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**Sr. Manager – Permitting & Approvals**

Dear Mr. Nielson and Mr. Antone III:

**Resolution Copper Project**  
**Response to BLM's Comments on the EIS TSF Stormwater Management and**  
**GISTM TSF Breach Analysis**

## **1 INTRODUCTION**

Resolution Copper Mining (RCM) is proposing to develop an underground copper mine, in the footprint of the Magma Copper Mine in the Pioneer Mining District, Pinal County, Arizona. The ore will be processed and generate two physically, mineralogically, and geochemically discrete tailings streams known as “scavenger” tailings and “pyrite” tailings. RCM submitted a General Plan of Operations (GPO) for the project to the Tonto National Forest (the Forest) for a mine plan which includes the production of 1.37 billion short tons (t) of tailings with a maximum tailings production rate of 120,000 short tons per day (tpd) over a 41-year mine life. The subsequent issue of a Notice of Intent by the Forest triggered the beginning of the Forest’s environmental analysis (to produce the Environmental Impact Statement (EIS)) of the project, in accordance with the National Environmental Policy Act (NEPA). The Forest issued the Draft Environmental Impact Statement (DEIS) for the proposed Resolution Copper Project and Land Exchange in August 2019.

During the EIS process the Forest and the US Army Corps of Engineers (USACE) evaluated many alternatives for tailings management (e.g., pit backfill, several brownfield sites in the state and several greenfield sites in the state). The analysis considered potential sites up to a 170 mile radius from the Resolution ore body and evaluated both placement of tailings in single and multiple locations. The Forest detailed and disclosed their tailings alternative analysis throughout the body of the EIS including the Executive Summary, Chapter 2, Chapter 3 and in Appendices E and F. The USACE tailings alternatives analysis is contained within Appendix C of the EIS. The alternatives analyses during the EIS process identified the preferred Tailings Storage Facility (TSF) as a thickened TSF with cycloned sand embankments at the Skunk Camp site. The Skunk Camp site is located east of the Ray

Mine open pit mining complex, on state land and private land (owned by RCM) in the headwaters of the Dripping Spring Wash Basin within the Pinal and Gila Counties, Arizona, U.S.A.

At the request of the Department of Agriculture – U.S. Forest Service (USFS), the Bureau of Land Management (BLM) provided a targeted technical review of the 2021 Final Environmental Impact Statement (FEIS) for the Resolution Copper Project and Land Exchange and supporting documents. BLM issued their review entitled Bureau of Land Management Review of Hydrology Aspects of the Resolution Copper Project on June 13, 2022 (BLM 2022).

BLM's review included several comments on TSF design related to stormwater management. This letter provides clarification and information on the TSF stormwater management design to address the BLM comments.

## 2 SUMMARY OF THE SKUNK CAMP TSF STORMWATER MANAGEMENT DESIGN

The Skunk Camp TSF stormwater management designs are summarized in the following reports:

- **Operations:** DEIS Design for Alternative 6 – Skunk Camp (KCB 2018).
- **Post-Closure:** Skunk Camp Reclamation Plan (KCB 2021).

The TSF will be impounded by a cross-valley, centerline-line raised, cycloned sand embankment. The pyrite tailings will be contained in two separate cells segregated by downstream-raised embankments within the overall TSF impoundment, as shown in Figure 2.1. The pyrite tailings cells are sited within the TSF impoundment to maximize storage capacity for pyrite tailings while minimizing pond area and pond volume, thus limiting evaporative losses and stored pond volume for dam safety considerations.

During operations, a series of diversion dams, pumps/pipelines and ditches will convey non-contact water from the natural catchment around the TSF. The diversion structures are sized to convey the peak flow or volume generated from a 24-hr duration, 1/100 Annual Exceedance Probability (AEP) storm (point-precipitation). The diversion configuration is selected to divert as much of the upstream catchment as practical. Diversion scenarios that diverted upstream, non-contact water catchment to the north (Mineral Creek) or to the west (back to Dripping Spring Wash) were considered but ultimately rejected based on technical feasibility, environmental impact and legal/permitting constraints. The TSF catchment is within the Dripping Spring Wash catchment, completely outside of the Mineral Creek catchment, as such stormwater flows should be maintained within the pre-mining watershed and not diverted cross-watershed. During more extreme storm events, the diversion structures would include emergency spillway structures that would convey flow to the TSF.

The TSF impoundment is designed to safely store, at minimum, the 72-hr duration Probable Maximum Flood (PMF)<sup>1</sup>. The PMF is a higher magnitude storm in comparison to the 1/10,000 AEP. During later in operations, the TSF will have storage capacity in excess of the 72-hr PMF. The PMF volume is calculated assuming a runoff coefficient of 1.0 (accounting for any antecedent moisture or

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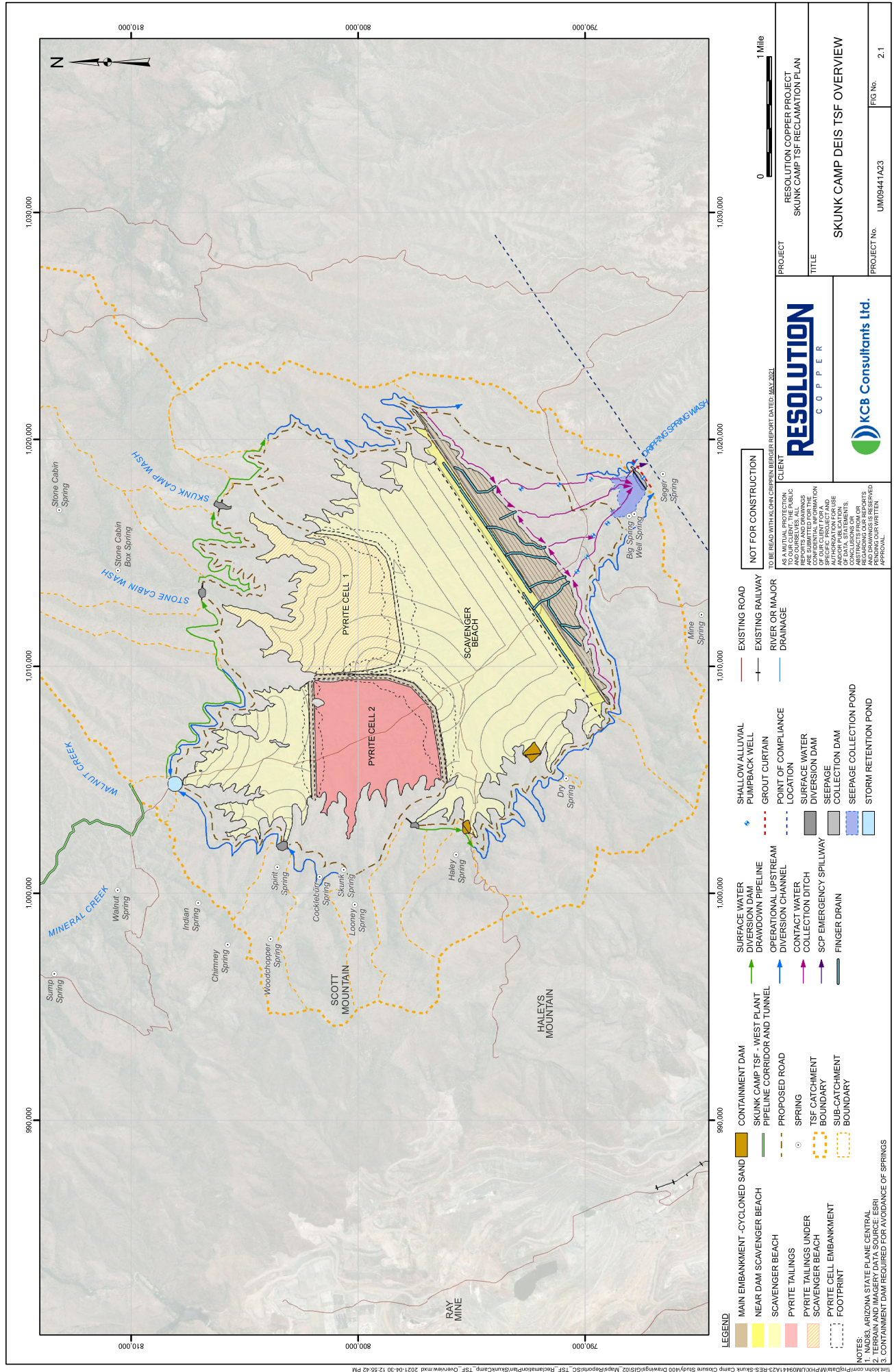
<sup>1</sup> The PMF is defined as the flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in a particular drainage area.

forest fire scenarios) and that the upstream diversions are non-operational (such that the entire upstream catchment reports to the TSF impoundment).

After operations, the TSF surface will be reclaimed, the diversion structures will be decommissioned, and a closure channel will be constructed at an elevation to limit ponding on the TSF surface so that the TSF impoundment discharges back to Dripping Spring Wash (the pre-mine condition). See Figure 2.2. The TSF closure configuration will be able to safely route the PMF with a high safety factor because the closure channel invert is set to limit ponding such that the TSF impoundment has a large attenuation capacity. This robustness in the closure design (closure channel invert elevation) will account for potentially increased magnitude storm events due to climate change.

In summary:

- The TSF is designed to safely manage storms greater than the 200yr, 1000yr, and 10,000yr, up to and in excess of the 72-hour PMF.
- There is no expected release of contact stormwater from the TSF due to a storm event.
- The TSF flood storage design accounts for antecedent conditions (e.g., moisture conditions or forest fires).







### 3 2022 BLM COMMENTS ON TSF STORMWATER MANAGEMENT

The following comments related to TSF stormwater management are excerpts from the 2022 BLM review letter. KCB has included clarifications for each comment in [blue text](#).

1. **Executive Summary (pg. 3):** *With literature suggesting a higher likelihood for severe storm events in the future, the BLM reviewers believe alternatives lack sufficient discussion on climate change and the potential for catastrophic events. Climate change predictions should be discussed, and potential impacts of floods greater than the 200-year event should be incorporated into the FEIS analysis and discussion.*

**Clarification:** During operations, the TSF design can safely store the PMF. Post closure, the TSF will safely convey well in excess of the 72-hour PMF, thus accounting for potential impacts of climate change (climate change is expected to have less than a potential increase of 20% in precipitation magnitudes), downstream via a closure diversion channel towards Dripping Spring Wash.

2. **Executive Summary (pg. 4):** *The BLM reviewers suggest looking at alternate Pyrite Cell locations within the Skunk Camp TSF layout to potentially negate exposure of the highest concentration tailings to stormwater runoff greater than the 200-year flood event. Alternatively, analysis is recommended for the permanent rerouting of Stone Cabin and Skunk Camp Washes to the west of the Skunk Camp TSF. The BLM reviewers believe a more thorough surface water hydrology characterization, as it concerns to climate change, needs to be completed for the Skunk Camp TSF.*

**Clarification:** The pyrite tailings cells within the Skunk Camp TSF are designed to safely manage the PMF during operations. Management of water within the pyrite tailings cells is preferred to maintain pyrite tailings saturation. Post closure, the TSF will safely convey well in excess of the 72-hour PMF, thus accounting for potential impacts of climate change (climate change is expected to have less than a potential increase of 20% in precipitation magnitudes), downstream via a closure diversion channel towards Dripping Spring Wash.

3. **Technical Comments – Introduction (pg. 10):** *Climate predictions of an increase in the severity of convective storm events must be adequately incorporated into assessments of future event magnitude and severity of storms related to the proposed tailings facility at Skunk Camp.*

**Clarification:** See response to #1.

4. **Technical Comments – Introduction (pg. 11):** *When it comes to surface features and mine waste it is important to ensure that impacts are disclosed well past the life of the mine. This involves identification of potential failure modes and more robust facilities design as these features continue in perpetuity. Because of the episodic nature of stresses like climate, earthquakes, wildfire, and stormwater events, catastrophic failure and rare natural events were not often seen as driving factors in alternative selection or mitigation planning. However,*

*in the last few decades, with increasing news reports of tailings facility failures occurring, the potential impacts of these rare natural events appear to be increasing in importance.*

**Clarification:** The proposed Resolution TSF design complies with the most stringent design criteria required by the Arizona Department of Environmental Quality (ADEQ)'s Best Available Demonstrated Control Technology (BADCT) Manual and the Global Industry Standard on Tailings Management (GISTM):

- Earthquake: greater of the Maximum Credible Earthquake (MCE) per BADCT and 1/10,000 AEP per GISTM.
- Flood event related to Dam Safety: greater of (72 hour) PMF as per BADCT and 1/10,000 AEP per GISTM.

During the NEPA process, a risk assessment (Failure Modes and Effects Analysis, FMEA) was conducted on the TSF and included participants from the Forest, RCM, EPA, USACE, ADEQ, design consultants and the USFS third party tailings consultants. The risk assessment process helped confirm that the TSF design aligned to the most stringent design criteria within global standards and state and federal regulations and highlight the resilient and robust nature of the design.

5. **Detailed Technical Comments – Impacts of Climate Change (pg. 14):** *Please incorporate climate change predictions into the stormwater event discussion and analyze the impacts of larger floods (1,000-year flood event has been suggested by the review team) into the analysis of all alternatives. In addition, please provide a summary for each alternative that states the predicted 1,000-year event entering and exiting the TSFs. Please provide the expected spill threshold for all alternatives. This could include buffering and storage based on the TSF pond depth. Also, please provide the expected contaminants and concentrations and their change as the contact water moves downstream and additional waters dilute. Finally, please provide the required mitigation measures if such an event takes place and provide impacts analysis and extent of the contaminants. Results should be reported in acre feet per day and ft<sup>3</sup>/s. Results should also be added to the text of the FEIS and provided in simple visual figures and tables for reference.*

**Clarification:** All of the tailings alternatives<sup>2</sup> were designed to safely manage or store the 72-hour PMF with adequate freeboard and assuming the diversions are not operational. The PMF is defined as the flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in a particular drainage area, which is much less frequent with a much greater magnitude in comparison to the 1/1,000 AEP flood. At closure, the tailings alternatives are designed to safely convey well in excess of the 72-hour PMF downstream (thus accounting for potential impacts from climate

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<sup>2</sup> One potential exception is Alternative 4: Silver King Filtered TSF, due to the configuration of the filtered stacks they have minimal upstream catchment, but could have significant erosion of the slopes during a PMF.



change, which is expected to have less than a potential increase of 20% in precipitation magnitudes).

6. **Detailed Technical Comments – Suggestion for Analysis of Alternatives (pg. 16):** *With the potential for extreme stormwater events on the rise and flows that would be catastrophic to downstream resources if the proposed Skunk Camp impoundment failed, what would be the extent of the damage? Has this potential stress on the TSF been considered in the design and placement of materials? What would the extent of the damage be for all the alternatives (not just Skunk Camp)? The BLM reviewers recommend a detailed analysis of the potential extent and impacts associated with each of the alternative tailing facility locations if a catastrophic failure occurred due to the Global Industry Standard 10,000-year stormwater runoff event.*

**Clarification:** The Skunk Camp TSF is designed to safely manage the PMF, which has a greater magnitude than 1/10,000 AEP storm event.

7. **Detailed Technical Comments – Suggestion for Analysis of Alternatives (pg. 17):** *The Reviewers found no evidence within the FEIS or supporting materials that forest fires were considered in the analysis for the alternatives presented for the TSF. Due to the decades long drought Arizona is currently experiencing there is a greater chance for wildfires in the state, and the Skunk Camp location is adjacent to several mountain ranges. If a wildfire were to occur upgradient of the tailings pile, the lack of vegetation caused by the fire could have a profound effect on the local hydrology and the BLM reviewers believe this scenario needs to be addressed as an environmental impact, or as part of a climate change discussion.*

**Clarification:** The TSF PMF design volume is calculated assuming the highest runoff coefficient possible of 1.0 (accounting for any antecedent moisture or forest fire scenarios) and that the upstream diversions are non-operational (such that the entire upstream catchment reports to the TSF impoundment).

8. **Detailed Technical Comments – Suggestion for Analysis of Alternatives (pg. 17):** *It is possible the following information has been presented in other documents that were provided as reference, but the BLM reviewers believe the FEIS should state that contamination of the aquifer and rivers/streams is possible during stormwater events. Please indicate in the FEIS under what scenarios this will happen and identify the extent of contamination for each scenario. The BLM reviewers noted 10 comments expressing concern about the environmental impacts of the TSF and 40 comments about impacts to water quality. The BLM Reviewers believe there needs to be a more thorough discussion in the FEIS about this topic.*

**Clarification:** There is no expected release of contact stormwater from the TSF due to a storm event.

9. **Detailed Technical Comments – Characterization of Preferred Alternative Skunk Camp TSF (pg. 18):** *BLM reviewers recognize that the alternatives presented in the FEIS are not fully developed and that the purpose of the alternatives analysis is to consider a reasonable range*



*of alternatives that can accomplish the purpose and need of the proposed action. With that in mind the following comments are concerns about the preferred alternative. The layout and positioning of the facilities for the Skunk Camp TSF illustrated in Appendix F of the FEIS shows Pyrite Cell 1 is planned in the path of the two largest drainages entering the Skunk Camp TSF (Stone Cabin and Skunk Camp Wash). The USGS StreamStats calculated 500-year event for the Skunk Camp Wash entering the TSF is 4750 ft<sup>3</sup>/s (PII 2430 and Plu 9270 ft<sup>3</sup>/s) while the Stone Cabin Wash for the same recurrence interval is 3760 ft<sup>3</sup>/s (PII 1910 and Plu 7390 ft<sup>3</sup>/s) ([StreamStats \(usgs.gov\)](https://streamstats.usgs.gov) accessed on 05/03/2022).*

*The BLM reviewers suggest looking at alternate Pyrite Cell locations within the Skunk Camp TSF layout to potentially negate exposure of the highest concentration tailings to stormwater runoff greater than the 200-year event.*

*Alternatively, please analyze the feasibility of permanently rerouting Stone Cabin and Skunk Camp Washes around the Skunk Camp TSF to the west. The USGS StreamStats calculated 500-year event for the Skunk Camp Wash at the downstream extent of the TSF is 13,100 ft<sup>3</sup>/s (PII 5900 and Plu 29,100 ft<sup>3</sup>/s) ([StreamStats \(usgs.gov\)](https://streamstats.usgs.gov) accessed on 05/03/2022). Diverting all the upstream inflow to the TSF from Skunk Camp and Stone Cabin Washes would reduce the 500-year flood event volume of water coming into contact with tailings in the Skunk Camp TSF by more than 50%. This has the long-term benefit of rerouting potential peak flows around the tailings facility and potentially generating more robust excavated material for tailings impoundment structures. The new alignment appears to be a paleo alignment of those washes prior to the washes eroding through the bed rock.*

*Permanent diversion dams for the Stone Wash and Skunk Camp Washes potentially entering the TSF should be of significant size and construction to prevent the suggested 1,000-year stormwater event from gaining contact with the TSF. As mentioned above, the probability of a 1,000-year stormwater event occurring during mining operations is low, but viewed at a longer temporal scale, it is an important consideration.*

*The BLM reviewers believe a more thorough surface water hydrology characterization as it concerns to climate change needs to be completed for the Skunk Camp TSF. This location has the largest 100-year floodplain footprint when compared to other drainages in the area and BLM reviewers are concerned that more frequent and more severe flood events that could result from climate change have not been addressed. The more severe flood events could cause erosion and breach of the tailings pile, which would lead to contamination and impact the Gila River. This location is mostly surrounded by mountains, and with wildfires more likely due to a drier climate, the risk of flood flows caused by fires in the mountains is also a concern for the reviewers.*

#### **Clarifications:**

- The pyrite tailings cells are sited within the TSF impoundment to maximize storage capacity for pyrite tailings while minimizing pond area and volume, thus limiting

evaporative losses and stored pond volume for dam safety considerations. The pyrite tailings cells within the Skunk Camp TSF are designed to safely manage the PMF. Management of water within the pyrite tailings cells are preferred to maintain pyrite tailings saturation.

- Diversion scenarios that diverted upstream, non-contact water catchment to the north (Mineral Creek) or to the west (back to Dripping Spring Wash) were considered but ultimately rejected based on technical feasibility, environmental impact and legal/permitting constraints. The diversion structures, included in the design, divert as much catchment as reasonably practical and would include overflows to safely pass storm events in excess of design capacity into the TSF, thus not threatening the dam safety of the TSF.
- During operations, the TSF design can safely store the PMF (assuming antecedent moisture and forest fire conditions). Post closure, the TSF will safely convey well in excess of the 72-hour PMF, thus accounting for potential impacts of climate change, which is expected to have less than a potential increase of 20% in precipitation magnitudes, downstream via a closure diversion channel towards Dripping Spring Wash.
- There is no expected release of contact stormwater from the TSF due to a storm event.

## 4 2022 BLM COMMENTS ON GISTM TSF BREACH ANALYSIS

### 10. Suggestions for Analysis of Alternatives (pg. 16)

*Tailings storage facilities continue in perpetuity after mine closure. The potential energy of upper drainage TSFs like Skunk Camp increases the **likelihood**<sup>3</sup> of TSF failure and increases the potential spatial extent of impacts. Because of the episodic nature of stresses like earthquakes and stormwater events, the chance for catastrophic tailings storage failure during the life of the mine is low. However, for the communities and environment they depend on for resources like water, the chance for catastrophic failure and the associated impacts is an important consideration.*

*In August of 2020, in response to the increasing number of TSF failures around the world, the Global Industry Standard on Tailings Management was published with the goal “of zero harm to people and the environment with zero tolerance for human fatality. It requires Operators to take responsibility and prioritize the safety of tailings facilities, through all phases of a facility’s lifecycle, including closure and post-closure. It also requires the disclosure of relevant information to support public accountability.”*

*The BLM reviewers believe TSF breach analysis should be conducted for the preferred alternative following the guidelines and standards put forth by the Global Industry Standard on Tailings Management. Study results should be disclosed in the FEIS to inform alternative*

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<sup>3</sup> “consequence” would be a better word, the “likelihood” does not necessarily increase

*selection and support public accountability. This analysis is typically conducted by a qualified third party, and like other external studies, the findings should be summarized in the FEIS and should include maps for the extent of impacts and modeling outputs to inform the public. If practicable, breach analysis or some variance thereof for all alternatives should be included in the alternatives analysis to inform the decision-making process. Results from additional breach analysis will inform other permitting data needs and emergency planning and response.*

#### **Clarifications:**

The Global Industry Standard for Tailings Management (GISTM) states that a TSF breach analysis should be completed and used to inform emergency preparedness and response planning and the consequence of failure classification. The classification is then used to inform the external loading component of the design criteria. The proposed Resolution TSF design already complies with the most stringent design criteria required by GISTM.

The third-party consulting company supporting the USFS for the Resolution EIS, SWCA and BGC, completed a high-level comparison of the tailings alternatives for potential consequences of a breach based on empirical relationships developed from historical dam breaches. The historical **tailings** dam breaches, except one, were from upstream dams and the one exception was a modified centerline. In comparison, the preferred TSF alternative at the Skunk Camp site is a dual-embankment approach with full downstream-raised embankments for pyrite tailings contained within the scavenger tailings impounded by a cross-valley centerline-raised outer embankment, designed to the most stringent design criteria from the GISTM. The preferred alternative is a far more robust and resilient TSF than a single upstream or modified centerline embankment.

The high-level approach used in the EIS is reasonable to complete for the EIS alternatives analysis because it provides a worst case, “apples to apples” comparison for the level of design of the alternatives included in the EIS. The results indicate that the Skunk Camp site would have the lowest potential impact of the alternatives. This is not surprising, given the proximity of the Skunk Camp site from populations and perennial waters in comparison to the other alternative sites. A different approach to the breach analysis would not change this positive feature of the Skunk Camp site in comparison to the other sites and the overall conclusion of the analysis.



## 5 CLOSING

This letter is an instrument of service of KCB Consultants Ltd. (KCB). The report has been prepared for the exclusive use of Resolution Copper Mining LLC (Client) for the specific application to the Resolution Copper Project, and it may not be relied upon by any other party without KCB's written consent. KCB has prepared this report in a manner consistent with the level of care, skill and diligence ordinarily provided by members of the same profession for projects of a similar nature at the time and place the services were rendered. KCB makes no warranty, express or implied.

Should you have any questions, please do not hesitate to contact the undersigned.

Yours truly,

**KCB CONSULTANTS LTD.**



Kate Patterson, P.E., M.Eng.  
Project Director

KP:dl

## REFERENCES

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