Prepared for
Montana Resources, LLC
600 Shields Avenue
Butte, Montana
USA 59701

Prepared by
Knight Piésold Ltd.
Suite 1400 - 750 West Pender Street
Vancouver, British Columbia
Canada, V6C 2T8

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MONTANA RESOURCES
YANKEE DOODLE TAILINGS IMPOUNDMENT - DESIGN BASIS REPORT FOR 6,560 AMENDMENT DESIGN DOCUMENT

Rev	Description	Date
0	Issued in Final	September 20, 2024

EXECUTIVE SUMMARY

Montana Resources, LLC (MR) is preparing a permit amendment application (6,560 Amendment Application) for continued use of the Yankee Doodle Tailings Impoundment (YDTI). The proposed amendment considers raising the crest elevation (EL.) of the YDTI embankments to EL. 6,560 feet (ft) to facilitate continued mining beyond 2034.

Knight Piésold Ltd. (KP) has prepared this Design Basis Report to outline the overall design basis criteria and design objectives considered in the 6,560 Amendment Application Design Document (Design Document). This report summarizes the guidelines and regulations, design philosophy, specific design criteria and other pertinent information. The principal design objectives for the YDTI are to:

- Provide secure tailings and operating pond storage
- Progressively improve the surface reclamation potential of the YDTI and surrounding facilities
- Protect regional groundwater and surface waters from further impact

The YDTI comprises a valley-fill style impoundment created by a continuous rockfill embankment that for descriptive purposes is divided into three embankment sections (North-South, East-West, and West). The YDTI was originally constructed in 1963 and has been continuously constructed to EL. 6,450 ft using rockfill from the Berkeley Pit (until 1982) and from the Continental Pit (beginning in 1986). The EL. 6,450 ft embankment is estimated to provide sufficient tailings storage capacity to allow continued mining and ore processing until approximately 2034.

Raising of the embankment crest elevation will be required prior to 2034 to facilitate continued mining beyond 2034. A maximum embankment design crest elevation of 6,560 ft provides storage capacity for the tailings generated from processing the remaining ore reserves identified in the 2022 End of Year Reserve Report (the Reserve Report) (MR, 2023). The Reserve Report prepared by MR considers various factors (ore cut-off grades, inferred and indicated reserves, etc.) and is updated on an annual basis by MR. The embankment will be progressively constructed in two or more lifts to reach a maximum crest elevation of 6,560 ft.

The YDTI relies on storm storage capacity to manage the Inflow Design Flood (IDF) during operations. A closure spillway is planned to manage the IDF in the long-term following mine closure. The Probable Maximum Flood (PMF) was selected as the IDF for the on-going design of the YDTI in accordance with Montana State law and consistent with the current design basis for the facility and good engineering practice.

Montana State law requires the earthquake design ground motion be the larger of the 1-in-10,000-year return period or the Maximum Credible Earthquake (MCE). An updated site-specific probabilistic and deterministic seismic hazard assessment (SHA) was completed by Al Atik and Gregor (Al Atik and Gregor, 2022) and will be included in the Design Document supporting the 6,560 Amendment Application. The updated SHA considers the findings of a recent fault study assessing the potential activity of faults located in the vicinity of the YDTI. The updated SHA will be used to select the maximum design earthquake and associated earthquake loading parameters for seismic design of the YDTI.

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ABBREVIATIONS

ACC .... Anaconda Copper Company
acre-ft .... acre-ft
ARM .... Administrative Rules of Montana
BC Mine Code .... Health, Safety and Reclamation Code for Mines in British Columbia
BMFOU .... Butte Mine Flooding Operable Unit
CDA .... Canadian Dam Association
CFR .... Code of Federal Regulations
DBR .... Design Basis Report
EL .... elevation
EOR .... Engineer of Record
EPA .... Environmental Protection Agency
ft .... feet
FEMA .... Federal Emergency Management Agency
GISTM .... Global Industry Standard on Tailings Management
GPM .... gallons per minute
GPS .... Global Positioning System
GTR .... Global Tailings Review
hp .... horsepower
HsB .... Horseshoe Bend
HsB CS .... Horseshoe Bend Capture System
ICMM .... International Council on Mining and Metals
ICOLD .... International Commission on Large Dams
IDF .... Inflow Design Flood
in .... inches
IRP .... Independent Review Panel
KP .... Knight Piésold Ltd.
MCA .... Montana Code Annotated
MCE .... Maximum Credible Earthquake
MDEQ .... Montana Department of Environmental Quality
Mine Act .... Federal Mine Safety and Health Act of 1977
Mgal .... million U.S. gallons
MGPD .... million gallons per day
MR .... Montana Resources, LLC
MSHA .... Mine Safety and Health Administration
NID .... National Inventory of Dams
pcf .... pound-force per cubic foot
PMF .... Probable Maximum Flood
PRI .... Principles for Responsible Investment
R7W .... Range 7 West
RDS .... Rock Disposal Site
RWS .... Reclaim Water System
SHA .... seismic hazard assessment
T3N .... Township 3 North
T4N .... Township 4 North
TDS .... Tailings Distribution System
TSF .... Tailings Storage Facility

USBR .... U.S. Department of the Interior Bureau of Reclamation
UNEP .... United Nations Environment Programme
U.S. .... United States
USACE .... United States Army Corps of Engineers
WED .... West Embankment Drain
WTP .... Water Treatment Plant
YDTI .... Yankee Doodle Tailings Impoundment

1.0 INTRODUCTION

1.1 MINE LOCATION

Montana Resources, LLC (MR) operates the Montana Resources open pit copper and molybdenum mine located in Butte, Montana. The operation includes a mill throughput of roughly 49,000 short tons per day. The mine produces copper sulfide concentrate, molybdenum disulfide concentrate, and copper precipitate (cement copper) for sale in the United States (U.S.) and world markets.

The site is located in Butte, Silver Bow County, Montana in Sections 5 and 6 Township 3 North (T3N), Range 7 West (R7W) and Sections 31 and 32 Township 4 North (T4N), Range 7 West (R7W) of the Montana Principal Meridian. The site is bounded by Interstate 15 and the Continental Divide on the east, Moulton Reservoir Road on the west, and Farrell Street, Continental Drive and Shields Avenue to the south. The project location is shown on Figure 1.1.

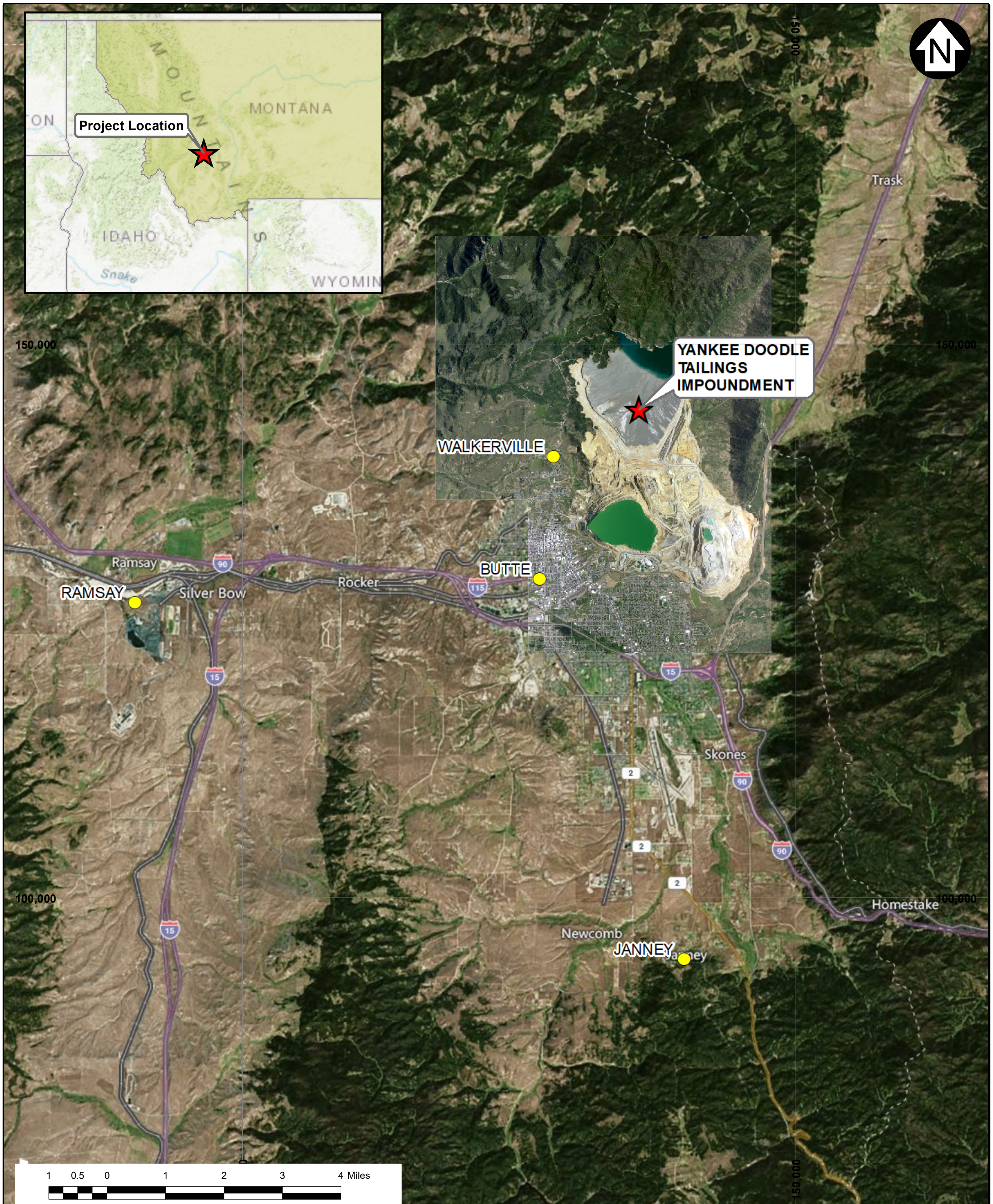
1.2 6,560 AMENDMENT APPLICATION

The tailings from ore processing are conveyed to the Yankee Doodle Tailings Impoundment (YDTI) for disposal and permanent storage. The YDTI is currently permitted to a maximum crest elevation (EL.) of 6,450 feet (ft). The EL. 6,450 ft embankment provides sufficient tailings storage capacity to support mining and ore processing until approximately 2034. MR is preparing a permit amendment application (6,560 Amendment Application) to facilitate continued operation of the mine thereafter by aligning approval for tailings storage at the YDTI with the remaining ore reserves. The permit amendment application process requires the permit applicant (MR) to submit a design document when expansion of an existing facility is proposed.

Knight Piésold Ltd. (KP) is developing the 6,560 Amendment Design Document (the Design Document) to support the 6,560 Amendment Application. The Design Document presents the plan to progressively raise the crest elevation of the YDTI embankments to a maximum design crest of EL. 6,560 ft in two or more lifts to support continued mining and ore processing. The Design Document comprises a series of technical reports covering the subject areas and content to meet the requirements specified in Montana State law as well as evaluating opportunities for continued risk reduction to enhance safety as part of the fundamental objective for on-going continuous improvement of the safety of the YDTI. The laws governing tailings storage facility design, operation and reclamation are contained within sections of Montana Code Annotated (MCA) Title 82 Chapter 4 Part 3 (MCA, 2023).

- Title 82: Minerals, Oil, and Gas
  - Chapter 4: Reclamation
    - Part 3: Metal Mine Reclamation

MCA 82-4-376 describes the design document requirements for a tailings storage facility (TSF) and is the governing regulation for preparation of the Design Document.



LEGEND

PROJECT LOCATION

CITY

NOTES:

1. BASE MAP: 2023 AERIAL IMAGERY PROVIDED BY MONTANA RESOURCES, LLC AND BING MAPS.

2. COORDINATE GRID IS IN FEET.
COORDINATE SYSTEM: MONTANA MINE GRID.

3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:150,000 FOR 8.5x11 (LETTER) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	18SEP'24	ISSUED WITH REPORT	KK	KK	DDF

MONTANA RESOURCES, LLC

MONTANA RESOURCES

PROJECT LOCATION

Knight Piésold CONSULTING

P/A NO. VA101-126/24

REF NO. 1

FIGURE 1.1

REV 0

1.3 REPORT PURPOSE

This Design Basis Report (DBR) will form a part of the Design Document and outlines the basic design criteria for the continued construction of the YDTI embankments to a maximum design crest elevation of 6,560 ft. It also summarizes the guidelines, regulations, specific design criteria and other pertinent information associated with on-going design of the YDTI embankments and Rock Disposal Sites (RDS). Components related to the ongoing design, construction and operation of the YDTI will be prepared in accordance with the most recent and applicable State and Federal design codes, which are summarized in Section 3. Additional industry accepted guidelines and recommendations outside of the State and Federal regulations will also be considered, as appropriate.

1.4 INDEPENDENT REVIEW PANEL

An Independent Review Panel (IRP) consisting of three independent review engineers or specialists is required when a new facility or existing facility expansion is proposed. The IRP is responsible for review of the Design Document, the underlying analyses, and assumptions for consistency with MCA 82-4-376. The IRP assesses the practicable application of current technology in the proposed design, submits review comments, indicates any recommended modifications and specifies the required IRP on-going progress review schedule relevant to the design.

The following international experts constitute the current IRP for the YDTI:

- Dr. Dirk Van Zyl, P.E. – Tailings and Geotechnical Specialist Engineer
- Dr. Leslie Smith, P.Geo – Hydrogeology Specialist
- Dr. Peter K. Robertson, P.E. – Tailings and Geotechnical Specialist Engineer

These three technical experts are the designated IRP for the Design Document. A fourth international expert Mr. James Swaisgood P.E., passed away in June 2024. He specialized in dam design and seismic assessment and was previously engaged as an IRP member to provide technical design review for the YDTI. Jim's contributions, advice and support to the project during his role as an IRP member from 2015 through to June 2024 are gratefully acknowledged.

1.5 ENGINEER OF RECORD

The requirements for an Engineer of Record (EOR) for the YDTI are described in MCA 82-4-375. The EOR for the YDTI is Mr. Daniel Fontaine, P.E. of KP. The EOR is required to be a Professional Engineer licensed in the State of Montana and cannot be an employee of the Operator or the permit holder. The EOR has the following responsibilities in relation to the preparation of the Design Document:

- Review design and other documents pertaining to the TSF.
- Certify and seal designs or other documents pertaining to the TSF submitted to the Montana Department of Environmental Quality (MDEQ).
- Participate in panel reviews with the IRP as required in MCA 82-4-377 and -380.

1.6 COORDINATE SYSTEM

The design of the YDTI references the site coordinate system known as the 'Anaconda Mine Grid' established by The Anaconda Company in 1957. The Anaconda Mine Grid is based on the Anaconda Copper Company (ACC) Datum established in 1915. All elevations are stated in Anaconda Mine Grid coordinates with respect to the ACC Vertical Datum unless specifically indicated otherwise. The Montana Resources Global Positioning System (GPS) Site Coordinate System is based on the 'Anaconda Mine Grid' and utilizes International Feet.

1.7 STANDARD UNITS FOR THE PROJECT

The standard units for the design of the project will be the following U.S. Customary Units:

- Length: feet (ft)
- Diameter: inches (in)
- Area: acres
- Volume: acre-feet (acre-ft)
- Fluid volume: million U.S. gallons (Mgal)
- Mass: short tons (tons)
- Density: pounds per cubic foot (pcf)
- Pressure: pound-force per square foot (psf)
- Temperature: degrees Fahrenheit (°F)
- Power: horsepower (hp)
- Flow rate: gallons per minute (GPM) or million gallons per day (MGPD)

2.0 DESCRIPTION OF MINE FACILITIES

2.1 EXISTING YANKEE DOODLE TAILINGS IMPOUNDMENT

The YDTI was originally constructed in 1963 using rockfill from the Berkeley Pit and has been continuously constructed to EL. 6,450 ft using rockfill from the Berkeley Pit (until 1982) and from the Continental Pit (beginning in 1986). The YDTI comprises a valley-fill style impoundment created by a continuous rockfill embankment that for descriptive purposes is divided into three rockfill embankments according to the general geometry of each limb of the continuous embankment. These embankments are the:

- North-South Embankment - The North-South Embankment forms the eastern to southeastern limb of the YDTI and runs approximately north to south in orientation. The North-South Embankment abuts onto the base of Rampart Mountain, forming the eastern battery limit of the facility.
- East-West Embankment - The East-West Embankment forms the southwestern limb of the YDTI and runs approximately east to west in orientation. The East-West Embankment is constructed upstream of the Horseshoe Bend (HsB) area and the Berkeley Pit.
- West Embankment - The West Embankment forms the western limb of the YDTI and runs approximately north to south in orientation. The West Embankment is constructed along the side of the West Ridge and forms the western battery limit of the facility. The West Embankment incorporates the West Embankment Drain (WED) and several other seepage control features, which will maintain hydrodynamic containment of YDTI seepage as the supernatant pond elevation rises above the lowest groundwater elevations in the West Ridge.

2.2 YANKEE DOODLE TAILINGS IMPOUNDMENT RAISES

The continued construction of the YDTI embankments will be completed with similar techniques and construction methodologies that have been adopted for past raises. The proposed 110 ft embankment crest elevation increase will be progressively constructed in two or more lifts to reach the maximum crest elevation of 6,560 ft.

The East-West and North-South Embankments will continue to be free-draining rockfill embankments constructed from pit-run material. The West Embankment will continue as a zoned embankment, constructed using selective rockfill placement sourced from pit-run material in predefined zones within the embankment. The WED and several other seepage control features maintaining hydrodynamic containment along the West Ridge will remain within the West Embankment.

2.3 ROCK DISPOSAL SITES

MR places surplus rockfill from mine operations in rock disposal sites adjacent to the YDTI embankments. Three RDS locations, adjacent to and downstream of the YDTI embankments, are proposed for on-going construction of the facility (expansion of two existing RDS and one new RDS). The locations of the RDS will continue to enhance the stability of the YDTI and may provide opportunities for progressive reclamation of the mine site.

The West RDS will be a new feature proposed as part of the 6,560 Amendment Application. The West RDS will be located adjacent to the northwest trending portion of the East-West Embankment on a previously disturbed area formerly referred to as the Northwest Dumps. The expansion of the two existing RDS includes the HsB RDS and the North RDS. The total volume of rockfill stored at these RDS in the long-term will be dependent on several factors, including MR's rockfill forecast schedule, pit stripping requirements, embankment rockfill material needs, cut-off grades due to fluctuating metal prices, other mine site uses and the duration of continued mining operations at the site. The locations and layouts of the RDS included in the 6,560 Amendment Application consider the volumes of rockfill presented in the Reserve Report and the rockfill requirements for embankment and other construction uses. Excess rockfill above the capacity of the proposed RDS locations is expected to be stored within the Continental Pit following active mining.

The design of rockfill storage within the pit is not specifically included in the Design Document.

2.4 BATTERY LIMITS AND OTHER FACILITIES

This DBR is for the continued construction of the YDTI embankments and RDS to a maximum design crest elevation of EL. 6,560 ft. Localized features such as pipe ramps along the embankment crest for tailings distribution and water reclaim pipeline access will be higher than the maximum embankment design elevation. The following mine facilities that are related to the continued operation of the YDTI will be described in the Design Document to provide appropriate context for the on-going operation of the YDTI but are not the subject of the amendment design unless otherwise noted:

- Tailings Distribution System (TDS)
- Reclaim Water System (RWS)
- Silver Lake Water System (SLWS)
- Continental Pit
- Berkeley Pit
- Concentrator
- Historical leach dumps and associated facilities
- Precipitation Plant
- Horseshoe Bend Water Treatment Plant (HsB WTP)
- Horseshoe Bend Capture System (HsB CS)
- Berkeley Pit Pumping System
- Polishing Plant
- Access and haul roads

3.0 REGULATORY GUIDELINES

3.1 GOVERNING STATE LEGISLATION AND REGULATIONS

3.1.1 MONTANA CODE ANNOTATED

The regulations and rules that govern the design and operation of TSFs in the State of Montana are summarized below and in Section 3.1.2. MCA is a codification of Montana State law. The laws governing TSF design, operation and reclamation are contained within Title 82 Chapter 4 Part 3 (MCA, 2023).

The legislative intent (MCA 82-4-301) is that TSFs are designed, operated, monitored, and closed in a manner that:

- Meets state-of-practice engineering design standards
- Uses applicable, appropriate, and current technologies and techniques as are practicable, given site-specific conditions and concerns
- Provides protection of human health and the environment

MCA 82-4-376 describes the design document requirements for a TSF and is the governing regulations for preparation of the Design Document. Select design criteria required by MCA 82-4-376 are described in Section 4.0 of this report.

The jurisdiction for regulation of tailings impoundments resides with the MDEQ. Dams for tailings impoundments and mine water reservoirs subject to permits issued by the MDEQ are specifically exempt from high-hazard dam determination (MCA 85-15-209). The governing regulations for new tailings storage facilities, including expansions requires (unless approved otherwise by the IRP) the design be sufficient to manage:

- The Probable Maximum Flood (PMF) (MCA 82-4-376 (2) (cc))
- The Maximum Credible Earthquake (MCE) or 1-in-10,000-year return period event, whichever is larger (MCA 82-4-376 (2) (i))

3.1.2 ADMINISTRATIVE RULES OF MONTANA

The Administrative Rules of Montana (ARM) are department rules to implement, interpret, or set policy in the State of Montana. The ARM are established by the State agencies to implement the laws passed by the Legislature. The most applicable set of rules established by MDEQ related to the project are ARM Chapter 17.24 Subchapter 1. These are the Rules applicable to the Montana Hard Rock Mining Reclamation Act (ARM, 2015).

3.2 FEDERAL REGULATORY ENVIRONMENT

3.2.1 UNITED STATES ARMY CORPS OF ENGINEERS

Federal regulatory involvement was initiated through the National Dam Inspection Act (Public Law 92-367) dated August 8, 1972, which directed the United States Army Corps of Engineers (USACE) to conduct inspections of non-federal dams and alert owners and the State to conditions that may constitute a danger to human life or property. The USACE inspections led to the development of a National Inventory of Dams (NID).

A delegation from USACE inspected the YDTI on May 11, 1978 and issued the Phase 1 Inspection Report in February of 1980 (USACE, 1980). The USACE has not inspected the YDTI since the initial Phase 1 Inspection and has not stated a regulatory interest since the initial inspection. The NID continues to include the YDTI (NID ID# MT01425) and indicates that it is a State regulated dam that falls under the jurisdiction of the MDEQ (USACE, 2024).

3.2.2 MINE SAFETY AND HEALTH ADMINISTRATION

The Mine Safety and Health Administration (MSHA) is responsible for administering the provisions of the Federal Mine Safety and Health Act of 1977 (Mine Act) and enforcing compliance with mandatory safety and health standards. Title 30 Code of Federal Regulations (CFR) part 56.20010 requires that *'if failure of a water or silt retaining dam at a mine will create a hazard, it shall be of substantial construction and inspected at regular intervals'*. The Mine Act requires that the MSHA inspect surface mines at least twice per year.

3.2.3 ENVIRONMENTAL PROTECTION AGENCY

The Environmental Protection Agency (EPA) is not directly involved in the current MR mine operations on site. The majority of the MR mine site; however, is contained within the Butte Mine Flooding Operable Unit (BMFOU) of the Silver Bow Creek/Butte Area Superfund Site, which is monitored and overseen by the EPA.

The BMFOU activities onsite are largely associated with water management. The Berkeley Pit and Discharge Pilot Project (the Pilot Project) was implemented in 2019 as part of the BMFOU activities. This water management strategy is now integrated with some of the existing YDTI water management systems. The strategy incorporates using the YDTI supernatant pond for treatment of Berkeley Pit and HsB Area waters while maintaining the current pond elevation within the Berkeley Pit.

3.2.4 FEDERAL EMERGENCY MANAGEMENT AGENCY

The Federal Emergency Management Agency (FEMA) of the U.S. Department of Homeland Security is the governing regulatory body responsible for preparing for, protecting against, responding to, recovering from and mitigating all hazards in the United States. FEMA has published a series of federal guidelines for dam safety. The guidelines provide recommendations for management practice to improve overall dam safety but are not intended as standards for technologies or design and are not mandated.

The Federal Guidelines for Dam Safety Risk Management (FEMA, 2015) provide recommendations for failure modes identification, risk analysis, risk assessment and risk management. Additionally, the procedures outlined in the Best Practices in Dam and Levee Safety Risk Analysis by the U.S. Department of the Interior Bureau of Reclamation (USBR) (USBR, 2019) are currently viewed as the best practices for dam risk analyses in the U.S. The recommendations provided by both the FEMA and USBR will be considered for the YDTI in future risk assessments.

3.3 INTERNATIONAL GUIDELINES

The following provides a summary of international guidelines, standards and organizations that are considered relevant sources of good engineering practice relating to tailings dams and will be referred to during development of the Design Document, as appropriate. Conformance with international guidelines and standards does not displace the requirements of any specific national, state, or local government statutes, laws, regulations, ordinances, or other government directives, including the governing regulations in the State of Montana.

- Global Tailings Review (GTR)
    - The GTR initiative was co-convened by the International Council on Mining and Metals (ICMM), the United Nations Environment Programme (UNEP), and the Principles for Responsible Investment (PRI).
    - The Global Industry Standard on Tailings Management (GISTM) was developed by the GTR to establish an international standard for the safer management of tailings storage facilities. The GISTM was prepared through an independent process with input from a multi-disciplinary expert panel and a multi-stakeholder advisory group. Extensive public consultant was also undertaken during document preparation. The first revision of the document was issued in August 2020 (GTR, 2020).
    - The design principles described in the GISTM suggest target external loading design criteria requirements for extreme events comparable to the Montana Regulations; however, the guideline also includes flexibility for selecting lesser flood and seismic design criteria based on the consequence classification along with plans to upgrade facilities to maximum credible external loading criteria over the tailings facility lifecycle.
- International Council of Mining and Metals (ICMM)
    - The ICMM published two companion documents to the GISTM as follows: (1) the Tailings Management: Good Practice Guide (ICMM, 2021a) to support safe, responsible management of tailings across the global mining industry and provide guidance on good governance and engineering practices to support continual improvement in the management of tailings facilities, and (2) the Conformance Protocols: Global Industry Standard on Tailings Management (ICMM, 2021b) to help operators and independent third parties assess implementation of and degree of conformance with the standards presented in the GISTM.
- International Commission on Large Dams (ICOLD)
    - ICOLD is a non-governing professional organization that provides suggested standards and guidelines for the construction and operation of dams in a safe, efficient, and economically sustainable manner. ICOLD publishes recommendations and technical bulletins to improve technical analysis and current design technology. Guidance provided by the various ICOLD bulletins covers various dam design topics including factors of safety, design floods and seismic events, seepage control and runoff, risk analysis and performance monitoring.

  - ICOLD is in the process of issuing a comprehensive new bulletin related to tailings dam design entitled Tailings Dam Safety (ICOLD, 2022). The current version is a draft that has been sent for publishing. This new ICOLD bulletin consolidates key aspects related to good design and good governance of tailings facilities with a focus on technical aspects that are mentioned but not fully developed in other recent National and Industry Guidelines and Standards. ICOLD has strived to consolidate technical guidance on “leading international practice” for tailings dams in this bulletin, which will be considered and incorporated where appropriate in the on-going design of the YDTI.
- Canadian Dam Associates (CDA)
  - The Canadian Dam Association (CDA) is a non-regulatory organization of dam owners, operators, regulators and consultants. The CDA published Dam Safety Guidelines in 2013 (CDA, 2013) that outline principles that are applicable to dams of all types, including mining dams. The CDA subsequently published a complementary technical bulletin in 2019 entitled Application of Dam Safety Guidelines to Mining Dams (CDA, 2019). In 2021, the CDA released a technical bulletin entitled Tailings Dam Breach Analysis (CDA, 2021) that describes the current state-of-practice in the mining industry for tailings dam breach assessments.
  - The focus of the CDA documents is on the Canadian context, but the principles are generally applicable to mining dams in any jurisdiction.
- British Columbia Mine Code and Guidance Document
  - The Health, Safety and Reclamation Code for Mines in British Columbia (BC Mine Code; EMLI, 2024a) and associated code guidance document (EMLI, 2024b) are collectively referred to as the BC Regulations. The code guidance document is meant to help owners, engineers, regulators, consultants and auditors apply the BC Mine Code to tailings facilities and dams. The BC Regulations are generally similar to the Montana Regulations; however, design criteria are based on a consequence classification system.

4.0 DESIGN BASIS CRITERIA

4.1 INTRODUCTION

This section outlines the specific design criteria for on-going development of the YDTI as required by MCA 82-4-376 and presents the minimum criteria to be achieved during the continued staged construction of the YDTI embankments presented in the Design Document associated with the 6,560 Amendment Application. The design will be prepared with consideration of opportunities to exceed the minimum design criteria, for continued risk reduction to enhance safety and to meet the fundamental objective of on-going continuous improvement of the YDTI. The YDTI will be a permanent structure and therefore the design life of the post closure facilities will be long-term. The principal design objectives are to:

- Provide secure tailings and operating pond storage
- Progressively improve the surface reclamation potential of the YDTI and surrounding facilities
- Protect regional groundwater and surface waters from further impact

The YDTI embankment raises will continue to be constructed using mine rockfill material from the Continental Pit. Pit-run rockfill materials will typically be placed and spread in up to maximum 50 ft thick lifts using the mine haul trucks and bulldozers, except along the downstream side of the West Embankment where thinner lifts will continue to be used to create an impediment to horizontal migration of perched seepage flow towards the downstream face of the embankment and to encourage free draining behavior of the upstream embankment fill zone such that seepage flows are ultimately collected in the WED. Embankment fill materials will be heterogeneous with variable geotechnical and hydraulic conductivity properties. The permeability contrast between the tailings and embankment materials as well as the permeability of the foundation materials will maintain the basal saturated zone deep within the embankment.

During continued operation of the facility, numerous tailings discharge locations will continue to facilitate development of a large, drained tailings beach forming part of the impoundment containment system.

The following embankment geometric configuration will be incorporated in the Design Document and 6,560 Amendment Application:

- New materials for constructing the embankment and RDS will be placed over existing embankment materials, previously placed rock dumps, or natural ground (i.e. downstream and centerline construction methods).
- Downstream overall slope angle: 3H:1V in general, local variations no steeper than 2H:1V overall.
- Upstream slope angle: no steeper than 1.3H:1V adjacent to tailings beaches with shallower slope angles where practicable to enhance stability and continuity of the alluvium facing.
- Localized surcharge loading of tailings beaches along the East-West Embankment. The surcharge area provides a lead-off berm for tailings discharge that extends in the YDTI resulting in decreased pore pressures within the tailings directly adjacent to the embankment and a corresponding reduction in embankment saturation. The surcharge loading also improves seismic performance of the facility by limiting the liquefaction potential of the tailings directly adjacent to the embankment.

These construction practices are consistent with the current design of the facility and remain applicable and appropriate for on-going development of the YDTI because the performance of the facility, which has been constructed in this manner for several decades, is well understood. The stability of the facility is not dependent on mechanical compaction of the new embankment fill areas as critical slip surfaces are primarily reliant on the strength of historically placed fill materials and not the new fill material. Objectives related to improving surface reclamation potential and progressively enhancing facility safety will be achieved by incorporating flatter overall slope angles compared to current conditions, developing rock disposal sites along the downstream side of the embankment, continued surcharge loading of the tailings beaches in select areas, and maintaining water management practices that are aligned with geotechnical objectives for the facility.

4.2 DESIGN STORM EVENTS AND STORM STORAGE

4.2.1 MCA REQUIREMENTS

MCA 82-4-376 (2) states:

(bb) a design storm event for operation and closure conforming to current engineering best practices for the type of facility proposed that includes:

- *(i) a rationale for the selection of the design storm event;*
- *(ii) the magnitude of the design storm event;*
- *(iii) the magnitude of runoff generated by the design storm event to and around the impoundment; and*
- *(iv) evidence that the dynamic nature of climatology was considered*

(cc) for a new tailings storage facility, design sufficient to store:

- *(i) the probable maximum flood event plus maximum operating water or solution volume plus sufficient freeboard for wave action; or*
- *(ii) a flood event design criterion less than the probable maximum flood but greater than the 1-in-500-year, 24-hour event if the panel agrees that site-specific conditions justify that design to the probable maximum flood standard is unnecessary.*

4.2.2 STORM EVENTS

The Inflow Design Flood (IDF) is an extreme flood hydrograph that is assumed to potentially flow into the impoundment. It is used to design and/or modify a specific dam and its appurtenant works; particularly for sizing the spillway and outlet works, and for evaluating maximum storage, height of dam, and freeboard requirements (FEMA, 2013). The IDF is the most severe flood that the YDTI will be designed to manage. The IDF was selected to be the PMF, consistent with MCA 82-4-376 (2) (cc) (i) and the current design approach of the facility. Selection of the PMF is considered good engineering practice due to the long-term design life of the facility and is in accordance with international guidelines.

The PMF is theoretically the largest flood resulting from a combination of the most severe meteorological and hydrologic conditions that could conceivably occur in a given area. There is no strict regulatory standard specifying how the PMF should be determined other than that it should involve the PMP, with consideration of coincident snowmelt, if applicable. The intent of adopting the PMF is to provide a design storm volume that is so great that it will never be exceeded, but not so great as to require excessive storage capacity. Historical rainfall and streamflow datasets were evaluated in previous assessments completed by KP (KP, 2021 and KP, 2016) in an effort to address the question of design storm adequacy and reasonableness. Probabilistic estimates were compared with the deterministic PMF flood volume estimates of 24- and 72-hour durations to see if there was any consistency in the values. This methodology was adopted to provide some historical context to the theoretical and deterministic PMP/PMF values. The comparisons indicated the PMF based volume estimates are extremely large relative to historical probability-based rainfall and runoff event volumes.

The selected design basis PMF event for the YDTI is the runoff generated by the 24-hour PMP combined with complete melt of the 1 in 100-year snowpack, and assuming full failure of the upstream Moulton Reservoirs. The determination of the PMP depth and 100-year snowpack and assessment of climate change are described in the Climate Conditions Report (KP, 2021). An updated assessment of the PMF runoff volume and comparison with extreme probabilistic flood volumes is provided in Appendix A. The estimated 24-hour PMF volume was approximately 20,000 acre-ft.

4.2.3 DESIGN FREEBOARD

The primary dam safety and flood management feature of the YDTI during operations is its ability to store the runoff volume from severe flooding, up to and including the PMF event, within the facility. A spillway will be constructed for YDTI closure to manage potential for severe flooding through a combination of storage and controlled release of flow above a specified maximum pond volume.

The minimum freeboard design criteria for the YDTI during operations and closure comprises storm storage freeboard to safely manage floods and additional minimum freeboard allowance for wave run-up. The overall freeboard design criteria consider the following requirements:

- Storage of a maximum normal operating pond volume of approximately 18,000 acre-ft (comprising 15,000 acre-ft nominal operating pond plus 3,000 acre-ft for normal seasonal fluctuation) prior to the design storm event.
- Containment of the 24-hour PMF volume of 20,000 acre-ft.
- A minimum dry freeboard requirement of 5 ft for wave action above and beyond the storm storage freeboard.

The freeboard required for storage of the PMF will vary depending on the evolving surface area of the facility during ongoing operations but is expected to be approximately 15 ft throughout the period contemplated in the Design Document. The surface area of the YDTI is approximately 1,850 acres at EL. 6,450 ft and will increase to approximately 2,150 acres at EL. 6,560 ft. The 5 ft minimum dry freeboard requirement creates an additional 9,250 to 10,750 acre-ft of capacity in addition to the storm storage freeboard. Embankment construction will be completed in up to 50 ft high stage lifts, and therefore the total actual freeboard will tend to be much larger than the design freeboard until just before operations cease.

4.3 STABILITY AND SEISMIC REQUIREMENTS

4.3.1 EXPANSION REQUIREMENTS

MCA 82-4-376 (2) (l) states the following requirements related to the stability and seismic requirements for the expansion of an existing TSF:

(l) for expansion of an existing tailings storage facility, either an analysis showing the proposed expansion meets the minimum design requirements for a new tailings storage facility under this section or an analysis showing the proposed expansion does not reduce the tailings storage facility's original design factors of safety and seismic event design criteria.

4.3.2 FACTOR OF SAFETY REQUIREMENTS FOR NEW FACILITIES

The minimum factor of safety requirements for a new tailings storage facility are stipulated in MCA 82-4-376 (2) and as listed below:

(h) for a new tailings storage facility, design factors of safety against slope instability not less than:

- *(i) 1.5 for static loading under normal operating conditions, with appropriate use of undrained shear strength analysis for saturated, contractive materials;*
- *(ii) 1.3 for static loading under construction conditions if the independent review panel created pursuant to 82-4-377 agrees that site-specific conditions justify the reduced factor of safety and that the extent and duration of the reduced factor of safety are acceptable; and*
- *(iii) 1.2 for post earthquake, static loading conditions with appropriate use of undrained analysis and selection of shear strength parameters. Under these conditions, a post earthquake factor of safety less than 1.2 but greater than 1.0 may be accepted if the amount of estimated deformation does not result in loss of containment.*

- The YDTI will continue to be designed and constructed such that it meets state-of-practice engineering design standards throughout all phases of expansion, as per MCA 82-4-301, and does not reduce the facility's original (i.e. current) design factors of safety and seismic event design criteria, as per MCA 82-4-376 (2) (I).
- The minimum target factor of safety requirements for the YDTI are based on the criteria established for the design and construction of a new TSF.
- The requirements stated in MCA 82-4-376 (2) (h) (ii) have limited application to the on-going design of the YDTI and will only apply if there is an expectation that a temporary condition during construction, such as construction induced pore pressures, could occur that may result in lower safety factors for a short period of time.

4.3.3 DESIGN EARTHQUAKE

The design earthquake will be selected to meet the obligations for a new TSF as stipulated in MCA 82-4-376 (2) (i), (j), (k), and (m), which state:

(i) for a new tailings storage facility, an analysis showing that the seismic response of the tailings storage facility does not result in the uncontrolled release of impounded materials or other undesirable consequences when subject to the ground motion associated with the 1-in-10,000-year event, or the maximum credible earthquake, whichever is larger. Any numeric analysis of the seismic response must be calculated for the normal maximum loading condition with steady-state seepage. The analysis must include, without limitation, consideration of:

- *(i) anticipated ground motion frequency content;*
- *(ii) fundamental period and dynamic response;*
- *(iii) potential liquefaction;*
- *(iv) loss of material strength;*
- *(v) settlement;*
- *(vi) ground displacement;*
- *(vii) deformation; and*
- (viii) *the potential for secondary failure modes.*

(j) if a pseudo-static stability analysis is performed to support the design, a justification for the use of the method with respect to the anticipated response to cyclic loading of the tailings facility structure and

constituent materials. The calculations must be accompanied by a description of the assumptions used in deriving the seismic coefficient.

(k) reduced factors of safety or seismic design criteria, if the Independent Review Panel agrees that site-specific conditions justify that design to the specified requirements of factors of safety or seismic design criteria in this section is not necessary;
(m) a probabilistic and deterministic seismic evaluation for the area and assessment of peak horizontal ground acceleration.

The regulations require the earthquake design ground motion be the larger of the 1-in-10,000-year return period or the MCE; however, it does not provide additional direction related to how the MCE shall be defined. A design Magnitude earthquake meeting this criterion will be selected for the design earthquake based on the site-specific probabilistic and deterministic seismic evaluation for the YDTI area and the assessment of peak horizontal ground acceleration conducted as part of the YDTI engineering design work. Detailed evaluations are included within appropriate technical reports in the Design Document.

The assessment of the 1 in 10,000-year ground motions considers earthquakes greater than or equal to a magnitude of 5 including probabilistic spectra with return periods of 475, 1,000, 2,475 and 10,000 years. The deterministic seismic hazard analysis included a derivation of both the 50^{th} (median) and 84^{th}-percentile response spectra for the MCE scenarios on the Continental-Elk Park Fault. The 84^{th}-percentile deterministic spectrum was chosen to represent the design MCE as recommended by Al Atik and Gregor (Al Atik and Gregor, 2022).

5.0 SUMMARY

This report summarizes the design basis criteria from the relevant governing regulations and good practice guidelines for continued construction of the YDTI up to a maximum crest elevation of EL. 6,560 ft. This document, along with additional subject matter reports, will comprise the Design Document supporting the 6,560 Amendment Application. The YDTI will be present after mine closure and therefore the design of the post closure facilities considers a time frame that extends for the long-term.

The principal design objectives are to:

- Provide secure tailings and operating pond storage.
- Progressively improve the surface reclamation potential of the YDTI and surrounding facilities.
- Protect regional groundwater and surface waters from further impact.

The ongoing development and operation of the YDTI considers continuously achieving four key performance objectives as fundamental requirements for maintaining consistency with the design of the facility. These objectives incorporate the following:

- The YDTI supernatant pond remains separated from the embankment by large tailings beaches.
- The embankments and adjacent tailings beaches remain well drained, and piezometric elevations within the embankments remain below prescribed levels.
- Sufficient freeboard is maintained at all times to manage risks associated with extreme flood and seismic events.
- The embankment geometry, including downstream slope angle and crest width, remains consistent with design criteria.

The primary dam safety and flood management feature of the YDTI during operations is its ability to store the runoff volume from severe flooding, up to and including the PMF event, within the facility. A spillway will be constructed for YDTI closure to manage potential for severe flooding through a combination of storage and controlled release of flow above a specified maximum pond volume.

The stability assessment of the YDTI will present the evaluation of the stability of the embankment configurations for the required loading conditions that include normal operating, earthquake, and post-earthquake. The design criteria selected for the Design Document consider the requirements for a new facility, and include the following:

- The response of the tailings, embankment, and foundation materials controlling slope stability under the anticipated static and/or dynamic loading conditions do not result in loss of containment.
- The minimum design FS against slope instability for the legislated loading conditions include the following:
  - 1.5 for normal operating, static loading conditions.
  - 1.2 for post-earthquake, static loading conditions.

The earthquake design ground motion is required to be the larger of the 1-in-10,000-year return period or the MCE. The updated site-specific SHA was based on a probabilistic and deterministic seismic evaluation, including consideration for both the 50th (median) and 84th-percentile response spectra for the MCE scenarios on the Continental-Elk Park Fault. The 84th-percentile deterministic spectrum was chosen to represent the design MCE.

The ongoing development of the YDTI embankments and adjacent RDS considers the design and operational objectives outlined above with the goal of continuous improvement in safety and enhancement of stability through slope flattening and progressive buttressing of the facility embankments. These progressive improvements are made possible by continued mining at the site.

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7.0 CERTIFICATION

This report was prepared and reviewed by the undersigned.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
J. R. R. GILLESPIE
42239
2024-09-20

Prepared:

Jason Gillespie, P.Eng.
Senior Engineer

MONTANA
DANIEL DYLAN FONTAINE
No. 59785 PE
LICENSED PROFESSIONAL ENGINEER
2024-09-20

Reviewed:

Daniel Fontaine, P.E.
Specialist Engineer | Associate
YDTI Engineer of Record

Approval that this document adheres to the Knight Piésold Quality System: DDF

APPENDIX A

YDTI Updated IDF Volumes

(Pages A-1 to A-6)

Knight Piésold CONSULTING

Management System Certified By: bsi ISO 9001 Quality Management Systems CERTIFIED FS 64925 | ISO 14001 Environmental Management CERTIFIED EMS 550121 | ISO 45001 Occupational Health and Safety Management CERTIFIED OHS 550122

MEMORANDUM

Date:	July 10, 2024	**File No.:**	VA101-00126/24-A.01
		Cont. No.:	VA24-01321
To:	Mr. Daniel Fontaine		
Copy To:			
From:	Dr. Jaime Cathcart		
Re:	**6,560 Amendment Design Document: Yankee Doodle Tailings Impoundment – Updated Inflow Design Flood Volumes**		

1.0 PURPOSE

This memorandum provides estimates and details of updated inflow design flood (IDF) volumes for the Yankee Doodle Tailings Impoundment (YDTI). Specifically, updated values are provided for the following:

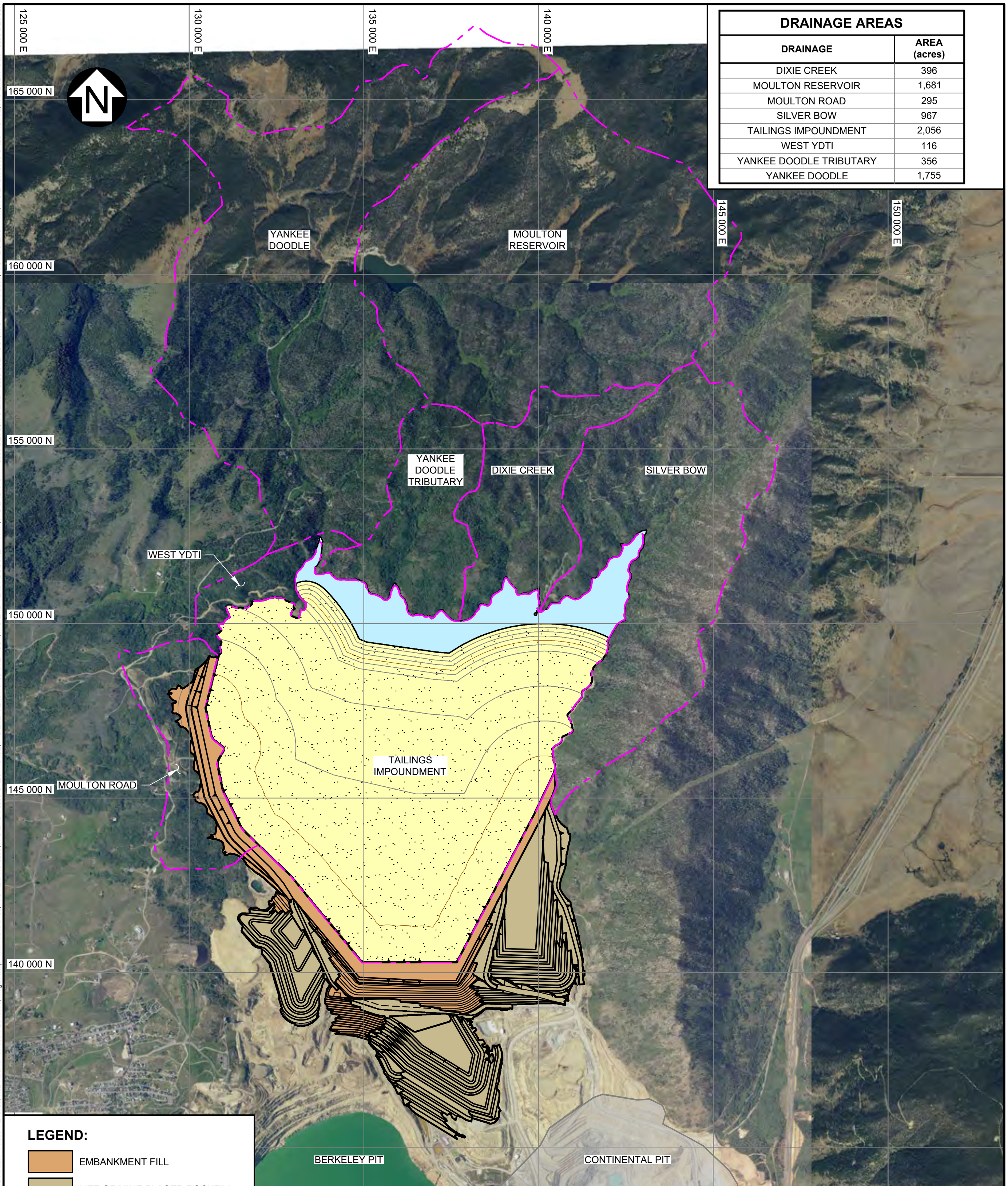
- 24-hour Probable Maximum Flood (PMF) volume
- 72-hour PMF volume
- 1,000-year 24-hour rainfall runoff volume
- 1,000-year 30-day rainfall runoff volume

The catchment areas that contribute runoff to the YDTI are shown on Figure 1.1. The areas are based on updated topography and differ slightly from areas used for previous calculations.

2.0 24-HOUR PROBABLE MAXIMUM FLOOD VOLUME

The estimated 24-hour PMF volume is approximately 20,000 acre-ft (ac-ft). This value is greater than the previously estimated PMF volume of approximately 19,000 ac-ft (KP, 2016b).

The 24-hour PMF volume was computed as the maximum potential runoff volume resulting from the 24-hour probable maximum precipitation (PMP) plus complete melt of the 100-year snowpack. This criterion was adopted from the Canadian Dam Safety Guidelines (CDA, 2007), and it exceeds the recommendations in Montana's Extreme Storm Working Group Report (DOWL, 2016), which specifies the need to consider antecedent moisture conditions in design flood estimation but does not specifically require that melt from a snowpack with a certain probability of occurrence be combined with a design rainfall event. The PMP and 100-year snowpack values used for the 24-hour PMF volume calculation are presented in Table 2.1. The 24-hour PMP value of 14.4 inches for the YDTI was obtained from HMR 57 (NWS, 1994), and the Upslope of YDTI value of 19.9 inches was determined by multiplying the 14.4 inches value by a factor of 1.38 to account for the wetter conditions upslope of the YDTI. The 1.38 factor represents the ratio between the mean annual rainfall (MAR) at the Moulton Reservoir and that at the YDTI embankment. Similarly, the 100-year snowpack value was based on a frequency analysis of annual maximum snowpack values for a snow survey site near the Moulton Reservoir, and it was adjusted to the YDTI location using a factor of 0.56 that represents the ratio between the mean annual snowfall at the YDTI and that at the Moulton Reservoir. The volume of water contained in the Moulton Reservoir was also included in the analysis and assumed to be released due to overtopping failure of the embankment during the PMF event.



DRAINAGE AREAS

DRAINAGE	AREA (acres)
DIXIE CREEK	396
MOULTON RESERVOIR	1,681
MOULTON ROAD	295
SILVER BOW	967
TAILINGS IMPOUNDMENT	2,056
WEST YDTI	116
YANKEE DOODLE TRIBUTARY	356
YANKEE DOODLE	1,755

LEGEND:

- EMBANKMENT FILL
- LIFE OF MINE PLACED ROCKFILL
- TAILINGS
- SUPERNATANT POND
- DRAINAGE BOUNDARIES

SCALE A: 2000 0 2000 4000 6000 8000 10000 ft

NOTES:

1. BASE MAP 2023 ORTHO IMAGERY PROVIDED BY MONTANA RESOURCES. BACKGROUND 2015 ORTHO IMAGERY PROVIDE BY MONTANA STATE LIBRARY - NATIONAL AGRICULTURAL IMAGERY PROGRAM.
2. COORDINATE SYSTEM AND ELEVATIONS BASED ON ANACONDA MINE GRID.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	09JUL'24	ISSUED WITH MEMO	RSD	NSD	JGC

MONTANA RESOURCES, LLC

MONTANA RESOURCES

YANKEE DOODLE TAILINGS IMPOUNDMENT DRAINAGE AREAS

Knight Piésold CONSULTING

P/A NO. VA101-126/24 | REF NO. VA24-01321

FIGURE 1.1 | REV 0

SAVED: M:\1\01\00126\24\A\Acad\FIGS\A44, 7/9/2024 1:12:19 PM , RMCLELLAN PRINTED: 7/9/2024 1:24:09 PM, FIG 3.1, RMCLELLAN ACAD VERSION: 24.1S (LMS TECH)

The volume calculations used a runoff coefficient of 100%, which is conservative but appropriate given the assumption of rain-on-snow conditions.

Table 2.1 24-hour PMF Volume

Status	Location	Area (acres)	100-yr Snowpack (SWE) (inches)	24-hr PMP (inches)	PMF Depth (inches)	PMF Volume (ac-ft)	Failed Reservoir (ac-ft)	Design Storm Volume (ac-ft)
Previous Estimate (2016)	All Area	7,600	14.6	14.4	29	18,367	540	**18,907**
Updated Estimate	YDTI	2,467	8.2	14.4	22.6	4,646	0	4,646
	Upslope of YDTI	5,155	14.6	19.9	34.5	14,821	540	15,361
	All Area	7,622	-	-	-	19,467	540	**20,007**

Note(s):

1. Total PMF volume calculations assume failure of the Moulton Reservoir embankment.
2. The updated PMF volume accounts for differences between the precipitation conditions for drainage areas near the YDTI pond and those for drainage areas upslope of the YDTI.
3. The previous Total PMF volume is from KP, 2016b.

3.0 72-HOUR PMF VOLUME

The estimated 72-hour PMF volume is approximately 24,000 acre-ft, which was computed in the same manner as the 24-hour PMF volume but using 72-hour PMP values rather than 24-hour PMP values. The 100-year snowpack values were the same for both 24-hour and 72-hour cases. The two 72-hour PMP values were computed by multiplying the respective 24-hour PMP values by a factor of 1.37, as specified in HMR 57. The PMP and 100-year snowpack values used for the 72-hour PMF volume calculation are presented in Table 3.1.

Table 3.1 72-hour PMF Volumes

Event	Location	Area (acres)	100 yr Snowpack (SWE) (inches)	PMP (inches)	PMF Depth (inches)	PMF Volume (ac-ft)	Failed Reservoir (ac-ft)	Design Storm Volume (ac-ft)
72-hr PMF	YDTI	2,467	8.2	19.7	27.9	5,736	0	5,736
	Upslope of YDTI	5,155	14.6	27.2	41.8	17,967	540	18,507
	All Area	7,622	-	-	-	23,703	540	**24,243**

Note(s):

1. The total PMF volume calculation assumes failure of the Moulton Reservoir embankment.
2. The PMF volume accounts for differences in precipitation conditions between drainage areas near the YDTI pond and drainage areas upslope of the YDTI.

4.0 RUNOFF VOLUME RESULTING FROM THE 1,000-YEAR 24-HOUR RAINFALL EVENT

The estimated 1 in 1,000-year 24-hour rainfall depths for three locations are provided in Table 4.1. The Butte Bert Mooney Airport (BBMA) Station values are based on a frequency analysis of the long-term historical annual extreme rainfall record for the BBMA (KP, 2016a). The values were increased by 15% to allow for the uncertainty of future conditions. There is no evidence of increasing storm severity in the long-term historical record of annual extreme daily rainfall, but general trends of warming temperatures suggest the potential for greater extreme rainfall depths in the future.

Table 4.1 Return Period 24-hour Rainfall Depths (inches)

Location	2 yrs	5 yrs	10 yrs	25 yrs	50 yrs	100 yrs	200 yrs	1000 yrs
BBMA Station	1.0	1.5	1.7	2.0	2.3	2.6	2.9	3.7
+ Climate Change	1.2	1.7	1.9	2.3	2.6	2.9	3.3	4.2
YDTI	1.2	1.7	2.0	2.3	2.7	3.0	3.4	4.3
+ Climate Change	1.3	2.0	2.3	2.7	3.1	3.5	3.9	4.9
Upslope of YDTI	1.4	2.1	2.3	2.8	3.2	3.6	4.0	5.1
+ Climate Change	1.6	2.4	2.7	3.2	3.7	4.1	4.6	5.9

Note(s):

1. The BBMA Station values were adopted from KP Memo VA15-03332.
2. The YDTI and Upslope of YDTI values account for differences in precipitation conditions between those at the BBMA and those in drainages near the YDTI pond and upslope of the YDTI.

The 1,000-year 24-hour rainfall values of 4.9 inches for drainages near the YDTI and 5.9 inches for drainages upslope of the YDTI were used to calculate the associated maximum potential runoff volume, assuming an SCS Curve Number (CN) of 85 to account for high antecedent moisture conditions. Furthermore, a CN of 100 was assumed for the YDTI itself. The storm runoff volumes contributed by each sub-basin draining to the YDTI are shown in Table 4.2. The estimated total runoff volume is approximately 2,800 ac-ft.

Table 4.2 1,000-year 24-hour Rainfall Event Runoff Volumes

Sub-Watershed	Area (acres)	Location	1,000-year Rainfall (inches)	CN	Runoff	
					Depth (inches)	Volume (ac-ft)
Tailings Impoundment	2,056	YDTI	4.9	100	4.90	839.5
Moulton Road	295	YDTI	4.9	85	3.28	80.6
West YDTI	116	YDTI	4.9	85	3.28	31.7
Dixie Creek	396	Upslope of YDTI	5.9	85	4.21	138.9
Moulton Reservoir	1,681	Upslope of YDTI	5.9	85	4.21	589.8
Silver Bow	967	Upslope of YDTI	5.9	85	4.21	339.3
Yankee Doodle Trib	356	Upslope of YDTI	5.9	85	4.21	124.9
Yankee Doodle	1,755	Upslope of YDTI	5.9	85	4.21	615.7
TOTAL	**7,622**	**All areas**				**2,760.4**

5.0 RUNOFF VOLUME RESULTING FROM THE 1,000-YEAR 30-DAY RAINFALL EVENT

The 1 in 1,000-year 30-day rainfall depth was previously estimated to be 9.4 inches (KP, 2016), based on long-term historical rainfall data for the BBMA. However, after a reassessment of the historical dataset, as well as accounting for the wetter conditions at the YTDI and upslope of the YTDI, plus potential climate change effects, as was done in Section 4.0, the 1,000-year 30-day rainfall values were estimated to be 14.0 inches for drainages near the YDTI and 16.7 inches for drainages upslope of the YDTI.

Following the same procedure shown in Table 4.2, the estimated total runoff volume is approximately 7,200 ac-ft, as shown in Table 5.1.

Table 5.1 1,000-year 30-day Rainfall Event Runoff Volumes

Sub-Watershed	Area (acres)	Location	1,000-year Rainfall (inches)	CN	Runoff	
					Depth (inches)	Volume (ac-ft)
Tailings Impoundment	2056	YDTI	14.0	100	14.0	2398.7
Moulton Road	295	YDTI	14.0	85	8.1	199.1
West YDTI	116	YDTI	14.0	85	8.1	78.3
Dixie Creek	396	Upslope of YDTI	16.7	85	10.4	343.2
Moulton Reservoir	1681	Upslope of YDTI	16.7	85	10.4	1456.9
Silver Bow	967	Upslope of YDTI	16.7	85	10.4	838.1
Yankee Doodle Trib	356	Upslope of YDTI	16.7	85	10.4	308.5
Yankee Doodle	1755	Upslope of YDTI	16.7	85	10.4	1521.0
TOTAL	**7622**	**All areas**				**7,143.8**

It is recognized that applying a CN value to a cumulative rainfall depth over 30 days is not technically correct, but it is not known how the rainfall would be distributed over 30 days, so to account for this shortcoming while still recognizing that the actual runoff would be less than the total maximum potential runoff, a CN of 85 (which represents saturated ground conditions) was applied to a quarter of the total rainfall and the resulting runoff was multiplied by four.

We trust this information meets your needs at this time. Please contact the undersigned if you have any questions or concerns.

Yours truly,
Knight Piésold Ltd.

PROFESSIONAL
PROVINCE OF
J. G. CATHCART
BRITISH COLUMBIA
ENGINEER
2024-07-10

Prepared: Jaime Cathcart, Ph.D., P.E.
Specialist Hydrotechnical Engineer | Associate

Reviewed: Roanna Dalton, P.E.
Specialist Engineer | Associate

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Approval that this document adheres to the Knight Piésold Quality System:

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