APPENDIX B

Technical Memorandum 2

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To: Montana Department of Environmental Quality

From: Environmental Resources Management

Date: December 29, 2017

Subject: Black Butte Copper Project - Whether there is an advantage to constructing the CTF so that the entire facility is above the water table

INTRODUCTION

The basis for this technical memorandum is the Mine Operating Permit Application (Tintina Montana, Inc. 2017) submitted to the Montana Department of Environment Quality on July 14, 2017. That document is referenced in the body of this memo as “MOP”, with the particular section and page numbers as appropriate.

BACKGROUND

CEMENTED TAILINGS FACILITY

During mill operations, the cemented tailings facility (CTF) would be filled with both waste rock from the mine development phase and with cemented tailings. The waste rock would be used in the construction of a drain blanket and sump before the tailings are placed. Waste rock also would be used in constructing a vehicle access ramp within the lined basin. In total, approximately 770,000 tons of waste rock would be placed in these areas. Across the life of the mill, a total of 7.1 million tons of cemented tailings (55 percent of total tailings) would be placed in the CTF.

The CTF composite underliner would include foundation drains, engineered fill subgrade bedding protective layer, double underliner (geotextile-high density polyethylene (HDPE)-geotextile-geonet-geotextile-HDPE-geotextile), engineered fill protective layer, and waste rock drainage layer (MOP Figure 3.33, p. 248).

Following placement of the cemented tailings within this lined basin and upon initiation of closure construction, the composite overliner would be installed directly on the cemented and hardened tailings. That closure system would include the primary overliner (geotextile-HDPE-geotextile), engineered fill protective layer, excess construction or fill material, subsoil, and topsoil (MOP Figure 7.3, p. 418).

PRE-CONSTRUCTION GROUNDWATER TABLE

The pre-construction groundwater table ranges from 31 feet (9.5 meters) above the CTF base elevation on the west side of the impoundment to 6 feet (2 meters) below on the east side (MOP Figure 2.8, p. 50; Figure 3.36, p. 254).

CURRENT MOP

Composite-Lined Facility (Earthen and Synthetic Components)

The CTF composite underliner would include foundation drains, engineered fill subgrade bedding protective layer, double underliner (geotextile-HDPE-geotextile-geonet-geotextile-HDPE-geotextile), engineered fill protective layer, and waste rock drainage layer (MOP Figure 3.33, p. 248). All of these components, foundation drains through drainage layer are best available technology (BAT) and best management practice (BMP) features with proven success in mining, municipal waste handling, and other industrial applications.

Composite-Capped Facility (Earthen and Synthetic Components)

Following placement of the cemented tailings within this lined basin and upon initiation of closure construction, the composite overliner would be installed directly on the cemented and hardened tailings. That closure system would include the primary overliner (geotextile-HDPE-geotextile), engineered fill protective layer, excess construction or fill material, subsoil, and topsoil (MOP Figure 7.3, p. 418). The excess fill, subsoil, and topsoil would provide long-term freeze-thaw protection, limit infiltration to the HPDE liner, and provide natural growth media for vegetation, reducing erosion.

CONSTRUCTION ISSUES

Conventional Construction Methods

The proposed foundation drains and overall CTF entail conventional contemporary construction methods in a canyon-fill setting. There is essentially one embankment (east side) and minimal footprint. The cut and fill balance and overall siting have been selected to provide construction materials for the CTF and other surface facilities throughout the Project.

Construction-Phase Protection of Synthetic Liners

The engineered fill protective layers are intended to avoid synthetic liner penetration due to construction and early stage filling operations. The fill suitability (angularity, gradation) must be confirmed to avoid damaging the synthetic media. Also, application must consider low-ground-pressure (LGP) equipment (wide-track small dozers or telescoping stacking conveyors on LGP crawlers) for placement of the protective layers (MOP Section 3.6.8.7; Section 3.6.8.8, p. 255; Section 3.6.8.10, p. 259). The bottom protective layer must not be rutted prior to receiving the synthetic liners. The upper protective layer must be thick enough to minimize stress transmittal by vehicles and machinery to the upper synthetic liners.

In the upper closure cap, care must be taken that potential liner bridges or penetrations are properly handled. Ruts, gullies, or ledges in the hardened cemented tailings must be reduced to smooth non-bridging or non-penetrating features. Alternatively, they can be covered with select fill to prevent either bridging or penetration.

The detailed construction specifications and steps must be clear and well-monitored to assure the synthetic liners would not be compromised during construction (Peggs 2003).

ELEVATING THE CTF ABOVE THE WATER TABLE THROUGHOUT

This construction issue:

- Enlarges CTF footprint;
- Increases CTF material import requirements (alters cut/fill material balance); and
- Triples (or more) the number of embankments, with concomitant seismic risk.

These three items are intertwined and addressed together in the following discussion.

Footprint enlargement is direct and indirect. Direct is in the footprint expansion of the CTF itself. Essentially, with a 2.5:1 slope, for every foot of elevation increase, the footprint extends outward 2.5 feet. To retain the same basin take-off point, the embankment centerline also moves outward so the downstream or out slope enlargement becomes 5 feet per vertical foot.

Indirect is the footprint expansion by relocating the associated structures to accommodate an enlarged or even relocated CTF. The associated structures would include but not be limited to the Process Water Pond (PWP), the reclamation materials stockpile, and the subsoil stockpile and their access roads.

By inspection (MOP Figure 3.34, p. 249), elevating the CTF as little as ten feet would dramatically enlarge the eastern embankment and entail sufficient fill along the north and south to form distinct embankment faces in those areas. In addition to presenting additional faces, that enlargement requires two out slope convex corners, which are not recommended geological engineering features (slope stability) for earthwork embankments.

Increasing the embankment size to raise the CTF above the water table would dramatically alter the cut/fill balance, requiring the import of engineered fill from offsite.

Alternatively, the eastern embankment could be constructed in a continuous or near-continuous out slope convex arc, but that shape simply extends the non-recommended convex feature.

If a 30-foot elevation increase is considered, the required embankments would be considerably larger than the selected siting. That embankment size could be somewhat reduced by sloping the basin floor to more closely follow the existing topography. Even with that, placing a solid cemented mass in a canyon mimics a wedge shape, which is a classic geological engineering failure analysis. Any tendency to slide would have to be analyzed, with conceptual potential remedies entailing keys (footings), which might in turn intercept the water table.

EIS ENVIRONMENTAL ISSUES

PERCHED OR REGIONAL GROUNDWATER

It reasonably could be expected that the water table intercept would be of a small perched aquifer, which may drain during the construction phase. Whether perched or part of the local regional aquifers, the intercept would direct remaining water (upgradient of the intercept) into the foundation drains or otherwise downgradient beneath the CTF. In either case, the ultimate disposition would remain in the regional groundwater system, analogous to surface runoff diversions.

Groundwater Mounding

Prior to insisting on an elevated CTF, it is appropriate to investigate whether groundwater mounding would occur. If so, elevating may have no benefit, as the result of mounding might simply replicate the interception now expected.

Wetland Impacts

On inspection, elevating the CTF would expand its footprint. A rigorous evaluation would be necessary to gauge the extent of impact into wetlands below the CTF, but the facilities site plan (MOP Figure 1.3, p. 9) shows that any increase in downstream footprint immediately impacts wetlands. If the nearby facilities (especially the PWP, but potentially the reclamation materials stockpile and subsoil stockpile) must be moved, there is a much greater chance of impacting wetlands beyond the selected siting.

It bears stressing that a part of the selection process for the current siting was to minimize the impact on drainages and wetlands (MOP Section 3.6.8.14, p. 261; Section 3.6.13, pp. 275-276).

Visual Impact

The visual impact would expand as the CTF increases in elevation, with concomitant embankment extension downslope to the North, East, and South. A lift of ten feet would be marginally more visible from Sheep Creek Road. A lift of 30 feet would be visible from portions of US 89.

Granodiorite Sourcing

In design and construction, the quality of the engineered fill is as important as the quantity. A principal focus of the CTF excavation is to access the chemically inert granodiorite, which is a critical component in the construction of the drainage blankets for the CTF and the PWP, as well as other structures of the surface facilities (MOP Section 3.6.8.10, p. 259).

A similar mechanically robust and chemically inert rock could be located, quarried, transported, stockpiled, and used in constructing the larger facility associated with elevating the CTF. That would increase the environmental impact far offsite (quarrying) and between sites (transportation) in addition to the local footprint increase.

Single versus Two-Phase Construction and Filling

With or without an expanded footprint, the query has been raised as to whether there is a benefit to constructing the CTF in one layer or phase. In a broadened facility, that conceivably could be done in one layer.

The phased CTF construction conforms to the mill schedule while minimizing liner exposure across the mine life (MOP Section 3.6.8.9, pp. 256-258). Among other construction efficiencies, it allows handling the tailings pipe spigots with close access during the early years of guiding and forming the cemented tailings deposition. Staging embankment construction also is a common technique to minimize the exposure time of both embankment faces (internal/external) to possible seismic activity.

A common driving practicality is that phased construction of these large earthwork structures is less disruptive in all aspects of heavy construction – workforce, equipment, construction materials, transportation, and support services (lodging, fuel, etc.).

TECHNICAL APPROACH

CONFIRM/PREPARE A TRADE-OFF STUDY OF PROPOSED AND ELEVATED IMPOUNDMENTS

A rigorous part of the selection process for the current siting was to minimize the impact on drainages and wetlands (MOP Section 3.6.8.14, p. 261; Section 3.6.13, pp. 275-276; MOP Appendix Q). There is no need to replicate those efforts, which in any event cannot be done within the scope of this memo.

The primary object of considering elevating the CTF is to avoid impacting the local water table. Evaluating the water table impact would likely address the detailed nature (perched or regional) of the water table, and whether mounding would occur. The evaluations would likely address if either the original intercept or interception of a mounded water table would be deleterious.

If a groundwater analysis indicates a deleterious condition, a cursory trade-off could be initiated based on the following investigations:

- Constructability
- Operability
- Long-term performance

The environmental issues presented above also could be folded into this trade-off analysis. Conventional weighting and ranking methods could be a relatively simple way to organize and evaluate the options, whether rigorous financial costs and benefits are included.

CONCLUSIONS AND RECOMMENDATIONS

Cemented tailings have become common for underground backfill, and the surface deposition of cemented tailings within a lined basin is a combination of the best of underground and surface tailings storage techniques.

Essentially, the groundwater intercepted by the CTF would be diverted beneath the composite liner system and/or captured by the foundation drains. In both cases, these are diversions, not removals from or degradations to the overall water system. In that regard, the groundwater diversion should be considered in the same regard as surface water diversions – spatial and temporal handling of water to the overall benefit of the system and environment. Any negative effects would be *de minimus* and significantly outweighed by the conservation and protection aspects of diversion. As such, there is no conceptual benefit to elevating the CTF above the groundwater table. Given the items addressed in this technical memo, it reasonably is expected that any ranking of current proposal versus elevated configurations would not favor the elevated configurations.

Proponent Proposes Application of Proven Technology

From the alternate site analyses through the specifics of foundation drain and liner design, the proponent has achieved BAT and BMP goals. The liner construction details noted above should be incorporated into the design and construction of the facility(ies). With that, there would be a reasonable expectation that execution of the construction and operating phases would bring those goals to safe and productive reality.

Determine Whether Re-Siting Improves or Worsens any Environmental Impact

Three of the four analyzed CTF sites were less favorable than the selected location and configuration. The selection is a culmination of direct and indirect aspects relating to impoundment size through wetlands and visual impacts. The presented configuration is optimal and re-siting would worsen the environmental impact.

REFERENCES

Peggs, Ian D. 2003. “Geomembrane Liner Durability: Contributing Factors and the Status-Quo.” In *Geosynthetics: protecting the environment*, Thomas Telford, London; UK IGS. June 2003. Accessed: November 2017. Retrieved from: https://www.geosynthetica.net/Uploads/IDPigsUKpaper.pdf

Tintina Montana, Inc. 2017. Mine Operating Permit Application. Black Butte Copper Project, Meagher County, Montana, Revision 3. PO Box 431, White Sulphur Springs, MT 59645.