National Air Quality Standards). Ongoing monitoring is performed at the Greeley School for TSP. Based on this, the spatial boundary is considered to be the regional air quality within and near the nonattainment area.

3.15.1.2 Temporal Boundary

The temporal boundary for the Proposed Action includes the construction of the dam raise, followed by reclamation of the constructed and material borrow areas. The temporal boundary extends through the completion of closure activities. Final closure activities include the reclamation of the Transition Zone and Northern Pond Perimeter. They are expected to continue incrementally for an estimated 40 years following the end of mining.

3.15.1.3 Methods

Emission factors are used to estimate emissions from sources based on measurable parameters for each activity. Control efficiencies for emissions are either included in the factor or are presented as a control efficiency. USEPA provides sources for these factors as well as procedures to develop site specific emission factors. Specific sources of emission factors and control efficiencies related to the activities at MR are detailed below.

USEPA's AP-42 document is a compilation of emission factor information for quantification of emissions from fugitive particulate matter. Chapter 11, Mineral Products Industry, includes a compilation of emission factors related to mining activities. The details were used to estimate the magnitude of particulate matter emissions from selected sources and activities (USEPA 2018b).

The AP-42 equations used to estimate quantity of particulate emissions per vehicle mile traveled on unpaved roads include information from Chapter 13, Miscellaneous Sources. Referenced equation estimate emissions for vehicles traveling on unpaved surfaces at industrial sites. The AP-42 equations used to estimate fugitive emissions from aggregate handling and storage piles related to road construction activities were obtained from 13.2.4 11/06, Aggregate Handling and Storage Piles. The AP-42 equations were used to estimate fugitive emissions from wind erosion include factors from 13.2.5 11/06, Industrial Wind Erosion.

USEPA's Factor Information Retrieval (FIRE) Data System provided additional emission factors recommended by the USEPA (USEPA 2016).

The permit and reported emission inventories include all mining and operation emissions in the mine permit area. The emission factors were derived using the USEPA's AP-42 equations referenced above, USEPA FIRE Data System, site specific information at the mine site, and are summarized in the current permit (MAQP #1749-12) and annual emission inventories. Additional information was also referenced from the permit.

The USEPA regulates diesel engine emission under the Clean Air Act (CAA) for on-road and non-road vehicles, such as locomotives, and engines by regulating fuel and sets emission standards on the amount of pollution a vehicle or engine can emit (USEPA 2017). This ensures that the vehicles meet federal emission standards; therefore, on-road and non-road vehicle related engine emissions are expected to meet regulations and were not addressed in this evaluation.

3.15.2 Affected Environment

3.15.2.1 Topography

Dispersion of air contaminants is highly dependent upon topography. The Continental Mine is located in Silver Bow County, Montana which is dissected by the Continental Divide, with the northern half of the project draining to the western side of the Divide and the southwestern and southeastern side of the project draining to the eastern side of the Divide.

According to the MR Amendment Applications, elevations in and around the YDTI range from about 6,340 feet, the current tailings pond level, to over 7,800 feet on Rampart Mountain to the east and to the north. The local terrain is characterized by abundant granitic outcrops with the dominant vegetation types including quaking aspen, sagebrush, grassland and lodgepole pine. The impoundment is bordered to the west by a relatively low elevation ridge referred to as the West Ridge, with elevations ranging from about 6,470 to 6,550 feet based on the Anaconda Copper Company (ACC) vertical datum. The West Ridge is of particular interest in the baseline investigations since the lower topographic elevations, and corresponding ground water levels, represent the lowest natural hydrologic barrier to potential uncontrolled seepage from the YDTI. The east flank of the ridge slopes relatively steeply towards the impoundment while the west flank slopes more gently for approximately five miles to Browns Gulch. Moulton Reservoir Road trends generally north-south along the ridge crest with a number of private residences located along the west flank of the ridge (Montana Resources 2018b)

3.15.2.2 Climate and Meteorology

Dispersion of air contaminants is highly dependent upon climate, wind speed, and atmospheric stability. Climate in this area is generally characterized by milder winters and cooler summers in comparison to the remainder of the State. This can be manifested in a shorter growing season, with more cloudiness and humidity.

Historical climate data was summarized from the Butte Bert Mooney Airport weather station (USC00241320), located approximately six miles south of the YDTI at elevation 5,600 feet, about 800 feet lower than the impoundment. The mean daily temperature for the project site was estimated to be 39° Fahrenheit (F), with an extreme high of 104° F and an extreme low of -63° F. Highest temperatures generally occur between July and August, and lowest temperatures typically occur between December and February (Knight Piesold 2018a). Average temperatures range from a minimum of 7.4° F in January to a maximum of 79.9° F in July (Western Regional Climate Center 2016).

Daily precipitation data are also available from the Bert Mooney Airport weather station (USC00241320). For the period 1990 through 2016, annual precipitation averaged 12.8 inches per year, ranging from 8.63 inches in 2000 to 19.96 inches in 1997 as shown in **Figure 3.1-1** earlier (Montana Resources 2018b). Schafer (2016) developed an adjustment factor for the Bert Mooney Airport precipitation data to address the higher elevation YDTI. Based on this adjustment, annual precipitation in the YDTI and West Ridge area is estimated to be 15.9 inches per year (Montana Resources 2018b).

Compilation of hourly data from the KBTM weather station at the Butte Bert Mooney Airport from 1992 through 2002 indicated the primary prevailing wind direction to be from the south with a north wind occurring in late spring and summer (Western Regional Climate Center 2018). Average wind speeds were compiled from data obtained from 2001 through 2011 at the same location. Data indicated that average wind speed at the airport ranged from 4.1 to 6.7 miles per

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hour with an average of 5.4 miles per hour. The highest average speeds were reported for March through June (Western Regional Climate Center 2018).

All major drainages within the analysis area for this project are subject to temperature inversions which trap air and reduce smoke dispersal. Temperature inversions can occur at any time during the year, but are most common in the fall and winter. Generally, emission dispersal within the analysis area is very high due to the mountainous terrain and high wind velocities. Valley locations in and adjacent to Butte have the greatest potential for cumulative concentrations of urban, industrial, and transportation emissions because up-valley winds during the daytime and down-valley winds (cold air drainage) at night can dominate wind direction and speed more than the overall prevailing winds.

In addition to reported climate data, MR operates a meteorological station to collect climate data for planning purposes.

3.15.2.3 Existing Air Quality

Sources of Regional Pollution

Butte is a secondary nonattainment area for Total Suspended Particulate and a Group 1 nonattainment area for PM₁₀. The extent of the PM-10 nonattainment area is show on **Figure 3.15-1** below. DEQ maintains an air monitoring station for particulate matter at the Greeley School located approximately 0.2 miles south of the permit area's southern perimeter. This monitoring site is show below on **Figure 3.15-1** as the Greeley School Monitoring Station. The data collected is used to monitor compliance with the local nonattainment area and provide information for public health protection plans during periods of poor air quality and to monitor compliance with NAAQS. Historically, MR had conducted air monitoring in the area of the mine; however, as of March 5, 2002, MR was no longer required to conduct this monitoring. DEQ has indicated that if conditions change, MR may be required to resume monitoring efforts and modify their appropriate control plans (DEQ 2004).

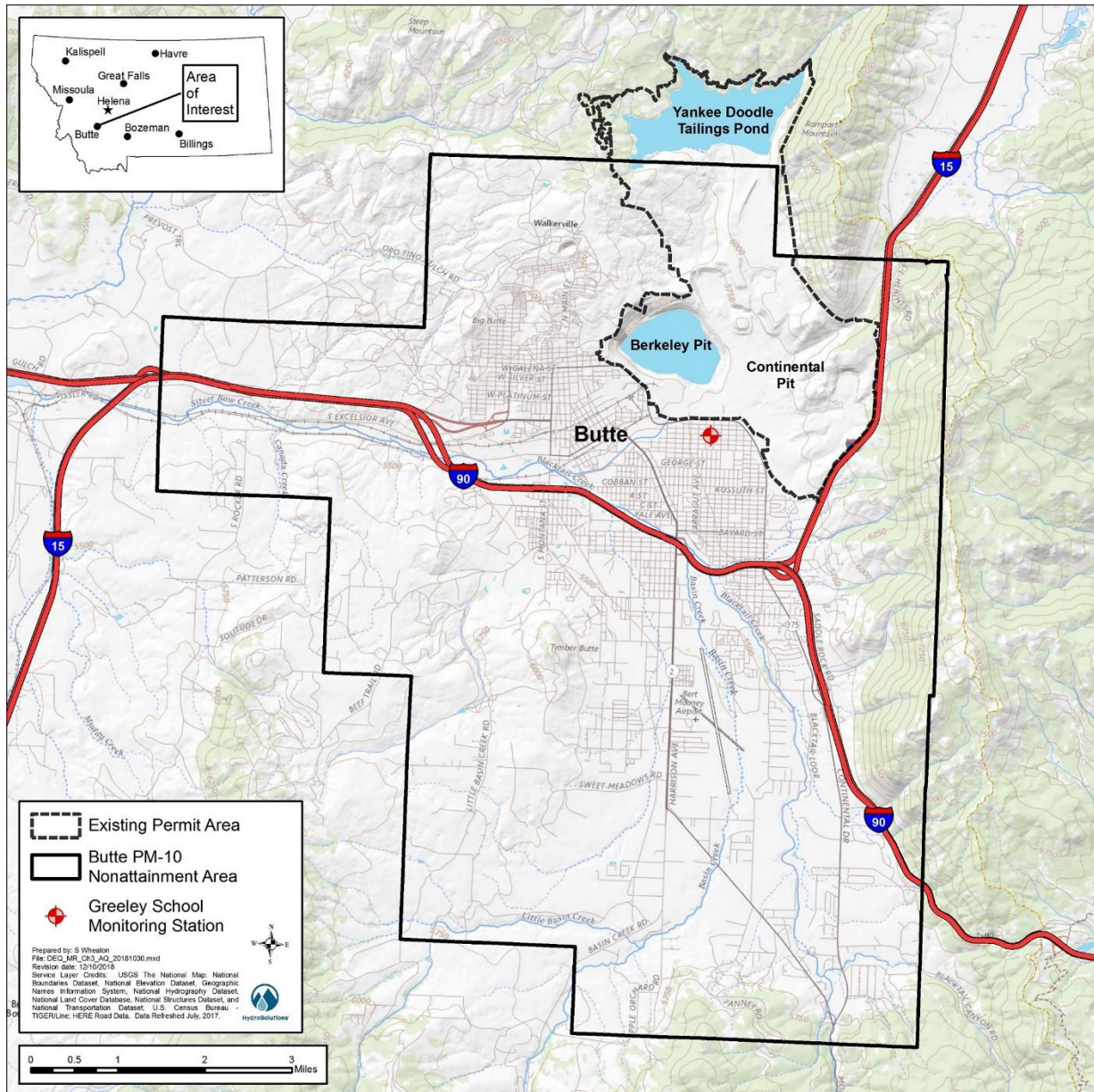


Figure 3.15-1. Butte PM-10 Nonattainment Area.

The mine site has an air quality permit through DEQ. The permit covers fugitive emissions, those which could not reasonably pass through a stack, chimney vent, or other functionally-equivalent opening (40 CFR Sections 70.2 and 71.2), and point source emissions, those that are released from a single point.

Fugitive emissions evaluated for the air quality permit included the following: drilling, blasting, travel (transport) of ore trucks, front end loader, loading, unloading, wind erosion, crushing, and drying. The facility’s potential to emit (PTE) is less than 100 tons per year for any pollutant, is less than 10 tons per year for any one hazardous air pollutant (HAP) and less than 25 tons per

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year of all HAPs, and not an USEPA designated Title V source; therefore, DEQ has determined MR is a minor source of emissions. The PSD program does not apply to MR because it is not listed as a major stationary source under PSD regulations.

The State Implementation Plan (SIP) has been developed in response to TSP emissions in the Butte nonattainment area. The plan applies to MR since it has the potential emissions of PM and PM₁₀ greater than 25 tons per year (TPY). DEQ evaluated PM₁₀ emissions using EPA-approved chemical mass balance computer models to demonstrate compliance with standards if MR allowable emissions were limited, and if controls were implemented to other sources.

DEQ concluded that the current air quality permitting action would not result in an increase in Montana Resources' ambient impact. Further, they determined that the permitting action would not cause or contribute to a violation of the ambient standards.

2017 Emission Inventory

MR is required to provide data such as production, disturbed acreage, vehicle miles traveled, and holes drilled to quantify emissions for compliance evaluation with annual, seasonal, and daily emission limits. The Emission Inventory Detail for 2017 was reviewed for the annual emission summary (DEQ Air Resources Management Bureau 2017).

For 2017, MR's facility had reported emissions of 1,981 tons per year of particulate matter with 660 tons per year of the particulate matter as PM₁₀. Of this total, material handling accounted for 11 percent of the PM₁₀ emissions. Transport of material with haul trucks accounted for 39 percent and fugitive dust from disturbed areas accounted for 15 percent of the PM₁₀ emissions. Of those disturbed areas, the dry tailings area in the impoundment accounted for 0.07 percent (0.475 tons per year) of the PM₁₀ emissions.

Sources of Regional Pollution – Dispersion Study

Due to the elevated PM in the Butte area, several studies have been completed to understand the trend of PM₁₀ and PM_{2.5}. PM₁₀ data was evaluated from 1993 through 2013. Modelling had concluded that wood smoke likely from forest fires was the major source of ambient PM_{2.5} during summer months and contributing as much as 72 percent of the PM_{2.5}. Apportionment determined the remaining contributions were from street/road dust (11.1 percent), secondary sulfate (7.8 percent), ammonium nitrate (1.3 percent) and automobile exhaust at 1.3 percent. Approximately 2.4 percent could not be definitively attributed to a specific source (Ward 2014).

Modeling of winter sources for PM_{2.5} also concluded that wood smoke was the primary contributor as high as 51.8 percent with other secondary sources similar to the summer study detailed above (Ward 2013).

Other monitoring sites were evaluated across the Butte Valley. The study indicated that during winter months, PM_{2.5} levels at the Greeley School could be twice as high as the average from other valley monitoring locations. The predominant wind direction influencing PM_{2.5} concentrations at the Greeley School site was from the southeast and east, while the other

valley sites were different at each site. Metal content from the Greeley site was compared to a background site located in Sieben Flats near Helena and indicated no major differences (Ganesan 2014).

Mitigations

For the air quality resource, all activities must be in compliance with the current air quality permit (MAQP #1749-12) and ambient air quality standards. The air quality permit outlines requirements for compliance. Specific mitigations are required for permit compliance and include water and chemical suppressants to control fugitive emissions to ensure compliance with opacity standards. MR must maintain wet tailings for dust control. MR must also implement engine controls to reduce particulate matter from engine exhaust. For fugitive dust, the permit includes conditions limiting the facility's emissions.

The permit also requires annual emission reporting. Production/activity reports based on onsite activities and approved emission factors are submitted by MR to complete annual emission reporting. This reporting ensures compliance with annual, seasonal and daily emission limits.

As part of the Butte SIP for complying with the CAA, MR is required to prepare and implement an approved dust control plan (DCP) to reduced particulate matter emissions. The DCP is included as part of MR's mine permit. The DCP outlines procedures to control dust by interim dust control measures, interim reclamation, weather monitoring and forecasting to avoid planning activities during dry or windy periods (Montana Resources 2018a).

If measures of the DCP are not followed or inadequate for the site activities, enforcement action would be implemented to correct the response. Also, monitoring at the Greeley School provides ongoing monitoring of particulate matter in the area. Should elevated levels of particulate matter be reported, DEQ can identify sources and apply mitigations to achieve ambient air quality. If particulate matter increases, additional air quality monitoring requirements may be required by MR (DEQ 2004).

According to the air quality permit, If conditions of the tailings pond change, MR would have to develop a long-term fugitive dust control plan for the tailings pond and would still comply with all statutes and rules of the Clean Air Act of Montana and specifically with AMR 17.8.308 Particulate Matter, Airborne (ARM 17.8.749) (DEQ 2004).

Table 3.15-1 presents mitigations implemented at the mine to control fugitive dust emissions during various activities.

**Table 3.15-1
Mitigation Measures for Fugitive Dust**

Control Measure	Activity	Source
Interim Dust Control	Wet tailings and roadway	MAQP #1749-12 DCP
	Annual application of chemical dust suppressants to roadways	MAQP #1749-12
	Conducting visual observations of the YDTI beach condition multiple times per day	DCP
Interim Reclamation	Placing a 6-inch thick rockfill cap over areas where equipment can operate	DCP
	Placing reclamation capping material and revegetating the transition zone as areas become available for reclamation	DCP
	Maintaining and utilizing the Terramac® to apply dust suppressant	DCP
Dust Prone Activity Planning	Manipulating tailings discharge lines to maintain wetted conditions of the tailings to the greatest extent possible	DCP
	Evaluating the effectiveness of control measures	DCP
	Maintaining a weather station and professional meteorologist to forecast weather for activity planning	DCP
Activity Planning	Using most recent past weather conditions at the site and the future predicted conditions to evaluate the likelihood of a dust event	DCP
Final Reclamation	Emplacement of a 28-inch thick amended alluvium cap and revegetating	Permit Amendment Application & Continental Mine Operations Plan

3.15.2.4 Monitoring

DEQ maintains an air monitoring station for particulate matter station at the Greeley School located approximately 0.2 miles south of the MR's southern perimeter. MR is no longer required to monitor air quality in the mine area. However, if conditions change, MR may be required to resume monitoring efforts and modify their DCP. The air quality permit requires monitoring of the tailings pond and road opacities and monitoring of weather for forecasting to plan activities which may increase dust emissions.

3.15.3 Environmental Consequences

3.15.3.1 No Action Alternative

Under the No Action Alternative, MR would continue to operate under existing operating permits. Mitigations for air quality are outlined in the current air quality permit, the DCP, and the operating permit. These control measures and activities are detailed in **Table 3.15-1**.

For final reclamation, tailings closure includes dewatering of the tailings impoundment which would incrementally increase the tailings beach or dry area. This would create a Transition Zone which would retain water, and a reduction in the supernatant pond resulting in a partial wet closure. The Transition Zone would be comprised of subaqueous tailings slimes, rather than the coarser materials found in the beach tailings. Slimes are composed of finer silt and clay particles while the beach is comprised of sand like particles. As the dewatering transitions, the slimes closest to the supernatant pond would remain saturated with water due to their inherent moisture holding capacity while the slimes nearest the beach would “crust” over as they dry. The beach, Transition Zone, and water level would be monitored to assess dusting potential, and if dust is detected, MR would be required to implement its DCP. The tailings beach areas susceptible to wind erosion would be covered after cessation of operations with 6-inch rock, leached cap, or similar material. Permanent reclamation of the tailings beach includes emplacement of a 28-inch thick amended alluvium cap followed by revegetation.

Current dust control mitigations are expected to meet requirements of the current air quality permit which is expected to protect ambient air quality conditions. These mitigations include water and chemical dust suppressants for fugitive dust control, limiting vehicle engines and speed, and capping of long-term sources of fugitive dust.

Ongoing monitoring of onsite conditions and local climate conditions consistent with the DCP would provide opportunities to plan proposed work and mitigations. Ongoing regional monitoring by DEQ would assure compliance with the existing air quality permit and compliance with ambient air quality standards. Should unacceptable impacts be discovered by monitoring, MR is required to update and modify its DCP to achieve compliance and may have to resume ambient air monitoring.

3.15.3.2 Proposed Action

The Proposed Action activities are consistent with current activities on the site and will include existing equipment. As a result, no significant increase in emissions is expected. However, MR would be required to modify their air quality permit if an emission increase would exceed the de-minimus threshold of 5 TPY of a regulated pollutant. Such an exceedance is unlikely based on review of the proposed activities. Regular emission inventories would quantify emissions to achieve compliance with annual, seasonal, and daily emission limits. Continued monitoring at the Greeley School would evaluate regional compliance with ambient air quality standards for PM₁₀.

West Embankment Raise Construction and Operations

No significant changes in operations are anticipated with the construction of the West Embankment raise or continued processing of ore. Construction of the embankment from waste rock and associated site modifications will be accomplished through the use of MR's existing equipment fleet. Current mitigations for fugitive dust from vehicles, material handling, and disturbed areas would remain in place. Emission reporting and monitoring outlined in the permit and DCP would be in effect along with DEQ's regional air monitoring at the Greeley School to ensure compliance with the existing air quality permit.

Tailings Management

Tailings would continue to be discharged to the YDTI under the Proposed Action. However, additional mitigation measures have been proposed in the amendment application regarding tailings disposal and reclamation.

Tailings would continue to be discharged to the YDTI under the Proposed Action. However, additional mitigation measures have been proposed in the Amendment regarding tailings disposal and reclamation.

To achieve the geotechnical objectives for beach development, enhance embankment stability, and limit the potential for internal erosion, the practice of inundation of tailings beaches with water to manage wind-blown dusting will be phased out. The potential for tailings dusting will be managed through the use of multiple discharge points or by other means to wet the beach by recycling water within the mine area during critical periods. Accessible areas prone to fugitive dust will be temporarily reclaimed with a 6-inch rock cap or use of a Terramac® to apply chemical dust suppressants.

Tailings Reclamation

For final reclamation of the YDTI to begin in 2031, a beach, Transition Zone, and an equilibrium pond volume of approximately 1,000 acre-feet will be created by 2060. The Transition Zone will be created as the pond recedes during drawdown and will be comprised of subaqueous tailings slimes as opposed to the coarser beach tailings. The slimes are comprised of much finer particles (primarily silt and clay) compared to the predominantly sandy beach (Montana Resources 2018).

The slimes, comprised of approximately 72 percent silt and clay compared to approximately 20.7 percent silt and clay for the beach, will tend to form a crust as drying occurs. The slimes closest to the receding pond will remain saturated due to greater moisture holding capacity. The combination of crusting and the saturated zone near the pond will reduce the probability of dust originating from the Transition Zone (Montana Resources Revised February 2018). MR has noted that the sandier areas of the beach outside of the Transition Zone have been the most prone to fugitive dust as the areas of the Transition Zone are comprised of finer material that tends to retain moisture.

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As areas become accessible during reclamation, further mitigations would include the placement of a 6-inch thick rockfill cap over areas to facilitate equipment operation, placement of capping material, and revegetating the Transition Zone. Other areas could be controlled by maintaining and using rubber wheeled equipment to apply dust suppressant as needed.

Long-term dust control would be achieved at closure through reclamation by capping with a 28-inch thick amended alluvial cap and revegetation of the tailings beach and an established wetland zone on the Transition Zone.

Proposed dust control mitigations are expected to meet requirements of the current air quality permit and protect ambient air quality conditions. Mitigations would include water and chemical dust suppressants for fugitive dust control, controlling vehicle engines and speed, and capping of long-term sources of fugitive dust.

Ongoing observations of onsite conditions and monitoring and forecasting of local climate conditions consistent with the DCP would provide opportunities to plan proposed work and mitigations for dust control. Ongoing regional monitoring by DEQ would ensure compliance with the air quality permit and ambient air quality standards. Should unacceptable impacts be determined by monitoring, MR is required to update and modify the DCP to achieve compliance and may have to resume ambient air monitoring.

With the Proposed Action, impacts are expected to be minimal, but risk to potential long-term dust generation would be greater than the No Action Alternative due to longer mine operation. Existing air quality impacts would continue until the site is reclaimed. Any changes to existing air quality would be regulated under current air quality rules and regulations. After reclamation, the site would have little potential to contribute to air quality degradation. Any additional dust created by expansion of the impoundment and additional beach area would be minimal.

3.15.3.3 Accelerated Drawdown Alternative

This alternative would result in accelerated tailings dewatering in comparison to the Proposed Action. Areas of the Transition Zone would be exposed sooner, making them available for reclamation within five to nine years, which could expedite closure activities of the YDTI. Similar mitigations would be implemented to reclaim the tailings beach and Transition Zone, but at an expedited schedule. Overall, no changes in mitigations would be anticipated as a result of accelerated tailings dewatering.

Proposed reclamation for this alternative would occur similarly to that of the Proposed Action, but on an accelerated timeline. Existing dust control mitigation measures outlined for the Proposed Action would be adequate to control dust generation for the accelerated drawdown scenarios. Should unacceptable impacts be discovered by monitoring, MR is required to update and modify its DCP to achieve compliance and may have to resume ambient air monitoring.

With the Accelerated Drawdown Alternative, drawdown and reclamation are accelerated, and the risk for potential long-term dust generation would be lessened for reclamation with respect to the Proposed Action.

3.15.3.4 *Elimination of West Embankment Drain Pumpback at Closure*

This alternative would eliminate the WED seepage pumpback to the YDTI and the seepage water would be treated and managed in accordance with the 2002 BMFOU Consent Decree (See Section 1.3.3.1). The result of this action would be similar to the Accelerated Drawdown Alternative, by exposing the transition areas of the pond sooner as drawdown progresses, which could expedite closure activities of the YDTI. Similar mitigations would be implemented to reclaim the tailings beach and Transition Zone, but reclamation could begin as much as seven years sooner than under the Proposed Action. Overall, no changes in mitigations would be anticipated as a result of accelerated tailings dewatering.

Proposed reclamation for this alternative would occur similarly to reclamation associated with the Proposed Action but would occur on an accelerated timeline. Existing dust control mitigation measures outlined for the Proposed Action would be adequate to control dust generation for the Accelerated Drawdown and the Elimination of West Embankment Drain Pumpback at Closure Alternatives. Should unacceptable impacts be discovered by monitoring, MR is required to update and modify its DCP to achieve compliance and may have to resume ambient air monitoring.

3.15.3.5 *Alternative Capping Methods*

The Proposed Action already incorporates multiple tailings discharge scenarios. However, capping with inert material through a modified alluvium run through the mill could expedite the initial capping phase of closure by placing an initial cap across areas of the tailings not accessible by equipment. Due to the hydraulic placement of the cap, less dust control mitigation may be necessary if timely and uniform cover of the modified alluvial cap is achieved. However, little is known as to the placement efficiency and particle distribution from the hydraulically deposited cap. If segregation of materials occur, inconsistent capping depth may result, and areas prone to excessive draining or water accumulation may hinder revegetation efforts for long-term dust control.

The reclamation for this alternative would differ slightly from the Proposed Action by hydraulically placing modified alluvial material as an initial cap for the YDTI for dust control in areas prone to dust generation with the remainder of the 28-inch cap placed by equipment. For the capping alternative, existing dust control mitigation measures outlined for the Proposed Action would be implemented during initial capping and final reclamation to control dust generation. Should unacceptable impacts be discovered by monitoring, MR is required to update and modify its DCP to achieve compliance and may have to resume ambient air monitoring.

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Risk for short-term intensity of dust generation during the initial reclamation phase would be lessened for the capping alternative with respect to the Proposed Action. However, long-term impacts would remain since final reclamation would only occur as available tailings beach is exposed during the YDTI drawdown over the next 30 to 40 years. However, limiting material segregation with hydraulic deposition of the cap is essential in achieving short-term reclamation goals for dust control. If the cap thickness covers all areas and achieves uniform particle distribution for minimization of short-term dust generation could occur until final reclamation is completed.

4 CUMULATIVE, UNAVOIDABLE, IRREVERSIBLE AND IRRETRIEVABLE, AND SECONDARY IMPACTS

4.1 RELATED FUTURE ACTIONS

MEPA requires that the Proposed Action be evaluated collectively with other past and present actions related to the Proposed Action by location or generic type (ARM 17.4.603(7)). Related future actions must also be considered when these actions are under concurrent evaluation by any state agency through pre-impact statement studies, separate impact statement evaluations, or permit processing procedures. At the time of publication of this EIS, the following projects and actions would be considered related future actions.

- Continued management of the BMFOU;
- The pilot study of the Berkeley Pit Water Treatment Plant (described below); and
- Continued monitoring and management of water by USEPA under CERCLA.

Possible projects managed by other local, state, and federal agencies were also researched for the area in and around the proposed amendment. The US Forest Service manages substantial acreage near the current mine permit boundary (**Figure 3.12-1**). A search of the Beaverhead-Deerlodge National Forest Projects pages for 2018 found one project related to cross-country ski trail grooming near Moulton Reservoir #1. This project would not affect resources in the area near the proposed amendment, and no other proposed changes to land use on Forest Service-managed lands near the proposed amendment area are currently under consideration. Butte-Silver Bow City-County is coordinating with the Forest Service on this and other recreational trail development and maintenance activities near the Moulton Reservoir (BSB 2017).

No other local, state, or federal actions with the potential to affect the area in or around the proposed amendment to the MR operating permits were identified as being under review at the time of publication of this EIS.

Berkeley Pit Water Treatment Pilot Study

MR and Atlantic Richfield plan to initiate a temporary pilot project in 2019 to control the rate of water level rise in the Berkeley Pit, monitor responses at points of compliance, treat Berkeley Pit water, and test water treatment options for discharge to Silver Bow Creek (Montana Resources 2018a). The pilot project is anticipated to operate for 2 to 4 years. The objectives of the proposed Pilot Project are described as follows:

- Berkeley Pit Inflow Control - The Pilot Project will evaluate the effectiveness of controlling the Berkeley Pit water level rise by removing water directly from the Pit and conveying Pit water into MR's Precipitation Plan for copper removal, if desired; running it through the HsB Water Treatment Plant, and then utilized in MR's milling operations. The flow rate will be approximately 3 MGD. All water run through the mill will be conveyed back to the YDTI. A component of the Pilot Project will be to evaluate the

ability of the HsB Water Treatment Plant to treat Berkeley Pit water after it is routed through MR's precipitation plant for copper recovery.

- Points of Compliance (POCs) Connectivity - The Pilot Project will evaluate the hydraulic connectivity of the Berkeley Pit water to the outlying POCs by monitoring the impact of the Pilot Project on slowing, or stopping, the rise of groundwater in the outlying POCs.
- Off-Site Discharge - The Pilot Project will test different off-site discharge scenarios using existing, new, and temporary discharge infrastructure over a period of 2-4 years, treating varying water flow rates and qualities, and discharging during varying seasonal fluctuations of the receiving water. Approximately 7 MGD of YDTI supernatant pond water will be conveyed through the return water line into the Pilot Project polishing plant.
- Yankee Doodle Tailings Impoundment (YDTI) Treatment - The Pilot Project will update information previously learned from 1996 to 2000 concerning the capability of the supernatant pond at YDTI to act as a component of the remedy to directly treat the HSB seepage water. Approximately 5 MGD of HsB seepage will be returned to YDTI. Lime will be added via super-charging the tailings line and blending with HsB seep water prior to discharge into YDTI.
- Industrial Re-use of Berkeley Pit Water - The Pilot Project will test the feasibility of using 3 MGD of water from the Berkeley Pit in the mill and ultimately to YDTI, similar to what is currently happening with treated Horseshoe Bend water. This will test the ability of the active mining operation to accept treated water into the future, potentially minimizing offsite discharge requirements while holding the water level in the Berkeley Pit steady.
- Active Mine Water Reduction Effort - Consistent with the recommendation of the YDTI EOR, MR is currently reducing the volume of water stored in the YDTI to the minimum amount needed for efficient mining operations of approximately 15,000 acre-feet.

4.2 CUMULATIVE IMPACTS

Cumulative impacts include the collective impacts of the human environment of the Proposed Action or any alternative under consideration in conjunction with other past, present, and future actions related to the alternative by location or generic type (75-1-220 (4), MCA).

Cumulative impacts can result from individual actions that are minor, but, when combined over time with other actions, become significant. 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 time scales appropriate to the alternatives being

evaluated. Cumulative impacts can only be assessed for resources that are likely to experience primary or secondary impacts due to an alternative.

4.2.1 Geology and Minerals

The cumulative effects area for geology and minerals is the area contained within the mine permit boundary. This area encompasses the Berkeley Pit area, the Continental Mine, and the YDTI and has a substantial amount of disturbance area associated with past and present mining activities. Actions considered in the cumulative effects analysis include continued operation of the Continental Mine and actions related to the BMFOU management under Superfund. The potential for cumulative impacts to geology and minerals exists under the action alternatives. These potential impacts are discussed in the following section.

4.2.1.1 No Action Alternative

Under the No Action Alternative, there would be no cumulative impacts to geology or minerals since the expansion of the YDTI would not occur. Mining at the Continental Pit would continue until tailings storage capacity is no longer available in the YDTI, approximately 2022, and reclamation of the mine facilities would begin. Disturbance associated with mining would conclude. Specifically, with no additional mining and expansion of the Continental Mine, geologic material would remain in the open pit.

4.2.1.2 Proposed Action

Under the Proposed Action, ore extraction would continue until 2031 and the depth of the Continental Pit would increase during mining. The bottom of the Continental Pit was approved to an elevation of 4,720 feet, ACM datum, in the D-East Pushback Amendment in 2013. Based on current mine design planning for the Proposed Action, the extended timeframe for mining operations in the Continental Pit would lower the bottom elevation to 4,900 feet in year 2031. This would deepen portions of the Continental Pit that are already disturbed within Permits 00030A and 00041, and it would not expand the footprint of the pit or the permit boundaries. Mining below that depth, presumably beyond 2031, would be contingent upon MR developing additional tailings disposal capacity and amending the operating permits accordingly.

The expansion of the YDTI under the Proposed Action would be necessary to store the additional tailings generated from mining at the Continental Pit and ore processing. The impacts to geology from mining would involve removal of geologic material from the Continental Pit, placement of waste rock in the West Embankment or Rock Disposal Sites, and salvaged soils placed in soil stockpile sites. Continued mining would affect the minerals available in and around the Continental Mine. The cumulative impact to minerals and geology when combined with the past and future extraction of ore and waste rock materials from the Continental Pit would be minimal.

4.2.1.3 Accelerated Drawdown at Closure Alternative

The Accelerated Drawdown at Closure Alternative does not specifically address geology and minerals, so there would be no change to the cumulative impacts described for the Proposed

Action. If the YDTI water is diverted into and stored in the Continental Pit, then future access to additional exploration and mining in flooded areas would be affected. The decision to begin diverting water into the Continental pit would be made following a decision that no further mining would occur (at least in the near term). If, after 2031, MR discontinues dewatering of the Continental Pit and no tailings storage expansion plan is under review or approved, reclamation activities would commence.

4.2.1.4 *Elimination of West Embankment Drain Pumpback at Closure*

The Elimination of WED Pumpback at Closure Alternative does not specifically address geology and minerals, so there would be no change to the cumulative impacts described for the Proposed Action. If the YDTI water is diverted into and stored in the Continental Pit, then future access to additional exploration and mining in flooded areas would be affected. The decision to begin diverting water into the Continental Pit would be made following a decision that no further mining would occur (at least in the near term). If, after 2031, MR discontinues dewatering of the Continental Pit and no tailings storage expansion plan is under review or approved, reclamation activities would commence.

4.2.1.5 *Alternative Capping Methods*

The Alternative Capping Methods Alternative is meant to accelerate the reclamation, control fugitive dust from the tailings, and potentially reduce the overall reclamation schedule. The Alternative Capping Methods does not specifically address geology and minerals, so there would be no change to the cumulative impacts described for the Proposed Action. The Central Zone alluvium and colluvium material excavated and proposed for capping as part of the Proposed Action would be the same material used for this Alternative Capping Method. No additional volume of material would be excavated.

4.2.2 *Geotechnical Stability*

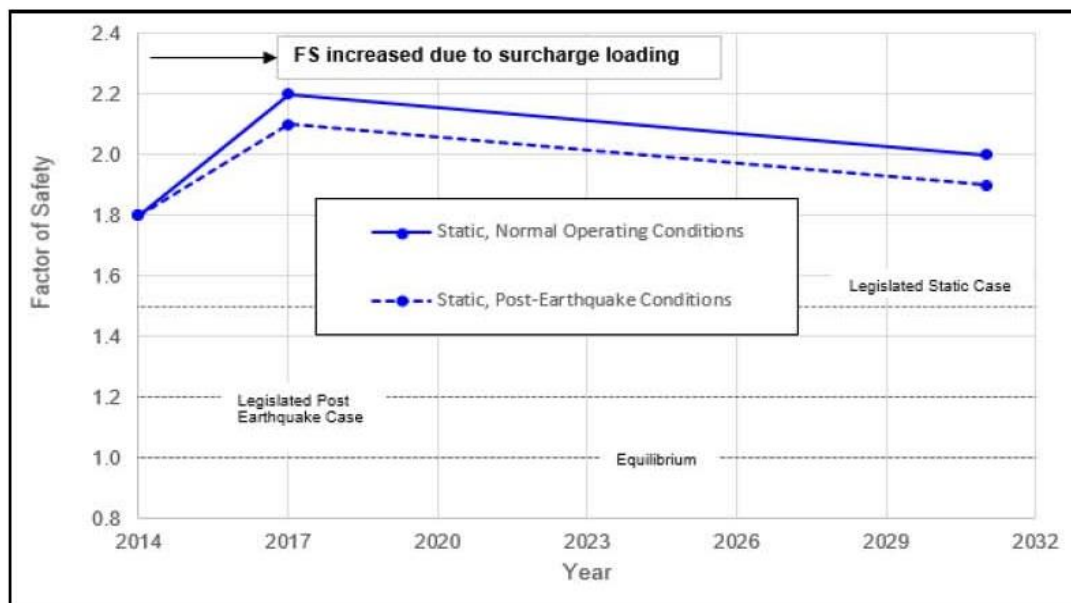
The cumulative effects area for geotechnical stability is the area within the Silver Bow Creek watershed downhill of the impoundment. This area includes the Continental Mine, the Berkeley Pit, and the area of Butte downstream of the YDTI. Actions considered in the cumulative adverse impacts analysis include the continued operation of MR within the Continental Mine, use of the YDTI until the end of mining, and consideration for the construction of rockfill surcharge adjacent to the East-West Embankment between 2014 and 2017. The surcharge, or rockfill placed on top of tailings to improve consolidation, increased the stability of the embankment in preparation for the proposed embankment raise. Other considerations include actions related to post-mining management of water from the YDTI as well as the level of development and human activity downstream of the YDTI.

4.2.2.1 *No Action Alternative*

Under the No Action Alternative, the permit amendment would not be approved and the YDTI West Embankment would not be raised 45 feet. The YDTI Embankment would not be affected and the No Action Alternative would not have any cumulative effects on the geotechnical stability of the YDTI Embankment.

4.2.2.2 Proposed Action

Under the Proposed Action, the YDTI West Embankment would be raised 50 feet and a North RDS would be added as a buttress to the downstream side of the North-South Embankment. The estimated factor of safety values resulting from increasing the embankment height and the construction of the North RDS would decrease steadily from completion of the West Embankment construction through the end of mining, due to increasing tailings volume and water in the YDTI. However, the safety values would far exceed the statutory design requirements, as shown on **Figure 4.2-1**. The stability of the embankment would remain well above statutory design requirements as a result of the addition of the North RDS as a buttress to the downstream North-South Embankment and from maintaining the embankment stability through the management of the embankment slopes and top width (See Section 3.3, Geotechnical Engineering). Therefore, there would be no cumulative adverse effects related to geotechnical engineering from the Proposed Action.



Source: Knight Piesold (2018)

Figure 4.2-1. Estimated YDTI Factor of Safety Values resulting from the action alternatives, from 2014 through the end of mining.

4.2.2.3 Accelerated Drawdown at Closure Alternative

The Accelerated Drawdown at Closure Alternative could substantially reduce the time necessary to reach equilibrium conditions in the YDTI. The Accelerated Drawdown at Closure Alternative would reduce the water levels within the YDTI from near the maximum pool elevation of 6,428 feet to near the equilibrium pool elevation of approximately 6,363 feet within a short timeframe dependent upon pumping rates and drawdown. The accelerated drawdown in the pool water levels would act to reduce the overall weight acting against the embankment. The YDTI embankments would not experience any changes in factor of safety due

to the accelerated drawdown, as the tailings mass immediately adjacent to the embankment would remain in place against the upstream face of the embankment. This alternative would not result in significant cumulative effects to the geotechnical stability of the YDTI Embankment. Therefore, the cumulative effects from this alternative would be the same as for the Proposed Action.

4.2.2.4 Elimination of West Embankment Drain Pumpback at Closure Alternative

The Elimination of the WED Pumpback at Closure Alternative would result in a reduction in the time to complete reclamation of the YDTI area due to a reduction in the amount of water within the YDTI by 7 years. Under this alternative, the geotechnical stability of the YDTI Embankment would not be significantly reduced and it would not result in additional cumulative effects to the geotechnical stability of the embankment. Therefore, the cumulative effects from this alternative would be the same as for the Proposed Action.

4.2.2.5 Alternative Capping Methods

The Alternative Capping Methods Alternative would also result in a reduction in the time to complete reclamation of the YDTI area. Under this alternative, the geotechnical stability of the YDTI Embankment would not be significantly reduced and it would not result in additional cumulative effects to the geotechnical stability of the embankment. Therefore, the cumulative effects from this alternative would be the same as for the Proposed Action.

4.2.3 Soils and Reclamation

The cumulative effects area for soils and reclamation is the area contained within the mine permit boundary and is the same area identified for geology and minerals. This area includes the Berkeley Pit area, the Continental Mine, and the YDTI and has a substantial amount of disturbance area associated with past and present mining activities.

None of the EIS alternatives have cumulative impacts related to soils and reclamation. Soil salvage and replacement is an ongoing process for the current mining effort. All of the proposed alternatives include stripping an additional 85.4 acres (**Table 3.5-3**), totaling 267,100 cubic yards, and replacing the same soil on mine site areas requiring reclamation or in stockpiles (Montana Resources 2018b). Reclamation timing differs among the alternatives.

4.2.3.1 No Action Alternative

Under the No Action Alternative, mining would be limited to what is currently permitted, and there would be no expansion of the YDTI. Soils are already stockpiled as part of the existing mining operation. Reclamation would be anticipated to begin approximately 2022. MR would reclaim existing disturbance with the existing stockpiled soils. Therefore, there would be no additional cumulative effects to soils for this alternative.

4.2.3.2 Proposed Action

The cumulative impacts under the Proposed Action would include impacts to the native soils including soil salvage and stockpiling ahead of construction and tailings inundation. Under the Proposed Action, the YDTI would be increased from its currently permitted acreage and

includes an additional 85.4 acres of soil disturbance (**Table 3.5-3**), and would generate an additional 267,100 cubic yards of salvaged soil to be used for future reclamation. This additional area would accommodate increased tailings storage, West Embankment construction, topsoil storage, roads, and monitoring wells. Associated facilities include a new RDS and addition to an existing RDS, soil and alluvium stockpiles, access roads, and new long-term monitoring sites are proposed within the existing disturbed areas.

Reclamation of the YDTI would be essentially the same as previously permitted under the No Action Alternative. The reclamation plan includes grading, capping, and revegetation of the embankment and beach; and wet closure of the open water component with a pond. The loss of additional acreage until reclamation is completed would not substantially change the character of the area near the active mine. Therefore, the cumulative impacts to soil and reclamation within the mine permit boundary would be temporary and would be mitigated by the reclamation plan. Therefore, the cumulative impacts under the Proposed Alternative are considered the same as the No Action Alternative.

4.2.3.3 Accelerated Drawdown at Closure Alternative

The Accelerated Drawdown at Closure Alternative would pump water directly from the YDTI and substantially reduce reclamation time. This alternative would have the same impacted area, quantity of stockpiled soils, similar supporting facilities and the same reclamation approach as described under the Proposed Action. The only change to soil and reclamation would be in the time to complete reclamation compared to the Proposed Action. The cumulative impacts for this alternative are also considered temporary and would be mitigated by the reclamation plan. Therefore, the cumulative impacts under the Accelerated Drawdown at Closure Alternative are considered the same as the Proposed Action.

4.2.3.4 Elimination of West Embankment Drain Pumpback at Closure

The Elimination of WED Pumpback Alternative reduces water input back to YDTI, which would speed up reclamation activities at the facility. Substantially less water would be collected in the WED and diverted away from the YDTI when compared to the volume of water in the pool. However, eliminating pumping water from the WED would still allow for some level of reducing drawdown time in the pond. This alternative is the same as the Proposed Action in terms of proposed acres of additional disturbance volume of stockpiled soils, supporting facilities and the reclamation approach. The cumulative impacts for this alternative would also be considered temporary and be the same as the Proposed Action.

4.2.3.5 Alternative Capping Methods Alternative

The Alternative Capping Methods Alternative would accelerate the reclamation timetable and control fugitive dust from the tailings prior to complete reclamation. The cumulative impacts for this alternative would be the same as the Proposed Action in terms of proposed acres of additional disturbance and the reclamation approach.

Under the Proposed Action, capping materials cannot be placed with trucks until the beach surface is dried and accessible by mechanical equipment. The Alternative Capping Methods Alternative would place subsoil via pumping the material through the mill using reclaimed water from the YDTI. Pumping the material would occur immediately after closure because the mill would need to remain functioning. Segregation of the alluvium material would likely occur since coarse- and fine-grained material will not be distributed evenly when discharged. Special handling may need to take place with dozers and trucks once the beach dries out in order to remix the segregated materials and construct a suitable seed bed prior to final topsoiling.

4.2.4 Ground and Surface Water Resources

The cumulative effects area for ground water and surface water resources is the BMFOU. The BMFOU is an EPA-managed Superfund operable unit that encompasses the YDTI and its contributing watersheds to the north, the MR mine site including the HsB Water Treatment Plant, the Continental Pit, and the Berkeley Pit, and flooded historic mine workings beneath the city of Butte.

4.2.4.1 No Action Alternative

Under the No Action Alternative, there would be no cumulative impacts to ground water in the BMFOU because existing inward-directed ground water gradients towards the YDTI pond would be preserved. These inward gradients would maintain hydrodynamic containment of the YDTI pond, thus preserving existing ground water quality around the YDTI.

Cumulative impacts to surface water in the BMFOU associated with active mine operations would be minimal. During current operations, YDTI seepage collected at Horseshoe Bend is captured, treated, used in the mill, and returned to the YDTI pond in the form of tailings slurry. This closed-loop system negates the need for off-site discharge of YDTI seepage.

However, a pilot study treatment test of indeterminate length is scheduled to begin at the HsB Water Treatment Plant by early 2019 (See Section 4.1). During this test, seepage at Horseshoe Bend will be returned to the supernatant pond with minimal lime treatment (Montana Resources and Atlantic Richfield Company 2018). Similar direct pumpback of Horseshoe Bend seepage occurred between approximately 1996 to 2000. During this period, concentrations of TDS, sulfate, metals, and other constituents increased in the supernatant pond but returned to near previous concentrations after pumpback ceased and mining operations began again and established basic pH conditions (Schafer Limited LLC 2018). Another component of the pilot study is the treatment of Berkeley Pit water at the existing HsB Water Treatment Plant and incorporating that water into the milling and tailings slurry circuit.

During the Superfund pilot test, it is anticipated that supernatant pond water quality will undergo a degradation similar to that observed during 1996 to 2000. Specifically, geochemical modeling conducted in support of the pilot test predicts an increase in supernatant pond aluminum concentrations from 60 µg/l to 2,200 µg/l and an increase in pond TDS from 2,080

mg/l to 2,200 mg/l (Wood 2018). Following the pilot test, recovery to previous pond water quality is anticipated, as long as alkaline conditions are maintained in the pond, whether through continued addition of high pH tailings or lime.

Following mine closure, cumulative impacts to BMFOU surface water and treatment infrastructure could increase, depending on the duration and results of pilot scale treatment testing. After closure in the absence of the pilot study, YDTI seepage at Horseshoe Bend would need to be captured, treated and discharged according to BMFOU remedial plans, but water in the supernatant pond would not be recirculated to the mill. Treatment and discharge of water from the mine site would need to meet performance standards outlined in the 2002 Consent Decree for BMFOU.

4.2.4.2 Proposed Action

Cumulative impacts to ground water are not anticipated, because engineered mitigations incorporated into the Proposed Action will alleviate direct impacts as discussed in Section 3.6.3. Cumulative impacts to surface water will be similar to those described for the No Action Alternative, although in some cases, the timing and duration will differ.

Cumulative impacts associated with the Superfund pilot study treatment test will have the same timing as described for the No Action Alternative (Section 4.2.4.1), although the duration of the pilot study has not been fully determined. With or without the pilot study occurring during the extended mine operation period, a portion of the YDTI supernatant pond water would be routed to the mill, supplanting the need for the BMFOU to manage this water. Similarly, Horseshoe Bend seepage will be kept in a closed loop on the mine site, either treated at the HsB Water Treatment Plant and used at the mill or pumped directly back to the YDTI during the pilot test. Thus, cumulative impacts to the BMFOU in the form of Horseshoe Bend seepage management and the potential future handling of some YDTI water will be deferred for approximately 10 years longer than under the No Action Alternative due to the longer period of mine operation.

However, following mine closure in 2031, cumulative impacts to BMFOU surface water and treatment infrastructure could increase, depending on the duration and results of pilot scale treatment testing as described in Section 4.2.4.1. Additionally, under the Proposed Action, an emergency spillway for the YDTI is proposed to be constructed following mine closure. The spillway would discharge water from the YDTI to the Continental Pit in the event that a highly unlikely sequence of storms caused the supernatant pond to rise above the 6,428-foot elevation (ACM datum). The spillway is proposed for emergency purposes only and is not likely to ever be used (Montana Resources 2018b). Still, the possibility of YDTI spillage entering the Continental Pit would mean that additional chemical loads and water volume could be released to an area that is managed by the BMFOU. Like the Berkeley Pit, the water that collects in the post-closure Continental Pit must be maintained below an elevation of 5,410 feet (USGS datum) (5,460.4 ACM datum) and treated prior to off-site discharge under Superfund. Emergency

discharge from the spillway could have a cumulative effect on the BMFOU water management obligations.

The available storage capacity for water in the Continental Pit below the critical water level was analyzed and described in detail in Section 2.5.2.2. In addition to the potential spillway discharge, the storm events that would contribute to an increased tailings pond volume (triggering spillway discharge) would also add water directly to the Continental Pit, which has a footprint of approximately 1,000 acres. The precipitation to the pit would include a 1 in 1,000 year, 30-day rainfall event, the 24-hour PMP, and the melting of a 1 in 100 year snowpack, but not the release of water from Moulton Reservoirs, considered as part of the PMF to be contained by the YDTI. These storm events, and the subsequent 1 in 1,000 year, 24-hour rainfall event that would trigger spillway discharge, would fill approximately 9.3 percent of total capacity below the critical water level. This rapid increase in inflow would shorten the time to reach the critical water level by approximately 13 years.

4.2.4.3 Accelerated Drawdown at Closure Alternative

The Accelerated Drawdown at Closure Alternative would generally have similar cumulative impacts as the Proposed Action alternative. However, for the period of accelerated drawdown that is necessary to achieve the equilibrium pond volume, there would be a greater impact on the BMFOU due to the need to store or treat and discharge the water pumped from the supernatant pond. The potential storage or treatment options for this water would need to be evaluated and approved by BMFOU parties. The potential impact to water storage capacity in the Continental Pit below the critical water level is described in Section 2.5.2.2. The addition of high-pH YDTI water to the Continental Pit would raise the pH and alkalinity of the initial pit lake and would flood exposed mineral surfaces, lowering the potential for sulfide oxidation and acid generation.

If the BMFOU parties agreed to discharge water off-site, all water would be treated to meet discharge performance standards for water quality and flow rate from the 2002 Consent Decree. The rate of discharge to Silver Bow Creek would vary in proportion to seasonal changes in natural streamflow.

The need to store or treat the drawdown water during this time would potentially alter the existing water volume and contaminant loading that the BMFOU parties must treat. Although more water may require management under Superfund at an earlier date, the expedited drawdown of the supernatant pond to the equilibrium volume (approximately 1,000 acre-feet) would reduce the reservoir available for seepage to Horseshoe Bend and the WED, and thus the duration of elevated flows, and would result in a lower likelihood of a spillway event that leads to discharge of pond water directly to the Continental Pit.

4.2.4.4 Elimination of West Embankment Drain Pumpback at Closure

Elimination of WED Pumpback at Closure would result in a faster supernatant pond drawdown than the Proposed Action, but a slower drawdown than the Accelerated Drawdown at Closure

Alternative. The cumulative impacts would be most similar to the Accelerated Drawdown at Closure Alternative. The water captured by the WED would not be returned to the supernatant pond, so it would need to be diverted to a storage or treatment facility prior to any off-site discharge. The potential storage or treatment options for this water would need to be evaluated by BMFOU parties. Based upon the predicted sources and rates of seepage into the WED (160 gpm) (Schafer Limited LLC 2018), the volume of water from the WED would be substantially less than the excess pond water removed by accelerated drawdown, resulting in a smaller magnitude of cumulative impacts to the BMFOU water management. The potential impact to water storage capacity in the Continental Pit below the critical water level is described in Section 2.6.2. To preclude acidification of the Continental Pit lake, WED seepage would be amended with lime if necessary to neutralize acidity before being stored in the pit.

4.2.4.5 *Alternative Capping Methods*

Cumulative impacts associated with the Alternative Capping Methods Alternative would be the same as under the Proposed Action. No makeup water from outside the YDTI system would be required to process and transport the cap material slurry. Therefore, no changes to post-closure water management would be required and cumulative impacts to water resources would be the same as under the Proposed Action.

4.2.5 *Vegetation and Wetlands*

The cumulative effects area for vegetation and wetlands is the Silver Bow Creek watershed. This area encompasses the Berkeley Pit area and the Continental Mine and has vegetative cover similar and connected to that represented in the proposed Permit 00030A expansion. Related future actions considered in the cumulative effects analysis include continued operation of the Continental Mine, actions related to the BMFOU management under Superfund, any relevant management of the adjacent Forest Service lands, and the current and expected level of residential development in and around the proposed permit amendment area.

4.2.5.1 *No Action Alternative*

Under the No Action Alternative, the permit amendment would not be approved, and ongoing land uses would continue. The No Action Alternative would not have any direct effect on vegetation or wetlands; therefore, it would not contribute to cumulative effects to vegetation or wetlands due to mining in the watershed.

4.2.5.2 *Proposed Action*

The amount of acreage that would be converted from forest and shrublands to open or shallow water under the Proposed Action would not substantially alter the vegetation community in the Silver Bow Creek watershed. The 4,632 mine-affected acres in the watershed would remain unvegetated until closure and reclamation are completed. The incremental loss of approximately 99 additional acres of forest and shrubland until reclamation is completed would not substantially change the overall vegetation community or character of the area near the active mine. Therefore, the cumulative impacts to vegetation and wetlands in the Silver Bow Creek watershed would be minimal.

4.2.5.3 Accelerated Drawdown at Closure Alternative

Although no aspect of this alternative would affect the extent of the areas to be inundated by YDTI water or disturbed, the reestablishment of vegetation is integral to the post-closure land uses identified, namely wildlife habitat and watershed protection. The Accelerated Drawdown at Closure Alternative may allow these land uses to be achieved as much as two to three decades sooner, which may be substantial in terms of vegetation succession, overall land appearance, and wildlife use. The final reseeding and vegetation reestablishment design would not be altered from the Proposed Action. Because of the potential reduction in time to reclamation of the Transition Zone, the potential for cumulative impacts to vegetation and wetlands would be reduced in comparison to the Proposed Action.

4.2.5.4 Elimination of West Embankment Drain Pumpback at Closure

Although the Elimination of the WED Pumpback at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by approximately 7 years, the final reseeding and vegetation reestablishment plan would not be altered. No aspect of this alternative would affect the extent of the areas to be inundated by the tailings pond expansion or disturbed by mine activities. Therefore, the potential for cumulative impacts to vegetation and wetlands would be the same as described for the Proposed Action.

4.2.5.5 Alternative Capping Methods

Although the Alternative Capping Methods Alternative may reduce the total time to complete reclamation of the YDTI area by approximately 2 years, the final reseeding and vegetation reestablishment plan would not be altered. No aspect of this alternative would affect the extent of the areas to be inundated by the tailings pond expansion or disturbed by mine activities. Therefore, the potential for cumulative impacts to vegetation and wetlands would be the same as described for the Proposed Action.

4.2.6 Wildlife

The cumulative effects area for wildlife is the existing mine permit area and the BMFOU area (**Figure 1.3-2**). Actions considered in the cumulative effects analysis include continued operation of the Continental Mine, actions related to the BMFOU management under Superfund, and the current level of residential development in and around the proposed permit amendment area. A search of the Beaverhead-Deerlodge National Forest Projects pages for 2018 found one project related to cross-country ski trail grooming near Moulton Reservoir #1, and no other proposed changes to land use with the potential to affect wildlife in the cumulative effects area on Forest Service-managed lands are currently under consideration.

4.2.6.1 No Action Alternative

Under the No Action Alternative, the permit amendment would not be approved and the tailings storage capacity in the YDTI would remain unchanged, the northern boundary of the YDTI would not be expanded, disturbed acreage would not be increased, and revisions to the existing reclamation and closure plans would not be necessary. Because there are no primary impacts to wildlife from the No Action Alternative, there would be no cumulative effects.

4.2.6.2 Proposed Action

Under the Proposed Action, the primary impact to wildlife would be the habitat loss associated with the 99 acres inundated by the expanded YDTI, with the greatest habitat loss in the deciduous forest habitat type. Additional habitat losses could occur in the cumulative effects area if residential development increases, and any such losses would contribute to the losses caused by the Proposed Action. Under the Proposed Action, reclamation would begin in 2031 and be completed in 2060. Therefore, wildlife habitat loss and associated cumulative effects would last 30 years or more but would not be permanent. The species that would benefit or lose from this change are described in Section 3.8.

The Moulton Cross-Country Ski Trail grooming proposed by the Forest Service has been ongoing for the past 30 years (USFS 2017). Any disturbance effects to wildlife from grooming and human use of the area could contribute to disturbance effects from the Proposed Action. However, this disturbance would be seasonally limited and wildlife in the cumulative effects area have likely acclimated to this activity.

4.2.6.3 Accelerated Drawdown at Closure Alternative

The cumulative effects to wildlife under the Accelerated Drawdown Alternative would be similar to those described for the Proposed Action. However, the Accelerated Drawdown Alternative has the potential to reduce the total time to complete reclamation of the YDTI area. If reclamation was completed more quickly, the temporal impact of habitat loss would be less under the Accelerated Drawdown Alternative than under the Proposed Action.

4.2.6.4 Elimination of West Embankment Drain Pumpback at Closure

The cumulative effects to wildlife under the Elimination of WED Pumpback at Closure Alternative would be similar to those described for the Proposed Action. However, the Elimination of WED Pumpback at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area. If reclamation was completed more quickly, the temporal impact of habitat loss would be less under the Elimination of WED Pumpback at Closure Alternative than under the Proposed Action.

4.2.6.5 Alternative Capping Methods

The cumulative effects to wildlife under the Alternative Capping Methods Alternative would be similar to those described for the Proposed Action. However, the Alternative Capping Methods Alternative has the potential to reduce the total time to complete reclamation of the YDTI area. If reclamation was completed more quickly, the temporal impact of habitat loss would be less under the Alternative Capping Methods Alternative than under the Proposed Action.

4.2.7 Aquatics

The cumulative effects area for aquatics is the Silver Bow Creek watershed upstream of where the tributary streams enter the YDTI. The YDTI and the watershed below the YDTI are disconnected from Silver Bow Creek (USACE 2018) and are not considered habitable by aquatic life. The lower Silver Bow Creek watershed encompasses the Berkeley Pit area and the

Continental Mine and is hydrologically (via ground water) connected to the area in the proposed Permit 00030A expansion, but there is no aquatic life in these areas because of the contaminated waters. Actions considered in the cumulative effects analysis include continued operation of the Continental Mine, actions related to the BMFOU management under Superfund, uses on the adjacent Forest Service Lands, and the current level of residential development in and around the proposed permit amendment area. A search of the Beaverhead-Deerlodge National Forest Projects pages for 2018 found one project related to cross-country ski trail grooming near Moulton Reservoir #1. This project would not affect waters in the cumulative effects area, and no other proposed changes to land use with the potential to affect waterbodies in the Silver Bow Creek watershed on Forest Service-managed lands are currently under consideration.

4.2.7.1 No Action Alternative

Under the No Action Alternative, the permit amendment would not be approved, and ongoing land uses would continue. Tributary streams would not be affected beyond the level of YDTI increase that has already been permitted. Cumulative impacts to aquatic resources related to the incremental changes to the watershed due to the No Action Alternative would be negligible. The closed-loop system currently used for water management negates the need for off-site discharge of YDTI seepage (See Section 4.2.4.1). Since this management system would continue under the No Action Alternative, there would be no effect on the BMFOU water management.

4.2.7.2 Proposed Action

The potential effects on aquatics from the Proposed Action relate to the total length of the streams tributary to the YDTI that would be inundated and a small loss of habitat for fish and other aquatic organisms inhabiting the lower reaches of those streams. In the context of the BMFOU and the long-term loss of connectivity between these headwater reaches and the rest of the Silver Bow Creek watershed, this incremental loss of habitat would not substantially alter conditions for the Westslope Cutthroat Trout or other aquatic organism residents. No other land use changes with the potential to affect waterbodies in this watershed were identified. Therefore, the potential for the Proposed Action to contribute to cumulative impacts of mine activity on aquatic resources would be minimal.

4.2.7.3 Accelerated Drawdown at Closure Alternative

Although the Accelerated Drawdown at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area, no other aspect of the Proposed Action would be altered. No aspect of this alternative would affect the extent of the tributary streams to be affected or the duration of the inundation of the mouths of the tributaries. Therefore, the potential for cumulative impacts to aquatic resources would be the same as described for the Proposed Action.

4.2.7.4 *Elimination of West Embankment Drain Pumpback at Closure*

Although the Elimination of the WED Pumpback at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area, no other aspect of the Proposed Action would be altered. No aspect of this alternative would affect the extent of the tributary streams to be affected or the duration of the inundation of the mouths of the tributaries. Therefore, the potential for cumulative impacts to aquatic resources would be the same as described for the Proposed Action.

4.2.7.5 *Alternative Capping Methods*

Although the Alternative Capping Methods Alternative has the potential to reduce the total time to complete reclamation of the YDTI area, no other aspect of the Proposed Action would be altered. No aspect of this alternative would affect the extent of the tributary streams to be affected or the duration of the inundation of the mouths of the tributaries. Therefore, the potential for cumulative impacts to aquatic resources would be the same as described for the Proposed Action.

4.2.8 Cultural Resources

The cumulative impact area for cultural resources is the currently permitted YDTI shoreline boundary, plus the proposed expansion area boundary of approximately 237 acres. A cultural resource inventory of the project area identified nine historic mining properties that were assessed to be ineligible for listing on the NRHP and one potentially NRHP-eligible cultural resource, the W.A. Clark Water Pipeline, Site 24SB940. The historical significance and integrity of the W.A. Clark pipeline has been diminished by section replacements, grade impacts, and successive new pipeline construction effects. Site 24SB940 is outside of the area of disturbance as described in the Proposed Action; therefore, it would not be impacted by any of the alternatives. As such, none of the proposed EIS alternatives would have an adverse effect on significant historical properties.

4.2.8.1 *No Action Alternative*

Under the No Action Alternative, ongoing land uses would continue and there would be no cumulative impacts to significant cultural resources within the expanded YDTI project area.

4.2.8.2 *Proposed Action*

The Proposed Action would not impact historical properties and there would be no cumulative impacts to significant cultural resources within the proposed expanded YDTI project area.

4.2.8.3 *Accelerated Drawdown at Closure Alternative*

Cumulative impacts under the Accelerated Drawdown Alternative would be the same as the Proposed Action. There would be no cumulative impacts to significant cultural resources within the proposed expanded YDTI permit area.

4.2.8.4 *Elimination of West Embankment Drain Pumpback at Closure*

Cumulative impacts under the Elimination of WED Pumpback at Closure Alternative would be the same as the Proposed Action. There would be no cumulative impacts to significant cultural resources within the proposed expanded YDTI permit area.

4.2.8.5 *Alternative Capping Methods*

Cumulative impacts under the Alternative Capping Methods Alternative would be the same as the Proposed Action. There would be no cumulative impacts to significant cultural resources within the expanded YDTI permit area.

4.2.9 Socioeconomics

The cumulative effects area for socioeconomics is the Butte-Silver Bow City County area.

4.2.9.1 *No Action Alternative*

Under the No Action Alternative, a status quo approach would be maintained. The No Action Alternative would have no cumulative effects because there are no related future actions that, when combined with the primary or secondary socioeconomic effects of the No Action Alternative, would have a cumulative effect. The primary socioeconomic effects of the No Action are described in the Environmental Consequences section (3.11.3) and in the Secondary Impacts section (4.5.8).

4.2.9.2 *Proposed Action*

As under the No Action Alternative, there would be no cumulative socioeconomic effects from implementation of the Proposed Action.

4.2.9.3 *Accelerated Drawdown Alternative*

As under the No Action Alternative, there would be no cumulative socioeconomic effects from implementation of the Accelerated Drawdown Alternative.

4.2.9.4 *Elimination of West Embankment Drain Pumpback at Closure*

As under the No Action Alternative, there would be no cumulative socioeconomic effects from implementation of the Elimination of WED Pumpback at Closure Alternative.

4.2.9.5 *Alternative Capping Methods*

As under the No Action Alternative, there would be no cumulative socioeconomic effects from implementation of the Alternative Capping Methods Alternative.

4.2.10 Land Use

The cumulative effects area for land use is the area in the Silver Bow Creek watershed. This area encompasses the Berkeley Pit area and the Continental Mine and has vegetative cover and associated land uses similar to that represented in the proposed expansion of Permit 00030A. Related future actions considered in the cumulative effects analysis include continued operation of the Continental Mine, actions related to the BMFOU management under Superfund, uses on the adjacent Forest Service Lands, and the current level of residential development in and around the proposed permit amendment area. A search of the

Beaverhead-Deerlodge National Forest Projects pages for 2018 found one project related to cross-country ski trail grooming near Moulton Reservoir #1, and no other proposed changes to land use for the Forest Service-managed lands are currently under consideration.

4.2.10.1 No Action Alternative

Under the No Action Alternative, the permit amendment would not be approved, and ongoing land uses would continue. The No Action Alternative would not have any direct effect on the mosaic of land uses; therefore, it would not contribute to cumulative effects to land uses in the watershed.

4.2.10.2 Proposed Action

The amount of acreage that would be converted from forest to open or shallow water under the Proposed Action would not substantially alter the vegetation community or the types and character of land uses in the Silver Bow Creek watershed. Mine-affected acres in the watershed would remain as industrial sites until closure and reclamation are completed. The loss of approximately 99 additional acres of forest and shrubland wildlife habitat until reclamation is completed would not substantially change the overall mosaic of land uses in the area near the active mine. The total mine permit area covers 5,890 acres and approximately 4,632 acres is currently disturbed and being used for mining (**Table 3.7-1**). The proposed disturbance of 99 acres would alter approximately 1.7 percent of the total mine permit area. No other substantial changes in land use were identified for the cumulative effects area. Therefore, the cumulative impacts to land uses in the Silver Bow Creek watershed due to the Proposed Action would be negligible.

4.2.10.3 Accelerated Drawdown at Closure Alternative

Although the Accelerated Drawdown at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by as much as 20 to 30 years, the final reseeded and vegetation reestablishment plan would not be altered. The reestablishment of vegetation is integral to the post-closure land uses identified, namely wildlife habitat and watershed protection. This alternative may allow these land uses to be achieved as much as two to three decades sooner, which may be substantial in terms of vegetation succession, overall land appearance, and wildlife use. Although it would affect the reclamation timeline, no aspect of this alternative would affect the extent of the lands to be affected. Therefore, the potential for cumulative impacts to land use would be the same as described for the Proposed Action.

4.2.10.4 Elimination of West Embankment Drain Pumpback at Closure

Although the Elimination of the WED Pumpback at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by as much as 7 years, the final reseeded and vegetation reestablishment plan would not be altered. The reestablishment of vegetation is integral to the post-closure land uses identified, namely wildlife habitat and watershed protection. No aspect of this alternative would affect the extent of the lands to be

affected. Therefore, the potential for cumulative impacts to land use would be the same as described for the Proposed Action.

4.2.10.5 Alternative Capping Methods

Although the Alternative Capping Methods Alternative has the potential to reduce the total time to complete reclamation of the YDTI area, the final reseeded and vegetation reestablishment plan would not be altered. The reestablishment of vegetation is integral to the post-closure land uses identified, namely wildlife habitat and watershed protection. No aspect of this alternative would affect the extent of the lands to be affected. Therefore, the potential for cumulative impacts to land use would be the same as described for the Proposed Action.

4.2.11 Visual Resources

The cumulative effects area for visual resources is focused on lands within the permit boundary surrounding the YDTI, the proposed permit expansion area, and the rock waste sites. Actions considered include the raising of the West Embankment to 6,450' and potentially the other Embankments to their currently permitted elevation of 6,450', soil stockpiling, expansion of the Great Northern RDS, construction of the Northern RDS and the reclamation of the YDTI after mine closure. This area has low scenic integrity due to historic and ongoing mining activity. The West Embankment of the YDTI has only limited public viewing potential due its position in a topographic depression and limited public access. However, the Great Northern and Northern RDS would be visible from several public places that include but are not limited to: the Top of the World Trailhead, the Granite Mountain Memorial to the west and from various points along Continental Drive to the south.

4.2.11.1 No Action Alternative

Under the No Action Alternative, the West Embankment would not be raised, the Great Northern RDS would not be expanded and Northern RDS would not be constructed. Reclamation would proceed as outlined in the existing Operating Permits 00030 and 00030A. The No Action Alternative would result in unchanged and unaffected visual resources and landscape.

4.2.11.2 Proposed Action

Under the Proposed Action, the West Embankment would be raised to 6,450', other Embankments may be raised to their currently permitted elevation of 6,450', soil stockpiling would continue, the Great Northern RDS would be expanded, the Northern RDS would be constructed and the reclamation would proceed later than under the No Action Alternative. Neither the raising of the Embankments, construction or expansion of the RDS, or the later reclamation of the YDTI would have significant cumulative impacts to visual resources. They represent only an incremental increase to existing visual impacts from mining activity and contribute little additional visual contrast to a landscape already dominated by mining related features. Additionally, these minor impacts are occurring in an area with low existing scenic integrity to begin with. Finally, the reclamation of the YDTI and RDS features following mine closure would lessen the minor impacts their expansion would have on visual resources.

Therefore, the Proposed Action would have no significant cumulative impacts to visual resources.

4.2.11.3 Accelerated Drawdown Alternative

Under the Accelerated Drawdown Alternative, reclamation of the YDTI would occur at a faster rate, but the potential for cumulative impacts to visual resources would remain the same as described under the Proposed Action.

4.2.11.4 Elimination of West Embankment Drain Pumpback at Closure

Under the Elimination of WED Pumpback at Closure Alternative, reclamation of the YDTI would occur at a faster rate but the potential for cumulative impacts to visual resources would remain the same as described under the Proposed Action.

4.2.11.5 Alternative Capping Methods

Under the Alternative Capping Methods Alternative, reclamation of the YDTI would occur at a faster rate but the potential for cumulative impacts to visual resources would remain the same as described under the Proposed Action.

4.2.12 Noise

The cumulative effects area for noise is the area contained within the mine permit boundary and the West Ridge area, which was used for the noise assessment in the Affected Environment and Environmental Consequences (Section 3.14.2).

4.2.12.1 No Action Alternative

Under the No Action Alternative, the proposed amendment would not be approved, and existing noise levels would not change. The No Action Alternative would not have any direct impact on noise levels; therefore, it would not contribute to cumulative noise effects within the cumulative noise study area.

4.2.12.2 Proposed Action

Under the Proposed Action, L_{dn} noise levels at the residences in the West Ridge area would increase between 0 and 6 dBA and the L_{eq} would increase between 0 and 8 dBA. Following the 50-foot height increase of the West Embankment, noise levels would likely increase due to the decrease in topographic relief. These noise levels would persist through the life of the YDTI. No other substantial non-project related sources of noise were identified for the cumulative noise study area. Therefore, the cumulative noise effects due to the Proposed Action would be negligible.

4.2.12.3 Accelerated Drawdown Alternative

Although the Accelerated Drawdown Alternative has the potential to reduce the total time to complete reclamation of the YDTI area, the noise levels associated with increasing the embankment height would not be altered. Therefore, the cumulative noise effects from the Accelerated Drawdown Alternative would be the same as described for the Proposed Action.

4.2.12.4 Elimination of West Embankment Drain Pumpback at Closure

Although the Elimination of WED Pumpback at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area, the noise levels associated with increasing the embankment height would not be altered. Therefore, the cumulative noise effects from the Elimination of WED Pumpback at Closure Alternative would be the same as described for the Proposed Action.

4.2.12.5 Alternative Capping Methods

Although the Alternative Capping Methods Alternative has the potential to reduce the total time to complete reclamation of the YDTI area, the noise levels associated with increasing the embankment height would not be altered. Therefore, the cumulative noise effects from the Alternative Capping Methods Alternative would be the same as described for the Proposed Action.

4.2.13 Air Quality

The cumulative effects area for air quality encompasses the areas within the mine permit boundary and the Butte PM-10 Nonattainment Area (**Figure 3.15-1**). The mine permit boundary encompasses the Berkeley Pit area, the Continental Mine, and the YDTI. The northern portion of the nonattainment area overlaps the Berkeley Pit and the Continental Mine and includes portions of the YDTI as depicted on **Figure 3.15-1**.

4.2.13.1 No Action

Under the No Action Alternative, mining would continue into approximately 2022. Cumulative impacts to air quality are expected to be minimal, mitigated by the current air quality rules and regulations which are enforced under the air permit.

4.2.13.2 Proposed Action

Under the Proposed Action, mining would continue into approximately 2031. Therefore, cumulative impacts from fugitive dust may increase, but the incremental increase in activity would not cause or contribute to a violation of ambient air quality standards.

4.2.13.3 Accelerated Drawdown at Closure Alternative

Under this alternative, mining would continue for a longer duration than the No Action, but time needed to complete reclamation would decrease in comparison to the Proposed Action. The decrease in the duration of reclamation activity would be expected to minimize the potential for fugitive dust and longer-term air quality impacts. Therefore, the potential cumulative impacts would decrease in comparison to the Proposed Action.

4.2.13.4 Elimination of West Embankment Drain Pumpback at Closure

Under this alternative, mining would continue for a longer duration than the No Action. The time needed to complete reclamation would decrease by up to seven years in comparison to the Proposed Action but not as quickly as proposed in the Accelerated Drawdown at Closure Alternative. The decrease in the duration of reclamation activity in comparison to the Proposed Action is expected to minimize the potential for fugitive dust and longer-term air quality

impacts. Therefore, the potential cumulative impacts would be less in comparison to the Proposed Action.

4.2.13.5 Alternative Capping Methods

Under the Alternative Capping Methods Alternative, mining would continue for a longer duration than the No Action. Following the cessation of mining, capping material would be pumped onto the YDTI in areas susceptible to dust generation immediately following milling operations. The time needed to complete initial reclamation would decrease in comparison to the Proposed Action but the duration until final reclamation would remain unchanged. Final reclamation would be dependent upon the rate of drawdown exposing tailings beach areas available for reclamation as the equilibrium pond recedes over the next 30 to 40 years. The decrease in the duration of initial reclamation time in comparison to the Proposed Action is expected to minimize the potential for short-term intensity of air quality impacts from fugitive dust. Therefore, the potential cumulative impacts to air quality would decrease in comparison to the Proposed Action.

4.3 UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts are those environmental consequences of an action alternative that cannot be avoided, either by changing the nature of the action or through mitigation.

4.3.1 Geology and Minerals

4.3.1.1 No Action Alternative

Under the No Action Alternative, there are no unavoidable adverse impacts to geology and minerals. If this expansion is not permitted, MR would continue mining until the end of the currently permitted mine and then reclamation would commence. Existing stockpiles and capping materials to be salvaged from the mine will be utilized for reclamation at the end of mining operations. Although most alluvium and leached cap to be mined in the near term in the Continental Pit would be used for embankment construction, reserves of alluvium in the Central Zone would be available for reclamation. This alluvium reserve is abundant and adequate for reclamation of mine components (Montana Resources 2018a).

4.3.1.2 Proposed Action

Under the Proposed Action, the capacity of YDTI would be increased to store additional tailings generated from mining at the Continental Pit. The unavoidable impact to geology and minerals is the additional surface disturbance and increase in size and depth of the Continental Pit due to the removal of waste rock and ore. Continued mining would result in additional tailings stored in the YDTI and inundation of the surficial geology and soils in the footprint of the expanding impoundment.

Similar to the No Action Alternative, existing stockpiles and capping materials to be salvaged from the mine will be utilized for reclamation at the end of mining operations. Although most

alluvium and leached cap to be mined in the near term in the Continental Pit would be used for embankment construction, reserves of alluvium in the Central Zone would be available for reclamation. Under the Proposed Action, the increase in the size of the mine and mine components would require additional material for reclamation when compared to the No Action Alternative. The alluvium reserve is abundant and adequate for reclamation of mine components (Montana Resources 2018a).

4.3.1.3 Accelerated Drawdown at Closure Alternative

The Accelerated Drawdown at Closure Alternative is the same as the Proposed Action in terms of unavoidable impact to geology and minerals. However, if the excess supernatant pond water is removed from the YDTI and stored in the Continental Pit, then impacts to access the pit bottom for additional exploration and mining would be unavoidable.

Similar to the No Action Alternative, existing stockpiles and capping materials to be salvaged from the mine, along with reserves of alluvium from the Central Zone, would be adequate for reclamation of mine components (Montana Resources 2018a).

4.3.1.4 Elimination of West Embankment Drain Pumpback at Closure

Elimination of WED Pumpback Alternative is the same as the Proposed Action in terms of unavoidable impact to geology and minerals. However, if the WED seepage water is diverted and stored in the Continental Pit, then impacts to access for additional exploration and mining would be unavoidable.

Similar to the No Action Alternative, existing stockpiles and capping materials to be salvaged from the mine, along with reserves of alluvium from the Central Zone, would be adequate for reclamation of mine components (Montana Resources 2018a).

4.3.1.5 Alternative Capping Methods

The Alternative Capping Methods Alternative would accelerate the reclamation of the YDTI and reduce the overall reclamation schedule. This alternative is the same as the Proposed Action in terms of unavoidable impact to geology and minerals.

Similar to the No Action Alternative, existing stockpiles and capping materials to be salvaged from the mine, along with reserves of alluvium from the Central Zone, would be adequate for reclamation of mine components (Montana Resources 2018a).

4.3.2 Geotechnical Stability

Unavoidable adverse impacts for the geotechnical stability of the YDTI Embankment would relate to the overall stability of the embankment over time due to continued mining operations from the Continental Mine. Considerations for unavoidable adverse impacts include the continued operation of MR within the Continental Mine, the use of the YDTI until the end of mining, and the construction of rockfill surcharge adjacent to the East-West Embankment from 2014-2017. The surcharge, or rockfill placed on top of tailings to improve consolidation, increased the stability of the embankment in preparation for the proposed embankment raise.

Other considerations include actions related to post-mining management of water from the YDTI as well as the level of development and human activity downstream of the YDTI.

4.3.2.1 No Action Alternative

Under the No Action Alternative, the permit amendment would not be approved and the YDTI West Embankment would not be raised to an elevation of 6,450 feet. The YDTI Embankment would not be affected and the No Action Alternative would not have any unavoidable adverse effects on the geotechnical stability of the embankment.

4.3.2.2 Proposed Action

Under the Proposed Action, the YDTI Embankment would be raised to an elevation of 6,450 feet and a North RDS would be added as a buttress to the downstream side of the North-South Embankment. The estimated factor of safety values resulting from increasing the embankment height and the construction of the North RDS would decrease steadily from completion of the West Embankment construction through end of mining. This decrease in safety values would result from the increase in tailings volume and water in the YDTI but the values would far exceed the statutory design requirements, as shown on **Figure 4.2-1**. The stability of the embankment would be maintained above regulatory requirements through the addition of the North RDS as a buttress to the downstream North- South Embankment and through the management of the embankment slopes and top width (see the discussion in Section 3.3, Geotechnical Engineering). With these design elements, there would be no unavoidable adverse effects related to geotechnical engineering from the Proposed Action.

4.3.2.3 Accelerated Drawdown at Closure Alternative

The Accelerated Drawdown at Closure Alternative could significantly reduce the time necessary to reach equilibrium conditions in the YDTI. The Accelerated Drawdown at Closure Alternative would reduce the water levels within the YDTI from near the maximum pool elevation of 6,428 feet in elevation to near the equilibrium pool elevation more quickly than under the No Action and Proposed Action Alternatives. The accelerated drawdown in the pool water levels within the YDTI would act to reduce the overall weight acting against the embankment. The YDTI Embankment would not experience any changes in factor of safety due to the accelerated drawdown, as the tailings mass immediately adjacent to the embankment would remain in place against the upstream face of the embankment. This alternative would not result in unavoidable adverse impacts to the geotechnical stability of the YDTI Embankment. Therefore, the unavoidable adverse impacts from this alternative would be the same as for the Proposed Action.

4.3.2.4 Elimination of West Embankment Drain Pumpback at Closure

The Elimination of the WED Pumpback at Closure would result in a reduction of approximately 7 years in the time to complete reclamation of the YDTI area due to a reduction in the amount of water within the YDTI. Under this alternative, the geotechnical stability of the YDTI Embankment would not be reduced. Therefore, the unavoidable adverse impacts from this alternative would be the same as for the Proposed Action.

4.3.2.5 *Alternative Capping Methods*

The Alternative Capping Methods Alternative would also result in an approximate 2 year reduction in the time to complete reclamation of the YDTI area. Under this alternative, the geotechnical stability of the YDTI Embankment would not be reduced. Therefore, the unavoidable adverse impacts from this alternative would be the same as for the Proposed Action.

4.3.3 Soils and Reclamation

4.3.3.1 *No Action Alternative*

Under the No Action Alternative, there are no unavoidable adverse impacts to soils or reclamation. MR would continue mining until the end of the currently permitted mine life and then reclaim existing disturbance with the stockpiled soils without additional disturbance.

4.3.3.2 *Proposed Action*

Under the Proposed Action, the YDTI would be increased in size. This would necessitate additional acres being disturbed and ultimately reclaimed. The unavoidable impact is the additional surface disturbance under the Proposed Action to support mine activities including 85.4 acres of soil disturbance (**Table 3.5-3**). All available soil or growth medium would be removed prior to commencing construction activities on new areas. The Proposed Action would generate an additional 267,100 cubic yards of soil and replace the same soil on mine site areas requiring reclamation or store in stockpiles (Montana Resources 2018b). Salvaged stockpiled soil would be stored until such time that reclamation could be initiated, and soil replaced onto disturbed areas.

New areas cleared of vegetation would be susceptible to soil erosion from wind and water. Erosion of soil would also occur as a result of soil removal and storage during mine operations and soil exposure during respreading and stabilization. Soil erosion on disturbed areas would likely occur until vegetation is established and surfaces are protected from erosive forces. Although completely eliminating erosion is unavoidable, best management practices (BMP) would be implemented to minimize negative impacts from erosion.

4.3.3.3 *Accelerated Drawdown at Closure Alternative*

This Accelerated Drawdown at Closure Alternative is the same as the Proposed Action in terms of proposed acres of additional disturbance and reclamation approach. Therefore, there would be no difference in unavoidable impacts as compared to the Proposed Action.

4.3.3.4 *Elimination of West Embankment Drain Pumpback at Closure*

This Elimination of WED Pumpback Alternative reduces water input back to YDTI, which would speed up reclamation activities at the facility. This Alternative is the same as the Proposed Action in terms of proposed acres of additional disturbance and reclamation approach. Therefore, there would be no difference in unavoidable impacts as compared to the Proposed Action.

4.3.3.5 *Alternative Capping Methods*

This Alternative Capping Methods Alternative is meant to accelerate the reclamation and reduce the overall reclamation schedule. This alternative is the same as the Proposed Action in terms of proposed acres of additional disturbance and reclamation approach. The only change to soil and reclamation would be in the timing compared to the Proposed Action. Therefore, there would be no difference in unavoidable impacts as compared to the Proposed Action.

4.3.4 *Ground and Surface Water Resources*

4.3.4.1 *No Action Alternative*

Under the No Action Alternative, mine operations and reclamation would continue as presently permitted. There would not be any unavoidable impacts on ground water resources due to the prevailing YDTI-directed hydraulic gradient. For surface water, the only unavoidable impact is the necessity that Horseshoe Bend seepage be continually managed and treated under Superfund for as long as seepage occurs.

4.3.4.2 *Proposed Action*

Compared to the No Action Alternative, there would be no additional unavoidable adverse impacts to ground water or surface water resources, because the main effect of the Proposed Action would be only to extend the duration of mining and reclamation.

4.3.4.3 *Accelerated Drawdown at Closure Alternative*

This alternative differs from the Proposed Action mainly in that it expedites drawdown of the supernatant pond, which does not alter the potential for unavoidable impacts to surface or ground water. Thus, as with the No Action and Proposed Action alternatives, the necessity of continuing treatment of Horseshoe Bend seepage is the only anticipated unavoidable impact.

4.3.4.4 *Elimination of West Embankment Drain Pumpback at Closure*

This alternative is similar to the Accelerated Drawdown at Closure Alternative. Thus, other than those noted in Section 4.3.4.3, no unavoidable adverse impacts to water resources are anticipated.

4.3.4.5 *Alternative Capping Methods*

The necessity of continuing treatment of Horseshoe Bend water is the only anticipated unavoidable impact. Therefore, unavoidable impacts under the Alternative Capping Methods Alternative are the same as for the other alternatives.

4.3.5 *Vegetation and Wetlands*

4.3.5.1 *No Action Alternative*

Under the No Action Alternative, the permit amendment would not be approved, and ongoing land uses would continue. The No Action Alternative would not have any direct effect on vegetation or wetlands; therefore, it would not have any unavoidable adverse effects to vegetation or wetlands.

4.3.5.2 Proposed Action

The inundation of approximately 99 acres of vegetated lands is a necessary component of the expansion of the YDTI (**Figure 3.7-1**). Therefore, this impact would be unavoidable under the Proposed Action. At closure, dewatering would reverse the inundation and reclamation would reestablish vegetation on the amended tailings surfaces. The post-closure land uses are identified as wildlife habitat and watershed protection and are supported by a detailed revegetation plan. Therefore, the unavoidable impacts would be temporary and would be mitigated by the reclamation plan. Revegetated habitats would be predominately grassland instead of the forested types currently present and reestablishment of premining vegetation composition would be subject to natural vegetation succession.

4.3.5.3 Accelerated Drawdown at Closure Alternative

Although the Accelerated Drawdown at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area, the final reseeding and vegetation reestablishment plan would not be altered. No aspect of this alternative would affect the extent of the areas to be inundated. The reduced time for reclamation would reduce the overall duration of the adverse impacts, but it would not circumvent them. Therefore, the potential for unavoidable adverse impacts to vegetation would be the same as described for the Proposed Action.

4.3.5.4 Elimination of West Embankment Drain Pumpback at Closure

Although the Elimination of the WED Pumpback at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area, the final reseeding and vegetation reestablishment plan would not be altered. No aspect of this alternative would affect the extent of the areas to be inundated. Therefore, the potential for unavoidable adverse impacts to vegetation would be the same as described for the Proposed Action.

4.3.5.5 Alternative Capping Methods

Although the Alternative Capping Methods Alternative has the potential to reduce the total time to complete reclamation of the YDTI area, the final reseeding and vegetation reestablishment plan would not be altered. No aspect of this alternative would affect the extent of the areas to be inundated. Therefore, the potential for unavoidable adverse impacts to vegetation would be the same as described for the Proposed Action.

4.3.6 Wildlife

4.3.6.1 No Action Alternative

Under the No Action Alternative, there would be no unavoidable adverse impacts because there would be no primary impacts to wildlife.

4.3.6.2 Proposed Action

The inundation of approximately 99 acres of vegetated lands is a necessary component of the expansion of the YDTI. Therefore, this impact would be unavoidable under the Proposed Action. At closure, dewatering would reverse the inundation and reclamation would reestablish

vegetation on the amended tailings surfaces. The post-closure land uses are identified as wildlife habitat and watershed protection and are supported by a detailed revegetation plan. However, the habitat types inundated would not be restored. Therefore, the unavoidable impacts would be the temporary loss of wildlife habitat while the mine is active, and the long-term or permanent loss of certain habitat types, especially deciduous forested habitat. The species that would benefit or lose from this change are described in Section 3.8.

4.3.6.3 Accelerated Drawdown Alternative

The unavoidable impacts under the Accelerated Drawdown Alternative are similar to those described under the Proposed Action. The Accelerated Drawdown Alternative has the potential to reduce the total time to complete reclamation of the YDTI area. Based on the tailings surface consolidation modeling, reclamation of the YDTI Transition Zone could begin between 5 to 9 years after closure rather than 30 to 40 years as anticipated under the Proposed Action. If so, the unavoidable impact from habitat loss would be of shorter duration than under the Proposed Action.

4.3.6.4 Elimination of West Embankment Drain Pumpback at Closure

The unavoidable adverse impacts to wildlife under the Elimination of WED Pumpback at Closure Alternative would be similar to those described for the Proposed Action. The Elimination of the WED Pumpback at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by as much as 7 years. If so, the unavoidable impact from habitat loss would be of shorter duration than under the Proposed Action.

4.3.6.5 Alternative Capping Methods

The unavoidable adverse impacts to wildlife under the Alternative Capping Methods Alternative would be similar to those described under the Proposed Action. The Alternative Capping Methods Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by as much as 2 years. If so, the unavoidable impact from habitat loss would be of shorter duration than under the Proposed Action.

4.3.7 Aquatics

4.3.7.1 No Action Alternative

There would be no unavoidable adverse impacts to aquatic resources under the No Action Alternative because disturbance of these resources would not occur, as described in Section 3.9.3.

4.3.7.2 Proposed Action

The potential unavoidable effects on aquatics from the Proposed Action relate to the length of the streams tributary to the YDTI that would be inundated as the YDTI expands. These impacts would be unavoidable because the water level in the YDTI would rise as part of its function to accommodate the additional tailings. Approximately 0.04 miles of Yankee Doodle Creek, 0.02

miles of Dixie Creek, and 0.06 miles of upper Silver Bow Creek would be converted to standing water (**Table 3.9-1**). Since the water quality in the YDTI is inhospitable to fish and macroinvertebrates (Section 3.9.2), this would constitute a small loss of habitat for fish and other aquatic organisms inhabiting the lower reaches of those streams. The filling of the YDTI would make the duration of the loss of these reaches extend through closure as the shoreline at closure would be maintained at about 6,428 feet (Montana Resources 2018b). The reclamation plan states that the pond would decrease in size as the tailings dry, and the final expected pond elevation would be around 67 feet lower at 6,363 feet. As the pond edge recedes, the streams may reestablish some of the channel length and maintain a connection to the pond. However, the pond water quality is not expected to improve from what is currently present for many years after closure (Section 3.6.2).

4.3.7.3 Accelerated Drawdown at Closure Alternative

Although the Accelerated Drawdown at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by as much as 20 to 30 years, the final reclamation plan would not be altered. No aspect of this alternative would affect the extent of the stream channels to be inundated. Therefore, the potential for unavoidable adverse impacts to aquatics would be the same as described for the Proposed Action.

4.3.7.4 Elimination of West Embankment Drain Pumpback at Closure

Although the Elimination of the WED Pumpback at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by as much as 7 years, the final reclamation plan would not be altered. No aspect of this alternative would affect the extent of the stream channels to be inundated. Therefore, the potential for unavoidable adverse impacts to aquatics would be the same as described for the Proposed Action.

4.3.7.5 Alternative Capping Methods

Although the Alternative Capping Methods Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by as much as 2 years, the final reclamation plan would not be altered. No aspect of this alternative would affect the extent of the stream channels to be inundated. Therefore, the potential for unavoidable adverse impacts to aquatics would be the same as described for the Proposed Action.

4.3.8 Cultural Resources

The project area of potential effect and cultural resource conditions considered for unavoidable adverse impacts would be the same as described in the Cultural Resources Cumulative Impacts (Section 4.2.8) of this EIS.

4.3.8.1 No Action Alternative

Under the No Action Alternative, ongoing land uses would continue and there would be no unavoidable adverse impacts to significant cultural resources within the proposed expanded YDTI area.

4.3.8.2 Proposed Action

The Proposed Action would not impact historical properties and there would be no unavoidable adverse impacts to significant cultural resources within the proposed expanded YDTI area.

4.3.8.3 Accelerated Drawdown Alternative

Unavoidable adverse impacts under the Accelerated Drawdown Alternative would be the same as the Proposed Action. There would be no unavoidable adverse impacts to significant cultural resources within the proposed expanded YDTI area.

4.3.8.4 Elimination of West Embankment Drain Pumpback at Closure

Unavoidable adverse impacts under the Elimination of WED Pumpback at Closure Alternative would be the same as the Proposed Action. There would be no unavoidable adverse impacts to significant cultural resources within the proposed expanded YDTI area.

4.3.8.5 Alternative Capping Methods

Unavoidable adverse impacts under the Alternative Capping Methods Alternative would be the same as the Proposed Action. There would be no unavoidable adverse impacts to significant cultural resources within the proposed expanded YDTI area.

4.3.9 Socioeconomics

4.3.9.1 No Action Alternative

Under the No Action Alternative unavoidable adverse impacts would be the loss of some of the approximately 364 jobs at mine closure (Year 2022). Although MR has not projected changes to employment during reclamation and after reclamation is complete, it is likely that some mine-related jobs would be eliminated or revised. The loss of tax revenue to Silver Bow County and to the Hard Rock Trust Account at mine closure would also be unavoidable.

4.3.9.2 Proposed Action

Under the Proposed Action, the loss of jobs and tax revenue at mine closure would be delayed for approximately nine years beyond the No Action Alternative, but losses would still be unavoidable. Therefore, the economic impact to the ROI would be less severe than under the No Action Alternative.

4.3.9.3 Accelerated Drawdown Alternative

Under the Accelerated Drawdown Alternative, the unavoidable adverse impacts would be similar to the Proposed Action. The Accelerated Drawdown Alternative has the potential to complete reclamation as much as 20 to 30 years sooner than under the Proposed Action. If reclamation were completed more quickly, any jobs associated with reclamation would be likely to end sooner than under the Proposed Action.

4.3.9.4 Elimination of West Embankment Drain Pumpback at Closure

The unavoidable adverse impacts associated with the Elimination of WED Pumpback at Closure Alternative would be similar to that described under the Proposed Action. The Elimination of the WED Pumpback at Closure Alternative has the potential to complete reclamation as much

as 7 years sooner than under the Proposed Action. If reclamation were completed more quickly, any jobs associated with reclamation would be likely to end sooner than under the Proposed Action.

4.3.9.5 *Alternative Capping Methods*

Under the Alternative Capping Methods Alternative, the unavoidable adverse impacts would be similar to that described under the Accelerated Drawdown Alternative. The Alternative Capping Methods Alternative has the potential to complete reclamation as much as 2 years sooner than under the Proposed Action. If reclamation were completed more quickly, any jobs associated with reclamation would be likely to end sooner than under the Proposed Action.

4.3.10 Land Use

4.3.10.1 *No Action Alternative*

Under the No Action Alternative, the permit amendment would not be approved, and ongoing land uses would continue. The No Action Alternative would not have any direct effect on land uses in the area; therefore, it would not have any unavoidable adverse effects on land use within the existing permit boundary.

4.3.10.2 *Proposed Action*

The inundation of approximately 99 acres of vegetated lands is a necessary component of the expansion of the YDTI. Therefore, this impact would be unavoidable under the Proposed Action. At closure, dewatering would reverse the inundation and reclamation would reestablish vegetation on the amended tailings surfaces. The final pond size would be reduced from the maximum of 26,000 acre-feet at post-closure to approximately 1,000 acre-feet. Therefore, the total land area covered by open water would also decrease. The post-closure land uses are identified as wildlife habitat and watershed protection and are supported by a detailed revegetation plan. Therefore, the unavoidable impacts to land use would be temporary and would be mitigated by the reclamation plan.

4.3.10.3 *Accelerated Drawdown at Closure Alternative*

Although the Accelerated Drawdown at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by as much as 20 to 30 years, the final reseeding and vegetation reestablishment design would not be altered. No aspect of this alternative would affect the extent of the areas to be inundated or the final size of the pond after closure. Therefore, the potential for unavoidable adverse impacts to land use during operations would be the same as described for the Proposed Action. The reestablishment of vegetation is integral to the post-closure land uses identified, namely wildlife habitat and watershed protection. This alternative may allow these land uses to be achieved as much as two to three decades sooner, which may be substantial in terms of vegetation succession, overall land appearance, and wildlife use.

4.3.10.4 Elimination of West Embankment Drain Pumpback at Closure

Although the Elimination of the WED Pumpback at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by as much as 7 years, the final reseeding and vegetation reestablishment plan would not be altered. No aspect of this alternative would affect the extent of the areas to be inundated or the final size of the pond after closure. Therefore, the potential for unavoidable adverse impacts to land use would be the same as described for the Proposed Action.

4.3.10.5 Alternative Capping Methods

Although the Alternative Capping Methods Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by as much as 2 years, the final reseeding and vegetation reestablishment plan would not be altered. No aspect of this alternative would affect the extent of the areas to be inundated or the final size of the pond after closure. Therefore, the potential for unavoidable adverse impacts to land use would be the same as described for the Proposed Action.

4.3.11 Visual Resources

4.3.11.1 No Action Alternative

Under the No Action Alternative, the West Embankment would not be raised, the Great Northern RDS would not be expanded and the Northern RDS would not be constructed. Reclamation would proceed as outlined in the existing Operating Permits 00030 and 00030A. The No Action Alternative would result in unchanged and unaffected visual resources and landscape.

4.3.11.2 Proposed Action

Under the Proposed Action, the West Embankment would be raised to 6,450', other Embankments may be raised to their currently permitted elevation of 6,450', soil stockpiling would continue, the Great Northern RDS would be expanded, the Northern RDS would be constructed and the reclamation would proceed later than under the No Action Alternative. These actions would have minor unavoidable impacts to visual resources. However, they represent only an incremental increase to existing visual impacts from mining activity and would contribute little additional visual contrast to a landscape already dominated by mining related features. Additionally, these minor unavoidable impacts are occurring in an area with low existing scenic integrity. Finally, the reclamation of the YDTI and RDS features following mine closure would lessen the minor impacts their expansion would have on visual resources. Therefore, the Proposed Action would have no significant unavoidable adverse impacts to visual resources.

4.3.11.3 Accelerated Drawdown Alternative

Under the Accelerated Drawdown Alternative, reclamation of the YDTI would occur at a faster rate but the potential unavoidable adverse impacts would remain the same as described in the Proposed Action.

4.3.11.4 Elimination of West Embankment Drain Pumpback at Closure

Under the Elimination of WED Pumpback at Closure Alternative, reclamation of the YDTI would occur at a faster rate but the potential for unavoidable adverse impacts would remain the same as described in the Proposed Action.

4.3.11.5 Alternative Capping Methods

Under the Alternative Capping Methods Alternative, reclamation of the YDTI would occur at a faster rate but the potential for unavoidable adverse impacts would remain the same as described in the Proposed Action.

4.3.12 Noise

4.3.12.1 No Action

Under the No Action Alternative, the proposed amendment would not be approved, and existing noise levels would not change. The No Action Alternative would not have any direct effect on noise levels in the area; therefore, it would not contribute to unavoidable adverse effects on noise within the noise study area (permit boundary and West Ridge area).

4.3.12.2 Proposed Action

Under the Proposed Action, L_{dn} noise levels at the residences in the West Ridge area would increase between 0 and 6 dBA and the L_{eq} would increase between 0 and 8 dBA. Following the 50-foot height increase of the West Embankment, noise levels would likely increase due to the decrease in topographic relief. These noise levels would persist through the life of the YDTI. The unavoidable adverse effects from noise would occur at residences, where noise levels would increase.

4.3.12.3 Accelerated Drawdown Alternative

Although the Accelerated Drawdown Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by as much as 20 to 30 years, the noise levels associated with increasing the embankment height and during reclamation activities would not be altered. Therefore, the potential for unavoidable adverse effects from noise would be the same as described for the Proposed Action, but the total duration of these effects may be reduced.

4.3.12.4 Elimination of West Embankment Drain Pumpback at Closure

Although the Elimination of WED Pumpback at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by as much as 7 years, the noise levels associated with increasing the embankment height and during reclamation activities would not be altered. Therefore, the potential for unavoidable adverse effects from noise would be the same as described for the Proposed Action.

4.3.12.5 Alternative Capping Methods

Although the Alternative Capping Methods Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by as much as 2 years, the noise levels associated with increasing the embankment height and during reclamation activities would not

be altered. Therefore, the potential for unavoidable adverse effects from noise would be the same as described for the Proposed Action.

4.3.13 Air Quality

4.3.13.1 No Action Alternative

Under the No Action Alternative, mining would continue. This activity does impact regional air quality and the impacts are unavoidable. However, air quality impacts are expected to be minor and would still meet ambient air quality standards.

4.3.13.2 Proposed Action

The Proposed Action would not increase the intensity of fugitive dust, but would increase the timeframe of dust generation by increasing the duration of mining activity. However minor, these impacts from fugitive dust would be unavoidable. MR would continue to implement its dust management plan to minimize these effects.

4.3.13.3 Accelerated Drawdown at Closure Alternative

This alternative would not increase the intensity of fugitive dust but could reduce the period of time dust is generated during reclamation with respect to the Proposed Action since reclamation would be completed as much as 20 to 30 years sooner. However minor, these impacts from fugitive dust would be unavoidable.

4.3.13.4 Elimination of West Embankment Drain Pumpback at Closure

This alternative would not increase the intensity of fugitive dust but could reduce the period of time dust is generated during reclamation by as much as 7 years. The elimination of the WED pumpback at closure following mining would accelerate drawdown and expedite access of heavy machinery on the YDTI for final reclamation. However, dust control measures would still be necessary prior to complete reclamation. However minor, these impacts from fugitive dust would be unavoidable.

4.3.13.5 Alternative Capping Methods

This alternative could decrease the short-term intensity of fugitive dust during initial reclamation by as much as 2 years but would not reduce the period of time dust may be generated until final reclamation is completed. The addition of alluvial capping material placed on the beach area immediately following mining would expedite access of heavy machinery on the YDTI. However, dust control measures would still be necessary prior to the completion of final reclamation as the equilibrium pond recedes over the next 30 to 40 years. However minor, these impacts from fugitive dust would be unavoidable.

4.4 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

An irreversible or irretrievable commitment of resources refers to impacts on or losses to resources that cannot be recovered or reversed. Examples include permanent conversion of wetlands, loss of agricultural production, or changes in socioeconomic conditions. The term

“irreversible” describes the loss of future options. It applies usually to the impacts of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity, that are renewable only over long periods. As an example, once ore is mined from a mineral deposit, it cannot be replaced.

Irretrievable is a term that applies to loss of production, harvest, or use of natural resources. As an example, grazing lands taken out of production while the land is used for a different purpose are lost irretrievably even if only temporarily. The production lost is irretrievable, but the action is not irreversible if the lands can be returned to their prior use.

4.4.1 Geology and Minerals

4.4.1.1 No Action Alternative

There would be irreversible and irretrievable commitments of mineral resources under the No Action Alternative because mining would continue until 2022. Therefore, there would be an irreversible removal of minerals from the Continental Pit. The removal of these minerals would be part of the function of the mine.

4.4.1.2 Proposed Action

Under the Proposed Action, the YDTI would be expanded from its currently permitted acreage and mining at the Continental Pit would continue beyond 2022 to approximately 2031 (Montana Resources 2018b). Therefore, there would be an additional period of irreversible removal of minerals from the Continental Pit as compared to the No Action Alternative. The removal of these minerals would result from mining operations.

4.4.1.3 Accelerated Drawdown at Closure Alternative

Under the Accelerated Drawdown at Closure Alternative, the irreversible mineral extraction would be identical to the Proposed Action. If the YDTI water is diverted into and stored in the Continental Pit, then access to additional exploration and mining would be irretrievably affected unless the stored water was removed from the pit and either treated and discharged off-site, or pumped back to the YDTI.

4.4.1.4 Elimination of West Embankment Drain Pumpback at Closure

Under the Elimination of WED Pumpback Alternative at Closure the irreversible mineral extraction would be identical to the Proposed Action. If the WED seepage water is diverted into and stored in the Continental Pit, then access to additional exploration and mining would be irretrievably affected unless the stored water could be removed from the pit.

4.4.1.5 Alternative Capping Methods

Under the Alternative Capping Methods Alternative, the irreversible and irretrievable mineral extraction would be identical to the Proposed Action.

4.4.2 Geotechnical Stability

4.4.2.1 No Action Alternative

Under the No Action Alternative, the permit amendment would not be approved and the YDTI Embankment would not be raised 50 feet. The YDTI Embankment would not be affected and the No Action Alternative would have no irreversible or irretrievable effects on the geotechnical stability of the embankment.

4.4.2.2 Proposed Action

Under the Proposed Action, the YDTI Embankment would be raised 45 feet to provide additional storage capacity within the YDTI for tailings and water. None of the alternatives would result in irreversible or irretrievable commitment of resources related to the geotechnical stability of the YDTI as this is not a non-renewable resource.

4.4.2.3 Other Action Alternatives

No aspect of the Accelerated Drawdown at Closure, the Elimination of WED Pumpback Alternative at Closure, or the Alternative Capping Methods Alternative would affect geotechnical stability of the embankment. Therefore, there would be no irreversible or irretrievable commitment of resources related to the geotechnical stability of the YDTI.

4.4.3 Soils and Reclamation

4.4.3.1 No Action Alternative

Under the No Action Alternative, there would be minimal irretrievable impacts to soils. MR would continue mining until the end of the currently permitted mine life and then reclaim existing disturbance with the existing soils without additional disturbance. However minor, some soils would be irretrievably displaced or removed from the area due to wind and water erosion during the mining, soil stockpiling, and reclamation activities. BMPs and other established soil management procedures would minimize these effects.

Soil disturbance and salvage would not be considered irreversible as reclamation activities would redistribute stockpiled soils and restore soil productivity to levels supportive of the post-closure land uses described in the reclamation plan.

4.4.3.2 Proposed Action

Under the Proposed Action, the YDTI would be increased from its currently permitted acreage and result in an irretrievable loss of approximately 85.4 acres due to expansion.

The irretrievable commitment of soil resources means all available soil or growth medium would be removed (salvaged) prior to commencing construction activities on new areas. The Proposed Action would generate an additional 267,100 cubic yards of salvaged soil. The soil salvage is not irreversible as salvaged stockpiled soil would be stored until such time that reclamation would be initiated when soil would be replaced onto disturbed areas. Soil

productivity would be restored to levels supportive of the post-closure land uses described in the reclamation plan

4.4.3.3 Accelerated Drawdown at Closure Alternative

This Accelerated Drawdown at Closure Alternative would be the same as the Proposed Action in terms of proposed acres of additional disturbance and reclamation approach. Under this Alternative, the irreversible and irretrievable soil salvage and replacement effects would be identical to the Proposed Action, except for the reduction in reclamation timing. Since reclamation would begin sooner, the duration of the irretrievable commitment of soil resources would be shorter.

4.4.3.4 Elimination of West Embankment Drain Pumpback at Closure

This Elimination of WED Pumpback Alternative reduces water input back to YDTI, which would speed up reclamation activities at the facility. This alternative would be the same as the Proposed Action in terms of proposed acres of additional disturbance and reclamation approach. Under this alternative, the irreversible and irretrievable soil salvage and replacement effects would be identical to the Proposed Action, except for the reclamation timing. Since reclamation would begin sooner, the duration of the irretrievable commitment of soil resources would be shorter.

4.4.3.5 Alternative Capping Methods

This Alternative Capping Methods Alternative is meant to reduce the overall time to complete reclamation. This alternative is the same as the Proposed Action in terms of proposed acres of additional disturbance and the same in terms of reclamation approach. The only change to soil and reclamation would be in the timing compared to the Proposed Action. Under this alternative, the irreversible and irretrievable soil salvage and replacement effects would be identical to the Proposed Action. This alternative would speed up reclamation by allowing access to the beach area sooner than the Proposed Action.

4.4.4 Ground and Surface Water Resources

4.4.4.1 No Action Alternative

Continuing operation of the mine and YDTI pond would lead to the ongoing irretrievable loss of water through pond evaporation (1 MGD) and to storage in tailings voids (4.5 MGD) during mine operations (Montana Resources 2018b). These losses would decrease following mine closure in 2022, because the size of the pond would decrease and new tailings would not continue to be added after this time. However, assuming an equilibrium pond volume of 1,000 acre-feet, the evaporative loss of water would continue into the future, albeit at a lower rate than during operations. Groundwater is anticipated to remain unaffected.

4.4.4.2 Proposed Action

Irreversible and irretrievable commitments of water resources under the Proposed Action would be similar to those under the No Action Alternative, although supernatant pond equilibrium is predicted to be reached sooner under the Proposed Action (Knight Piesold 2018d). However, the additional tailings volume that would be added to the pond during the period of extended mining would likely increase the amount of water lost to storage in tailings voids compared to the No Action Alternative. Irretrievable evaporative losses would continue for as long as a reclamation pond exists.

4.4.4.3 Accelerated Drawdown at Closure Alternative

Irreversible and irretrievable commitments of water resources under the Accelerated Drawdown at Closure Alternative would be similar to those under the Proposed Action. This alternative reduces the duration of supernatant pond drawdown to its equilibrium volume of 1,000 acre-feet, which would likely moderately reduce the amount of irretrievable evaporative losses from the pond compared to the Proposed Action.

4.4.4.4 Elimination of West Embankment Drain Pumpback at Closure

Irreversible and irretrievable commitments of water resources under this alternative would be similar to those described for the Accelerated Drawdown at Closure Alternative. Irreversible evaporative losses would occur from the supernatant pond but would decrease as the pond area is reduced. However, irretrievable evaporative losses would continue for as long as a reclamation pond exists.

4.4.4.5 Alternative Capping Methods

Irreversible and irretrievable commitments of water resources under the Alternative Capping Methods Alternative would be similar to those under the Proposed Action and would be related to the irretrievable loss of water to evaporation and storage in tailings pore space.

4.4.5 Vegetation and Wetlands

4.4.5.1 No Action Alternative

There would be no irreversible or irretrievable impacts to vegetation resources under the No Action Alternative because disturbance of these resources beyond what has already been permitted would not occur, as described in Section 3.7.3.

4.4.5.2 Proposed Action

Under the Proposed Action there would be an irretrievable loss of approximately 99 acres of forested land and shrublands due to inundation as the YDTI level rises. The trees and shrubs are likely to die off if inundated for extended periods and would be lost for the duration of the project and until vegetation is reestablished through reclamation. The land would be returned to predominately grassland types of vegetated cover, so the loss is not irreversible, but reestablishing trees would take years and would only occur through natural vegetation succession. As stated in the reclamation plan there are suitable seed sources nearby on

undisturbed lands that would augment the replanting and reseeded and make reestablishment of pre-mining vegetation communities likely over the decades after closure. However, the reseeded plan would shift the vegetation composition on those 99 acres from forested to grassland (see **Table 3.7-1**) and any return to the current composition would be dependent on vegetation succession.

4.4.5.3 Accelerated Drawdown at Closure Alternative

The Accelerated Drawdown at Closure Alternative would reduce the total time to dewater the tailings to the point where reclamation and reseeded could begin. Therefore, vegetation may be able to become reestablished as much as two to three decades sooner than under the Proposed Action. The exact reduction would depend on the rate of drawdown realized and how that affects reclamation progress. The extent and intensity of irretrievable losses would be the same as under the Proposed Action, but the duration of the loss may be shorter. Similar to the Proposed Action, no irreversible impacts to vegetation would occur.

4.4.5.4 Elimination of West Embankment Drain Pumpback at Closure

The Elimination of the WED Pumpback Drain at Closure Alternative would reduce the total time to dewater the tailings to the point where reclamation and reseeded could begin. Therefore, vegetation may be able to become reestablished a few years sooner than under the Proposed Action. The exact reduction would depend on how much of a reduction in total volume of the YDTI can be achieved by eliminating the WED pumpback and how that affects the surface conditions necessary for reclamation progress. The extent and intensity of irretrievable losses would be the same as under the Proposed Action, but the duration of the loss may be shorter. Similar to the Proposed Action, no irreversible impacts to vegetation would occur.

4.4.5.5 Alternative Capping Methods

Similar to the previous two alternatives, the Alternative Capping Methods Alternative would reduce the overall time to reclamation initiation. Therefore, vegetation may be able to become reestablished as much as 2 years sooner than under the Proposed Action. The exact reduction would depend on how the tailings placement would affect the surface conditions necessary for reclamation progress. The extent and intensity of irretrievable losses would be the same as under the Proposed Action, but the duration of the loss may be shorter. Similar to the Proposed Action, no irreversible impacts to vegetation would occur.

4.4.6 Wildlife

4.4.6.1 No Action Alternative

Under the No Action Alternative, there would be no irreversible or irretrievable impacts to wildlife because the permit amendment would not be approved, and the impacts described under the action alternatives would not occur.

4.4.6.2 Proposed Action

Under the Proposed Action, the loss of wildlife productivity on the 99 acres inundated by the YDTI from 2031 to 2060 (when reclamation is projected to be complete) would be irretrievable. As the YDTI is filled and expanded, there would be a gradual habitat loss from 2022 to 2031. Wildlife productivity from the habitat types inundated and not reclaimed to the same habitat value would be irretrievable and possibly irreversible if habitat conditions, such as forest succession type, are not supported by favorable hydrologic conditions and soil conditions. Section 3.8 describes which species would benefit from this change and which species would lose habitat.

4.4.6.3 Accelerated Drawdown Alternative

Under the Accelerated Drawdown Alternative, the irreversible and irretrievable impacts would be similar to those described under the Proposed Action. Irretrievable impacts would be shorter duration if the increased drawdown allows reclamation to be completed sooner.

4.4.6.4 Elimination of West Embankment Drain Pumpback at Closure

Under the Elimination of WED Pumpback at Closure Alternative the irreversible and irretrievable impacts would be similar to those described under the Proposed Action.

4.4.6.5 Alternative Capping Methods

Under the Alternative Capping Methods Alternative the irreversible and irretrievable impacts would be similar to those described under the Proposed Action. Irretrievable impacts would be slightly shorter duration if reclamation was completed sooner.

4.4.7 Aquatics

4.4.7.1 No Action Alternative

There would be no irreversible or irretrievable impacts to aquatic resources under the No Action Alternative because disturbance of these resources would not occur beyond what has already been permitted, as described in Section 3.9.3.

4.4.7.2 Proposed Action

Under the Proposed Action there would be an irretrievable loss of 0.28 miles of Yankee Doodle Creek, 0.18 miles of Dixie Creek, and 0.36 miles of upper Silver Bow Creek as they would be converted to standing water as the YDTI expands (**Table 3.9-1**). Since the water quality in the YDTI is inhospitable to fish and macroinvertebrates (Section 3.9.2), this would constitute a small loss of habitat for fish and other aquatic organisms inhabiting the lower reaches of those streams. The filling of the YDTI would make the loss of these reaches essentially permanent as the shoreline at closure would equilibrate at about 6,363 feet (Montana Resources 2018b). The reclamation plan states that the pond would decrease in size as the tailings dry, and the final expected pond elevation would be around 67 feet lower at 6,363 feet. As the pond edge recedes, the streams may reestablish some of the channel length and maintain a connection to

the pond. However, the pond water quality is not expected to improve from what is currently present (Section 3.6.2).

The channel habitat at each stream mouth would be likely to fill in as finer materials are deposited during inundation and would be lost for the duration of the project. Although the loss would not be irreversible, there is no plan to restore the stream channel.

4.4.7.3 Accelerated Drawdown Alternative

Under the Accelerated Drawdown Alternative, the irretrievable impacts would be similar to those described under the Proposed Action. Irretrievable impacts would be shorter in duration if reclamation was completed sooner.

4.4.7.4 Elimination of West Embankment Drain Pumpback at Closure

Under the Elimination of WED Pumpback at Closure Alternative the irretrievable impacts would be similar to those described under the Proposed Action. Irretrievable impacts would be slightly shorter in duration if reclamation was completed sooner.

4.4.7.5 Alternative Capping Methods

Under the Alternative Capping Methods Alternative the irretrievable impacts would be similar to those described under the Proposed Action. Irretrievable impacts would be slightly shorter in duration if reclamation was completed sooner.

4.4.8 Cultural Resources

4.4.8.1 No Action Alternative

Under the No Action Alternative, ongoing land uses would continue and there would be no irreversible or irretrievable impacts to significant cultural resources within the proposed expanded YDTI area.

4.4.8.2 Proposed Action

The Proposed Action would not impact historical properties and there would be no irreversible and irretrievable Impacts to significant cultural resources within the proposed expanded YDTI area.

4.4.8.3 Accelerated Drawdown Alternative

Irreversible and irretrievable impacts under the Accelerated Drawdown Alternative would be the same as the Proposed Action. There would be no irreversible and irretrievable Impacts to significant cultural resources within the proposed expanded YDTI area.

4.4.8.4 Elimination of West Embankment Drain Pumpback at Closure

Irreversible and irretrievable impacts under the Elimination of WED Pumpback at Closure Alternative would be the same as the Proposed Action. There would be no irreversible and irretrievable impacts to significant cultural resources within the proposed expanded YDTI area.

4.4.8.5 *Alternative Capping Methods*

Irreversible and irretrievable impacts under the Alternative Capping Methods Alternative would be the same as the Proposed Action. There would be no irreversible and irretrievable impacts to significant cultural resources within the proposed expanded YDTI area.

4.4.9 *Socioeconomics*

4.4.9.1 *No Action Alternative*

There would be no irreversible commitments of socioeconomic resources under the No Action Alternative. The loss of some portion of the 364 jobs in 2022 under the No Action Alternative would be irretrievable to the ROI until those individuals found other employment. Jobs in natural resources and mining have the highest annual pay in the ROI and jobs at MR account for almost 80 percent of the natural resources and mining jobs. It would therefore be difficult for people to find comparable work in the ROI and the adverse effects could extend for years into the future. MR has paid the largest or second largest percentage of the total property taxes to Silver Bow County over the past five years. When the mine closes, tax revenue would be significantly less and contributions to the Hard Rock Trust Account would end (D. Gleason; pers. comm. 2018). Both of these losses would represent irretrievable commitments of economic resources, at least in the short term.

4.4.9.2 *Proposed Action*

Under the Proposed Action there would be no irreversible socioeconomic impacts. The irretrievable commitments associated with the loss of some portion of the 364 jobs and reduction in tax revenue would occur later than under the No Action Alternative, in 2031, at the proposed time of mine closure. Therefore, the Proposed Action would have some short-term socioeconomic benefits compared to the No Action Alternative.

4.4.9.3 *Accelerated Drawdown Alternative*

Under the Accelerated Drawdown Alternative there would be no irreversible socioeconomic impacts. The irretrievable commitments associated with the loss of some portion of the 364 jobs and reduction in tax revenue would be intermediate to the Proposed Action and the No Action alternatives, assuming reclamation would be completed more quickly under this alternative.

4.4.9.4 *Elimination of West Embankment Drain Pumpback at Closure*

Under the Elimination of WED Pumpback at Closure Alternative there would be no irreversible socioeconomic impacts. The irretrievable commitments associated with the loss of some portion of the 364 jobs and reduction in tax revenue would be intermediate to the Proposed Action and the No Action alternatives, assuming reclamation would be completed more quickly under this alternative.

4.4.9.5 *Alternative Capping Methods*

Under the Alternative Capping Methods Alternative there would be no irreversible socioeconomic impacts. The irretrievable commitments associated with the loss of some portion of the 364 jobs and reduction in tax revenue would be intermediate to the Proposed Action and the No Action alternatives, assuming reclamation would be completed more quickly under this alternative.

4.4.10 Land Use

4.4.10.1 *No Action Alternative*

There would be no irreversible or irretrievable impacts to land use under the No Action because changes in land use beyond what has already been permitted would not occur, as described in Section 3.12.3. The post-closure land uses included in the reclamation plan would be the same for any alternative, wildlife habitat and watershed protection.

4.4.10.2 *Proposed Action*

Under the Proposed Action there would be an irretrievable loss of approximately 99 acres of forested and shrublands due to inundation as the YDTI level rises. The conversion to open water would persist for the duration of the project and until vegetation is reestablished through reclamation. The land would be revegetated to grassland types of vegetated cover, so the loss of use would not be irreversible, but reestablishing wildlife habitat similar to premining conditions may take several decades. As stated in the reclamation plan, there are suitable seed sources nearby on undisturbed lands that would augment the replanting and reseeded and make reestablishment of premining vegetation communities likely.

4.4.10.3 *Accelerated Drawdown at Closure Alternative*

The Accelerated Drawdown at Closure Alternative would reduce the total time to dewater the tailings to the point where reclamation and reseeded could begin. Therefore, vegetation and functional land uses may be able to become reestablished as much as two to three decades sooner than under the Proposed Action. The exact reduction would depend on the rate of drawdown realized and how that affects reclamation progress. The extent and intensity of irretrievable losses would be the same as under the Proposed Action, but the duration of the loss may be shorter. Similar to the Proposed Action, no irreversible impacts to land use would occur.

4.4.10.4 *Elimination of West Embankment Drain Pumpback at Closure*

The Elimination of the WED Pumpback Drain at Closure Alternative would reduce the total time to dewater the tailings to the point where reclamation and reseeded could begin. Therefore, vegetation and functional land use may be able to become reestablished a few years sooner than under the Proposed Action. The exact reduction would depend on how much of a reduction in total volume of the YDTI can be achieved by eliminating the WED pumpback and how that affects the surface conditions necessary for reclamation progress. The extent and

intensity of irretrievable losses would be the same as under the Proposed Action, but the duration of the loss may be shorter. Similar to the Proposed Action, no irreversible impacts to land use would occur.

4.4.10.5 *Alternative Capping Methods*

Similar to the previous two alternatives, the Alternative Capping Methods Alternative would reduce the overall time to reclamation initiation. Therefore, vegetation and functional land use may be able to become reestablished as much as 2 years sooner than under the Proposed Action. The exact reduction would depend on how the tailings placement would affect the surface conditions necessary for reclamation progress. The extent and intensity of irretrievable losses would be the same as under the Proposed Action, but the duration of the loss may be shorter. Similar to the Proposed Action, no irreversible impacts to land use would occur.

4.4.11 Visual Resources

4.4.11.1 *No Action Alternative*

Under the No Action Alternative, the West Embankment would not be raised, the Great Northern RDS would not be expanded and the Northern RDS would not be constructed. Reclamation would proceed as outlined in the existing Operating Permits 00030 and 00030A. The No Action Alternative would result in unchanged and unaffected visual resources and landscape.

4.4.11.2 *Proposed Action*

Under the Proposed Action, the West Embankment would be raised to 6,450', other Embankments may be raised to their currently permitted elevation of 6,450', soil stockpiling would continue, the Great Northern RDS would be expanded, the Northern RDS would be constructed and the reclamation would proceed later than under the No Action Alternative. There would be no irreversible or irretrievable loss to visual resources from any of these actions. The reclamation and revegetation activities proposed for the YDTI and RDS features represent a mitigation to the incremental increase in visual resource impacts caused by their expansion. As such, the Proposed Action would have no irreversible or irretrievable impacts to visual resources.

4.4.11.3 *Accelerated Drawdown Alternative*

Under the Accelerated Drawdown Alternative, reclamation of the YDTI would occur at a faster rate, but the lack of irreversible or irretrievable impacts would remain the same as described under the Proposed Action.

4.4.11.4 *Elimination of West Embankment Drain Pumpback at Closure*

Under the Elimination of WED Pumpback at Closure Alternative, reclamation of the YDTI would occur at a faster rate, but the lack of irreversible or irretrievable impacts would remain the same as described under the Proposed Action.

4.4.11.5 Alternative Capping Methods

Under the Alternative Capping Methods Alternative, reclamation of the YDTI would occur at a faster rate, but the lack of irreversible or irretrievable impacts would remain the same as described under the Proposed Action.

4.4.12 Noise

There would not be any irreversible or irretrievable impacts to noise, since noise is not a non-renewable resource and would not affect the lands.

4.4.13 Air Quality

4.4.13.1 No Action Alternative

There are irreversible or irretrievable commitment of air quality resources related to the No Action Alternative since mining would continue. However, actions that would contribute to the deposition of fugitive dust are mitigated by the current air quality rules and regulations and are expected to be minor.

4.4.13.2 Proposed Action

Under the Proposed Action, mining would continue into approximately 2031. Expanding the timeframe for reclamation of the YDTI to occur, generation of fugitive dust would increase. Air quality would be mitigated under the current air quality rules and regulations. However minor, the effects from the generation and deposition of fugitive dust would be irreversible.

4.4.13.3 Accelerated Drawdown at Closure Alternative

This alternative would not increase the intensity of fugitive dust but would reduce the timeframe for dust generation in comparison to the Proposed Action. Reclamation of the YDTI would be able to begin sooner. However minor, the effects from the generation and deposition of fugitive dust would be irreversible.

4.4.13.4 Elimination of West Embankment Drain Pumpback at Closure

This alternative would not increase the intensity of fugitive dust but could reduce the timeframe of dust generation potential with respect to the Proposed Action. Reclamation of the YDTI would be able to begin sooner. Minor effects from the generation and deposition of fugitive dust would be irreversible.

4.4.13.5 Alternative Capping Methods

This alternative could decrease the intensity of fugitive dust in the short-term during initial reclamation but would not reduce the timeframe of dust generation potential with respect to the Proposed Action. Installation of the partial cap immediately following mining would help expediate access of machinery onto the beach area. However, dust control measures would still be necessary prior to completion of final reclamation as the equilibrium pond recedes over the next 30 to 40 years. Any effects from the generation and deposition of fugitive dust would be minor but irreversible.

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. For example, a possible secondary impact of establishing settling ponds to capture surface runoff water from the road would be changes in vegetation down gradient from the ponds due to increased seepage.

4.5.1 Geology and Minerals

4.5.1.1 *No Action Alternative*

Under the No Action Alternative, current mining would continue until 2022 when current capacity of the YDTI is reached. Reclamation would occur under the current permitted schedule. Mineral development would proceed as permitted. Therefore, there are no additional secondary impacts to geology and minerals under this alternative.

4.5.1.2 *Proposed Action*

Under the Proposed Action, the YDTI would be increased from its currently permitted acreage. No secondary impacts to geology and minerals are anticipated because the disturbed geology would be confined to the Continental Pit. Excavation would not affect geologic or mineral resources beyond the actively mined area.

4.5.1.3 *Accelerated Drawdown at Closure Alternative*

No secondary impacts are anticipated from the Accelerated Drawdown at Closure Alternative because the area of disturbed geology and the proposed reclamation plan would be the same as the Proposed Action. However, if water is diverted to and stored in the Continental Pit, access to future exploration and mining in flooded areas would be impacted.

4.5.1.4 *Elimination of West Embankment Drain Pumpback at Closure*

No secondary impacts are anticipated from the Elimination of WED Pumpback at Closure Alternative because the area of disturbed geology and the proposed reclamation plan would be the same as the Proposed Action. However, if water is diverted to and stored in the Continental Pit, access to future exploration and mining in flooded areas would be impacted.

4.5.1.5 *Alternative Capping Methods*

Under the Alternative Capping Methods Alternative, no secondary impacts to geology and minerals are anticipated because the area of disturbed geology would be confined to the Continental Pit. Reclamation would not affect geologic or mineral resources beyond the actively mined area.

4.5.2 Geotechnical Stability

Under the Proposed Action and other alternatives, the YDTI Embankment would be raised 45 feet to provide additional storage capacity within the YDTI for tailings and water. None of the

alternatives, including the No Action, would result in secondary impacts related to the geotechnical stability of the YDTI.

4.5.3 Soils and Reclamation

4.5.3.1 *No Action Alternative*

Under the No Action Alternative, MR would continue mining until the end of the currently permitted mine life and then reclaim existing disturbance with the existing soils without additional disturbance. No secondary impacts to soils beyond what have already been permitted would occur.

4.5.3.2 *Proposed Action*

Under the Proposed Action, the capacity of the YDTI would increase from its currently permitted area and an additional 85.4 acres of soil disturbance would occur. Erosion potential increases as soils are moved and BMPs would be implemented to minimize secondary impacts to soils during reclamation.

4.5.3.3 *Accelerated Drawdown at Closure Alternative*

The Accelerated Drawdown at Closure Alternative would be the same as the Proposed Action in terms of proposed acres of additional disturbance and reclamation approach. The only change to soil and reclamation would be in the timing compared to the Proposed Action. Topsoil would spend less time in stockpile prior to placement and revegetation.

4.5.3.4 *Elimination of West Embankment Drain Pumpback at Closure*

The Elimination of WED Pumpback Alternative reduces water input back to YDTI, which would speed up reclamation activities. The secondary impacts of this alternative would be similar to the Proposed Action, except that stockpiled topsoil would spend less time exposed to the weather prior to placement and revegetation. Accelerated drawdown would allow surface reclamation to occur sooner.

4.5.3.5 *Alternative Capping Methods*

The Alternative Capping Method Alternative would accelerate the reclamation of the beach and reduce the overall reclamation schedule. This alternative would be the same as the Proposed Action in terms of proposed acres of additional disturbance and reclamation approach. The only change to soil and reclamation would be in the timing compared to the Proposed Action.

Alluvium would be placed in advance of final capping, with the potential to reduce fugitive dust. The secondary impacts of this alternative are similar to the Proposed Action.

4.5.4 Ground and Surface Water Resources

4.5.4.1 *No Action Alternative*

Under the No Action alternative, mining and water management would continue as currently permitted. Impacts to water resources would be similar to existing impacts and would not lead

to any new secondary impacts because YDTI water is either maintained in a closed-loop system or impacted seepage is captured and treated.

4.5.4.2 Proposed Action

No secondary impacts are anticipated under the Proposed Action. Any impacted seepage would be collected either in the WED or at Horseshoe Bend and pumped back to the YDTI or treated and released under BMFOU remedial actions, respectively.

4.5.4.3 Accelerated Drawdown at Closure Alternative

A secondary impact to the Accelerated Drawdown at Closure Alternative arises from this alternative's water management needs. Water would be collected and either stored on-site prior to treatment or treated and discharged. If on-site storage is needed, water may be diverted into the Continental Pit. The impacts of storing water in the Continental Pit include reducing the estimated time for it to reach its critical level from 137 to 112 years and increasing the pH of the initial Continental Pit lake, as discussed in **Section 2.5.2.2**.

If water was to be treated and discharged, MR would need to coordinate with parties in the 2002 Consent Decree to review the options and feasibility for handling and treating this water, the potential use of existing or upgraded water treatment facilities and infrastructure, and to amend their agreement accordingly. Any discharged water would need to meet water quality criteria and final off-site discharge performance standards as described in the 2002 Consent Decree prior to discharge (Consent Decree for the Butte Mine Flooding Site 2002).

4.5.4.4 Elimination of West Embankment Drain Pumpback at Closure

A secondary impact to the WED Pumpback at Closure Alternative would be the additional amount of water diverted into the Continental Pit, if the WED seepage is not directly treated at a BMFOU facility. The increase in volume would be much less than what is anticipated from the Accelerated Drawdown at Closure Alternative, with the best estimate of WED influx following mine closure being 160 GPM (Schafer Limited LLC 2018).

Seepage collected in the WED drain would be redirected by pumping or gravity away from the YDTI and would not be pumped back into the pond. Less water would be available to seep from the YDTI and the pond would reach equilibrium sooner. In addition, a shortening of the reclamation timeframe by approximately 7 years would occur as a result of this alternative (see **Section 2.6.5**).

4.5.4.5 Alternative Capping Methods

No secondary impacts are anticipated under the Alternative Capping Methods for the same reasons described under the Proposed Action.

4.5.5 Vegetation and Wetlands

4.5.5.1 No Action Alternative

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

4.5.5.2 Proposed Action

Under the Proposed Action, as the YDTI pond fills to the increased capacity, it would extend the northern boundary of the tailings pond to an elevation of approximately 6,428 feet. The total permitted area would increase by about 237 acres. As the tailings pond fills to the higher elevation, water would inundate shoreline acres and riparian areas near the mouths of the three tributary streams. The inundation would replace shoreline habitat with open water and would likely displace vegetation as described in Section 3.7.3. The open water expansion would directly affect vegetation by flooding the plants. However, the water present would also move the edge of seasonally saturated soils uphill as well. This increase in soil moisture may affect the composition and density of vegetation in the areas adjacent to the YDTI. Essentially, the change in soil moisture would shift the vegetation communities upslope. As an example, an area of emergent (shallow water) wetland near the current shore might gradually colonize new shallow water habitat as the shoreline moves northward. The plants in the pre-expansion wetland may die off as the water level rises, but their seeds would be more likely to thrive in newly established shoreline areas.

The extent of this shift would be affected by local soil conditions, slope aspect, and shading. Areas with established vegetation may see slow changes as conditions gradually displace previously dominant vegetation. Some vegetation such as larger, mature trees may be able to persist in these altered conditions. The change would be gradual as the YDTI's northern shoreline expands over several years. At closure and drawdown, the water level and inundation would recede and the reclamation plan would be initiated. Some of the upland shift in vegetation would gradually revert to pre-inundation species composition. Again, the shift would be gradual, be subject to the rate of dewatering, and would affect annual species and less mature trees and shrubs to a greater extent. None of these changes would affect the long-term vegetation on a landscape scale.

The reclamation plan would favor herbaceous species for initial planting with some forbs and shrubs where conditions would support these types (Montana Resources 2018b). Current grassland habitat patches adjacent to the impoundment are comparatively small and intermixed with sagebrush and aspen habitats; consequently, reclaimed areas may provide larger, more contiguous blocks of grassland than are presently available (Montana Resources 2018b). Over time, tree species present in adjacent areas would likely colonize reclaimed areas where conditions are favorable. All areas disturbed within the proposed amendment area would be revegetated to meet county standards for noxious weed control which should minimize long-term weed establishment after closure.

4.5.5.3 Accelerated Drawdown at Closure Alternative

The Accelerated Drawdown at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by as much as 20 to 30 years. The final reseeding and vegetation reestablishment plan would not be altered, but the reestablishment of vegetation is integral to the post-closure land uses identified, namely wildlife habitat and watershed protection. This alternative may allow these land uses to be achieved as much as two to three decades sooner, which may be substantial in terms of vegetation succession, overall land appearance, and wildlife use. No aspect of this alternative would affect the extent of the areas to be inundated or how far upslope the changes in soil moisture may persist. Therefore, the potential for these secondary impacts to vegetation would be the same as described for the Proposed Action.

4.5.5.4 Elimination of West Embankment Drain Pumpback at Closure

Although the Elimination of the WED Pumpback at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by as much as 7 years, the final reseeding and vegetation reestablishment plan would not be altered. No aspect of this alternative would affect the extent of the areas to be inundated or how far upslope the changes in soil moisture may persist. Therefore, the potential for secondary impacts to vegetation would be the same as described for the Proposed Action.

4.5.5.5 Alternative Capping Methods

Although the Alternative Capping Methods Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by as much as 2 years, the final reseeding and vegetation reestablishment plan would not be altered. No aspect of this alternative would affect the extent of the areas to be inundated or how far upslope the changes in soil moisture may persist. Therefore, the potential for secondary impacts to vegetation would be the same as described for the Proposed Action.

4.5.6 Wildlife

4.5.6.1 No Action Alternative

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

4.5.6.2 Proposed Action

Under the Proposed Action, the impacts resulting from the 99-acre habitat loss, even if temporary, would result in a reduced carrying capacity of the YDTI area for all wildlife species. There would be a short-term decrease in wildlife populations, especially those that are less mobile or have smaller home ranges (e.g., small mammals, amphibians). However, because the loss would occur gradually, individuals would have some ability to adapt. The vegetation changes discussed in Section 4.5.5 would result in changes in wildlife habitat, benefiting some

species but detrimental to others (see Section 3.8). Following reclamation, shrubs and trees would gradually become reestablished on the reclaimed land, but the loss of habitat currently there would persist for years.

Elevated noise levels that would persist throughout the life of the mine under the Proposed Action may have secondary impacts on wildlife (Section 4.5.12.2). Areas with higher noise levels would be avoided by wildlife and could affect some individuals during certain times of year (e.g., breeding season for birds). Noise effects, however, are expected to be minimal (Section 3.14.3.2).

4.5.6.3 Accelerated Drawdown Alternative

Under the Accelerated Drawdown Alternative the secondary impacts to wildlife would be similar to those described under the Proposed Action. As noted in Section 4.5.5, The reestablishment of vegetation is integral to the post-closure land uses identified, namely wildlife habitat and watershed protection. This alternative's effect on reclamation timing may allow these land uses to be achieved as much as two to three decades sooner, which may be substantial in terms of vegetation succession, overall land appearance, and wildlife use.

4.5.6.4 Elimination of West Embankment Drain Pumpback at Closure

Under the Elimination of WED Pumpback at Closure Alternative the secondary impacts to wildlife would be similar to those described under the Proposed Action.

4.5.6.5 Alternative Capping Methods

Under the Alternative Capping Methods Alternative the secondary impacts to wildlife would be similar to those described under the Proposed Action.

4.5.7 Aquatics

4.5.7.1 No Action Alternative

There would be no secondary impacts to aquatic resources under the No Action Alternative because disturbance of these resources beyond what has already been permitted would not occur, as described in Sections 3.9.3.

4.5.7.2 Proposed Action

Secondary impacts to aquatics would be minimal and would result from the changes in instream conditions both upstream of the inundated mouths of the three tributary streams during operation and after closure and reclamation is complete. The inundation of the mouths of the tributaries would shift this transitional habitat upstream. The level of secondary impact is expected to be minimal as the fish and other aquatic organisms present would easily move upstream. Macroinvertebrates are also capable of shifting their habitat use over short time frames because of their relatively short reproductive cycles and terrestrial life stages.

The changes to the tributary mouth habitat are expected to be permanent because the reclamation plan and post-closure pond management would not restore the stream channels

(Montana Resources 2018b). The inundated reaches would be likely to infill with fine sediments. The flow regimes of these creeks may not be large enough to scour channels in the sediments after the pond edges recede. As noted earlier, the level of impact to the fishery in Yankee Doodle Creek is expected to be minor given the fish population present (MFWP 2018a). Neither Dixie nor the upper section of Silver Bow Creek have been shown to support fish populations (MFWP 2018b). Therefore, secondary impacts to aquatic organisms in these two creeks would be likely to be negligible.

The reclamation plan states that, “overall, pond water quality should reflect chemistry of upstream water sources (Yankee Doodle, Silver Bow, and Dixie creeks) within a few decades following closure.” If water quality does approach levels present in the tributary streams, then fish may use the approximately 1,000-acre feet pond as habitat at that time. However, it is not possible to know when water quality would become suitable or if other aspects such as temperature in a shallow pond might limit the utility of the pond as habitat.

4.5.7.3 Accelerated Drawdown at Closure Alternative

Under the Accelerated Drawdown Alternative the secondary impacts to aquatics would be similar to those described under the Proposed Action.

4.5.7.4 Elimination of West Embankment Drain Pumpback at Closure

Under the Elimination of WED Pumpback at Closure Alternative the secondary impacts to aquatics would be similar to those described under the Proposed Action.

4.5.7.5 Alternative Capping Methods

Under the Alternative Capping Methods Alternative the secondary impacts to aquatics would be similar to those described under the Proposed Action.

4.5.8 Cultural Resources

4.5.8.1 No Action Alternative

Under the No Action Alternative, ongoing land uses would continue and there would be no secondary impacts to significant cultural resources within the expanded YDTI project area.

4.5.8.2 Proposed Action

The Proposed Action would not impact historical properties and there would be no secondary impacts to significant cultural resources within the proposed expanded YDTI area.

4.5.8.3 Accelerated Drawdown Alternative

Secondary impacts under the Accelerated Drawdown Alternative would be the same as the Proposed Action. There would be no secondary impacts to significant cultural resources within the proposed expanded YDTI area.

4.5.8.4 *Elimination of West Embankment Drain Pumpback at Closure*

Secondary impacts under the Elimination of the WED Pumpback at Closure Alternative would be the same as the Proposed Action. There would be no secondary Impacts to significant cultural resources within the proposed expanded YDTI area.

4.5.8.5 *Alternative Capping Methods*

Secondary impacts under the Alternative Capping Methods Alternative would be the same as the Proposed Action. There would be no secondary Impacts to significant cultural resources within the proposed expanded YDTI area.

4.5.9 Socioeconomics

Under all alternatives, adverse secondary impacts would occur when the mine closes and some portion of the 364 high paying jobs are lost. Tax revenues associated with metals production would end as would MR's contribution to the Hard Rock Trust Account. The secondary impacts include loss of associated spending by MR employees in the ROI, loss of the revenue from the Hard Rock Trust Account that is allocated to School District No. 1, and impacts to the County when the tax revenue from MR is significantly reduced. These impacts vary by alternative with the action alternatives providing clear secondary socioeconomic benefits over the No Action Alternative.

4.5.9.1 *No Action Alternative*

Under the No Action Alternative the adverse secondary impacts mentioned above would occur sooner than under the action alternatives. The exact magnitude of these impacts is not known, but would be likely to be substantive in the ROI because of the relatively high wages paid by MR and because MR has recently been the second highest tax payer in Silver Bow County (**Table 3.11-4**).

4.5.9.2 *Proposed Action*

Under the Proposed Action, there would be beneficial secondary impacts from nine more years of employment for approximately 364 people at MR and nine more years of tax revenue to Silver Bow County (as compared to the No Action Alternative).

4.5.9.3 *Accelerated Drawdown Alternative*

Secondary impacts from the Accelerated Drawdown Alternative would be intermediate to the No Action and the Proposed Action alternatives if reclamation were completed more quickly under this alternative.

4.5.9.4 *Elimination of West Embankment Drain Pumpback at Closure*

Secondary beneficial impacts from the Elimination of WED Pumpback at Closure Alternative would be intermediate to the No Action and the Proposed Action alternatives if reclamation were completed more quickly under this alternative.

4.5.9.5 *Alternative Capping Methods*

Secondary impacts from the Alternative Capping Methods Alternative would be intermediate between the No Action and the Proposed Action alternatives if reclamation were completed more quickly under this alternative.

4.5.10 Land Use

4.5.10.1 *No Action Alternative*

Under the No Action Alternative, the permit amendment would not be approved, and ongoing land uses would continue. The No Action Alternative would not have any direct effect on the mosaic of land uses; therefore, it would not have any secondary effects to land uses in the watershed.

4.5.10.2 *Proposed Action*

The amount of acreage that would be converted from forest to open or shallow water under the Proposed Action would not substantially alter the vegetation community or the types and character of land uses in the Silver Bow Creek watershed. Mine-affected acres in the watershed would remain as industrial sites until closure and reclamation are completed. The secondary vegetation changes described in Section 4.5.5 would not affect the current use of these lands as they are undeveloped. Therefore, the secondary impacts to land uses in the Silver Bow Creek watershed due to the Proposed Action would be negligible.

4.5.10.3 *Accelerated Drawdown at Closure Alternative*

Although the Accelerated Drawdown at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area, the final reseeding and vegetation reestablishment plan would not be altered. No aspect of this alternative would affect the extent of the lands to be affected. Therefore, the potential for secondary impacts to land use due to operations would be the same as described for the Proposed Action. As noted in Section 4.5.5, The reestablishment of vegetation is integral to the post-closure land uses identified, namely wildlife habitat and watershed protection. This alternative's effect on reclamation timing may allow these land uses to be achieved as much as two to three decades sooner, which may be substantial in terms of vegetation succession, overall land appearance, and wildlife use.

4.5.10.4 *Elimination of West Embankment Drain Pumpback at Closure*

Although the Elimination of the WED Pumpback at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by as much as 7 years, the final reseeding and vegetation reestablishment plan would not be altered. No aspect of this alternative would affect the extent of the lands to be affected. Therefore, the potential for secondary impacts to land use would be the same as described for the Proposed Action.

4.5.10.5 *Alternative Capping Methods*

Although the Alternative Capping Methods Alternative has the potential to reduce the total time to complete reclamation of the YDTI area by as much as 2 years, the final reseeding and vegetation reestablishment plan would not be altered. Therefore, the potential for secondary impacts to land use would be the same as described for the Proposed Action.

4.5.11 Visual Resources

4.5.11.1 *No Action Alternative*

Under the No Action Alternative, the West Embankment would not be raised, the Great Northern RDS would not be expanded and the Northern RDS would not be constructed. Reclamation would proceed as outlined in the existing Operating Permits 00030 and 00030A. The No Action Alternative would result in unchanged and unaffected visual resources and landscape.

4.5.11.2 *Proposed Action*

Under the Proposed Action, the West Embankment would be raised to 6,450 feet, other Embankments may be raised to their currently permitted elevation of 6,450 feet, soil stockpiling would continue, the Great Northern RDS would be expanded, the Northern RDS would be constructed and the reclamation would proceed later than under the No Action Alternative. The raising of the West Embankment, expansion of Great Northern RDS and construction of Northern RDS represent only incremental increases to existing direct impacts. Reclamation and revegetation activities proposed would mitigate the direct impacts and there would be no anticipated secondary impacts following this. Therefore, the Proposed Action would have no secondary impacts to visual resources.

4.5.11.3 *Accelerated Drawdown Alternative*

Under the Accelerated Drawdown Alternative, reclamation of the YDTI would occur at a faster rate but the potential for secondary impacts would remain the same as described in the Proposed Action.

4.5.11.4 *Elimination of West Embankment Drain Pumpback at Closure*

Under the Elimination of WED Pumpback at Closure Alternative, reclamation of the YDTI would occur at a faster rate but the potential for secondary impacts would remain the same as described in the Proposed Action.

4.5.11.5 *Alternative Capping Methods*

Under the Alternative Capping Methods Alternative, reclamation of the YDTI would occur at a faster rate but the potential for secondary impacts would remain the same as described in the Proposed Action.

4.5.12 Noise

Under the No Action Alternative, the proposed amendment would not be approved, and existing noise levels would not change. The No Action Alternative would not have any direct effect on noise levels in the area; therefore, it would not contribute to secondary impacts.

4.5.12.1 Proposed Action

Elevated noise levels associated with the Proposed Action would have secondary impacts on wildlife. Areas with higher noise levels would be avoided by wildlife and could potentially affect winter habitats.

4.5.12.2 Accelerated Drawdown Alternative

Although the Accelerated Drawdown Alternative has the potential to reduce the total time to complete reclamation of the YDTI area, the noise levels associated with increasing the embankment height would not be altered. Therefore, the secondary impacts from noise would be the same as described for the Proposed Action.

4.5.12.3 Elimination of West Embankment Drain Pumpback at Closure

Although the Elimination of WED Pumpback at Closure Alternative has the potential to reduce the total time to complete reclamation of the YDTI area, the noise levels associated with increasing the embankment height would not be altered. Therefore, the secondary impacts from noise would be the same as described for the Proposed Action.

4.5.12.4 Alternative Capping Methods

Although the Alternative Capping Methods Alternative has the potential to reduce the total time to complete reclamation of the YDTI area, the noise levels associated with increasing the embankment height would not be altered. Therefore, the secondary impacts from noise would be the same as described for the Proposed Action.

4.5.13 Air Quality

4.5.13.1 No Action Alternative

Under the No Action Alternative, mining would continue, but air quality impacts are expected to be minimal, mitigated by the current air quality rules and regulations, and would not contribute to a violation of ambient standards. With the No Action Alternative, air quality would remain essentially unchanged and would not be indirectly affected by ore hauling or other mine-related, traffic, or reclamation activities.

4.5.13.2 Proposed Action

Secondary impacts from the Proposed Action would not result in an increase in the intensity of fugitive dust emissions in the area with respect to the No Action Alternative but would increase the duration of potential impacts. However, secondary impacts in the area as a result of the Proposed Action are expected to be minor and within the air quality permit requirements.

4.5.13.3 Accelerated Drawdown at Closure Alternative

This alternative would not increase the intensity of air quality impacts but would reduce the duration of impacts with respect to the Proposed Action. Reclamation would begin sooner and reduce the time frame material in the impoundment is available for wind erosion. However, secondary impacts in the area as a result of this alternative are expected to be minor and within the air quality permit requirements.

4.5.13.4 Elimination of West Embankment Drain Pumpback at Closure

This alternative would not increase the intensity of air quality impacts but would reduce the duration of impacts with respect to the Proposed Action. Reclamation would begin sooner and reduce the time frame material in the impoundment is available for wind erosion. However, secondary impacts in the area as a result of this alternative are expected to be minor and within the air quality permit requirements.

4.5.13.5 Alternative Capping Methods

This alternative could decrease the intensity of short-term air quality impacts during the initial reclamation but would not reduce the duration of impacts with respect to the Proposed Action. Reclamation would begin sooner by hydraulically placing an initial cap in areas that would not be accessible with mechanized equipment. This would reduce the short-term time frame material in the impoundment is available for wind erosion during initial reclamation. However, dust control measures would still be necessary prior to completion of final reclamation as the equilibrium pond recedes over the next 30 to 40 years. Consequently, secondary impacts in the area as a result of this alternative are expected to be minor.

5 COMPARISON OF ALTERNATIVES

Tables 5.1-1, 5.1-2, and 5.1-3 summarize and compare the potential primary, secondary, and cumulative impacts on natural, cultural, and human resources associated with the alternatives. Primary impacts are described fully in Chapter 3; secondary and cumulative impacts are discussed in Chapter 4.

Chapter 5: Comparison of Alternatives

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5.1 COMPARISON OF ALTERNATIVES

The following tables summarize the substantive impacts identified in Chapters 3 and 4 of the DEIS for each of the alternatives. This is meant to facilitate a comparison based on the impacts most likely to occur or those that would have the potential to affect some aspect of the human environment in a substantial way. The full discussion of all potential impacts is contained in Chapters 3 and 4 in the resource-specific subsections.

Table 5.1-1 Summary of the Primary Impacts of the No Action, Proposed Action, and other Alternatives organized by Resource Area.					
	No Action	Proposed Action	Accelerated Drawdown at Closure	Elimination of West Embankment Drain Pumpback at Closure	Alternative Capping Methods
Geology and Minerals	No impacts.	Disturbance to the geology of the West Embankment area would occur. Supernatant pond area would increase to the north. Drainages entering the pond would be impacted by sediment and pond water.	The impacts to the geology resources under this alternative would be identical to the Proposed Action, except for the potential reduction in time for reclamation.	The impacts to the geology resources under this alternative would be identical to the Proposed Action, except for the timing of the reclamation.	The impacts to the geology resources under this alternative would be identical to the Proposed Action, except for the potential reduction in time for reclamation.
Geotechnical Stability	No impacts.	A slight decrease in the calculated Factor of Safety values as a result of increasing the height of the West Embankment by 45 feet and from increasing the storage of tailings materials and process water.	Primary impacts would be identical to the Proposed Action. Reduction in the impounded water volume may relieve weight on the embankment.	Primary impacts would be identical to the Proposed Action. Reduction in the impounded water volume may relieve weight on the embankment.	Primary impacts would be identical to the Proposed Action
Soils and Reclamation	No impacts.	Impacts to the native soils include soil salvage and stockpiling ahead of construction and tailings inundation. The disturbed area within Operating Permit 00030A would increase by about 99 acres to accommodate increased tailings storage, West Embankment construction, topsoil storage, roads, and monitoring wells. Associated facilities, including a new RDS, an addition to an existing RDS, soil and alluvium stockpiles, access roads, and long-term monitoring sites are proposed within existing disturbed areas. Reclamation of the YDTI would be essentially the same as previously permitted. The reclamation plan includes grading, capping, and revegetation of the embankment and beach; and wet closure of the open water component with a pond volume smaller than the operation condition; and grading, capping, and revegetation of associated facilities.	The soils and the reclamation methods and procedures under this alternative are identical to the Proposed Action, except for the timing of the reclamation.	The soils and the reclamation methods and procedures under this alternative are identical to the Proposed Action, except for the timing of the reclamation.	This alternative would not allow for even placement of the alluvial material; material would segregate during the discharge process. Methods to prevent segregation of alluvial material would need to be developed to make this a viable alternative with respect to its potential impacts on soil resources and reclamation success.

Table 5.1-1 Summary of the Primary Impacts of the No Action, Proposed Action, and other Alternatives organized by Resource Area.					
	No Action	Proposed Action	Accelerated Drawdown at Closure	Elimination of West Embankment Drain Pumpback at Closure	Alternative Capping Methods
Surface and Ground Water	No impacts to ground water are anticipated. Water balance modeling indicates following completion of mining operations, the supernatant pond volume will reach an equilibrium volume about seven years later than under the Proposed Action. The supernatant pond water's chemical composition is forecast to be similar to local surface runoff within about 20 years of closure.	No impacts to ground water are anticipated because of natural conditions and engineered mitigation measures, primarily the WED, which are intended to maintain hydrodynamic containment of YDTI seepage. The pumpback of WED seepage to the supernatant pond is predicted to occur for 20 years until the saturated elevation within the facility is below the invert elevation of the WED. Under average climate conditions, the supernatant pond will reach an equilibrium volume of approximately 1,000 acre-feet. MR will maintain alkaline conditions in the YDTI pond during operations and with the addition of lime following closure, if needed.	Drawdown of the supernatant pond to the equilibrium volume would occur over about 1 to 16 years (Table 2.5-2) as opposed to over 30 years in the Proposed Action and No Action alternatives. Pumpback of seepage collected in the WED would cease sooner because the pond will be rapidly drawn below the critical level, potentially reducing or eliminating the need for lime to maintain alkaline pond conditions.	This alternative would reduce impacts in the same manner as the Accelerated Drawdown at Closure alternative, except pond drawdown would take longer.	No impacts to ground water quality are anticipated. Water for milling and slurry transport would be sourced from the supernatant pond, so a closed loop system would be maintained, which would result in a similar supernatant pond drawdown profile as under the Proposed Action. The additional capping proposed could theoretically reduce or stop tailings acidification that may occur under other alternatives, although MR has already committed under the Proposed Action to maintain alkaline pond conditions using lime if needed.
Vegetation and Wetlands	No Impacts	Conversion of up to approximately 99 acres of forested and shrublands to open water for the duration of the project due to inundation.	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action.
Wildlife	No Impacts	Habitat loss (especially deciduous forest) associated with the 99 additional acres inundated.	Primary impacts would be similar to the Proposed Action; possibly of shorter duration.	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action; possibly of shorter duration.
Aquatics	No impacts	Loss of short sections (<0.1 mile each) of lower channel for three tributary streams. Possible reduction in habitat for fish in Yankee Doodle Creek. Loss of instream habitat for macroinvertebrates for the duration of the project.	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action.
Cultural Resources	No Impacts	No impacts to significant cultural resources	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action.
Socioeconomics	No Impacts	Beneficial impact of jobs and tax revenue for longer duration	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action.
Land Use	No Impacts	Temporary change of land use for 99 additional acres that are new disturbance until reclamation is completed.	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action.	Primary impacts would be identical to the Proposed Action.
Visual Resources	No significant impacts	No significant impacts	No significant impacts	No significant impacts	No significant impacts

Table 5.1-1 Summary of the Primary Impacts of the No Action, Proposed Action, and other Alternatives organized by Resource Area.					
	No Action	Proposed Action	Accelerated Drawdown at Closure	Elimination of West Embankment Drain Pumpback at Closure	Alternative Capping Methods
Noise	No Impacts	Increase noise levels at residences in the West Ridge area.	Primary impacts would be identical to the Proposed Action	Primary impacts would be identical to the Proposed Action	Primary impacts would be identical to the Proposed Action
Air Quality	Minor primary impacts meeting ambient air quality standards	Minor primary impacts with no increase in ambient air impacts, but the potential for long term impacts is increased with respect to the No Action	Minor primary impacts with no increase in ambient air impacts, but the potential long-term impacts are decreased in comparison to Proposed Action, due to reduced reclamation timeline	Minor primary impacts with no increase in ambient air impacts, but the potential long-term impacts are decreased in comparison to Proposed Action	Minor primary impacts with no increase in ambient air impacts, but the potential short-term impacts are decreased in comparison to Proposed Action

The following table is a summary of the secondary impacts discussions in Section 4.5. Please see the resource specific subsections for more details on the rationale for these impacts.

Table 5.1-2 Summary of the Secondary Impacts of the No Action, Proposed Action, and other Alternatives organized by Resource Area.					
	No Action	Proposed Action	Accelerated Drawdown at Closure	Elimination of West Embankment Drain Pumpback at Closure	Alternative Capping Methods
Geology and Minerals	No Secondary Impacts	No Secondary Impacts	No Secondary Impacts	No Secondary Impacts	No Secondary Impacts
Geotechnical Stability	No Secondary Impacts	No Secondary Impacts	No Secondary Impacts	No Secondary Impacts	No Secondary Impacts
Soils and Reclamation	No Secondary Impacts	Secondary impacts similar to impacts associated with the No Action Alternative except for potential erosion due to the addition of 85.4 acres of soil salvaged.	Secondary impacts of this Alternative are similar to the Proposed Action except that topsoil would spend less time in a stockpile prior to placement and revegetation.	Secondary impacts of this Alternative are similar to the Proposed Action except that topsoil would spend less time in a stockpile prior to placement and revegetation.	Secondary impacts similar to the Proposed Action. The potential for reducing wind erosion would be possible. The addition of extra water to move the capping materials into place may have the opposite effect of speeding the reclamation effort and slow the reclamation process due to the extra water being added.
Surface and Ground Water	No Secondary Impacts	No Secondary Impacts	Management of water pumped from the YDTI under this alternative may lead to secondary impacts. If water drawn from the YDTI is stored in the Continental Pit, the estimated time for the Continental Pit to reach its critical level could change from 137 to 110 years. Additionally, the reclamation timeframe would be reduced under this alternative.	If WED pumpback water is diverted and stored in the Continental Pit under this alternative, the timeframe for the Continental Pit to reach its critical level will be reduced, although less so compared to the Accelerated Drawdown at Closure alternative because a smaller volume of YDTI water would ultimately be stored. The reclamation timeframe would also be reduced under this alternative.	No Secondary Impacts

Table 5.1-2 Summary of the Secondary Impacts of the No Action, Proposed Action, and other Alternatives organized by Resource Area.					
	No Action	Proposed Action	Accelerated Drawdown at Closure	Elimination of West Embankment Drain Pumpback at Closure	Alternative Capping Methods
Vegetation and Wetlands	No Secondary Impacts	Changes to vegetation in areas inundated or adjacent to the inundated areas due to soil moisture and changing conditions.	Secondary impacts would be similar to the Proposed Action. Time to total reclamation may be reduced by as much as 20 to 30 years if the tailings consolidates as modeled. This would allow more rapid reseeding and replanting which may be substantial in terms of vegetation succession, overall land appearance, and wildlife use.	Secondary impacts would be similar to the Proposed Action. Time to total reclamation may be reduced by as much as 7 years if the tailings dry sooner and allow more rapid reseeding and replanting.	Secondary impacts would be similar to the Proposed Action. Time to total reclamation may be reduced if the tailings dry sooner and allow more rapid reseeding and replanting.
Wildlife	No Secondary Impacts	Temporary reduced carrying capacity for some wildlife species. Disturbance from elevated noise levels.	Secondary impacts would be similar to the Proposed Action. However, this alternative may allow post-closure land uses to be achieved as much as two to three decades sooner, which may be substantial in terms of vegetation succession, overall land appearance, and wildlife use.	Secondary impacts would be similar to the Proposed Action.	Secondary impacts would be similar to the Proposed Action.
Aquatics	No Secondary Impacts	Changes in the tributary channel conditions adjacent to inundated area.	Secondary impacts would be identical to the Proposed Action.	Secondary impacts would be identical to the Proposed Action.	Secondary impacts would be identical to the Proposed Action.
Cultural Resources	No Secondary Impacts	No Secondary Impacts	No Secondary Impacts	No Secondary Impacts	No Secondary Impacts
Socioeconomics	No Secondary Impacts	Beneficial effect from MR jobs and tax revenue for longer duration	Secondary impacts would be similar to the Proposed Action.	Secondary impacts would be similar to the Proposed Action.	Secondary impacts would be similar to the Proposed Action.
Land Use	No Secondary Impacts	Negligible effects from vegetation shifts	Secondary impacts would be identical to the Proposed Action.	Secondary impacts would be identical to the Proposed Action.	Secondary impacts would be identical to the Proposed Action.
Visual Resources	No Secondary Impacts	No significant impacts	No significant impacts	No significant impacts	No significant impacts
Noise	No Secondary Impacts	Wildlife avoidance of area, including winter habitats.	Secondary impacts would be identical to the Proposed Action. However, this alternative may allow post-closure land uses to be achieved as much as two to three decades sooner, which may be substantial in terms of vegetation succession, overall land appearance, and wildlife use.	Secondary impacts would be identical to the Proposed Action.	Secondary impacts would be identical to the Proposed Action.
Air Quality	Minor secondary impacts	Minor secondary impacts with an increase in potential for long term secondary impacts with respect to the No Action	Minor secondary impacts with a decrease in potential long term secondary impacts with respect to the Proposed Action	Minor secondary impacts with a decrease in potential long term secondary impacts with respect to the Proposed Action	Minor secondary impacts with a decrease in potential short term secondary impacts with respect to the Proposed Action

The following table is a summary of the cumulative impacts discussions in Section 4.2. Please see the resource specific subsections for more details on the rationale for these impacts.

Table 5.1-3 Summary of the Cumulative Impacts of the No Action, Proposed Action, and other Alternatives organized by Resource Area.					
	No Action	Proposed Action	Accelerated Drawdown at Closure	Elimination of West Embankment Drain Pumpback at Closure	Alternative Capping Methods
Geology and Minerals	No cumulative impacts	Continued mining would remove the minerals available in and around the Continental Mine. The cumulative impact to minerals and geology when combined with the past and future activity in the area would be measurable, but these impacts would not be considered adverse as the removal of minerals is part of the purpose and need of the Proposed Action.	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action
Geotechnical Stability	No cumulative impacts	A slight decrease in the calculated Factor of Safety values as a result of increasing the height of embankment by 45 feet and from increasing the storage of tailings materials and process water.	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action
Soils and Reclamation	No cumulative impacts	No cumulative impacts to soil and reclamation.	The only change to soil and reclamation would be in the timing compared to the Proposed Action. No cumulative impacts to soil and reclamation.	The only change to soil and reclamation would be in the timing compared to the Proposed Action. No cumulative impacts to soil and reclamation.	The only change to soil and reclamation would be in the timing compared to the Proposed Action. No cumulative impacts to soil and reclamation.
Surface and Ground Water	There would be no cumulative impacts to ground water. During operations, a Superfund-managed pilot-scale treatment test at HsB Water Treatment Plant will require pumpback of minimally treated Horseshoe Bend seepage into the supernatant pond. This may lead to temporary increases in TDS, sulfate, and other constituents in the supernatant pond. Following closure, cumulative impacts to the BMFOU would increase because the YDTI supernatant pond and Horseshoe Bend seepage would no longer be managed in a closed-loop by MR. Rather, the seepage would become the responsibility of the BMFOU to	There would be no cumulative impacts to ground water due to proposed strategies for hydrodynamic containment. During operations, cumulative effects will be the same as for the No Action Alternative, including the effect of the Superfund pilot-scale treatment project. Closure-related cumulative effects to the BMFOU will be deferred by about 10 years compared to the No Action Alternative because mine operations will keep Horseshoe Bend seepage in a closed loop during the extended life of the mine. After closure, cumulative effects will be the same as under the No Action alternative, with the addition of the	Cumulative impacts would be similar to those anticipated for the Proposed Action except that they will differ during the accelerated drawdown period. During this time, excess water could potentially be stored in the Continental Pit, or a BMFOU treatment facility would directly receive water from the supernatant pond, which would result in a large volume of water and chemical load requiring treatment sooner compared to the No Action and Proposed Action alternatives.	Cumulative effects would be similar to those anticipated for the Accelerated Drawdown at Closure Alternative except that potential BMFOU facilities would receive WED seepage flow, at a lower rate than the Accelerated Drawdown scenario, and for a longer period of time.	Cumulative impacts associated with the Alternative Capping Methods Alternative would be the same as under the Proposed Action. No makeup water from outside the YDTI system would be required to process and transport the cap material slurry. Therefore, no changes to post-closure water management would be required.

Table 5.1-3 Summary of the Cumulative Impacts of the No Action, Proposed Action, and other Alternatives organized by Resource Area.					
	No Action	Proposed Action	Accelerated Drawdown at Closure	Elimination of West Embankment Drain Pumpback at Closure	Alternative Capping Methods
	manage, resulting in increased water volume and chemical constituent loading to the BMFOU.	possibility that water from the YDTI could end up in the Continental Pit via a proposed emergency spillway.			
Vegetation and Wetlands	No cumulative impacts	Minor changes in vegetation composition and mosaic in the context of the surrounding mined area. Cumulative impacts would be negligible.	Cumulative impacts would be similar to the Proposed Action	Cumulative impacts would be similar to the Proposed Action	Cumulative impacts would be similar to the Proposed Action
Wildlife	No cumulative impacts	Minor additional cumulative habitat losses if additional residential development in cumulative effects area	Cumulative impacts would be similar to the Proposed Action	Cumulative impacts would be similar to the Proposed Action	Cumulative impacts would be similar to the Proposed Action
Aquatics	No cumulative impacts	Minor additional changes to aquatic habitat in the mouths of the tributary streams. In the context of the Silver Bow Creek watershed, these impacts are negligible.	Cumulative impacts would be similar to the Proposed Action	Cumulative impacts would be similar to the Proposed Action	Cumulative impacts would be similar to the Proposed Action
Cultural Resources	No cumulative impacts	No cumulative impacts	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action
Socioeconomics	No cumulative impacts	No cumulative impacts	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action
Land Use	No cumulative impacts	No cumulative impacts	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action
Visual Resources	No cumulative impacts	No cumulative impacts	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action
Noise	No cumulative impacts	No cumulative impacts	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action	Cumulative impacts would be identical to the Proposed Action
Air Quality	Minor cumulative impacts	Minor cumulative impacts with an increase in potential for cumulative impacts with respect to the No Action	Minor cumulative impacts with a decrease in potential for cumulative impacts with respect to the Proposed Action	Minor cumulative impacts with a decrease in potential for cumulative impacts with respect to the Proposed Action	Minor cumulative impacts with a decrease in potential for cumulative impacts with respect to the Proposed Action

6 CONSULTATION AND COORDINATION

DEQ consulted the following agencies during the development of this EIS:

Agency	Individual	Title	Date
US EPA	Nikia Greene	Remedial Project Manager	November 8, 2018
DEQ	Daryl Reed	Superfund Project Manager	September 25 and October 22, 2018 and January 9, 2019
DEQ	Craig Henrikson	Air Quality Engineer	October 2, 2018
Montana Department of Fish, Wildlife, and Parks	Jason Lindstrom	Fisheries Biologist, Region 2	October 30, 2018
Montana Department of Fish, Wildlife, and Parks	Vanna Boccadori	Wildlife Biologist, Region 2	November 9, December 11, 2018
City-County of Butte Silver Bow	Danette Gleason	Finance and Budget Director	November 8, 9, 13, 23, 2018
MT Department of Labor and Industry	Chris Bradley	Economist	November 1, 2018
DEQ	James Strait	Archaeologist	October 11, 2018
State Historic Preservation Office	Damon Murdo	Cultural Records Manager	October 30, 2018
State Historic Preservation Office	Michelle Phair	Cultural Records Assistant	October 26, 2018 October 30, 2018
State Historic Preservation Office	Stan Wilmoth	State Archaeologist	January 4, 2019
US Fish and Wildlife Service	Jim Zelinack	Wildlife Biologist	February 7, 2019

7 LIST OF PREPARERS

Resource Area	DEQ Specialist
Cultural	James Strait
Engineering	Charles Freshman
Geology/Geochemistry	Garrett Smith
Ground water	Wayne Jepson
MEPA Coordinator	Craig Jones
Permit Coordinator	Herb Rolfes
Socioeconomics	Jeff Blend
Soils and Reclamation	John Koerth
Surface Water	Garrett Smith/Wayne Jepson
Vegetation	John Koerth
Wetlands	John Koerth
Wildlife	John Koerth/Craig Jones
Visual	Craig Jones
Land Use	Craig Jones
Noise	Craig Jones
Air Quality	Craig Henrikson
Legal Counsel	Ed Hayes

Consultant Team: HydroSolutions	
Cultural	Dave Schwab
Geology	Dave Donohue; Bill Maehl
Ground water	Mike Meredith
Reviewer	Dave Donohue; Pam Spinelli

Chapter 7: List of Preparers

Consultant Team: HydroSolutions	
Socioeconomics	Pam Spinelli
Geotechnical Stability	Shawn Higley
Soils and Reclamation	Shane Bofto; Bill Maehl
Surface Water	Mike Meredith
Vegetation	Leanne Roulson
Wetlands	Leanne Roulson
Wildlife	Pam Spinelli
Visual Resources	Alex Schwab
Noise	Beth Kelly
Air Quality	Shane Bofto

8 GLOSSARY AND ACRONYMS

8.1 LIST OF ACRONYMS AND SYMBOLS

Symbol/ Acronym	Definition
L _{dn}	Day-night average noise level
L _{eq}	Equivalent noise level
L _{max}	Maximum noise level
L ₅₀	50th percentile-exceeded noise level
L ₉₀	90th percentile-exceeded noise level
%	Percent
°F	Degrees Fahrenheit
<	Less than
>	Greater than
ACM	Anaconda Copper Mining Company, part of the Amalgamated Copper Company
ac-ft	Acre-feet
AMSL	Above mean sea level
APE	Acid Potential
APE	Area of Potential Effects
ARM	Atlantic Richfield Company
ARM	Administrative Rules of Montana
BACT	Best Available Control Technology
BGEPA	Bald and Golden Eagle Protection Act
BAMAOU	Butte Active Mine Area Operable Unit
BCC	Birds of Conservation Concern (USFWS)
BMFOU	Butte Mine Flooding Operable Unit
BMP	Best Management Practice
BPSOU	Butte Priority Soils Operable Unit
BQM	Butte Quartz Monzonite
CAA	Clean Air Act
CD	Consent Decree
CDP	Census Designated Place
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
Cfs	Cubic feet per second (referring to water flow)

Chapter 8: Glossary and Acronyms

Symbol/ Acronym	Definition
CRABS	Cultural Resource Annotated Bibliography System
CWA	Clean Water Act
CWL	Critical Water Levels
CRIS	Cultural Resource Inventory System
dB	Decibels
dBA	A-weighted decibels
Dbh	Diameter at breast height
DCP	Dust Control Plan
DEQ	Department of Environmental Quality
DNRC	Department of Natural Resources and Conservation
EA	Environmental Assessment
EC	Electrical Conductivity
EDAS	Ecological Data Application System
EIS	Environmental Impact Statement
EO	Executive Order
EOR	Engineer of Record
EPA	U.S. Environmental Protection Agency
EQC	Environmental Quality Council
ESA	Endangered Species Act
ESD	Explanation of Significant Differences
FAR	Functional at Risk
FIRE	USEPA's Factor Information Retrieval Data System
FishMT	Montana Fisheries Information System
FTA	Federal Transit Administration
GIS	Geographic Information System
gpm	Gallons per minute
GPS	Global Positioning System
GWIC	Groundwater Information Center
HAP	Hazardous Air Pollutant
HDS	High Density Sludge
HHS	Human Health Standard
HsB	Horseshoe Bend
H:V	Horizontal to vertical ratio
Hz	Hertz
IDT	Interdisciplinary Team
IPaC	Information for Planning and Consultation (USFWS)
IRP	Independent Review Panel

Chapter 8: Glossary and Acronyms

Symbol/ Acronym	Definition
JD	Jurisdictional Determination
Kf	Soil Erodibility Factor
KP	Knight Piesold
kg	Kilogram
kV	Kilovolts
LCV	Lowland Creek Volcanics
MAAQS	Montana Ambient Air Quality Standards
MAL	Minimal-Activiy Loci
MAQP	Montana Air Quality Permit
MBMG	Montana Bureau of Mines and Geology
MBTA	Migratory Bird Treaty Act
MCA	Montana Code Annotated
MCE	Maximum Credible Earthquake
MCL	Maximum Contaminant Level
MDLI	Montana Department of Labor & Industry
MDT	Montana Department of Transportation
MEPA	Montana Environmental Policy Act
MFWP	Montana Fish, Wildlife, and Parks
MGD	Million gallons per day (flow rate)
mg/L	Milligrams per liter (concentration)
MMRA	Metal Mine Reclamation Act
MNHP	Montana Natural Heritage Program
MOU	Memorandum of Understanding
MP	Milepost
MPDES	Montana Pollution Discharge Elimination System
mph	Miles per hour
MR	Montana Resources LLP
MRI	Montana Resources Inc.
MSHA	Mine Safety and Health Administration
MWQA	Montana Water Quality Act
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOI	Notice of Intent
NOT	Notice of Termination
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List (under Superfund)
NRCS	USDA Natural Resources Conservation Service

Chapter 8: Glossary and Acronyms

Symbol/ Acronym	Definition
NRHP	National Register of Historic Places
NRIS	Natural Resource Inventory System
NWI	National Wetland Inventory
OU	Operable Unit
PCI	Per capita income
PM10	Particulate Matter <10 microns
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PMT	Post Mining Topography
POC	Points of Compliance
PRP	Potentially Responsible Parties
PSD	Prevention of Significant Deterioration
PTE	Potential to Emit
RDS	Rock Disposal Sites
ROD	Record of Decision
ROI	Region of Influence
ROW	Right-of-way
SAR	Sodium Adsorption Ratio
SC	Specific conductance ($\mu\text{S}/\text{cm}$)
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SOC	Species of Concern
sp. or spp.	One or more species of a given genus
SSTOU	Streamside Tailings Operable Unit
SWPPP	Storm Water Pollution Prevention Plan
TCP	Traditional Cultural Properties
TDS	Total Dissolved Solids
TES	Threatened, Endangered and Sensitive
TMDL	Total Maximum Daily Load
TPY	Tons per Year
TSP	Total Suspended Particles
USBEA	United States Bureau of Economic Analysis
USBLS	United States Bureau of Labor Statistics
US CB	United States Census Bureau
USACE	US Army Corps of Engineers
USFS	U.S. Forest Service
USFWS	U.S. Fish & Wildlife Service
USGS	U.S. Geological Survey

Symbol/ Acronym	Definition
VOC	Volatile Organic Compounds
WED	West Embankment Drain
WQA	Montana Water Quality Act
WSA	Wildlife Study Area
YDTI	Yankee Doodle Tailings Impoundment

8.2 GLOSSARY

Term	Definition
active mining area	Areas in a mining operation where mining is taking place or areas where mining is complete and reclamation activities are taking place.
air pollutant	Any substance in air that could, in high enough concentration, harm animals, humans, vegetation, and/or materials. Such pollutants may be present as solid particles, liquid droplets, or gases. Air pollutants fall into two main groups: (1) those emitted from identifiable sources and, (2) those formed in the air by interaction between other pollutants.
air quality	A measure of the health-related and visual characteristics of the air, often derived from quantitative measurements of the concentrations of specific injurious or contaminating substances.
alkalinity	The extent to which water or soil contains soluble mineral salts.
alluvium	Unconsolidated material that is deposited by flowing water.
alternative	A 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.
annuals	Plants that complete their life cycle and die in one year or less.

Term	Definition
aquifer	A water-bearing geological formation capable of yielding water in sufficient quantity to constitute a usable supply.
attainment area	An area that the U.S. Environmental Protection Agency has designated as being in compliance with one or more of the National Ambient Air Quality Standards (NAAQS) for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants but not for others.
backfilling and grading	The operation of refilling an excavation and finishing the surface.
Bald and Golden Eagle Protection Act	An act enacted in 1940 that prohibits “take” of a bald or golden eagle without a permit from the Secretary of the Interior. “Take” is defined as “take, possesses, sell, purchase, barter, offer to sell, export, or import, at any time or in any manner, any bald eagle ... [or any golden eagle], alive or dead, or any part, nest, or egg thereof.”
base flow	Sustained flow of a stream in the absence of direct runoff. It includes natural and human-induced streamflows. Natural base flow is sustained largely by groundwater discharges.
baseline	The existing conditions against which impacts of the alternatives are compared.
Best Management Practices	Structural, non-structural, and managerial techniques that are recognized to be the most effective and practicable means to reduce or prevent water pollution.
biodiversity	A term that describes the variety of life-forms, the ecological role they perform, and the genetic diversity they contain.
blasting	The act of removing, opening, or forming by or as if by an explosive.
bond 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.
cone of depression	occurs in an aquifer when groundwater 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 contaminant (CAC) (or criteria air pollutant)	A set of air pollutants that cause smog, acid rain, and other health hazards. They are typically products of fossil-fuel combustion and are emitted from many sources in industry, mining, transportation, electricity generation, and agriculture. The following six CACs were the first set of pollutants recognized by USEPA as needing standards

Term	Definition
	on a national level: particulate matter, nitrogen oxides, ozone, carbon monoxide, sulfur oxides, and lead.
criteria pollutant	An air pollutant that is regulated by the National Ambient Air Quality Standards (NAAQS). Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and two size classes of particulate matter, less than 10 micrometers (0.0004 inch) in aerodynamic diameter, and less than 2.5 micrometers (0.0001 inch) in aerodynamic diameter. Pollutants may be added to, or removed from, the list of criteria pollutants as more information becomes available. Note: Sometimes pollutants regulated by state laws also are called criteria pollutants.
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 actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.
Day-night average noise level (L_{dn})	A noise metric that represents the constantly varying sound level during a continuous 24-hour period.
dBA or decibels A scale	A logarithmic unit for measuring sound intensity, using the decibel A-weighted scale, which approximates the sound levels heard by the human ear at moderate sound levels, with a 10-decibel increase being a doubling in sound loudness.
degradation	A process by which the quality of water in the natural environment is lowered. When used specifically in regard to DEQ's nondegradation rules, this term can relate to a reduction in quantity as well.
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.
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.
emissions inventory	An emission inventory is an accounting of the amount of pollutants discharged into the atmosphere.
endangered species	Any species of plant or animal that is in danger of extinction throughout all or a significant portion of its range. Endangered species are identified by the Secretary of the Interior in accordance with the 1973 Endangered Species Act.
Endangered Species Act	An act of Congress, enacted in 1973, to protect and recover threatened or endangered plant or animal species and their habitats. The Secretary of the Interior, in accordance with the act, identifies or lists the species as “threatened” or “endangered.”
Environmental Assessment (EA)	A concise public document that an agency prepares under the Montana Environmental Policy Act to provide sufficient evidence and analysis to determine whether a proposed action requires preparation of an Environmental Impact Statement (EIS) or whether a Finding of No Significant Impact can be issued. An EA must include brief discussions on the need for the proposal, the alternatives, the environmental impacts of the proposed action and alternatives, and a list of agencies and persons consulted.
environmental consequences	Environmental effects of project alternatives, including the proposed action, which cannot be avoided; the relationship between short-term uses of the human environment, and any irreversible or irretrievable commitments of resources which would be involved if the proposal should be implemented.
Environmental Impact Statement (EIS)	A document prepared to analyze the impacts on the environment of a proposed action and released to the public for review and comment. An EIS must meet the requirements of MEPA, CEQ, and the directives of the agency responsible for the proposed action.
ephemeral stream	A stream that flows only as a direct response to rainfall or snowmelt events, having no baseflow from ground water.
Equivalent noise level (L_{eq})	An environmental noise metric, similar to an average, to describe the constantly fluctuating instantaneous noise levels at a location.
evaporation	The physical process by which a liquid is transformed to a gaseous state.
fault	A fracture or fracture zone where there has been displacement of the sides relative to one another.
forb	Any herbaceous plant, usually broadleaved, that is not a grass or grass-like plant.
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

Term	Definition
	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.
genus	A group of related species used in the classification of organisms (plural = genera).
habituate	Become accustomed to.
hanging wall	The side of a non-vertical fault which occurs above the fault plane.
hardness	A measure of the amount of calcium and magnesium dissolved in the water.
Hazardous Air Pollutants	pollutants which are not covered by NAAQS and which may, at
hazardous air pollutants (HAPs)	Air pollutants not covered by the National Ambient Air Quality Standards (NAAQS) but which may present a threat of adverse human health effects or adverse environmental effects. Those specifically listed in 40 CFR 61.01 are asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. More broadly, HAPs are any of the 189 pollutants listed in or pursuant to section 112(b) of the Clean Air Act. Very generally, HAPs are any air pollutants that may realistically be expected to pose a threat to human health or welfare.
haze	A form of air pollution caused when sunlight encounters tiny pollution particles in the air, which reduce the clarity and color of what we see, and particularly during humid conditions.
heavy metals	Metallic elements with high molecular weights, generally toxic in low concentrations to plants and animals.
highwall	The face of exposed overburden and mineral in surface mining operations or for entry to underground mining operations.
historic properties	Cultural resources that are listed on or eligible for listing on the NRHP.
home range	An area in which an individual animal spends most of its time doing normal activities.
horsetail ore zones	Ore present in fractures which diverge from a major fracture.
hybrid, hybridized	An individual that is a mix of closely related species. More common in plants and aquatic vertebrates.
hydraulic conductivity	The rate of flow of water through geologic material.
hydraulic head	A specific measurement of liquid pressure above a geodetic datum.
hydric soil	A soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part.
hydrophytic	Growing either partly or totally submerged in water. Plants that are capable of growing under such conditions.
impoundment	a body of water confined within an enclosure, as a reservoir.

Term	Definition
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.
inundate	To flood or cover with water.
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.
L₅₀ (50th percentile-exceeded noise level)	A noise metric that represents the single noise level exceeded during 50 percent of a measurement period. The L ₅₀ is the median noise level during a period of time.
L₉₀ (90th percentile-exceeded noise level)	A noise metric that represents the noise level exceeded during 90 percent of a measurement period, and is typically considered the ambient noise level.
land use	The activities and inputs undertaken in a certain land cover type, or the way in which land is managed (e.g., grazing pastures, managed forests).
land-use change	Change in the use of land by humans that may result in a change in land cover.
leach	To drain away from a material by the action of percolating liquid, especially water.
leached cap	A leach cap is rock which used to carry mineralized ore, but has since been depleted due to weathering.
life-of-mine	Length of time after permitting during which minerals are extracted and mine-related activities can occur.
lineaments	a linear feature in a landscape which is an expression of an underlying geological structure such as a fault. Typically a lineament will appear as a fault-aligned valley, a series of fault or fold-aligned hills, a straight coastline or indeed a combination of these features
lithology	The structure and composition of a rock formation.
loading	The quantity of material or chemicals entering the environment, such as a receiving water body
long-term effect	A change in a resource or its condition that does not immediately return the resource to pre-mine condition, appearance, or productivity; long-term impacts would apply to changes in condition that continue beyond the bond liability period but would be expected to eventually return to pre-mine condition, or as required under the Surface Mining Control and Reclamation Act (SMCRA).
macroinvertebrates	Small animals without backbones that are visible without a microscope (e.g., insects, small crustaceans, and worms).

Term	Definition
macrophytes	Plants visible to the unaided eye. In terms of plants found in wetlands, macrophytes are the conspicuous multicellular plants.
mainstem	The primary channel in a stream or river.
Maximum noise level (L_{max})	A noise metric denotes the maximum instantaneous sound level recorded during a measurement period.
mean	The average number of a set of values. The sum of the values divided by the count of values.
mean annual high water	The annual flood is defined as the highest instantaneous peak flow each year at a gage site on a river. Therefore, the mean annual high water is the arithmetic average of all the annual flood levels for the gage period of record or other specified time interval.
median	A numerical value in the midpoint of a range of values with half the value points above and half the points below.
mesic	Having intermediate or moderate moisture or temperature; or reference to organisms adapted to moderate climates.
metric	A value calculated from existing data and used for summarization purposes.
Migratory Bird Treaty Act	Enacted in 1918 between the United States and several other countries. The act forbids any person without a permit to “pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird, included in the terms of this Convention...for the protection of migratory birds...or any part, nest, or egg of any such bird.”
mitigation	An action to avoid, minimize, reduce, eliminate, replace, or rectify the impact of a management practice.
Montana Natural Heritage Program	The 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. National ambient air quality standards are based on the air quality
National Emissions Standards for Air Quality	Emissions standards set by the Environmental Protection Agency for air
neutralization	A neutralization reaction is a chemical reaction between an acid and a base which produces a more neutral solution (closer to a pH of 7). The final pH depends on the strength of the acid and base in the reaction. At the end of a neutralization reaction in water, no excess hydrogen or hydroxide ions remain.

Term	Definition
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 U.S. Environmental Protection Agency has designated as not meeting (i.e., not being in attainment of) one or more of the National Ambient Air Quality Standards (NAAQS) for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants, but not for others.
noxious weed	Any exotic plant species established or that may be introduced in the state that may render land unfit for agriculture, forestry, livestock, wildlife, or other beneficial uses, or that may harm native plant communities.
opportunistic species	A species that can adapt to, and take advantage of, a variety of habitats or situations. This ability provides a benefit to the species in its distribution, numbers, and survival during changing conditions.
open pit mine	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 an large, canyonlike depression.
orthophoto	An aerial photograph or image geometrically corrected ("orthorectified") such that the scale is uniform: the photo has the same lack of distortion as a map.
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. PM10 includes only those particles equal to or less than 10 micrometers (0.0004 inch) in aerodynamic diameter; PM2.5 includes only those particles equal to or less than 2.5 aerodynamic micrometers (0.0001 inch) in diameter.
peak flow	The maximum flow of a stream in a specified period of time.
perennial stream	A stream or reach of a stream that flows continuously during all of the year as a result of ground water discharge or surface runoff.
perennials	Plants that live longer than 2 years.
permafrost	Ground (soil, rock, or sediment) that remains frozen for more than two consecutive years.
permeable	Allowing the passage of fluids.

Term	Definition
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.
piezometer	A small well used to measure the ground water surface.
placer mining	A method of using water to excavate, transport, concentrate, and recover heavy minerals from alluvial (stream) or placer (sand or gravel) deposits
population	A collection of individuals that share a common gene pool. In this document, local population refers to those breeding individuals within the analysis area.
postmining land use	The specific use or management-related activity to which a disturbed area is restored after completion of mining and reclamation.
postmining topography	The relief and contour of the land that remains after backfilling of the mine pit, grading, and recontouring have been completed.
potentiometric surface	A hypothetical surface representing the level to which groundwater would rise if not trapped in a confined aquifer (an aquifer in which the water is under pressure because of an impermeable layer above it that keeps it from seeking its level)
precipitate	A substance that falls out of solution, usually in response to a chemical reaction.
prevention of significant deterioration (of air quality) (PSD)	Regulations established to prevent significant deterioration of air quality in areas that already meet NAAQS. Specific details of PSD are found in 40 CFR 51.166.
primary impact	An impact caused by an action and that 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 referring to a plan that contains sufficient details about the intended actions to be taken, or that will result, to allow alternatives to be developed and its environmental impacts analyzed.
public health	The science of protecting the safety and improving the health of communities through education, policy making and research for disease and injury prevention.
Q100	The flow estimated for the 100-year flood of a stream or river, or a flood event that has a one percent probability of occurring in any given year.
raptors	Birds of prey (e.g., hawks, owls, vultures, eagles)

Term	Definition
reclamation	Per MMRA at ARM, 17.24.102, reclamation means the return of lands disturbed by mining or mining-related activities to an approved postmining land use which 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.
recontouring	The movement of quantities of earth, usually by mechanical means, to reconfigure the relief and contour of the land.
regeneration	Regrowth of a tree crop or other vegetation, whether by natural or artificial means.
regional haze	Visibility impairment that is caused by the emission of air pollutants from numerous sources located over a wide geographic area. Such sources include, but are not limited to, major and minor stationary sources, mobile sources, and area sources. (40 CFR 51.301)
revegetation	Plant growth that replaces original ground cover following land disturbance.
riparian areas	Areas with distinct resource values and characteristics that comprise an aquatic ecosystem, and adjacent upland areas that have direct relationships with the aquatic system. This includes floodplains, wetlands, and lake shores.
ripped	Torn, split apart, or opened.
scenic integrity	the degree of intactness and wholeness of the landscape character. Inventoried scenic integrity levels reflect current conditions of scenic resources.
secondary impact	An impact caused by an action but that occurs later in time (reasonably foreseeable) or farther away in distance.
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, 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.
smelter	A site where the process of applying heat to ore in order to extract out a base metal occurs. Smelting is a form of extractive metallurgy

Chapter 8: Glossary and Acronyms

Term	Definition
sodium adsorption ratio (SAR)	A relation between soluble sodium and soluble divalent cations that can be used to predict the exchangeable sodium percentage of soil equilibrated with a given solution.
soil erodibility	A measure of the inherent susceptibility of a soil to erosion, without regard to topography, vegetation cover, management, or weather conditions.
soil pH	The negative logarithm of the hydrogen ion activity of a soil. The degree of acidity or alkalinity.
soil texture	Soil textural units are based on the relative proportions of sand, silt, and clay.
spillway	A water conveyance meant to allow excess water to drain from an impoundment or pond so that the waterbody does not overflow.
spoil	Overburden that has been removed during surface or underground mining operations.
spring	A localized point of discharge where ground water emerges onto the land or into a surface water body.
stratigraphy	The arrangement of strata (layers).
subpopulation	A well-defined set of interacting individuals that comprise a portion of a larger, interbreeding population.
Superfund	US federal government program designed to fund the cleanup of toxic wastes, administered by USEPA under the Comprehensive Environmental Response, Compensation and Liability Act
supernatant	The liquid lying above a solid residue after crystallization, precipitation, centrifugation, or other process.
sustainability	The ability of a population to maintain a relatively stable population size over time.
tailings	waste left over after certain processes, such as from an ore-crushing plant or mill.
tailings pond	Tailing ponds are areas of refused mining tailings where the waterborne refuse material is pumped into a pond to allow the sedimentation (meaning separation) of solids from the water. The pond is generally impounded with a dam, and known as tailings impoundments or tailings dams
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).

Term	Definition
total maximum daily load	is a regulatory term in the U.S. Clean Water Act, describing a plan for restoring impaired waters that identifies the maximum amount of a pollutant that a body of water can receive while still meeting water quality standards
total suspended solids	A measure of the amount of undissolved particles suspended in water.
toxic parameter	A chemical that has an immediate, deleterious effect on the metabolism of a living organism.
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 water body.
trigger value	A value listed in DEQ Circular WQB-7 for a toxic parameter, used to determine if proposed activities will cause degradation.
unconsolidated deposits	Sediment not cemented together, containing sand, silt, clay, and organic material.
upgradient	The direction from which ground water flows.
viability	Ability of a population to maintain sufficient size so that it persists over time in spite of normal fluctuations in numbers; usually expressed as a probability of maintaining a specific population for a specific period.
viewshed	The portion of the surrounding landscape that is visible from a single observation point or set of points.
visibility	The distance to which an observer can distinguish objects from their background. The determinants of visibility include the characteristics of the target object (shape, size, color, and pattern), the angle and intensity of sunlight, the observer's eyesight, and any screening present between the viewer and the object (i.e., vegetation, landform, even pollution such as regional haze).
water of the U.S.	Waters including : all interstate waters use din interstate or foregin 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.

9 RESPONSE TO COMMENTS

This chapter will be completed in the Final EIS.

Chapter 9: Response to Comments

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