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"Technical Support for Grassroots Public Interest Groups"

October 13, 2021

To: Gayle Hartmann, President
Save the Scenic Santa Ritas
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Re: Rosemont Copper World Project, Arizona Mined Land Reclamation Plan, Rosemont Copper Company and CDM Smith, August 2021

Background

David Chambers has 40 years of experience in mineral exploration and development – 15 years of technical and management experience in the mineral exploration industry, and for the past 25+ years he has served as an advisor on the environmental effects of mining projects both nationally and internationally. He has Professional Engineering Degree in physics from the Colorado School of Mines, a Master of Science Degree in geophysics from the University of California at Berkeley, and is a registered professional geophysicist in California (# GP 972). Dr. Chambers received his Ph.D. in environmental planning from Berkeley. His recent research focuses on tailings dam failures, and the intersection of science and technology with public policy and natural resource management.

This review was conducted at the request, and with the financial support, of Save the Scenic Santa Ritas.

Summary Comments

The primary flaw of this conceptual Reclamation Plan is that it is a reclamation plan without a supporting mine plan. While it is obvious from the technical drawings for the pits, waste rock piles, and tailings impoundments that this information must have been available in order to develop the Reclamation Plan, none of the supporting technical information is available to reviewers, presumably including the Arizona State Mine Inspector, to support the assumptions made in the Reclamation Plan.

Lack of this detailed supporting data leaves the Reclamation Plan deficient in two critical areas. First, there is no geochemistry data accompanying the Plan. Second, there is no hydrology or water quality predictions accompanying the Plan.

Lacking geochemistry data, it is not possible to determine whether acid drainage or metals leaching will be a factor at the mine. The geochemistry drives seepage and stormwater management. Geochemistry also drives the type of cover that will be required for waste rock and tailings, and the costs for the different cover types can vary significantly.

Lack of hydrology and water quality prediction information makes it impossible to determine what mitigation may be required as a part of reclamation. Should long-term water treatment be required, the cost of this mitigation measure could easily double the reclamation cost.

A reclamation should not be approved before first, or at least simultaneously, approving a mine plan. Approving a reclamation plan first is putting the cart before the horse – on a steep mountain road, in the dark of night.

Finally, it is obvious from the way the mine is designed that proposed mine is intended to avoid the use of federal lands, and hence federal regulation and oversight. This is most obvious from the layout of the Peach-Elgin Pit, which is configured to avoid federal lands. While this is technically feasible, it is most inefficient from a mining standpoint. This is a management-driven design, not a mining engineering-driven design. However, once the project has been approved by the State of Arizona, and mining has begun, it would be much easier to go the federal government for approval to mine on federal lands, given the disturbance that has already occurred, and the miners already employed.

Geochemistry

There is no discussion of the geochemistry of the tailings, waste rock, or pit-wall rock in the Reclamation Plan. There is no mention of the geochemistry of the waste, or reference to any geochemical testing that has been done for the proposed mine. It is obvious that some of this information must exist, at least the sulfur content of the rock from the exploration drill cores.

If metallurgical testing has been done on the copper ore, which would normally be required before a mine moves from the exploration to the proposal stage, then information would be available on the acid-producing and neutral leaching properties of the rougher and cleaner tailings. Copper cleaner tailings are typically acid-producing, and rougher tailings can produce neutral leaching contaminants like selenium. Typically, the rougher and cleaner tailings are recombined before disposal in the tailings facility, and it is important to understand the geochemistry of the recombined tailings stream.

Acid producing/neutral leaching material requires additional measures to mitigate the contaminants that are produced. Lacking the proper geochemistry data, it is not possible to determine whether the design of the waste disposal facilities, both the tailings impoundments and the waste rock dumps, is appropriate for the type of material being disposed. The reclamation plan is incomplete without this information.

Water Quality

A mine reclamation plan must depend on the predictions of the potential impacts on both surface and ground water quality. These predictions for the Copper World project are not available.

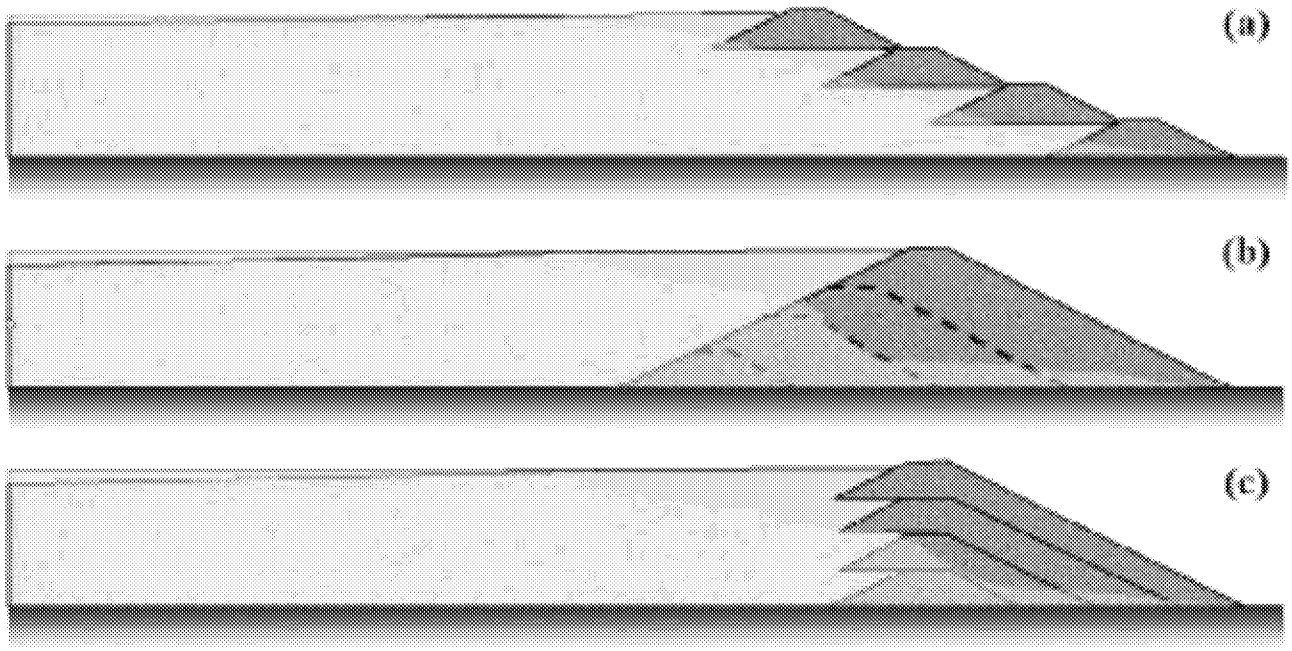
Copper mining in Arizona has contaminated many miles of surface streams. In the Tucson area, sulfate plumes have affected groundwater downgradient of tailings impoundments. In order to make predictions on potential impacts to water quality, both geochemistry and hydrology information is required. Neither hydrology nor geochemistry information is being presented as a reference to the Reclamation Plan.

The reclamation plan is incomplete without predictions for surface and ground water quality. Without these predictions, we don't what water quality potential impacts we are managing for, or the nature of the surface and ground water resources that might be impacted.

Tailings Dam Construction

The Reclamation Plan states that a "*conventional impoundment*" will be used for tailings disposal (Section 5). This evidently means that unlike the original Rosemont project proposal, Copper World will not utilize dry tailings, a best available technology. The Reclamation Plan does not disclose the type of tailings dam construction to be used for the Rosemont Copper World Project dams. However, since the use of upstream-type dam construction is common in Arizona, it is appropriate to assume that upstream-type construction may be the dam design-type employed.

There are three fundamental design-types with which to construct a tailings dam: (a) upstream-type; (b) downstream-type; and, (c) centerline-type.



Downstream-type construction uses the full triangular cross section construction approach, like that employed for water reservoir dams built with natural rock. This is safest design-type from a stability standpoint. The centerline-type design uses less engineered material than the downstream-type dam, and depends on the tailings to provide horizontal support. Centerline dams are theoretically less robust than downstream-type dams, but have a strong safety record. Upstream-type dams rely on the tailings themselves for support. Because the tailings that are hydraulically deposited are not dewatered and compacted, upstream-type dams have the worst safety record of the three design types.

After the tailings dam failure at Mount Polley in British Columbia, an Expert Panel (2015) was convened to review the failure recommended that Best Available Technology (BAT) be used for the placement of tailings. The Expert Panel concluded:

> *"The goal of BAT for tailings management is to assure physical stability of the tailings deposit. This is achieved by preventing release of impoundment contents, independent of the integrity of any containment structures. In accomplishing this objective, BAT has three components that derive from first principles of soil mechanics:*
>
> *1. Eliminate surface water from the impoundment.*
>
> *2. Promote unsaturated conditions in the tailings with drainage provisions.*
>
> *3. Achieve dilatant conditions throughout the tailings deposit by compaction."* (Expert Panel 2015)

Good reclamation planning would begin with these assumptions, then if a less costly method, like conventional wet tailings, posed no additional risk to public and environmental safety, then the less costly method should be used. There does not appear to have been any evaluation of using BAT for tailings at Rosemont Copper World, nor any explanation why the BAT approach was not followed. This is especially relevant because the original Rosemont project utilized filtered tailings.

Reclamation Cost Estimate

In the closure discussion section of the Reclamation Plan it is mentioned that "*For reclamation monitoring, it is assumed that field visits to evaluate site conditions would be required 4 times per year for 5 years*." (Appendix A, Reclamation Maintenance and Monitoring, p. A-5, *emphasis added*) The costing in the Nevada Standardized Reclamation Cost Estimator calculations echo the 5-year monitoring timeframe.

In all truth, monitoring and long-term maintenance will be required for tailings dams in perpetuity. A responsible reclamation plan would account for this, even if it were not required by regulation. Climate change could also affect long-term phreatic levels and erosion. Climate change has not been considered in the Reclamation Plan.

Long-term monitoring of the phreatic levels in the dams and tailings is important to ensure public and environmental safety. This should have been included in the post-closure costing. In addition, some long-term maintenance, due to normal wear from storm events and unplanned erosion, will be required. Long-term monitoring and maintenance has not been included in the reclamation costing.

The Reclamation Plan used the Nevada Standardized Reclamation Cost Estimator to calculate the closure costs. This is well accepted model for mine closure cost planning. It is also a model that requires a great deal of detailed information on the mine, information that would typically accompany a mine plan of operations. However, there is no mine plan of operations to accompany the reclamation plan. as a result, there is no way to check to see if all of the appropriate items have been included in the cost estimate, and if the cost estimate for those items included agree with the information in the mine plan.

The only reference listed for the Reclamation Plan is the Arizona Mining BADCT Guidance Manual. Because there is no geochemical testing to use as a reference, it is not possible to determine whether acid drainage or neutral leaching are potential problems. If acid drainage or neutral leaching become a problem, then seepage collection and water treatment would be required. For reclamation cost estimates, perpetual water treatment typically costs hundreds of millions of dollars, and can easily double the cost of the closure estimate.

Lacking the usual information on the geochemistry of the mine waste, the pit walls, and the hydrology of the area, it is not possible to determine whether long-term water treatment needs to be included as a part of the reclamation cost estimate.

Thank you for the opportunity to comment on the reclamation plan.

Sincerely;

David M. Chambers, Ph.D., P.Geop.

References:

Expert Panel 2015. Report on Mount Polley Tailings Storage Facility Breach, Independent Expert Engineering Investigation and Review Panel, Province of British Columbia, January 30, 2015, https://www.mountpolleyreviewpanel.ca/final-report

Rosemont 2021. Rosemont Copper World Project, Arizona Mined Land Reclamation Plan, Rosemont Copper Company and CDM Smith, August 2021