SAVE THE SCENIC SANTA RITAS ASSOCIATION

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April 7, 2024

Karen Peters, Director
Arizona Department of Environmental Quality
1110 W. Washington Street
Phoenix, AZ 85007

Dear Director Peters:

Save the Scenic Santa Ritas (SSSR) and the 13 other organizations listed below herein submit our formal comments on the Draft Aquifer Protection Permit No. P-513690 (APP) for the Copper World Project in Arizona (ADEQ, 2024) and the APP application submitted by Hudbay in 2022 for the Copper World Project. Our comments address issues related to procedures, best practices, water quality, geochemistry, geophysics, and hydrogeology.

Our joint organizational comments reflect in-depth review and analysis of the APP by four PhD scientists and engineers: Ann Maest (hydrogeochemistry), Laurel Lacher (hydrogeology and groundwater modeling), David Chambers (mining engineering and geophysics), and Stan Hart (geochemist). Taken together, their conclusions are that the draft APP lacks essential information and that its engineering and monitoring requirements would fail to adequately protect the natural environment and the health of the surrounding human communities. ADEQ should require the additional permit conditions, design requirements and agency reviews detailed in our comments to better ensure that the design of this mine adequately protects the aquifer.

In addition to our own comments, we adopt and include by reference the comments on the draft APP submitted to ADEQ by Pima County Administrator Jan Lesher on March 11, 2024.

The undersigned organizations conclude that, not only is the APP inadequate, but its approval would be premature, given that the mine has changed its plans radically in the past year, and, as yet, has no mining plan that has been approved by Hudbay's board of directors. Given the many significant inadequacies in the draft APP permit, as detailed in this comment letter and the comments submitted by Pima County, no permit should be granted until all missing information is gathered and analyzed, and the glaring failures to provide sufficient environmental protections are rectified.

The following Executive Summary presents key findings, which are subsequently detailed in the following four reports provided by the four experts identified

above. Note that each paragraph in the Executive Summary refers to a particular section of this document for substantiation and additional detail.

You may contact me, Rob Peters, directly with questions or other follow-up, or reach out to the signatories below.

Rob Peters, PhD, Executive Director
Save the Scenic Santa Ritas
970 201-7642

Signatory organizations:

American Rivers: American Rivers is a national nonprofit conservation organization championing an effort to protect and restore all rivers, from remote mountain streams to urban waterways. Healthy rivers provide people and nature with clean, abundant water and natural habitat. For over 50 years, American Rivers staff, supporters, volunteers, and partners have shared a common belief: Life Depends on Rivers. With headquarters in Washington, D.C., and offices in every region of the country, including throughout the Southwest, we have protected more than 150,000 river miles, removed more than 200 dams, and conserved clean water for people and nature.
Signing representative: Michael Fiebig, Director, Southwest River Protection Program

Arizona Mining Coalition: The Arizona Mining Reform Coalition is comprised of Arizona groups and individuals that work to ensure that responsible mining contributes to healthy communities, a healthy environment, and, when all costs are factored in, is a net benefit to Arizona. The Arizona Mining Reform Coalition expects the mining industry to clean up after itself, comply fully with the spirit of safeguards in place to protect Arizona, and to interact in a transparent and open manner with Arizona citizens.
Signing representative: Roger Featherstone, Director, Arizona Mining Coalition

Calabasas Alliance: The mission of the Calabasas Alliance is to preserve and protect the natural environment of biodiverse flora and fauna, water resources, air quality, and the health and safety of all residents of Santa Cruz County, and all of Southern Arizona. Through active advocacy, in cooperation with like-minded groups and legal counsel, the Alliance seeks to mitigate major industrial development, especially any mining, ore processing, and transport along the I-19 corridor in Santa Cruz County, Arizona.
Signing representative: Robin Lucky, President, Calabasas Alliance

Center for Biological Diversity: The Center for Biological Diversity represents over 1.7 million supporters, many of whom live and recreate in and around southern Arizona, the Santa Rita Mountains and its watershed. The organization is a 501(c)(3) nonprofit founded in the 1990s, headquartered in Tucson, Arizona. Since its founding, the Center has been dedicated to protecting and restoring imperiled species and natural ecosystems. The Center uses science, policy, and law to advocate for the conservation and recovery of species on the brink of extinction and the habitats they need to survive.

Signing representative: Russ McSpadden, Southwest Conservation Advocate, Center for Biological Diversity

Coalition for Sonoran Desert Protection: Established in 1998 and with 32 member groups, a committed staff, and a large group of volunteers, the Coalition for Sonoran Desert Protection's mission is to protect the biodiversity of the Sonoran Desert in southern Arizona through science-based advocacy, education, and collaboration.
Signing representative: Carolyn Campbell, Executive Director

Great Old Broads for Wilderness, Tucson Broadband: Great Old Broads for Wilderness is a women-led national grassroots organization that engages and inspires activism to preserve and protect wilderness and wild lands. The Tucson Broadband covers Southern Arizona from Tucson south to the Mexican border.
Signing representative: Andrea Hoerr, Co-Leader, Great Old Broads for Wilderness, Tucson Broadband

Friends of Madera Canyon: Friends of Madera Canyon is a non-profit 501(c)(3) volunteer organization affiliated with the U.S. Forest Service. The organization provides informational brochures, clean-up crews, research and education programs for adults and school children, maintenance of trails for the handicapped, designs and maintains trail and nature signs, welcomes visitors, and finances the building of many of the facilities throughout the Canyon.
Signing representative: Dan White, President, Friends of Madera Canyon

Patagonia Area Resources Alliance: The Patagonia Area Resource Alliance is a grassroots community-driven nonprofit dedicated to the preservation and protection of the Patagonia Mountains and the Sonoita Creek Watershed from the impacts of 21st century industrialized mining.
Signing representative: Carolyn Shafer, Board Co-Chair and Mission Coordinator, Patagonia Area Resource Alliance

Save the Scenic Santa Ritas: Save the Scenic Santa Ritas is a non-profit citizen group with 3,000 members dedicated to protecting the Santa Rita and Patagonia Mountains from environmental degradation caused by metal mining and mineral exploration.
Signing representative: Rob Peters, Executive Director, Save the Scenic Santa Ritas

Sierra Club, Grand Canyon Chapter: The Sierra Club is one of the largest and most influential grassroots environmental organizations in the U.S., with more than 3 million members and supporters. In addition to protecting every person's right to get outdoors and access the healing power of nature, the Sierra Club works to promote clean energy, safeguard the health of our communities, protect wildlife, and preserve our remaining wild places through grassroots activism, public education, lobbying, and legal action. The Grand Canyon Chapter of the Sierra Club has a long history of public education and advocacy to protect the public lands, waters, wildlife and our Arizona communities.
Signing representative: Sandy Bahr, Chapter Director, Sierra Club - Grand Canyon Chapter

Sky Island Alliance: Sky Island Alliance is a regional conservation nonprofit dedicated to protecting and restoring the diversity of life and lands in the Sky Islands of the U.S. and Mexico. Sky Island Alliance is working to ensure the Sky Islands are a place where nature thrives, open

space and clean water are available to all, and people are connected to the region and its innate ability to enrich our lives.
Signing representative: Louise Misztal, Executive Director, Sky Island Alliance

Tohono O'odham Nation: The Tohono O'odham Nation is a federally-recognized tribe that includes approximately 28,000 members occupying tribal lands in Southwestern Arizona The Nation is the second largest reservations in Arizona in both population and geographical size, with a land base of 2.8 million acres and 4,460 square miles, approximately the size of the State of Connecticut. Its four non-contiguous segments total more than 2.8 million acres at an elevation of 2,674 feet.
Signing representative: Verlon M. Jose, Chairman, Tohono O'odham Nation

Tucson Audubon: Tucson Audubon Society, founded in 1949, is a member-supported, non-profit organization dedicated to inspiring people to enjoy and protect birds and their habitats through recreation, education, wildlife conservation, advocacy, and protection and restoration of the environment on which we all depend. Tucson Audubon has approximately 3,200 members, many of whom live, work, or recreate in areas that would be directly or indirectly impacted by the Copper World mining project.
Signing representative: Melissa Fratello, Executive Director, Tucson Audubon

Wild Earth Guardians: Wild Earth Guardians protects and restores the wildlife, wild places, wild rivers, and health of the American West. They envision a world where wildlife and wild places are respected and valued and our world is sustainable for all beings.
Signing representative: Erica Prather, Wild Earth Guardians

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Biosketches

Dr. David Chambers, Center for Science in Public Participation (CSP2)

David Chambers has 45 years of experience in mineral exploration and development – 15 years of technical and management experience in the mineral exploration industry, and for the past 30+ 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.

Dr. Stanley Hart

Stanley Hart was full professor at M.I.T. and Senior Scientist at the Woods Hole Oceanographic Institution (now Emeritus from that institution). He holds a Ph.D.in geochemistry, with research focus on the kinetics and thermodynamics of chemical interactions between natural waters and various rock types and a specialization in the isotopic geochemistry of lead (Pb) as a tracer of water-rock reactions. Dr. Hart has published more than 250 peer-reviewed papers and is a member of the American Academy of Arts and Sciences, and the National Academy of Sciences.

Dr. Hart lives near Madera Canyon, about 9 miles from the proposed mine, and well within the areas of environmental concern and impact of the mine.

Dr. Laurel Lacher, Lacher Hydrological Consulting

Laurel Lacher has owned her own consulting firm since 2002. Prior to that, she received her PhD in Hydrology from the University of Arizona and developed and managed the Water Resources Program for the White Mountain Apache Tribe's 1.6-million-acre reservation. Her career has focused on hydrologic data collection and computer modeling of stream-aquifer interactions in the desert southwest, including the Verde, Santa Cruz, and San Pedro basins in Arizona and the Rio Grande basin in New Mexico. Her clients include Indian tribes, NGOs, federal, state, and local government agencies, corporate attorneys, and private foundations. She has conducted hydrological evaluations of mining projects in Montana and Southern Arizona. She has been a Registered Geologist (#49074) in Arizona since 2006.

Dr. Ann Maest, Buka Environmental

Ann Maest is an aqueous geochemist with Buka Environmental in Telluride, Colorado, USA. She specializes in the environmental effects of hardrock mining, baseline water quality evaluations, geochemical testing methods and modeling, and responsible mining certification. After completing her PhD, Dr. Maest was a research geochemist in the U.S. Geological Survey's National Research Program, where she conducted research on the geochemistry of surface water and groundwater systems. She has served on several U.S. National Academy of Sciences committees and a Board related to earth resources and was an invited speaker on technical challenges and solutions for the mining sector at the United Nations. Ann holds a PhD in geochemistry and water resources from Princeton University.

Executive Summary of Key Findings and Recommendations

Some of the inadequacies in the draft APP, as detailed below:

- *Failure to account for significant changes in Hudbay's plans since the application was filed.*
- *Reliance on a BADCT and "best practices" at least 20 years out of date.*
- *Faulty modeling assumptions.*
- *Failure to consider recent data on climate change.*
- *Missing elements, including missing facilities, numeric limits, and parameters of concern.*
- *Need for more compliance wells.*
- *Lack of a biological assessment as required in the governing legislation.*
- *Inadequate transparency in data availability and monitoring.*

More detail on the points summarized in the Executive Summary can be found in the reports indicated at the end of each key finding.

General considerations

- According to the Hudbay Pre-Feasibility Study (PFS, 2023), the description of the mine in the APP Application is out of date. There are significant changes to the mine as proposed in the APP Application, and these changes will require additional technical analysis. [Maest report]

- Because the new PFS report (Hudbay, 2023) increases the number of tailings storage facilities (TSFs) from 2 to 3, eliminates the heap leach pad, and increases the waste rock facility (WRF) volume by more than 70%, this entire modeling report (and the related APP application) should be revised. These changes presented by Hudbay (2023) to its shareholders a year *after* submission of the APP application to ADEQ constitute a significant change and merit a significant amendment to the draft APP currently in review by ADEQ. [Lacher report]

- In addition, in accordance with ADEQ regulations these changes will require an opportunity for public review and comment. The mine proposed in the APP Application is a placeholder only and is not the mine Hudbay intends to build. The application process should be suspended until an accurate mine description, with accompanying technical analysis, is included in the APP Application. [Chambers report]

- The current Arizona BADCT manual is at least two – and possibly three – decades out of date. Mining best practices have improved greatly over the intervening decades. Instead of using the BADCT manual, ADEQ should require the use of state-of-the-art best

practices to minimize the adverse effects of the Copper World Project on groundwater resources. Examples of recent best practice guidance documents are included in the Maest report. [Maest report]

Tailings storage facilities

- There is no information available for TSF-N, a new tailings facility proposed for the mine in the Pre-Feasibility Study (2023). Appropriate engineering detail should be provided for TSF-N. [Chambers report]

- The Piedmont Alluvium under the tailings impoundments is described as having high hydraulic conductivity and storage characteristics, so seepage not captured by the drain systems could reach groundwater by flowing under the tailings dams. It is predicted in the APP Application technical support documents that the drain systems will capture 98% of the seepage from the tailings, but this is an unrealistic and unsubstantiated capture rate for an unlined drainage collection system. If this assumption is to be used for the Application, then ADEQ should require documentation of where this capture rate has been achieved. ADEQ should also clearly explain why the liner system described as Best Available Demonstrated Control Technology by ADEQ should not be required. [Chambers report]

- The Hudbay tailings dam failure model assumes only 1% of the tailings would be released in a dam failure. The amount of tailings assumed to be released should be between 25% and 90% for a catastrophic dam failure. A worst-case failure model must be run in order to provide emergency planners with the information needed to protect against loss of human life, and to avoid building critical public infrastructure in areas that could be inundated by an unplanned release of tailings. [Chambers report]

- Hudbay has stated it no longer intends to use heap leaching, but will use the Albion Process to produce refined copper after the first 4 years of mine operation. The waste from the Albion Process will be blended into the rougher tailings in the tailings facilities, and could affect the level of contaminants in TSF seepage. A geochemical analysis of the waste from the Albion Process is required. [Chambers report]

- The APP proposes to permit TSFs that are not lined. TSFs should be appropriately lined as is typical in other states like Nevada. The APP must address long-term pollution control from all three TSFs now proposed by Hudbay (2023) and recognize the imminent threat to downstream drinking water systems. [Lacher report]

Water quantity and quality evaluation and control

- There is no discussion of the quantity of water lost due to post-closure pit lake evaporation. All of the water lost to evaporation in the pit lakes would have become groundwater, so pit lake evaporation is equivalent to groundwater loss. Groundwater loss from pit lakes can be mitigated by backfilling the pit lakes with waste rock, as is being planned for several of the proposed mine pits. [Chambers report]

- The large increase in the amount of waste rock proposed in the Hudbay Pre-Feasibility Study (2023), and the increased area of the Waste Rock Facility footprint, means that the hydrology and water quality analysis are no longer accurate and must be amended. [Chambers report]

- Stormwater will not be excluded from the waste rock piles and there is no clear evidence that potentially acid generating (PAG) rock would be insulated from the effects of stormwater runoff or direct precipitation. The sediment basins proposed to reduce sediment discharge from the mine site must be monitored for water quality to ensure that PAG rock is not producing acidic runoff that is discharged to natural channels or the aquifer. [Lacher report]

- Rosemont pit lake could receive tremendous runoff during a large storm event, thus reversing the hydraulic gradient from the aquifer to the lake to create a discharge from the lake to the aquifer. The Rosemont Pit must be included in the APP as a discharging facility and have additional POC wells to monitor for contamination leaving the mine site. [Lacher report]

- During the post closure period, seepage from the TSFs will increase. Considering the proximity of the Santa Cruz River and the thousands of drinking water wells downgradient in Green Valley, Sahuarita and Tucson, permitting pollutants to leave the site as defined by the simulated the Discharge Impact Area should be impermissible and is not a BADCT procedure. [Lacher report]

- Surface runoff modeling does not account for changing surface conditions, such as vegetation removal and road construction. All surface runoff modeling must incorporate future developed mine conditions. [Lacher report]

Climate change

- The Hydrogeologic Characterization Study (Hudbay, 2022, Att F.1, Sect. 2.2) describes the climate data used for evaluating the hydrologic conditions at the mine site. This report describes the use of precipitation data from the Helvetia monitoring station for the period 1916-1950 and pan evaporation data from the Nogales monitoring station for the period 1952- 2007. Whether or not the methods applied in this APP are appropriate, they include no consideration for an uncertain future climate. Other work in central and southern Arizona using five downscaled global climate change models under two emissions scenarios suggests that significantly more precipitation (and less evaporation) may occur in the future during certain months, despite warming temperatures. More precipitation and less evaporation could reverse the currently anticipated source/sink condition of future pit lakes, particularly considering that most forecasts suggest more extreme weather events in the future. [Lacher report]

Mine facility designations and BADCT

- Certain mine facilities are designated as exempt or non-discharging and are therefore not included in the Draft APP and are not subject to BADCT requirements. These facilities include but are not limited to the Rosemont Pit; truck shop, fuel storage and dispensing stations, and truck wash; primary and secondary crushers for sulfide and oxide ore; reagent storage facility; and the acid plant. The Rosemont Pit is the largest of the six proposed pits and will have the deepest pit lake. It is predicted to be a hydrologic sink during post-closure but will not be during construction, operation, or closure. It should therefore be included in the Final APP and have point-of-compliance monitoring wells. No compliance monitoring is currently proposed for the Rosemont Pit. [Maest report]

- The two tailings facilities, the waste rock facilities, and the five remaining open pits are included in the Draft APP, but Hudbay applied the less protective individual BADCT measures to these facilities. Because these facilities will be some of the primary contaminant sources on the mine site, the more protective prescriptive BADCT measures should be applied. [Maest report]

POC wells, monitoring, analytical, and reporting issues

- The Draft APP has no numeric permit limits. Numeric aquifer quality limits (AQLs) and alert levels (ALs) will eventually be established for parameters with Arizona aquifer water quality standards (AWQS), but only after baseline monitoring of the 10 proposed point of compliance (POC) wells has been completed. Meanwhile, construction of the Copper World Project, which will result in contaminant releases, is allowed to begin before the baseline monitoring is completed. This gap in coverage allows for groundwater contamination without regulation and biases the results of baseline monitoring. [Maest report]

- Baseline groundwater monitoring data exist for 31 wells located in similar locations to the 10 POC wells. No exceedances of AWQS values have been reported for any of these 31 wells. Given the good water quality in and the similar locations of these 31 wells, AQL and AL values based on AWQS values should be included in the Final APP to protect groundwater quality. ADEQ should stipulate initial values for AQLs and ALs for all 10 POCs based on existing data. [Maest and Lacher reports]

- Recent water quality sampling of drainages on the east side of the site, including Barrel Canyon and Davidson Canyon, have shown increasing metal concentrations, suggesting that Hudbay's exploration activities have already adversely affected water quality. Increases have been seen in both total and dissolved metal concentrations starting in April 2023. Based on these initial results, ADEQ should add groundwater and surface water monitoring locations on the east side of the site in Barrel Canyon, Davidson Canyon, and Cienega Creek. [Justin Headley, University of Arizona graduate student, personal communication and poster included below in these comments.]

- Even though sulfate does not have an AWQS, ADEQ is authorized by statute to establish an AL for pollutants that indicate the potential appearance of another pollutant. Sulfate is an early indicator of acid mine drainage and the most mobile mine contaminant. Including a numeric AL based on existing groundwater monitoring results is a prudent approach to ensuring an effective early warning system. [Maest report]

- Groundwater metal concentrations should be reported as the total metal because of the potential to use groundwater as a domestic water source without filtering. Arizona surface water quality regulations for domestic water sources require that metals be determined as the total metal. Reporting as the dissolved metal will minimize the total concentration of mine contaminants in groundwater. [Maest report]

- The 10 POC wells proposed by ADEQ (2022) in Figure 36 do not provide adequate coverage for detecting groundwater contamination from the mine site, especially considering the newly proposed (Hudbay, 2023) TSF-N and expanded waste rock facility. At least one additional POC should be installed on the north boundary of the PMA between POC 7 and POC 9. Three additional POCs should be added east and north of the Rosemont Pit, and three additional POCs should be added to the west/northwest of TSF-1 and the proposed TFS-N to protect the thousands of drinking water wells downgradient in Sahuarita and Tucson. [Lacher report]

- To expedite the public accessibility of the monitoring data, the laboratory results should be sent to ADEQ at the same time they are sent to the company. ADEQ should then upload the results to their website to improve transparency and public access to the data. [Maest report]

- ADEQ should consider adding an option for local stakeholders to conduct participatory monitoring. As part of such a program, the independent monitors could take split samples and send them to a separate laboratory for analysis. [Maest report]

Geochemical testing and relevance to the Draft APP

- Many parameters that are known contaminants of potential concern (COPCs) based on geochemical testing are proposed to have no numeric limits in the Final APP. A list of COPCs is included in Section 5.1.2 of the Maest report. Some key mine contaminants without numeric permit limits include copper, zinc, sulfate, and acidity (low pH) – all of which are the result of weathering of metal sulfides and are associated with acid drainage at mine sites. Numeric permit limits, whether AQL or AL values, should be established for all COPCs, based on the results of ambient groundwater monitoring. [Maest report]

- Although the predicted seepage and pit lake chemistries are based on results from laboratory leach testing, the modeling approaches and the use of scaling factors appear to make the predictions unrealistically low. Protective facility design and careful

monitoring of compliance wells, stormwater, and pit lake locations for all contaminants of potential concern before, during, and after mining with meaningful alert levels and well-designed contingency plans are needed to minimize groundwater contamination from this very large mining project. [Maest report]

Lack of microbiological evaluation and modelling

- The Arizona Administrative Code (A.A.C.) R18-9-A202(A)(4) requires that a summary of the known past facility discharge activities and the proposed facility discharge activities be conducted, and that this summary must include biological characteristics. Biological characterization is essential because microbial activity can greatly increase weathering and leaching rates of some toxic metals. Despite this legal requirement, Hudbay's APP application included no information on microbial activity in tailings piles and their discharge. Therefore, before a permit can be granted, ADEQ should require adequate modelling that includes the microbial contribution, as detailed in Hart's comments below. [Hart report]

Report by David Chambers, PhD; Center for Science in Public Participation (CSP2)

Comments on the Copper World Project Individual Aquifer Protection Permit Application

CENTER for SCIENCE in PUBLIC PARTICIPATION
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"Technical Support for Grassroots Public Interest Groups"

March 18, 2024

ADEQ
Water Quality Division/Groundwater Protection
Attn: Bernice Manuelito
1110 W. Washington St.
Phoenix, AZ 85007

Re: Comments on the Copper World Project Individual Aquifer Protection Permit Application

GENERAL COMMENT

The public is being asked to comment on a permit for a project that, according to the project proponent's public and legal statements, will not be built. In the 2023 Pre-Feasibility Study (Hudbay 2023), it is stated; "*This Technical Report describes the* ***latest resource model and mine plan****, and the current state of metallurgical testing, operating cost, and capital cost estimates which constitute the basis for the mineral reserve estimates supporting the PFS*." (***emphasis added***).

The 2023 Hudbay mine plan has significant differences from the mine plan proposed in the Aquifer Protection Permit Application (APP), most notably (1) a new Tailings Storage Facility (TSF-N), a (2) reconfiguration of TSF-2, (3) almost doubling the amount of waste in the waste rock storage facilities; and, (4) elimination of the heap leach facility.

ADEQ Regulations state:

> "*Significant permit amendment: The Director shall make a significant amendment to an individual permit if …. Material and substantial alterations or additions (*are made*) to a permitted facility…"* (ADEQ 2023, R18-9-A211.B.9.)

And;

> "*The public notice and public participation requirements of R18-9-108 and R18-9-109 apply to a significant amendment*." (ADEQ 2023, R18-9-A211.E.)

The ADEQ regulations clearly state that a public review process would be triggered when the 2023 mine amendments are officially presented to ADEQ. As explained in the comment to follow, Hudbay has clearly stated it intends to build a mine that has significant differences from that in the 2022 APP Application. ADEQ can continue with the process of issuing a permit for the mine proposed in the APP Application, but the mine now proposed by Hudbay (2023) would trigger another round of permit revisions, including public comment. This brings into question why the public is being asked to comment on a mine that will not be built as described in the present APP Application, and why ADEQ is spending its staff resources on this application.

DOCUMENT-SPECIFIC COMMENTS

APP Application Mine Description

The 2022 Arizona Aquifer Protection Permit (APP) Application references Appendix I.10 – Technical Report Summary on the Pre-Feasibility Study (PFS) for information on the Tailings Storage Facilities, Heap Leach Facility, and Waste Rock Facility, for the Rosemont Copper World Project (Wood 2022,

Appendix I.10). Appendix I.10 was published the same month (September 2022) as the APP Application (Hudbay 2022).

The 2022 pre-feasibility study in Appendix I.10 is no longer valid, because it has been superseded by the Pre-Feasibility Study and Updated Mineral Resource Estimates (Hudbay 2023). "*This pre-feasibility study ("PFS") is the current NI 43-101 technical report in respect of all of the mineral properties that form part of the Copper World project and* ***supersedes and replaces the 2022 PEA (as defined herein) in its entirety***." (Hudbay 2023, ***emphasis added***). This statement is unambiguous.

The description of the mine in the APP Application is out of date, and the mine as now proposed by Hudbay (2023) is significantly different from the mine proposed for public comment. The application process should be suspended until an accurate mine description is included in the APP Application.

Waste Rock and Tailings Facility Size and Location

Figure 1a shows the mine facility layout from the APP Application. Figure 1b shows the facility location from the 2023 Pre-Feasibility Study, which Hudbay states is now the actual mine plan (Hudbay 2023).

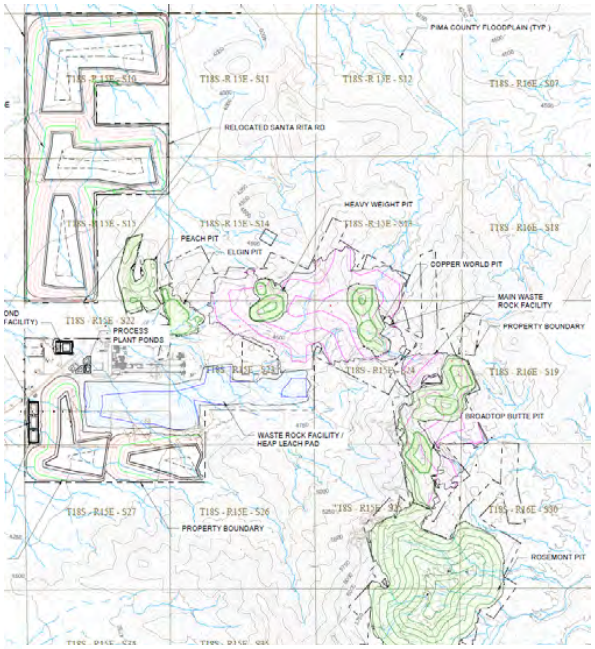


Figure 1a: Facility Location from APP Application (2022, Appendix I.10)

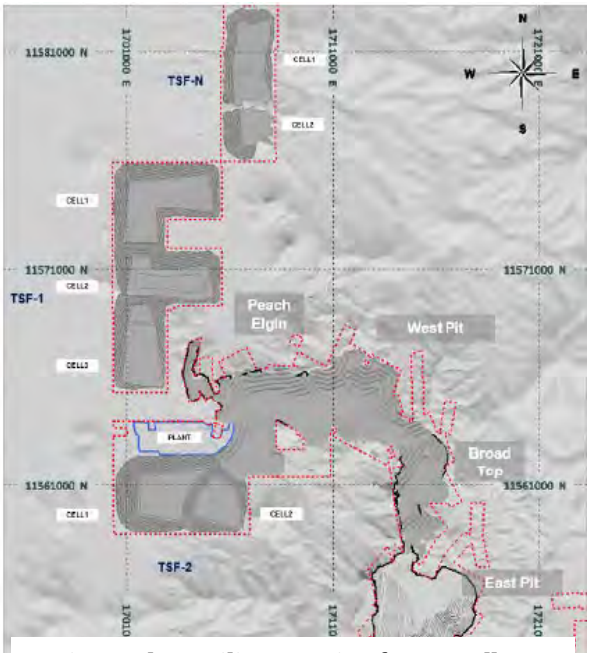


Figure 1b: Facility Location from Hudbay Pre-Feasibility Study (2023)

The heap leach pad, which appears in light blue in Figure 1a, is gone from Figure 1b, and has been replaced by expanded TSF-2 cells, and by an expanded waste rock dump. These changes in mine layout footprint affect the potential impacts to groundwater. The heap leach pad was a lined facility, which has been replaced by unlined TSFs, and an increase in the footprint of the Waste Rock Facility.

There is also a new TSF-N, which would also contribute to potential groundwater contamination. There are no details on TSF-N supplied in the 2023 Pre-Feasibility Study. Hudbay has indicated they believe a 'better option' to the TSF-N location will show up toward the end the planned mining, but ADEQ is apparently being asked to include this phantom TSF in the APP.

The amount of waste rock produced has increased from 477.4 million tons in the 2022 APP Application (Hudbay 2022, APP Application, Table 4.01), to 856 million tons in the 2023 Pre-Feasibility Study …" (Hudbay 2023, Table 16-3), an increase of 88%. The large increase in the amount of waste rock, and the increased area of the Waste Rock Facility footprint, means that the hydrology and water quality analysis are no longer accurate, and must be amended.

Albion Process Geochemistry

In year 5 of the mine life, it is proposed in the 2023 Pre-Feasibility Study that the Albion Process will be used to process copper concentrate. The solid waste that remains from the Albion Process will be mixed into the rougher tailings stream for disposal in the TSFs ((Piteau 2022, Appendix G.1, and Hudbay 2023, Figure 17-2: Process Plant Flowsheet – Concentrate Leach Facility).

The Albion Process is an aggressive oxidation process designed to separate metal ions from their sulfide mineral bonds. In addition to copper, a number of metals can be expected to be freed from their sulfide bonds, and remain either as free ions, or combined into hydroxides, oxides, or other compounds that could be easily dissolved in the post-processing geochemical environment of the TSF.

Cyanide will also be used to process the leach residues from the electrowinning circuit of the Albion Process material (Hudbay 2023). Even though the amount of electrowinning leach residues will be relatively small (exactly how much, we do not know), cyanidation is an aggressive dissociation process that liberates metal ions. Measurable cyanide will exist in the treated residues, even after it has gone through a cyanide-destruct process. Cyanide ions, and any potential contaminants the cyanidation process also liberates, must be tracked through the water balance cycle.

There is no published geochemical analysis of the solid waste from the Albion Process. It is important to know what contaminants will be in that waste, and to model what the projected contaminants would contribute to groundwater seepage. A geochemical analysis of the waste from the Albion Process is required.

TSF Pit Lakes and Evaporation

At mine closure, several lakes will form in the mined-out pits that are not backfilled with waste rock. The Rosemont (East), Elgin, and Peach pits will have pit lakes after mining ceases. Pit water will be likely be high in fluoride and sulfate, with other contaminants elevated.

The water quality comparison for pit lakes was made to groundwater standards, not surface water standards (Piteau 2022, Appendix G.1). These lakes will be surface waters, accessible to aquatic life, so the comparison of predicted contaminant levels in the pit water to water quality standards should be to surface water quality standards, not groundwater standards. Groundwater standards are not protective of aquatic life. Copper, fluoride, and selenium are all projected to be elevated, and near or higher than aquatic life standards in the pit lakes (Piteau 2022, Appendix G.1). Selenium exceeds surface water standards in the predictions.

There is no discussion of the quantity of water lost due to pit lake evaporation, although it is obvious that modeling included enough information to develop this number (Piteau 2022, Appendix F.2; Wood 2022, Appendix E). All of the water lost to evaporation in the pit lakes would have become groundwater, so pit lake evaporation is equivalent to groundwater loss.

Groundwater loss from pit lakes can be mitigated by backfilling the pit lakes with waste rock, as is being planned for several of the proposed mine pits. The reason the Rosemont, Elgin, and Peach pits are not being backfilled is the cost of the backfilling. However, without knowing how much groundwater will be lost, it is not possible to have a discussion of whether the cost of backfilling would be justified by the groundwater to be saved.

Lining TSFs to Avoid Groundwater Contamination

For the APP Application, three options were evaluated for the impoundment design:

(1) Unlined, which means that seepage from the tailings can enter the groundwater underneath the impoundment, and can flow under the dam if a groundwater pathway exists.

(2) Underdrains, where a series of drain pipes are placed at the bottom of impoundment to collect seepage. This engineering approach would collect most, but not all, of the seepage moving through the tailings toward groundwater; and,

(3) Lined, where a synthetic liner would be placed on the bottom of the impoundment, providing a barrier to seepage migration that would prevent almost all of the seepage from reaching groundwater.

The amount of seepage, which will contain contaminants, was estimated by Wood (2022, Appendix H1, Table 3-3):

Table 3-3: Comparison of Individual Discharge Control Technologies to BADCT Design

Facility	Alternative	Discharge from Facility (gal/min)	Discharge from Facility (gal/day)
TSF-1	1 - Unlined – no underdrain	759	1,095,672
	2 – Unlined, finger underdrain -	159	218,534
	3- Geomembrane liner on compacted subgrade and overliner drain (BADCT)	0.32	465
TSF-2	1 - Unlined – no underdrain	377	542,880
	2 – Unlined, finger underdrain	75	108,576
	3- Geomembrane liner on compacted subgrade and overliner drain (BADCT)	0.11	154

As can be seen in Table 3-3, adding the underdrains reduces the amount of seepage, compared to an unlined impoundment, by 80%. Using a liner on the impoundment will reduce seepage to groundwater over 99.5% compared to the unlined impoundment, and over 99%% compared to an underdrain-only. These are very significant reductions in the amount of seepage entering groundwater. Therefore, if there are contaminants that are of concern for polluting groundwater, and if seepage from the tailings is able to flow under the dam, reducing seepage flow from the tailings could be important.

Similar to the contaminants mentioned in the previous discussion of potential pit lake contamination, the tailings could potentially leach selenium (0.026 ug/L), fluoride (1.2 mg/L), and sulfate (808 mg/L) from the tailings into groundwater (Piteau 2022, Appendix G.1, Table 6.3). There is no discussion of additional contaminants that could be liberated during the Albion Process treatment now being proposed for the mine.

Since there is no modelling of contaminant plumes from the tailings impoundments, this leads to the conclusion that Hudbay and ADEQ have assumed that seepage to groundwater and under the tailings dams, is insignificant. This may not be correct.

Finally, in 2023 Hudbay was asked by ADEQ to clarify whether; "*Based on seepage modeling of the seepage collection system,* ***approximately 98% of seepage from the TSF will be captured*** *and reused in*

the process circuit." – Page 8 (12 pdf) Appendix M / Attachment 1." The response from WSP was; "***The seepage collection system is designed to achieve 98% recovery.***" (WSP 2023, Technical Memorandum, ***emphasis added***). This estimate does not agree with Wood, Appendix H.1 (2022). It is unrealistically high, and probably not achievable without the addition of a liner below the seepage drains.

Arizona Best Available Demonstrated Control Technology (BADCT) requires:

> "*Tailing Impoundments will be designed with a composite liner consisting of single geomembrane of at least 30 mil thickness (60 mil if HDPE) over, a minimum, twelve inches (placed in two 6-inch lifts) of 3/8 inch minus native or natural materials compacted to achieve a saturated hydraulic conductivity of no greater than 10^{-6} cm/sec*." (ADEQ 2004).

This is "Prescriptive Criteria" for tailings impoundments. However, there is an ADEQ (2004) exception for "Individual Guidance", which allows "*tailing impoundments with low permeability foundations and good isolation from protected aquifers*" to be exempted from the liner requirement.

The tailings impoundment design proposed for the Aquifer Protection Permit does not have liners, so Arizona DEQ believes the natural formations under the tailings impoundments meet this requirement. However, although the area bedrock is described as having low hydraulic conductivity, the Piedmont Alluvium under the tailings impoundments has "*high hydraulic conductivity and storage characteristics*" (Piteau 2022, Appendix F.1).

It has been reported that an ADEQ representative responded during the February 20, 2024, public meeting that liners for the tailings ponds were unfeasible because the weight of the "lake" that would form above the liner would make the liner unstable. There is no information in any of the technical support documents for the APP Application that suggests that a lined tailings impoundment at this site is technically infeasible. In fact, a liner system virtually identical to one that would be used for the tailings ponds has already been designed for the now-abandoned heap leach facility. With regard to the proposition that a "lake" would form above the tailings pond liner, the ADEQ representative should have been aware that a drain system similar to the one already proposed, placed on top of the liner, would almost certainly be incorporated into a tailings facility liner design. This drain system would reduce or essentially eliminate the water pressure on a liner. Drains on top of liners is a standard design feature.

Liners for tailings facilities have been adopted as best available technology by ADEQ. The primary downside to using a liner is cost. In this case, there is the question of whether the cost of the liner would be worth the additional protection for groundwater. Hudbay has assumed that 98% of tailings seepage would be captured by a drain system (Wood 2022, Appendix H.1), and that the contribution of seepage to groundwater is de minimis. Hudbay did not model what a seepage contaminant plume would look like.

Table 2-1: Depth to Bedrock (using 2021 and 2023 investigation data)

Facility	Range of Depth to Bedrock (ft)
TSF-1	0 to 50
TSF-2	28 to 65.5
HLF	14 to 55
Process Plant	6 to 76
WRF	0 to 20

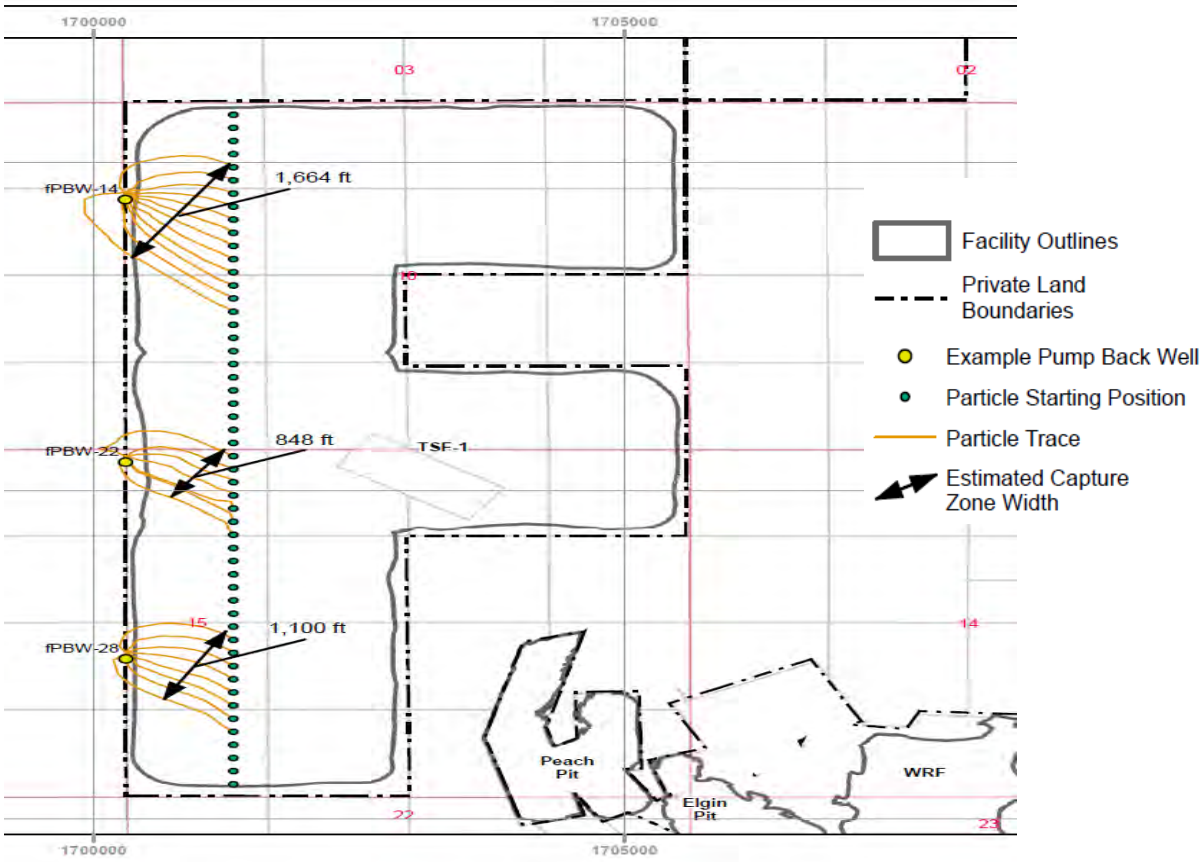
However, the information provided by Wood on the character of the sediments that underlie the tailings dam locations suggests that there is a possibility for significant seepage under the tailings dams.

The most effective way to prevent seepage under a dam is to use a slurry wall to prevent flow. Sediments depths below the tailings dams are reported to be a maximum of 50 feet below TSF-1, and 65.5 feet below TSF-2 (WSP 2023, APP-irss Attachment 14, Supplemental Geotechnical Site Investigation, Table 2-1). There is no information available for TSF-N. It is possible to install slurry walls at the depths cited in Table 2-1, but this approach has not been discussed.

Grouting the underlying sediments can also be effective at slowing water flow, but is more dependent on the physical characteristics of the rock than slurry walls, and is generally less effective at impeding the flow of water.

It appears that Hudbay has chosen to use seepage collection wells should the flow of contamination under the dams become a problem (Hudbay 2022, APP-irss Attachment 18, Figure 49-1). Seepage collection wells are the least effective and most costly way to intercept deep seepage flow. For example, seepage under the Fort Knox Mine (Alaska) tailings dam required the installation of two rows of seepage collection wells, because the seepage flow was controlled by fractures that were not intercepted by the first row of wells. Seepage collection wells also pull water from all directions, so excess "clean" groundwater is also typically collected by these wells. Seepage well collection is expensive because of the long-term costs for electricity, and maintaining the pumps and wells.

Figure 49-1, Capture Zone Estimation, Hudbay, August 2022



There is no discussion of grouting or placing a slurry wall to block seepage movement into groundwater. The APP Application relies on the presumed "low permeability" of the sediments underlying the tailings dam to justify removing the BADCT requirement for a tailings impoundment liner. However, as noted in Piteau (2022, Appendix F.1), the assumptions of low permeability and inability of seepage to move under the tailings dams are not substantiated by the technical report documentation.

Tailings Dam Failure Modeling

The tailings dams proposed for the mine are what is generally termed "modified centerline-type" construction. More appropriately, modified centerline can more accurately be described as centerline-type construction with upstream-type construction for the upper dam structure. From the Pre-Feasibility Study: "*... each (TSF) cell will be raised by centerline construction methods, and in some areas followed by the upstream construction methods until the final dam configuration is achieved*." (Hudbay 2023). Upstream-type construction is the most vulnerable to failure, because the dam depends on the tailings themselves for structural support. The tailings are more susceptible to slip-type failures, and if the tailings become saturated, they are vulnerable to failure under seismic loading. Upstream-type construction is utilized to save money, but it depends on everything working as planned to be safe.

The tailings dams, as presently proposed, would include upstream-type raises of a total of approximately 60 feet on top of the centerline-type portion of the dams. The upstream raises would be placed on whole tailings, but these whole tailings would in turn rest on slime tailings that have much lower inherent strength (WSP 2023, APP-rais Attachment 14, Additional Stability Analysis, Tailings Storage Facilities).

Hudbay has conducted failure models of the tailings dams, using a widely accepted dam failure model (FLO-2D). However, like some companies, it has not modelled a catastrophic failure that would release most of the tailings. The amount of tailings released in the Hudbay failure model is only 1% of the maximum tailings that will be stored in the respective impoundments. The average release of tailings from a dam failure is approximately 25%, and at the Brumadinho dam failure in Brazil approximately 90% of the impounded tailings were released (Rana et al 2021).

It is important to model a maximum release of tailings because emergency planners need to know where the tailings could go, how fast they will get there, and how deep the tailings surge would be. This allows planning for escape zones and routes, and longer range planning to avoid building critical structures like schools, hospitals, and public safety facilities in potential flood zones. The tailings failure models should be redone to reflect the maximum amount of tailings that might be released in a catastrophic dam failure.

About the commenter

David Chambers has 45 years of experience in mineral exploration and development – 15 years of technical and management experience in the mineral exploration industry, and for the past 30+ 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.

Thank you for the opportunity to comment on this mine proposal.

Sincerely;

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

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Lacher Hydrological Consulting

Laurel J. Lacher, PhD, RG

MEMORANDUM

March 29, 2024

TO: Dr. Rob Peters, Executive Director
Save the Scenic Santa Ritas

FROM: Laurel Lacher, Consulting Hydrologist

RE: Comments on Draft Aquifer Protection Permit No. P-513690 for Copper World Project

The following comments represent the most salient conclusions from my review of the Draft Aquifer Protection Permit (APP) No P-513690 published by the Arizona Department of Environmental Quality (ADEQ) for the Copper World Project based on the APP application submitted to ADEQ by Rosemont Copper Company in September 2022.

1. **APP Application is inconsistent with the latest mine plan.**

   Rosemont Copper Company, a subsidiary of Canadian mining company Hudbay Minerals, Inc., submitted an APP application to ADEQ in September 2022. This application formed the basis for the draft APP that ADEQ is now reviewing and that is the subject of this review.

   On July 1, 2023, Hudbay released a 228-page NI 43-101 Technical Report – "Phase I Pre-Feasibility Study and Updated Mineral Resources Estimates" (https://s23.q4cdn.com/405985100/files/doc_downloads/2023/09/20230907-2023-CopperWorld-PFS_FINAL.pdf). In its press release announcing this new document (2023 No. 21), Hudbay touts several changes to its Copper World project, including:

   a) An extended Phase I mine life from 16 to 20 years;
   b) "Lowered initial capital cost estimate to approximately $1.3 billion ($1.1 billion net of existing stream agreement), compared to $1.9 billion in the previous preliminary economic assessment, due to the deferral of the construction of a concentrate leach facility to year 4…"'; and
   c) "Simplified project flow sheet includes a 60,000 ton per day sulfide concentrator that will produce copper concentrate as a final product until the addition of a concentrate leach facility and a solvent extraction and electrowinning plant in year 5 that will allow the project to produce copper cathodes."
   d) Simplified Phase I permitting process that no longer relied on permits to use federal lands.

   Physical changes to the mine site announced in the 2023 Pre-Feasibility Study (PFS)

include:

i) A new (3rd) 70-million-ton tailings storage facility (TSF-N) north of the TSF-1 location, increasing the TSF capacity from 330 to 400 million tons to accommodate a 20-year mine life (Phase I only);
ii) Elimination of the heap leach facility;
iii) Expansion of the waste rock facility (WRF) from 500 (Hudbay, 2002, Att G.3, p. 2) to 856 million tons;
iv) Consideration of different leach technology (Glencore Technology's Albion Process).

From Hudbay, 2022, Att F.1- Water Quantity Impacts Assessment (modeling report):

p. xii - *The Predictive Model was used to predict future groundwater conditions based on phased implementation of the Project mine plan, including the planned open pit mining areas, one heap leach pad, one waste rock facility, two tailing storage facilities, and accessory processing facilities.These elements were implemented in the model incrementally over time based on the mine sequence plan.*

Since the new PFS report (Hudbay, 2023) increases the number of TFSs from 2 to 3, eliminates the heap leach pad, and increases the WRF volume by more than 70%, this entire modeling report (and the related APP application) should be revised. These changes presented by Hudbay (2023) to its shareholders a year AFTER submission of the APP application to ADEQ constitute a SIGNIFICANT change and merit a SIGNIFICANT Amendment to the draft APP currently in review by ADEQ.

2. No numerical compliance monitoring levels for Point of Compliance (POC) wells.

Table 19 (ADEQ, 2023) presents Quarterly Compliance Monitoring requirements for the 10 POC wells proposed by Hudbay (2022). Unfortunately, all aquifer quality limits (AQLs) and alert levels (ALs) for the POC wells are designated as either "monitor" or "reserved." Footnote 8 of the table states, "*Reserved = At the conclusion of eight (8) rounds of quarterly groundwater sampling, the permittee is required to submit an Ambient Groundwater Monitoring Report and permit amendment request to ADEQ to propose ALs and AQLs based on ambient data. The permit will be amended at the conclusion of Ambient Groundwater Monitoring to establish reserved values*."

This condition permits mining operations to proceed for 2 years with zero regulation of discharges from the mine site.

Considering that extensive water chemistry sampling has already been conducted in 30 monitoring wells (Hudbay, 2022, Att. G.1 -Table 3.11), 40 satellite pit samples (Hudbay, 2022, Att. G.2 -Table 1), and 21 springs (Hudbay, 2022, Att. F.1- App. A and Figure 2.5), and that many of these sites lie near proposed POC locations, ADEQ should stipulate initial values for AQLs and ALs for all 10 POCs based on existing data. If, after 2 years, the ambient water quality proves to be significantly different from that identified by previous sampling, then ADEQ could amend the APP to adjust the AQL and AL values.

3. No consideration for changing climate.

Hudbay's site-wide water balance (Hudbay, 2022, Att. J) estimates the distribution of water on the mine site by estimating inputs (from nature and external production wells) minus outputs

(surface runoff, leakage to the aquifer, storage in mine materials, and evaporation) based on projected mine operations and hydrologic values for simulated runoff, infiltration, and evaporation. The Hydrogeologic Characterization Study (Hudbay, 2022, Att F.1, Sect. 2.2) describes the climate data used for evaluating the hydrologic conditions at the mine site. This report describes the use of precipitation data from the Helvetia monitoring station for the period 1916-1950 and pan evaporation data from the Nogales monitoring station for the period 1952- 2007. These inputs (precipitation) and outputs (evaporation) were then used to estimate seepage rates from the TSFs during the life of the mine and at the "end-of-mine" condition (Hudbay, 2022, Att J, p.3). These evaporation and precipitation values were also key inputs to the -USG model used to evaluate the water quantity impacts from mining activities, including the source vs sink nature of the three perennial pit lakes (Peach, Elgin, and Rosemont) that will be formed after the conclusion of mining. This modeling determined, for example, that the Rosemont pit lake would be a perennial "strong sink" because of the long-term exceedance of incoming precipitation by annual evaporation. The annual evaporation rate for TSFs was derived by applying various "evaporation factors" for the decant pond area, wet beach area, dry beach area, and drying beach (Hudbay, 2022, Att. J, p. 3). These evaporation factors were used to reduce pan evaporation rates (from a period of record that does not overlap with the precipitation record) but were never justified by any reference.

Whether or not the methods applied in this APP are appropriate, they include no consideration for an uncertain future climate. The computed balance between precipitation and evaporation reflects the historic data used (1916-1950 precipitation; 1952-2007 pan evaporation) and should include some discussion of the potential range in uncertainty in these values. For instance, several other weather stations in the area (Sahuarita, Tucson, and others) could have been used to extend the Helvetia precipitation record. The use of such an old period of record that does not even overlap with the pan evaporation data leads to significant uncertainty in the balance of those two components. Secondly, other work in central and southern Arizona by CK Blueshift (2024) using five downscaled global climate change models under two emissions scenarios (RCP 4.5 and RCP 8.5) suggests that significantly more precipitation (and less evaporation) may occur in the future during certain months, despite warming temperatures. While these forecasts are uncertain, they should be considered as part of the multi-century evaluation of the mining and post-closure period for the Copper World Project. More precipitation and less evaporation could reverse the currently anticipated source/sink condition of future pit lakes, particularly considering that most forecasts suggest more extreme weather events in the future.

4. Rosemont Pit Lake not in Pollutant Management Area.

With a 1-square-mile pit area, the Rosemont pit lake could receive tremendous runoff just from the exposed mineralized pit walls during a large storm event, thus reversing the hydraulic gradient from the aquifer to the lake (sink condition) to create a discharge from the lake to the aquifer (source condition). While this condition may be transient, it would, nevertheless, potentially discharge contaminants to the aquifer. The Rosemont Pit must be included in the APP as a discharging facility and have additional POC wells to monitor for contamination leaving the mine site.

5. Insufficient POC wells

The 10 POC wells proposed by ADEQ (2022) in Figure 36 do not provide adequate coverage for detecting groundwater contamination from the mine site, *especially* considering the newly proposed (Hudbay, 2023) TSF-N and expanded waste rock facility. Davidson Canyon (northeast of the Copper World Pit) is listed by ADEQ as "impaired for Copper" (see Figure 1, eMaps (arcgis.com)). At least one additional POC should be installed on the north boundary of the PMA between POC 7 and POC 9. Three additional POCs should be added east and north of the Rosemont Pit, and three additional POCs should be added to the west/northwest of TSF-1 and

the proposed TFS-N to protect the thousands of drinking water wells downgradient in Sahuarita and Tucson.

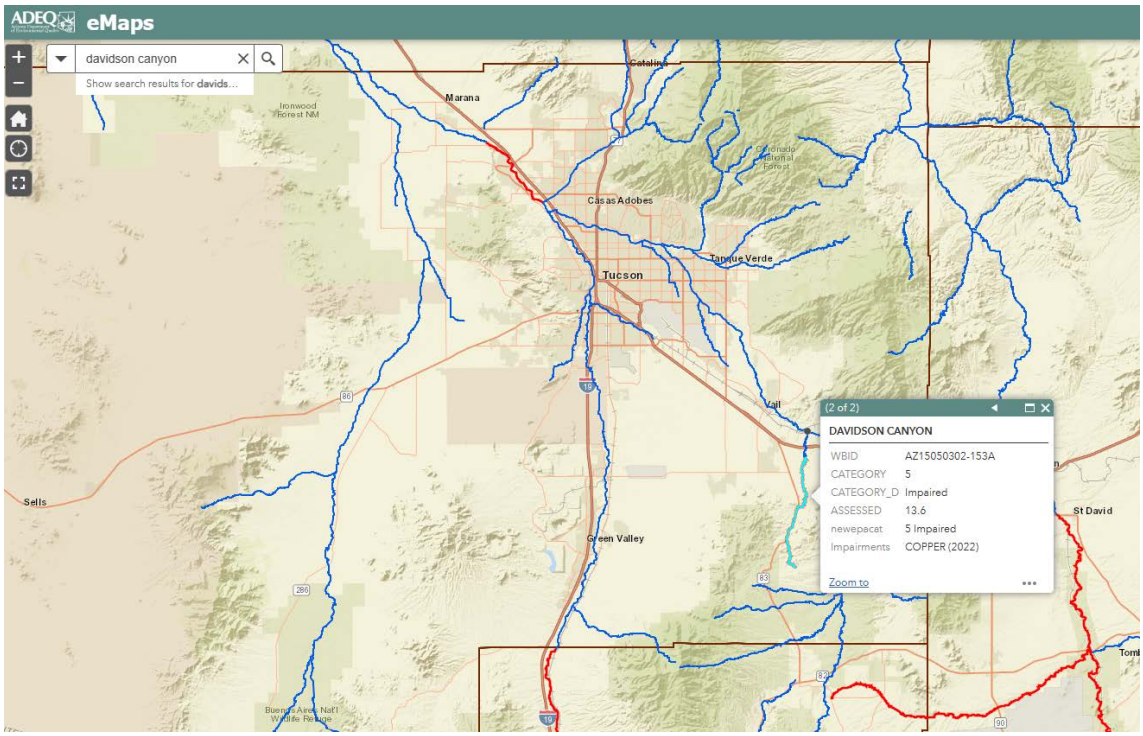


Figure 1. Davidson Canyon Impaired for Copper (ADEQ, eMaps (arcgis.com).

6. Potentially Acid-generating (PAG) waste rock not protected or monitored.

Hudbay, 2022 - Att.G.3. Waste Rock Handling Plan, p. 3 states:

"Waste rock material placement will be as follows:

- *Material classified as NAG will preferentially be placed on the outer slopes of the WRF;*
- *Material classified as PAG/AG will be placed on the interior of the WRF, with AG materials encapsulated with NAG material."*

From Hudbay, 2022, Att E – Site Water Management Plan, p.6 & 7:

Haul trucks will be used to transport the waste material, beginning in the pre-production period starting in Year -2. The initial production of waste rock will be placed within the footprint of the HLP and process area and used for road construction.

To the extent possible, placement of the waste rock and limited grading will promote runoff into the existing pits or by surface flow via benches to a low point in the topography, where runoff and seepage will be collected in a temporary or permanent WRF sediment basins. WRF sediment basins will be located at these low points to capture runoff and allow settling of suspended solids prior to release of the stormwater to the natural drainages.

Stormwater will not be excluded from the waste rock piles and there is no clear evidence that PAG would be insulated from the effects of stormwater runoff or direct precipitation. The sediment basins proposed to reduce sediment discharge from the mine site must be monitored for water quality to ensure that PAG is not producing acidic runoff that is discharged to natural channels or the aquifer.

7. Post-closure pollutant and water management.

Hudbay (2022), Att. E, p. 9) states:

Precipitation that falls within the facility will become part of the fluid that is captured in the decant pond or in the seepage collection system. Precipitation that falls on the outer slopes of the TSF embankments and runoff will be captured by a collection channel along the toe of the embankment. This runoff collection channel will convey water to seepage collection trenches and pumped to the Primary Settling Pond for use in the sulfide ore processing circuit. (Att E, p. 9); This solution collection system for the TSFs will be operated throughout the life of the mine and into closure. (Att E, p.10).

This water management scheme to prevent pollutants from leaving the TSFs relies heavily on pumping back seepage and pooled precipitation from the TSFs to reuse in the mining operations. At the end of the mine life, the demand for this polluted water will disappear and seepage will increase. Hudbay (2022)- Att. F.2 (Water Quantity Impacts Assessment) describes the need to simulate a long-term pump back system to prevent simulated pollutant particles from leaving the mine site.

Piteau's modeling of the Discharge Impact Area (DIA) (Hudbay, 2022, Att. F.2, Figure 4.13) indicates that pollutants may travel close to 2 miles west-northwest of the mine site without a pump-back system in the post-closure period. Considering the proximity of the Santa Cruz River and the thousands of drinking water wells downgradient in Green Valley, Sahuarita and Tucson, permitting pollutants to leave the site as defined by the simulated the DIA should be impermissible and not BADCT procedure.

From Hudbay'(2022) – Att. M (Conceptual Closure Plan), p. 8:

The HLDE was used to estimate draindown from the TSF during closure. The HLDE is a model developed jointly by the Nevada Division of Environmental Protection, the Bureau of Land Management and the mining industry in Nevada. This model was specifically developed to estimate draindown from heap leach facilities but has also been used for similar modeling with tailing storage facilities.

The HLDE and PFCE user guide indicates that HLDE is to be used for heap leach draindown but that, "…there is not a standardized tool for calculating tailings draindown like we have for heap leach draindown. The mining industry will use various models to calculate the water balance of the TSF and estimate tailings draindown rates." https://ndep.nv.gov/uploads/land-mining-recl-rcedocs/20220822_HLDE_PFCE_Guide_ADA.pdf). Thus, Wood's use of HLDE to compute TSF draindown is not appropriate.

ADEQ should compare Hudbay's (2022) draindown modeling predictions to actual data from the very nearby Sierrita mine. That mine provides a direct analog and also represents a real-world case where a massive sulfate plume is now being mitigated under a consent decree.

From Att F.2, p. xiii - *During mining and processing of ore, stacking will occur on the TSFs and HLP. Low seepage rates are simulated from these facilities to the groundwater system. Groundwater mounding is predicted, with peak mound heights occurring soon after the final materials are stacked. The groundwater mound beneath TSF-1 is simulated to rise above ground surface, but its growth is limited by a facility underdrain system.*

TSF-1 seepage is estimate at 695 gpm (Att J – Site Wide Water Balance, p.3) or 1,121 AF/yr. Hudbay's (2022) own modeling (Att F.2, p. xxiii) indicates that the groundwater mound expected to develop from seepage under TFS-1 will reach the ground surface. If this is true, then the underdrain pipes designed to capture seepage from TSF-1 will be inundated and unable to receive any draindown flow (seepage) from the TSF. That will result in direct discharge to the aquifer until and unless the groundwater level below this TSF recedes and exposes the seepage collection system to atmospheric pressure. To solve this problem and the likely contamination of native groundwater, all TSFs should be appropriately lined as is typical in other states like Nevada.

The Nevada Department of Environmental Protection (NDEP) allows a variety of low permeability barriers to restrict seepage from Tailing Storage Facilities (TSFs) such as 12 inches of compacted clay equivalent to 10E-06 cm/sec or equivalent liner material. In practice, TSFs similar in size to the proposed Copper World TSFs are all geomembrane or composite geomembrane lined, underlain by low permeability compacted soil material. Even the largest copper TSF in NV, the Robinson Mine Giroux Wash TSF, which was built in the 1990s has been required to geomembrane line their expansion footprint (https://eplanning.blm.gov/eplanning-ui/project/1504878/510).

The APP must address long-term pollution control from all three TSFs now proposed by Hudbay (2023) and recognize the imminent threat to downstream drinking water systems.

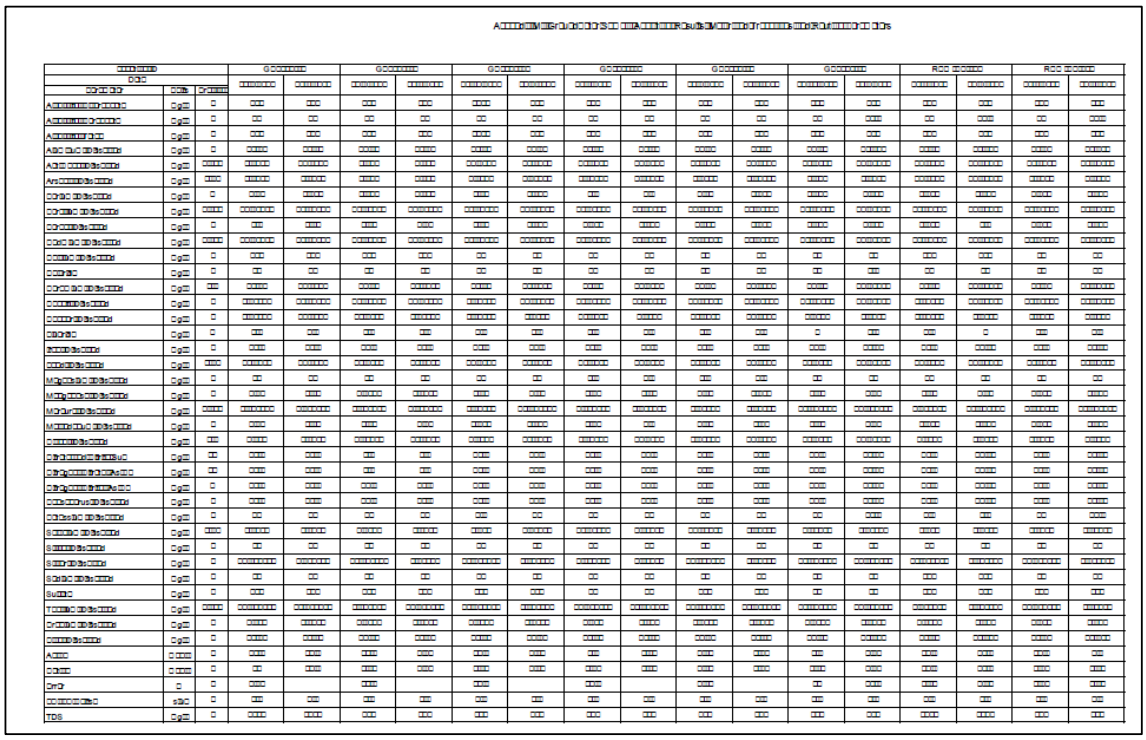
8. Surface runoff modeling does not account for changing surface conditions.

The SCS curve numbers, site vegetation and soils values used for runoff modeling (see Hudbay, 2022, Att B.2., Section 2.0) all reflect current site conditions. The modeling effort includes no consideration for changes in land surface (eg, vegetation removal, soil compaction for roads, impervious surfaces (WRF, other structures). These changing conditions are already visible from satellite imagery and directly affect the amount and timing of runoff within, and from, the mine site. All surface runoff modeling must incorporate future developed mine conditions.

9. Appendices in Attachment F.1 illegible.

Appendix M (Groundwater Sample Analytical Results: Major and Trace Ions and Routine Parameters) in Attachment F.1 contains only 1 table and it is completely illegible (see Table 1 below). All 6 figure titles and descriptions in Appendix N (Test Pit Infiltration Testing Data) in Attachment F.1 are also illegible (see example in Figure 2 below). Please replace this table and these figures with legible ones.

Table 1. Copy of table in Appendix M of Attachment F.1 (PDF p. 699)



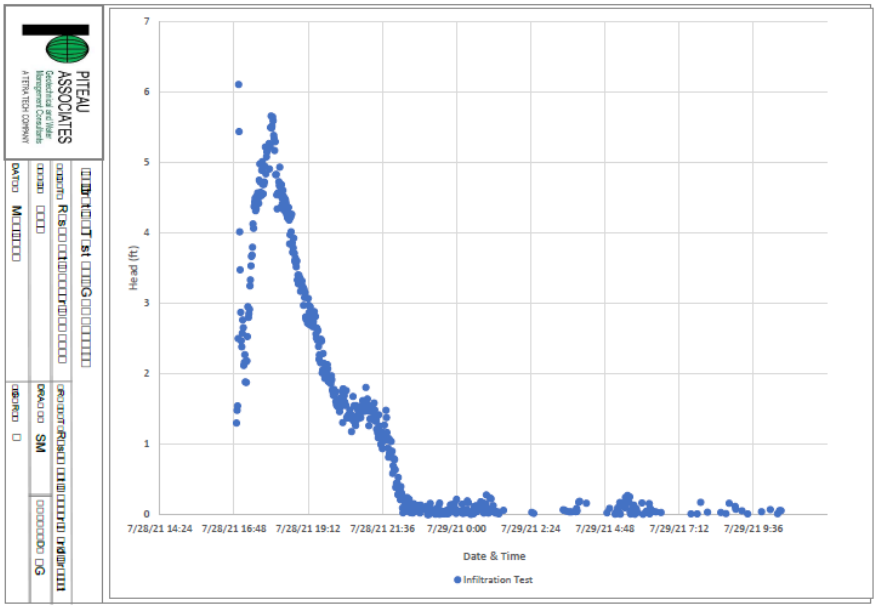


Figure 2. Figure 1 (of 7) of Appendix N in Attachment F.1. (PDF 701).

References Cited:

Arizona Department of Environmental Quality (ADEQ), 2022, Draft Aquifer Protection Permit (APP) No P-513690 for the Copper World Project based on the APP application submitted to ADEQ by Rosemont Copper Company in Sept., 57 p. plus attachments.

CK Blueshift, 2024, Internal Memorandum to Lacher Hydrological Consulting on Verde and San Pedro Climate Change Simulations, Jan., 5 p.

Hudbay Minerals, Inc. (Hudbay), 2022, Aquifer Protection Permit Application, prep. by Rosemont Copper Company, Sept., 243 p. plus attachments:

Attachment B.2 – Baseline and Final Facility Configuration Hydrology Modeling Report, Bowman Consulting Group, Aug. 18, 2022, 40 p.

Attachment E – Site Water Management Plan, Wood Environment & Infrastructure Solutions, Inc., June 24, 2022, 71 p.

Attachment F.1 – Appendix F.1 Hydrogeologic Characterization Study, Piteau Associates Geotechnical and Water Management Consultants, Project 4286, May 2022, 706 p.

Attachment F.2 – Appendix F.2 Water Quantity Impacts Assessment, Piteau Associates Geotechnical and Water Management Consultants, Project 4286, May 2022, 190 p.

Attachment G.1 – Appendix G.1 Geochemical Impact Assessment, Piteau Associates Geotechnical and Water Management Consultants, Project 4286 R22-03, May 2022, 789 p.

Attachment G.2 – Appendix G.2 Supplemental Geochemical Samples, Piteau Associates Geotechnical and Water Management Consultants, Technical Memorandum File: 4286 22TM-01, July 15, 2022, 67 p.

Attachment G.3 – Appendix G.3 Waste Rock Handling Plan, prep. by Rosemont Copper Company, Aug. 2022, 30 p.

Attachment H – Appendix H.1 APP Facilities Discharge Calculation and BADCT Evaluation, Wood Environment & Infrastructure Solutions, Inc., Technical Memorandum, Sept. 1, 2022, 76 p.

Attachment J – Site-Wide Water Balance Memorandum, Wood Environment & Infrastructure Solutions, Inc., Technical Memorandum, Proj No. 1720214024, Mar. 25, 2022, 19 p.

Attachment M – Conceptual Closure Plan, Rosemont Copper World Project, Wood Environment & Infrastructure Solutions, Inc., Jan 7, 2022, 63 p.

Hudbay, 2023, Phase I Pre-Feasibility Study and Updated Mineral Resource Estimates, Copper World Project, Pima County, Arizona, USA, NI 43-101 Technical Report, July 1, 288 p.

Report by Ann Maest, PhD, Buka Environmental

Review of best practices, geochemical, and water quality issues in the Draft Aquifer Protection Permit for the Copper World Project, Arizona

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MEMORANDUM

To: Rob Peters, Executive Director; Save the Scenic Santa Ritas
From: Ann Maest, PhD; Buka Environmental
Date: 29 March 2024
Re: Review of best practices, geochemical, and water quality issues in the Draft Aquifer Protection Permit for the Copper World Project, Arizona

Summary of Key Findings and Recommendations

Mine facility designations and the Best Available Demonstrated Control Technology (BADCT) document:

- Certain mine facilities are designated as exempt or non-discharging and are therefore not included in the Draft Aquifer Protection Permit (APP) and are not subject to BADCT requirements. These facilities include but are not limited to the Rosemont Pit; truck shop, fuel storage and dispensing stations, and truck wash; primary and secondary crushers for sulfide and oxide ore; reagent storage facility; and the acid plant. The Rosemont Pit is the largest of the six proposed pits and will have the deepest pit lake. It is predicted to be a hydrologic sink, but the models upon which this conclusion is based are uncertain and do not consider most recent climate modeling or the potential for escape of pit water along faults. The Rosemont Pit should therefore be included in the Final APP and have point-of-compliance monitoring wells. No compliance monitoring is currently proposed for the Rosemont Pit.
- The two tailings facilities, the waste rock facilities, and the five remaining open pits are included in the Draft APP, but Hudbay applied the less protective individual BADCT measures to these facilities. Because these facilities will be some of the primary contaminant sources on the mine site, the more protective prescriptive BADCT measures should be applied.
- However…the current Arizona BADCT manual is at least two – and possibly three – decades out of date. Mining best practices have improved greatly over the intervening decades. Instead of using the BADCT manual, ADEQ should require the use of state-of-the-art best practices to minimize the adverse effects of the Copper World Project on groundwater resources. Examples of recent best practice guidance documents are included in my comments.

Draft APP monitoring, analytical, and reporting issues:

- The Draft APP has no numeric permit limits. Numeric aquifer quality limits (AQLs) and alert levels (ALs) will eventually be established for parameters with Arizona aquifer water quality standards (AWQS), but only after baseline monitoring of the 10 proposed point of compliance (POC) wells has been completed. Meanwhile, construction of the Copper World Project, which will result in contaminant releases, is allowed to begin before the baseline monitoring is completed. This gap in coverage allows for groundwater contamination without regulation and biases the results of baseline monitoring.
- The 10 proposed POC wells are located right on the facility boundaries. Additional compliance monitoring wells should be included in downgradient locations between the western mine facilities and the Santa Cruz River and between the Rosemont Pit and Davidson Canyon.
- Baseline groundwater monitoring data exist for 31 wells located in similar locations to the 10 POC wells. No exceedances of AWQS values have been reported for any of these 31 wells. Given the good water quality in and the similar locations of these 31 wells, AQL and AL values based on AWQS values should be included in the Final APP to protect groundwater quality.
- Even though sulfate does not have an AWQS, ADEQ is authorized by statute to establish an AL for pollutants that indicate the potential appearance of another pollutant. Sulfate is an early indicator of acid mine drainage and the most mobile mine contaminant. Including a numeric AL based on existing groundwater monitoring results is a prudent approach to ensuring an effective early warning system.
- Groundwater metal concentrations should be reported as the total metal because of the potential to use groundwater as a domestic water source without filtering. Arizona surface water quality regulations for domestic water sources require that metals be determined as the total metal. Reporting as the dissolved metal will minimize the total concentration of mine contaminants in groundwater.
- To expedite the public accessibility of the monitoring data, the laboratory results should be sent to ADEQ at the same time they are sent to the company. ADEQ should then upload the results to their website to improve transparency and public access to the data.
- ADEQ should consider adding an option for local stakeholders to conduct participatory monitoring. As part of such a program, the independent monitors could take split samples and send them to a separate laboratory for analysis.

Geochemical testing and relevance to the Draft APP:

- Many parameters that are known contaminants of potential concern (COPCs) based on geochemical testing are proposed to have no numeric limits in the Final APP. A list of COPCs is included in Section 5.1.2 of my comments. Some key mine contaminants without numeric permit limits include copper, zinc, sulfate, and acidity (low pH) – all of which are the result of weathering of metal sulfides and are associated with acid drainage at mine

sites. Numeric permit limits, whether AQL or AL values, should be established for all COPCs, based on the results of ambient groundwater monitoring.

- Although the predicted seepage and pit lake chemistries are based on results from laboratory leach testing, the modeling approaches and the use of scaling factors appear to make the predictions unrealistically low. Importantly, the laboratory humidity cell tests were not conducted for long enough time periods. Protective facility design and careful monitoring of compliance wells, stormwater, and pit lake locations for all contaminants of potential concern before, during, and after mining with meaningful alert levels and well designed contingency plans are needed to minimize groundwater contamination from this very large mining project.

1. Introduction

The comments contained herein are submitted on behalf of Save the Scenic Santa Ritas and address best practices, geochemical, and water quality issues related to the Draft Aquifer Protection Permit (APP) for the Copper World Project in Arizona (ADEQ, 2024a) and the APP application (Hudbay, 2022a). The documents reviewed are listed in Section 6 References.

2. Mine Facility Designations and BADCT

2.1 Certain mine facilities designated as exempt or non-discharging should be regulated by the APP program

Appendix D of the APP application (Hudbay, 2022b) notes that exempt facilities are not subject to BADCT (as cited in the BADCT document). The appendix includes vague and unsubstantiated use of the terms “ensure,” “eliminate,” and “prevent discharge” as applied to mine facilities. For example, Appendix D repeatedly states that a concrete pad will eliminate the possibility of discharge and is therefore exempt from APP regulation pursuant to A.R.S. §49-250 (B)(21). Exemption 21 states: Structures that are designed and constructed not to discharge and that are built on an impermeable barrier that can be visually inspected for leakage. However, a concrete barrier will not remain impermeable over time, and if mined or other material is covering the concrete pad, it cannot be visually inspected for leakage. Concrete pads must be waterproofed to be considered impermeable, and waterproofing can be achieved using a variety of sealers and other methods (see Muhammad et al., 2015 for a review). It is worth noting that the BADCT manual does not address this issue at all and includes no requirements for waterproofing concrete to achieve impermeability. Blasting on the mine site, which will continue from construction through the end of operations and possibly beyond, can enhance fracturing of the concrete pads under the mine facilities, even if they are waterproofed. Frequent inspection and maintenance are needed, but in some cases, mined materials will be placed directly on the concrete pads, and visual inspection will not be possible. Therefore, downgradient and stormwater monitoring will be needed.

Mine facilities that are but should not be considered exempt from the APP program include but are not limited to those in Table 1. These facilities are proposed by Hudbay to not be regulated

under the APP program, the facilities are not proposed for authorization by the stormwater general permit, and they are not included in ADEQ's Draft APP for the Copper World Project. The potential for leakage and discharge exists for each of these facilities, and because the sources contain mine-related contaminants or fuel, groundwater quality can be threatened if no regulatory control is provided.

It is especially important that the largest pit and the one that will have the deepest pit lake, the Rosemont Pit, is included in the final APP. Because the Rosemont Pit is not included in the APP, no compliance monitoring wells are proposed around this pit (see Section 3.1). Many of the other facilities are on the mine site proper in a relatively small area, and careful stormwater and additional groundwater monitoring immediately downgradient of the facilities would provide an early warning system that could minimize the extent of groundwater contamination from the mine site.

Table 1. Selected facilities proposed by Hudbay to be exempt or non-discharging under the Aquifer Protection Program, responses, and recommendations

Facility Name	Reason stated for being exempt or not being a discharging facility	Arizona rule cited for exemption	Response	Recommendation
Rosemont Pit	Based on groundwater modeling, it will be a hydrologic sink	None	The Rosemont Pit is predicted to be a hydrologic sink, but climate change was not adequately considered. Large faults will result in increased hydraulic conductivity in the north pit area and connection with other pits.	Require compliance monitoring wells, inclusion of this facility in the APP, and application of prescriptive BADCT measures
Truck shop and fuel storage and dispensing stations	Concrete pad will eliminate the possibility of discharge; tanks constructed, operated, maintained to not discharge	A.R.S. § 49-250(B)(21) and A.R.S. § 49-250(B)(22)	Concrete pad is not an impermeable barrier; unclear if facilities can be visually inspected for leakage. Large diesel storage tanks (2 100,000 gallon and 2 10,000-12,000 gallon) will eventually leak.	Require downgradient monitoring wells and stormwater monitoring
Truck wash	Concrete pad and separator tanks will be operated and	A.R.S. § 49-250(B)(22)	Concrete pad is not an impermeable barrier; A.R.S. § 49-250(B)(22) refers to	Require downgradient monitoring wells

Facility Name	Reason stated for being exempt or not being a discharging facility	Arizona rule cited for exemption	Response	Recommendation
	maintained to not discharge		pipelines and tanks – truck wash is not a tank	and stormwater monitoring
Primary crusher – sulfide ore, Sulfide ore grinding circuit, Primary crusher – oxide ore; Oxide secondary crusher; Oxide conveyor transfer point/ agglomerator	Concrete pad will eliminate the possibility of discharge; accumulated water will report to a sump(s) that qualifies as a tank that will be designed, operated and maintained to not discharge	A.R.S. § 49-250(B)(21) and A.R.S. § 49-250(B)(22)	Concrete pad is not an impermeable barrier; crusher will be covered with ore and may not be able to be visually inspected for leakage.	Require downgradient monitoring wells and stormwater monitoring
Reagent storage	Reagents will be stored on a concrete pad in secondary containment areas designed, constructed, and maintained to not discharge	A.R.S. § 49-250(B)(21)	Concrete pad is not an impermeable barrier; reagents stored will be acidic, caustic, and toxic and threaten ground-water quality	Require downgradient monitoring wells and stormwater monitoring
Acid plant	Concrete pad will eliminate the possibility of discharge; associated tanks will be constructed, operated, and maintained to not discharge; pipelines will be inspected	A.R.S. § 49-250(B)(21) and A.R.S. § 49-250(B)(22)	The acid plant and associated tanks and pipelines will create and transport highly acidic solutions that could contaminate groundwater	Require downgradient monitoring wells and stormwater monitoring
Sources: APP, Appendix D; APP, Appendix F.1				

2.2 Facilities with proposed individual BADCT assessments and measures

In addition to facilities that are proposed to be wholly excluded from the Aquifer Protection Program, individual BADCT measures are proposed for some mine facilities. Prescriptive BADCT assessments and measures are more protective of water resources than individual BADCT assessments. Appendix D to the APP application (Facility Summary Compiled, p. 23) notes that the less protective individual BADCT assessment was applied to the tailings facilities, waste rock facilities, and open pits. The facilities proposed to be included in this category are the Tailings

Storage Facility No. 1, Tailings Storage Facility No. 2, Waste Rock Facility, Peach Pit, Elgin Pit, Heavy Weight Pit, Copper World Pit, and Broadtop Butte Pit (see APP application, Appendix D, Section 5.0 Area-Wide APP Regulated Facilities). Because of the high potential for these facilities to contaminate groundwater, all should be subject to prescriptive BADCT assessments and measures. However, as noted in the following section, the existing Arizona BADCT guidance does not provide adequate protection of water resources, even if prescriptive BADCT measures are employed.

2.3 The BADCT document is severely out of date

Even the facilities that are included in the APP Program, whether for prescriptive or individual BADCT assessments, will be designed, constructed, and maintained using information that has not been updated in at least two decades. The BADCT document currently used in Arizona does not have a date, but it is cited as being released in 2004. In the intervening 20 years, mining practices have improved and resulted in better environmental performance and safety. None of the improved best practices are included in the Arizona BADCT document. An update of the BADCT document is urgently needed.

The BADCT document may be even further out of date. The references for the BADCT document are included in Part 6. The references in Part 6 range from publication dates of 1964 to 1995. This date range implies that the BADCT document may be almost 30 years out of date. The Transportation Research Board (1996) is cited several times in the main text, but it is not included in the references in Part 6. Three references in Part 6 have no dates, some references are included in the text but not in the references (e.g., Keaton et al., 1995; Bray and others, 1995); and some are included in the references but not in the text (e.g., Smith and Welkner, 1995; Smith and Mudder, 1993). These errors might seem small, but they imply that the document was not carefully reviewed, and if references are cited in the text but not Part 6, the readers could have difficulty finding the information that forms the basis of the stated best practice.

Instead of using the severely outdated Arizona BADCT manual, ADEQ should require the use of state-of-the-art best practices to minimize the adverse effects of the Copper World Project on groundwater resources. Best practice guidance is available from many jurisdictions, companies, and organizations, including the Yukon Government (2023; note that Dirk VanZyl, who is often cited in the Arizona BADCT manual, is an author of the Yukon guidelines), ICOLD (2021; note that a more recent bulletin on Tailings Dam Safety is currently under review), Newmont Corporation (2020; Newmont minimum standards require a composite liner (compacted soil and a geosynthetic liner with a permeability of $1x10^{-11}$ cm/sec or lower) under the full extent of tailings facilities), the Mining Association of Canada (MAC, 2021), and many others.

3. Draft APP Monitoring, Analytical, and Reporting Issues

The Draft APP has no numeric permit limits, has missing parameters and monitoring locations, and has requirements related to measurement of total vs. dissolved metals that will minimize the presence of contaminants in groundwater (Section 2.5.3.2). Reporting of the monitoring results can be streamlined, and opportunities for stakeholder auditing should be provided.

3.1 Lack of numeric permit limits

Tables 19 and 20 in the Draft APP respectively show which parameters will eventually have numeric AQL and AL values for the 10 point of compliance (POC) wells, based on the results of baseline groundwater monitoring. Currently, no numeric values are included in these tables. The entries "monitor" and "reserve" are instead listed to indicate whether numeric permit limits will be established: no numeric limits for "monitor," numeric limits for "reserve." Apparently it is common practice for Arizona aquifer protection permits to not include numeric permit limits. However, this practice allows contamination of groundwater before the permit is finalized. My understanding is that mine construction can occur before the APP is finalized and while ambient groundwater monitoring is conducted. Mine construction activities include dewatering and blasting, which can cause groundwater contamination.

Aquifer quality limits. A parameter may have an aquifer quality limit (AQL) for a POC well, based on its AWQS value or the results of baseline/ambient groundwater monitoring (see footnote 1). If the parameter exceeds its AWQS value, the AQL value will be set higher than the AWQS value.

Alert levels. Alert levels (ALs) are designed to provide an early warning system for groundwater protection. In the Copper World draft APP, ALs are only applied to the POC wells, not to the discharge monitoring locations. Alert levels exceedances trigger as an adaptive management plan of sorts: if measured concentrations exceed an AL, response measures are required to be taken, including more frequent monitoring and investigating the cause of the exceedance (Draft APP, Section 2.6.2.8). A similar approach is taken for exceedance of an AQL value (Section 2.6.4).

At least two problems could arise that would not be addressed by the response actions: 1) If a facility that is not designated as discharging (e.g., the waste rock facility, the Rosemont pit) is the source of the exceedance, these facilities will not be sampled, and the cause of the exceedance will not be known. Also note that no proposed POC wells exist for the Rosemont Pit (Figure 1); 2) The ALs are so close to the AQLs in other permits (Table 2) that an AQL exceedance would almost certainly follow. In other words, the ALs are essentially useless in many cases. As shown in Table 2, the ALs are always 80% of the AQL value. It is worth noting that the ASARCO Ray APP is also a draft permit, but some numeric limits are established for groundwater POC monitoring. And the Hermosa permit does contain AL and AQL values for the discharge (treated mine water), but the Copper World Project does not.

The Draft APP sets certain criteria for establishing ALs in the Copper World permit, including that no AL shall be lower than 80% of the AWQS (Section 2.5.3.3). However, nothing in Arizona statute dictates that an AL cannot be lower than 80% of the AWQS (18 A.A.C. 9 R18-9-A205). To achieve groundwater quality protection, which is the purview of the ADEQ, ALs should be established between baseline values and the AWQS. The baseline value and the detection limit for a given parameter must be taken into account. For example, Table 2 shows that the AL values for arsenic and selenium are 0.04 mg/L. However, detection limits of 0.001 mg/L for these two parameters are easily obtained if ICP-MS is used as the analytical method. Therefore, depending on the baseline value for arsenic and selenium in ambient groundwater, a much more protective and informative AL value could be set.

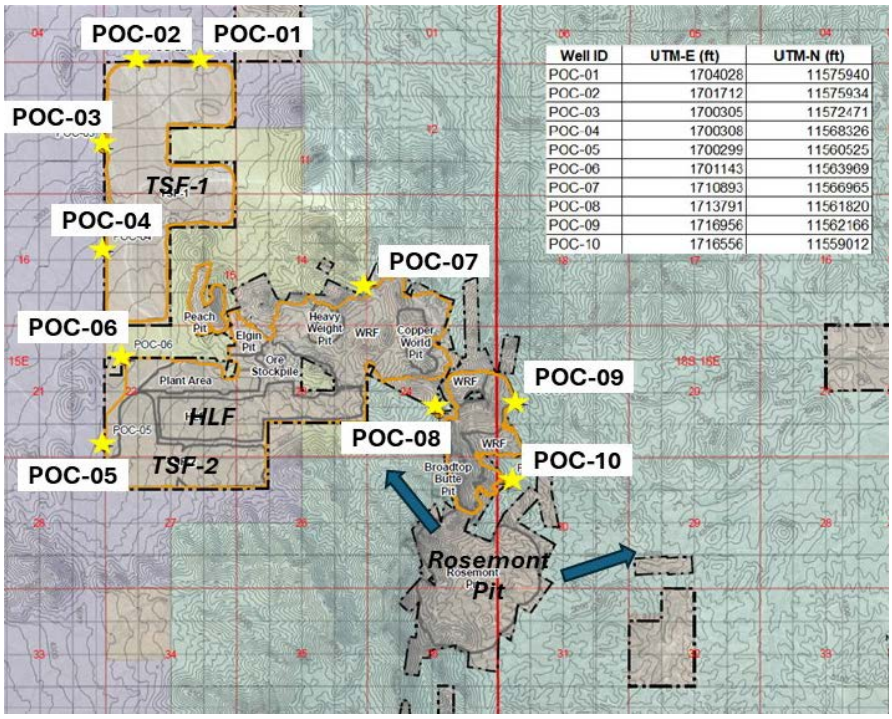

Figure 1. Proposed point of compliance wells and mine facilities. Blue arrows indicate approximate groundwater flow directions from the Rosemont Pit area, based on flow directions shown in the Draft APP, Figure 35. *Source: Modified from Hudbay, 2022a, Figure 36*.

Table 2. Examples of Alert Levels (AL) and Aquifer Quality Limits (AQL) in other Arizona APPs mg/L)

Parameter	Hermosa: Discharge Monitoring		ASARCO Ray – Groundwater POC	
	AL	AQL	AL	AQL
Antimony	0.0048	0.006	0.0048	0.006
Arsenic	0.04	0.05	0.04	0.05
Cadmium	0.008	0.010	0.004	0.005
Chromium	0.08	0.1	0.08	0.010
Selenium	0.04	0.05	0.04	0.05
Sources: Hermosa APP No. P-512235 https://static.azdeq.gov/pn/210326_hermosa_dp.pdf; ASARCO Ray Draft APP No. P-100525. https://static.azdeq.gov/pn/draft_permit_asarco_ray.pdf				

Note that ALs can be established for parameters without an AWQC. According to 18 A.A.C. 9 R18-9-A205 A.2: The Department may specify an alert level based on a pollutant that indicates the potential appearance of another pollutant. Sulfate is one such pollutant. Increasing concentrations of sulfate are often an early indicator of acid mine drainage or releases from mine facilities. Sulfate derives from the weathering of metal sulfide minerals, which will also release copper, lead, zinc, molybdenum, and other mine-related contaminants (Hudbay, 2017). An example from the Buckhorn Mine is shown in Figure 2. Because sulfate in groundwater behaves

conservatively (that is, its concentration in groundwater is not decreased by adsorption, precipitation, or other reactions), it will arrive at compliance monitoring locations in advance of other pollutants that can be adsorbed on aquifer materials. Establishing an AL for sulfate at the POCs, based on ambient groundwater monitoring results, would provide the most effective early warning signal for the presence of mine-influenced groundwater.

Tables 19 and 20 in the Draft APP show the parameters that will eventually have numeric aquifer quality limits (AQL) or alert levels (AL). Table 3 shows the parameters that will and will not have numeric permit limits. Parameters with no numeric limits ("monitor") will be for monitoring only. Parameters in the second and third columns in the table are not proposed to have numeric limits in the Final Aquifer Protection Permit. The parameters that will eventually have numeric permit limits ("reserve") all have aquifer water quality standards (AWQS) according to 18 A.A.C. 11 R18-11-406 (Arizona Administrative Code, 2023). The one exception to this is adjusted gross alpha, which has no AWQS value. As noted above, ADEQ can establish ALs for parameters without AWQS values. Arizona numeric AWQS values in R18-11-406 apply to aquifers that are classified for drinking water protected use.[1] According to Arizona statute, all aquifers in the state are classified for drinking water protected use except for aquifers that are reclassified to a nondrinking water protected use pursuant to A.R.S. § 49-224 and A.A.C. R18-11-503.[2]

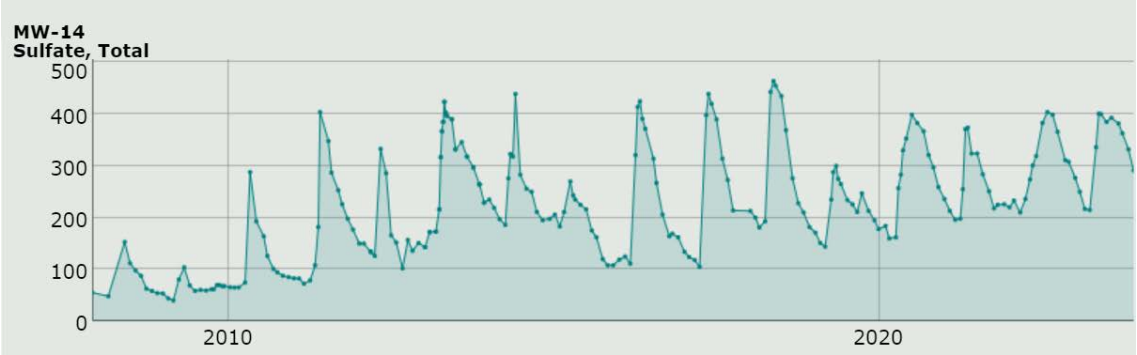

Figure 2. Increasing sulfate concentrations in a groundwater compliance well at the Buckhorn Mine, Washington State. Mining began in January 2008, and sulfate concentrations began to increase in June 2008 (first peak on graph); concentrations vary seasonally, associated with changing groundwater elevations. *Data source: State of Washington, 2007-2023. Graph: http://database.okanoganhighlands.org/monitoring/display.php*

The parameters in red in Table 3 can adversely affect groundwater quality or characteristics but are not proposed to have numeric limits in the Final APP for Copper World. Two of these are "indicator parameters" (pH, specific conductance – and total dissolved solids is closely linked to specific conductance). Two are nitrogen compounds that can result from blasting of the open pits

[1] Defined as the protection and maintenance of aquifer water quality for human consumption (R18-11-501. Definitions).
[2] R18-11-407. Aquifer Water Quality Standards in Reclassified Aquifers.

(total nitrogen and ammonia), the remaining red parameters are associated with the exposure and weathering of metal sulfides and other minerals in mine waste, ore, and the pit walls. The Draft APP states that monitoring for indicator parameters is not required under the terms of this permit (Section 2.6.2.8.1), but obviously that is not the case. And as noted above, ADEQ can establish ALs for these and other parameters that indicate the potential appearance of another pollutant, and specific conductance can be an indicator for total dissolved solids and potentially sulfate. Continuous monitoring for field specific conductance in groundwater wells can be an even more effective early warning approach than monitoring for sulfate, if a good relationship can be established between the two using monitoring results. Arizona is in the process of establishing an AWQS for uranium (none currently exists) and lowering its AWQS for arsenic to be congruent with federal Safe Drinking Water Act standards (ADEQ, 2023). An AWQS of 0.030 mg/L for uranium and 0.01 mg/L for arsenic should be included in the Final APP. ADEQ could also include, at a minimum, ALs for many of the other metal parameters listed in red in Table 3 because most are known to leach from Copper World mine wastes, as discussed in Section 5 of this memorandum.

3.2 Baseline monitoring and missing parameters

According to the Draft APP, eight rounds of "ambient" (that is, baseline) groundwater monitoring will be conducted at the 10 groundwater compliance wells. Copper World is allowed to decide whether the frequency of baseline monitoring will be monthly or quarterly. However, footnote 8 to Table 19 and footnote 13 to Table 20 state that after eight rounds of quarterly groundwater sampling, the permittee is required to propose numeric aquifer quality limits (AQLs) and alert levels (ALs).[3] ADEQ should clear up this confusion in the Final APP.

If the frequency of ambient/baseline groundwater monitoring is monthly, only eight months of baseline monitoring will be conducted; if it is quarterly, the total length will be two years. Baseline water quality sampling should also take place around high and low groundwater elevations to determine the variability in groundwater quality related to seasonal or other hydrologic/climatic fluctuations, yet the permit makes no mention of this. IRMA (2018, Chapter 4.2) and British Columbia (2016, Section 6.5.1) require baseline groundwater monitoring that captures such hydrologic and climatic variability.

Baseline monitoring should measure all parameters that are included in the APP. Nearly all parameters are included in Table 18 Parameters for Ambient Groundwater Monitoring, but ammonia is missing. Ammonia is an important parameter because it results from blasting and routinely contaminates groundwater and nearby surface water resources downgradient of open

[3] From 18 A.A.C. 9 R18-9-101: "Alert level" means a value or criterion established in an individual permit that serves as an early warning indicating a potential violation of a permit condition related to BADCT or the discharge of a pollutant to groundwater. "AQL" means an aquifer quality limit and is a permit limitation set for aquifer water quality measured at the point of compliance that either represents an Aquifer Water Quality Standard or, if an Aquifer Water Quality Standard for a pollutant is exceeded in an aquifer at the time of permit issuance, represents the ambient water quality for that pollutant.

pits, waste rock, heap leach, and tailings facilities. Ammonia should be added to Table 18 in the Final APP. Additionally, radium-226 and radium-288 (separately from Radium 226 + 228) should also be included in Table 18 because they are included in Tables 16 and 20. The individual values can be obtained from the total Radium 226+228 measurement, but they should be reported as part of baseline monitoring. The concentration of gross alpha particle activity includes radium-226 but excludes radon and uranium (18 A.A.C. 11 Appendix A, Table 1, footnote h). Also note that Table 18 contains two entries for lead; one of these should be removed in the Final APP.

Table 3. Parameters that will and will not have numeric limits in the final Aquifer Protection Permit for the Copper World Project. Parameters without proposed numeric limits that could adversely affect groundwater quality or characteristics are noted in red.

Will eventually have numeric AQL and AL values	**For monitoring only – *no numeric limits proposed***	**Parameters listed for discharge/ contingency or ambient groundwater monitoring (Tables 16 & 18) but not for compliance monitoring – *no numeric limits proposed***
For quarterly compliance monitoring (Table 19): Cyanide (free cyanide) Fluoride Nitrate as N Nitrite as N Nitrate+Nitrite Antimony (D) Arsenic (D) Barium (D) Beryllium (D) Cadmium (D) Chromium (D) Lead (D) Mercury (D) Nickel (D) Selenium (D) Thallium (D) *For biennial compliance monitoring (Table 20):* Benzene Toluene Ethylbenzene Total xylenes Gross alpha particle activity Adjusted gross alpha Total radium 226+228	*For quarterly monitoring (Table 19):* Depth to groundwater Water level elevation Field temperature Field and lab pH Field specific conductance Total dissolved solids Total alkalinity Bicarbonate (alkalinity) Carbonate (alkalinity) Hydroxide (alkalinity Chloride Sulfate Total nitrogen Ammonia Calcium Zinc (D) Uranium (T) *For biennial monitoring (Table 20):* Carbon disulfide Radium 226 Radium 228 Uranium isotopes	Magnesium Potassium Sodium Aluminum (D) Cobalt (D) Copper (D) Manganese (D) Iron (T) Molybdenum (D)
AQL aquifer quality limit; AL alert limit (D) measured as dissolved metal; (T) measured as total metal *Source: Draft APP, Tables 16, 18, 19, 20.*		

3.3 Discharge monitoring and missing regulated facilities

Table 16 in the Draft APP lists parameters that shall be determined for discharge and contingency monitoring. According to the Draft APP, discharge monitoring is a one-time effort to "verify" the composition of process solutions (Section 2.5.1) – presumably to understand sources of potential groundwater contamination, should they discharge to the environment. However, many other ponds and sources should be included in this list. At a minimum, all ponds listed as permitted facilities in Section 2.1.1 of the Draft APP should be sampled as part of discharge monitoring. Only four of the 10 facilities are included in discharge monitoring: PLS Pond, Raffinate Pond, Reclaim Pond, and the Primary Settling Pond. Permitted facilities with ponded water that are excluded from discharge monitoring include both tailings storage facilities (TSF-1 and TSF-2), the HLF South and North Stormwater Ponds, and the Process Area Stormwater Pond.[4] In addition, all six open pits will contain ponded water during operations (and possibly during construction) and should be sampled when ponded water is present. Clearly, the composition of water in these ponds and facilities will change over time. Unless a separate mechanism is provided, ponds in TSF-1, TSF-1, the six open pits, the HLF South and North Stormwater Ponds, and the Process Area Stormwater Pond should be regularly sampled as part of the Final APP.

3.4 Analyzing samples for dissolved vs total metals

Tables 16 and 18 in the Draft APP require all metals to be determined as dissolved metals, with the exception of iron and uranium, which are determined as the total metal. Arizona statute 18 A.A.C. 11 does not specify whether the metals with AWQS values should be measured as total or dissolved. However, Arizona surface water quality standards for domestic water sources (that is, for protection as a drinking water source) for all the metal/metalloid parameters listed in Table 16 (Sb, As, Ba, Be, Cd, Cr, Pb, Ni, Se, Tl, Hg) are required to be determined as the total metal. Although copper and zinc do not have Arizona AQWS values, Arizona surface water standards require measuring as the total metal. Because groundwater used as a drinking water source cannot be guaranteed to be filtered, metals in groundwater should be measured as total and compared to AWQS values. The confusion over total vs dissolved metals could be solved by requiring that groundwater samples be measured for both total and dissolved metal concentrations.

3.5 Additional POC monitoring locations are needed

The 10 proposed POC wells are located right on the facility boundaries (see Figure 1). Additional compliance monitoring points, including wells and springs, should be included in downgradient locations between the western mine facilities and the Santa Cruz River and between the Rosemont Pit and Davidson Canyon.

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[4] Note that the PLS Pond will contain solutions from the HLF, and the Primary Settling Pond will contain water reclaimed from both tailings facilities. However, because of the geographic separation of the HLF South and North Settling Ponds and the two tailings facilities, ponded water from these four facilities should also be sampled for discharge monitoring.

3.6 Reporting and auditing

The monitoring results will go to the company (Hudbay) before they are sent to ADEQ. To expedite the public accessibility of the monitoring data, the laboratory results should be sent to ADEQ at the same time they are sent to the company. ADEQ should then upload the results to their website to improve transparency and public access to the data.

ADEQ should consider adding an option for local stakeholders to conduct participatory monitoring. As part of such a program, the independent monitors could take split samples and send them to a separate laboratory for analysis.

3.7 Additional comments on parameters in the Draft APP tables

Tables 16, 18, and 20 list Total alkalinity, carbonate, bicarbonate, and hydroxide. Total alkalinity is comprised of carbonate, bicarbonate, and hydroxide alkalinity, but the list is confusing without adding "alkalinity" after the words carbonate, bicarbonate, and hydroxide in the table. Please add the word alkalinity after these three parameters in Tables 16, 18, and 19.

4. Existing Baseline/Background Groundwater Quality

Table 3.11a in Appendix G.1 of the Draft APP provides mean concentrations for parameters in 31 wells, and the associated text states "water quality sampling has not indicated values above AWQS." In addition, individual results for each sample are provided in Appendix I of Appendix G.1, and no individual results exceed an AWQS value. Mean values in three of the 31 wells would slightly exceed the federal MCL for arsenic (0.013-0.016 mg/L vs the MCL of 0.01 mg/L), and three of the 31 wells would slightly exceed the federal MCL for uranium (0.032-0.046 mg/L vs the MCL of 0.03 mg/L). These values will become relevant for the APP if ADEQ adopts the MCLs as AWQS values in the near future (ADEQ, 2023).

As shown in Figure 3, the existing groundwater monitoring wells are in the same areas as the proposed mine facilities and POCs. Because none of the wells exceeded AWQS values in ambient/baseline water quality and the wells are in similar locations, ADEQ could include temporary AQL and AL values in the Final APP for at least all parameters with AWQS values until sampling of the 10 POC wells is completed. This approach would provide more certainty than entering "reserve" in Table 19 of the Draft APP and would provide protection during mine construction.

5. Geochemical Testing Issues and Relevance to the APP

5.1 Contaminants of potential concern and leach test limitations

The results from short-term leach tests (MWMP and SPLP)[5] and kinetic (long-term) humidity cell testing can be used to determine the contaminants of potential concern for the Copper World Project. Much more work has been done on ore and wastes from the Rosemont Pit (Draft APP,

[5] MWMP=meteoric water mobility procedure, 1:1 solution:solid ratio; SPLP=synthetic precipitation leaching procedure, 3:1 solution:solid ratio (SPLP samples are three times more dilute than MWMP samples).

Appendix G.1), and relatively little work, including humidity cell tests of short duration, has been completed for the other five proposed pits (Draft APP, Appendix G.2).

5.1.1 Limitations on leach test results

Uranium was not determined in MWMP leachate samples (Appendix G.1, Appendix C), but it was in SPLP tests. However, SPLP uses three times more dilution than the MWMP. The results from MWMP and SPLP testing were combined in an unusual fashion, and the uranium results were not carried through to geochemical modeling. Therefore, uranium inputs for all the predictions discussed in Section 5.2 of this memorandum were entered as zero.

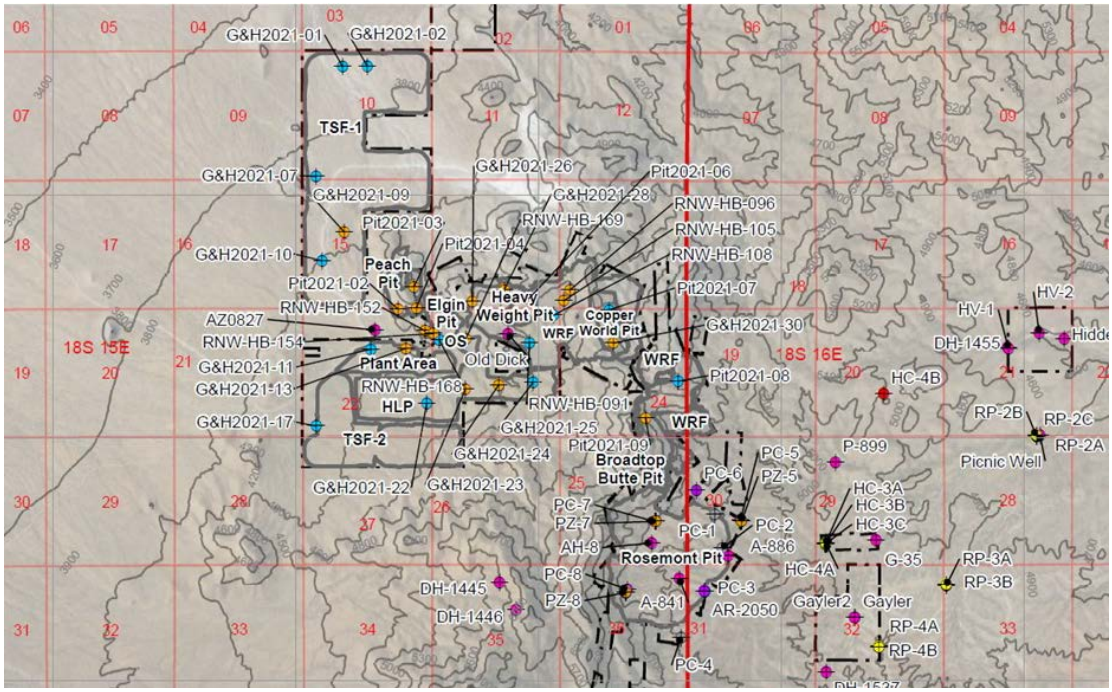

Figure 3. Locations of existing groundwater monitoring wells. The wells sampled are in the same locations as the proposed point of compliance wells (refer to Figure 1).
Source: Modified from Hudbay, 2022a. Figure 23.

Many of the detection limits in the MWMP leachate results were too high (Appendix G.1, Appendix C; the following values are in micrograms/liter, AQL=aquifer quality limit, MCL=federal drinking water limit if different), including those for antimony (20, AQL=6), lead (7.5, AQL=50, MCL=15), selenium (40, AQL=50), and thallium (15, AQL=2). Because the uncertainty in analytical results increases dramatically as the detection limit is approached, detection limits should be at least 5 times lower than water quality standards (US EPA, 2020). The high detection limits make the leach test results for these parameters less reliable.

The humidity cell tests were run for a maximum of 35 weeks. Common industry practice is to run these tests for at least one year (Maest and Nordstrom, 2017). Samples with higher neutralization potential can take longer to produce acid, and such a short test duration tends to underestimate the long-term potential to generate acid.

5.1.2 Contaminants of potential concern

Despite the limitations discussed above, the results from short-term and kinetic leach testing can be used to make an initial estimate of the contaminants of potential concern. Total metal concentrations in MWMP leachate were categorized as "high," and the highest metal releases were from the andesite and tailings samples; the highest metal concentrations in SPLP leachate were from the tailings and limestone skarn samples (Appendix G.1, pg. 24). Leachate from the ore grade samples were acidic, and the lithologies most likely to be potentially acid generating are andesite, arkose, and Bolsa Quartzite units. Acid-producing samples had leachate with elevated concentrations of iron, copper, aluminum, manganese, and zinc.

Selenium was elevated in short-term leach tests (MWMP) in andesite, Horquilla, and Colina tailings samples. No treatment method is proposed for removing selenium. Antimony was consistently release at concentrations exceeding AWQS values from the andesite and arkose rock units.

The following parameters are known to be mine-related contaminants of potential concern, based on the results from geochemical testing. Table 3.5 in Appendix G.1 lists parameters with short-term leach test results above AWQS values, and Section 3.4 in Appendix G.1 discussed the results of kinetic testing and their results. Ammonia and nitrate+nitrite are added to the list of mine contaminants because they will be released from blasting activity and will be present in waste rock, tailings, ore, and the pits. Parameters that are not proposed to have numeric AQLs or ALs in the Copper World APP are indicated with an asterisk:

- Acidity (low pH)*
- Aluminum*
- Ammonia*
- Antimony
- Beryllium
- Cadmium
- Sulfate*
- Copper*
- Iron*
- Lead
- Manganese*
- Nitrate+nitrite
- Selenium
- Total dissolved solids*
- Uranium*
- Zinc*

5.2 Predicted pit, waste rock, tailings, and heap leach water quality

Geochemical models were constructed and run to predict water quality in the pits, waste rock seepage, tailings seepage, and heap leach draindown (Draft APP, Appendix G.1, Chapter 4). The models used the results from humidity cell tests (limited to the Rosemont Pit material) and scaling factors to try to account for differences between the laboratory results and the field. Two scaling factors were used: surface area and water:rock ratio. Temperature was "conservatively omitted" as a scaling factor, even though field temperatures at this location in Arizona would undoubtedly be higher than those in the laboratory, and higher temperatures accelerate leaching reactions. In addition, no field tests (e.g., field bins filled with crushed drill core) were conducted that would give a more site-specific estimate of the effects of field conditions on rock weathering. The scaling factors used decrease weathering rates (and therefore predicted leachate concentrations) compared to those in the laboratory, but because no field tests were conducted, the validity of the scaling factors is unknown. Many of the final predicted seepage chemistry

values were zero (e.g., 0.00 or 0.000), which is not a substantiated number and does not incorporate detection limits.

The pit lake methodology used water balance information (precipitation, pit lake evaporation, groundwater inflow and outflow) and geochemical mass loading from reactive wall rock (using humidity cell and leach testing results) to predict pit water quality over time (up to 200 years post-closure). Water and mass balances were performed using GoldSim software, and chemical reactions were accounted for using the geochemical code PHREEQC.

A much more thorough evaluation of the water quality predictions and modeling approaches and assumptions is needed than can be provided in this memorandum, which focuses on the Draft APP. As a first approximation, the results of the geochemical modeling are used to estimate water quality in mine waste leachate and in the open pits (pit lakes, which are predicted to form in each of the six pits). Predicted waste rock facility seepage, tailings seepage, heap leach pad draindown, and pit lake chemistry (for Rosemont Pit lake) are provided in Tables 5.2, 6.3, 7.3, and 8.3, respectively. Based on the results in these tables, the following comments can be made:

- Waste rock seepage (Table 5.2): The predicted results for waste rock seepage are not credible and appear to be unrealistically low. Eleven of the final results (even before scaling, which will further reduce concentrations) are zero. Many of the entries are even lower than ambient groundwater concentrations.
- Tailings seepage (Table 6.3): These results also appear to be unrealistically low. Fifteen of the results are zero. Three parameters do show elevated concentrations: selenium, sulfate, and total dissolved solids.
- Heap leach seepage (Table 7.3): Many of the predicted final seepage values do exceed EPA drinking water standards or AWQS values, including pH (pH 0.73), aluminum (31.7 mg/L), beryllium (0.015 mg/L), cadmium (0.180 mg/L), chromium (0.02 mg/L), copper (2,700 mg/L), iron (758 mg/L), lead (0.039 mg/L), nickel (0.32 mg/L), selenium (0.051 mg/L), sulfate (32,600 mg/L), total dissolved solids (36,700 mg/L), and zinc (10.4 mg/L). Given the very poor predicted seepage quality from heap leach draindown, frequent downgradient monitoring is crucial.
- Rosemont pit lake chemistry (Table 8.3): Predictions are presented for post-closure years 1 through 200. Many of the concentrations are predicted to increase over time due to evaporation. However, none of the values for any of the years are predicted to exceed EPA or Arizona AWQS values. Many parameters are predicted to have concentrations below detection limits throughout the 200 years, including aluminum, arsenic, beryllium, chromium, iron, and nickel. Predicted concentrations of copper and zinc (respectively 0.026 and 0.30 mg/L at year 200) in a pit lake where copper is being mined are not credible. The only mine-related contaminants with somewhat elevated concentrations are fluoride, selenium, sulfate, and total dissolved solids.

Although the predicted seepage and pit lake chemistries are based on results from laboratory leach testing, the modeling approaches and the use of scaling factors appear to make the predictions unrealistically low, with the possible exception of results for heap leach draindown seepage. However, geochemical testing does reveal the contaminants of potential concern. Protective facility design and careful monitoring of compliance wells, stormwater, and pit lake

locations for all contaminants of potential concern before, during, and after mining with meaningful alert levels and well designed contingency plans are needed to minimize groundwater contamination from this very large mining project.

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Report by Stanley Hart, Ph.D.

Failure to characterize and model microbial activity and effects of leaching in the Draft Aquifer Protection Permit for the Copper World Project, Arizona

The Hudbay APP Application contains no information whatsoever regarding microbial activity in the tailings discharge or in the aging tailings pile, despite that this is mandated by regulation. Arizona Statutes and the Arizona Mining Guidance Manual (BADCT) are clear: "The Arizona Administrative Code (A.A.C.) R18-9-A202(A)(4) requires that a summary of the known past facility discharge activities and the proposed facility discharge activities be conducted to indicate all of the following:

- The chemical, biological, and physical characteristics of the discharge;
- The rates, volumes and frequency of the discharge for each facility;
- The location of the discharge."

It is well known that the presence of active biological processes can increase weathering and leaching rates of some toxic metals by huge factors. Therefore, in actuality, the results from the seepage modelling discussed in the APP application, which do not include consideration of microbiological activity, should all be viewed as lower limits because the leaching rates under field conditions will certainly higher, and probably much higher.

Absent a full geo-membrane lining under the tailings piles, there is no way to properly characterize the seepage of toxic metals except to run new water-rock interaction experiments under well-designed and carefully executed conditions, with particular attention to the microbial aspects. Without these tests, existing Infiltration, Seepage, Fate and Transport modeling is absolutely incomplete and cannot be used to certify protection of the aquifer. As a result, the APP Application then must be considered inadequate.

There is a huge literature on this subject that should provide guidance to designing useful experiments. Because these leaching tests provide the basic starting data for the seepage models, and because in the APP application numerous toxic metals are already exceeding or nearly exceeding AWQS, every detail of these tests must be carefully controlled and documented.

Jason Headley, PhD candidate, University of Arizona. Poster showing results of surface water monitoring in Davidson Canyon, 2024.

INTRODUCTION

Many intermittent and ephemeral washes drain metals-rich catchments, but the short duration and irregularity of their surface flows limit sampling opportunities, hindering research into the natural concentrations and transport mechanisms of metals in their streamwater discharge. Mining activities related to a porphyry copper deposit in the Santa Rita Mountains have occurred on a small scale for decades, but in recent years, large-scale open-pit mining has been proposed and is awaiting approval from regulators. Some construction and land excavation is reportedly already occurring.

When metals-rich ore is brought to the surface through excavation, potentially-harmful metals and other contaminants can mobilize and enter waterways through several different mechanisms. Oxygenated water that infiltrates through mine tailings can decrease the pH of waters through the oxidation of sulfide minerals (which are characteristic of porphyry deposits) or the hydrolysis of iron(III) minerals. The water's increased acidity and oxidative potential can release further metals through mechanisms such as surface site desorption and mineral dissolution.

This study aims to establish the baseline concentrations of trace metals in Davidson Canyon (DC) and Lower Cienega Creek (LCC) surface waters during both baseflow and precipitation-induced runoff (a.k.a. "stormflow") conditions. We then propose several hypotheses for the specific geochemical conditions and mechanisms that could explain the watershed's current baseline concentrations of trace metals. A thorough understanding of current conditions in the watershed could help to identify and remedy any future declines in water quality.

SITE DESCRIPTION

The Davidson Canyon subbasin (a part of the Cienega Creek watershed) is a narrow 16-mile-long catchment that drains the northeastern slopes of the Santa Rita Mountains. It merges with lower Cienega Creek 20 miles southeast of Tucson, AZ. The research sites "BAR" and "DAV1" are within this subbasin.

Lower Davidson Canyon and Lower Cienega Creek contain stream sections with high-quality aquifer-fed intermittent-to-perennial surface water. They are designated as "Outstanding Waters" by the State of Arizona and are also part of Cienega Creek Natural Preserve. They are home to several threatened and endangered species, such as the Chiricahua leopard frog and the Gila topminnow.

Watershed delineation by USGS StreamStats. 3D elevation not to scale.

METHODS

- This study focused on four sites that are hydrologically-connected via their surface water flow:
- **BAR – in DC** – ephemeral wash that drains the proposed mine area
- **DAV1 – in DC** – an intermittent stream 9 miles downstream of BAR
- **CC2 – in LCC** – 3 miles downstream of DAV1 & ¼ mile downstream of the DC/LCC confluence. Also downstream of CC1.
- **CC1 – in LCC** – ½ mile upstream of CC2 & ¼ mile upstream DC/LCC confluence. Hydrologically connected to CC2 only.
- **"Grab" samples** of surface water were taken by hand during baseflow conditions (generally, 3+ days since the last precipitation event) and 1-2 days after a precipitation event ("After Stormflow"). Parameters such as temperature, dissolved oxygen (DO), electrical conductivity (EC), and pH were measured in the field.
- **Stormflow samples** were collected with Teledyne ISCO® Model 6712 autosamplers that activated during high-flow events caused by precipitation and stormwater runoff. Once activated, an autosampler uses a peristaltic pumps to collect samples from the streams every 15 minutes until the flow subsides or until sample bottles were exhausted. Each autosampler can collect up to 24 one-liter samples.

Teledyne ISCO® Model 6712 autosampler

- Samples were recovered from the field and brought to a UArizona lab for initial filtering (0.45 µm pore size), preserving, and measurement of pH, EC, and alkalinity, before being sent to other labs for analysis of stable water isotopes ($\delta^{18}O$ & $\delta^{2}H$), major cations & anions, and total & dissolved trace metals.

- All sample bottles and filtering equipment were washed overnight in an acid bath of 20% trace metal grade nitric acid and rinsed 5 times with 18.2 MΩ/cm Type 1 deionized water before being double-Ziploc®-bagged and stored for later use.

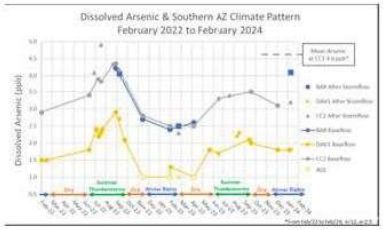
- Of the 182 samples collected between June 2022 (the start of this project) and January 2024, 120 were analyzed for trace metals. Additionally, this research incorporated data from 65 previous samples taken sporadically between 2002 and 2022 by state, local government, and University of Arizona researchers.

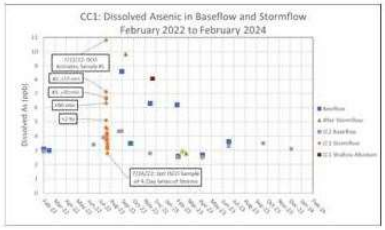
RESULTS

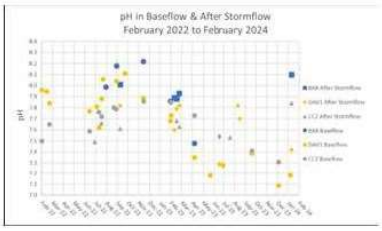
Up to 30 different metals were analyzed for dissolved concentrations and 19 were analyzed for total (i.e., including particulates) concentrations. Results were compared to published water quality standards, including the EPA's Drinking Water Maximum Contaminant Level (MCL) Freshwater Criterion Maximum Concentration (CMC), Freshwater Criterion Continuous Concentration (CCC), and the ADEQ Aquatic and Wildlife warm water standards (A&Ww).

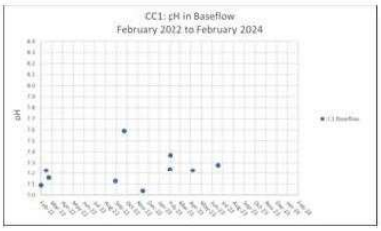
Update:

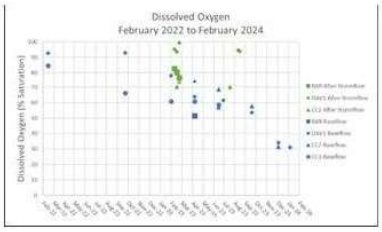
RESULTS

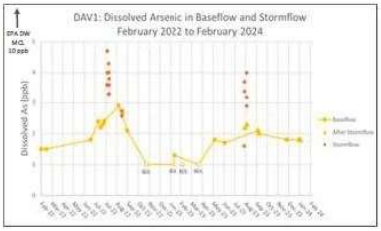


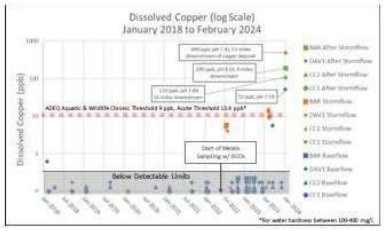


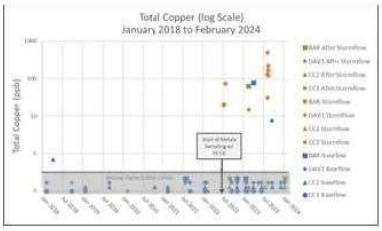


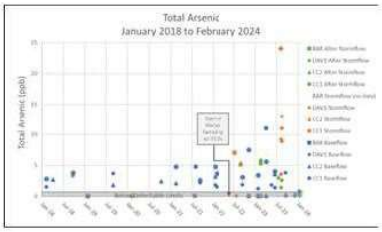


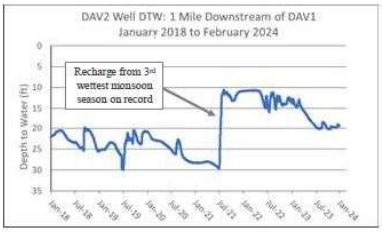






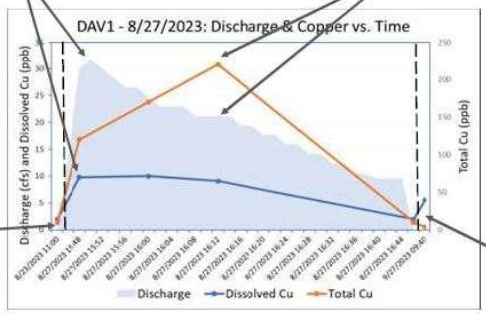






Generally, we found that dissolved metals concentrations peak with the hydrograph peak

Total metals concentrations peaked during the falling limb of the hydrograph



8/23/23 Baseflow

9/27/23 Baseflow

CONCLUSIONS

Arsenic is a naturally-occurring but toxic metal that is present in the Davidson Canyon and Lower Cienega Creek watersheds. If improper mining practices mobilize arsenic in the Santa Ritas porphyry ore, it has the potential to adversely affect the environmental health of Cienega Creek Natural Preserve. Future work could involve tracing Cienega Creek's unidentified arsenic source further upstream.

Copper concentrations in Davidson Canyon waters have increased above historical trends, according to analyses of recent samples. Future sampling of its surface waters on a consistent basis is necessary for further investigation.

While stormflow clearly disrupts a surface stream's geochemical equilibrium, the effect is not long-lasting. Further investigation into the observed general decline of dissolved oxygen and pH in baseflow between 2022 and today could provide insight into hydrologic changes occurring in the watershed on an interannual time frame.

ISCO autosamplers are effective at capturing samples of flashy, short-lived stormflows in ephemeral and intermittent washes. They have shown that both dissolved metals and total metals are mobilized during storms, with dissolved metals concentrations peaking with peak discharge, and total metals peaking later.

Metals leaching experiments on stream sediment could be useful for testing the arsenic sorption hypothesis. Configuring ISCO autosamplers to collect for dissolved organic carbon (DOC) could also help with determining if metal-ligand complexation is occurring to a significant degree in the watershed.

ACKNOWLEDGMENT & CONTACT

We would like to thank Pima County Regional Flood Control District for funding and supporting this project.

PIMA COUNTY

Pima County comments on Copper World Operations, Aquifer Protection Permit No. 513690, LTF 90620

Submitted to ADEQ by Jan Lesher, March 11, 2024

COUNTY ADMINISTRATOR'S OFFICE
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JAN LESHER
County Administrator

March 11, 2024

Arizona Dept. of Environmental Quality
Water Quality Division/Groundwater Protection
Attn: Bernice Manuelito
1110 W. Washington St.
Phoenix, AZ 85007

Re: **Copper World Operations; Aquifer Protection Permit No. 513690, LTF 90620**

Dear Ms. Manuelito:

Pima County, Pima County Regional Flood Control District, Pima County Regional Wastewater Reclamation Department, and Pima County Department of Environmental Quality (collectively referred to here as Pima County) submit the attached comments on the above-referenced draft Aquifer Protection Permit (APP) for Copper World Operations.

As reflected in the attached comments, Pima County is concerned that in several important respects the design proposed in Hudbay's application is even less protective of the environment than designs submitted by previous owners of the original Rosemont Mine Project. Under this current application, Hudbay proposes to use water to convey tailings in a slurry pipeline, operate an unlined tailings facility, leave waste rock dumps uncovered at closure, and deploy inadequate monitoring systems. The planned processing facilities include a heap leach and other facilities that will process significant amounts of acid, and they will be located much closer to Tucson and Sahuarita's municipal water supplies and rural domestic wells than was formerly the case.

Pima County respectfully requests greater deployment of industry standard technologies for minimizing pollution, and we ask that ADEQ require the additional permit conditions, design requirements and agency reviews detailed in our comments to better ensure the design of this mine is more protective of the aquifer.

Where ADEQ is unable to require the deployment of industry standards to minimize pollution, ADEQ should encourage Hudbay to voluntarily incorporate such standards. ADEQ's Best Available Demonstrated Control Technology is no longer the "Best Available" when it is outdated and less than industry standards. Compromising the quality of our community's

water supply due to outdated standards in Arizona law in the name of reducing Hudbay's costs is unacceptable.

We appreciate the opportunity to comment on this matter and the time ADEQ staff have taken to meet with us and the community, but our community deserves more protection than this.

Sincerely,

Jan Lesher
County Administrator

Attachment

c: Honorable Chair and Members, Pima County Board of Supervisors
Carmine DeBonis, Jr., Deputy County Administrator
Francisco Garcia, MD, MPH, Deputy County Administrator and Chief Medical Officer
Steve Holmes, Deputy County Administrator
Scott DiBiase, Director, Environmental Quality
Nicole Fyffe, Interim Director, Conservation Lands and Resources
Jackson Jenkins, Director, Regional Wastewater Reclamation
Eric Shepp, Director, Regional Flood Control District

Copper World Aquifer Protection Permit: Pima County Staff Comments

Staff have reviewed the application materials submitted by Hudbay Minerals as well as the proposed Copper World Aquifer Protection Program (APP) draft permit # P-513690. The following comments are submitted on behalf of Pima County, Pima County Regional Flood Control District, Pima County Regional Wastewater Reclamation Department, and Pima County Department of Environmental Quality, collectively referred to here as Pima County. The comments are organized in the order of the draft permit terms.

In general, the mine's design should be made more protective of the aquifer through additional permit conditions, design requirements and reviews by your agency. In several important respects, Hudbay has proposed a design that is inherently less protective of the environment than was the case for the Rosemont project under Augusta. Hudbay will use water to convey tailings in a slurry pipeline; they propose no liner under the tailings facility, no cover for waste rock dumps at closure, and inadequate monitoring systems. The processing facilities now include a heap leach and other facilities producing and using much acid, and they are located much closer to Tucson and Sahuarita's municipal water supplies and rural domestic wells than was formerly the case. Local communities deserve greater protection from pollution than is reflected in the draft permit conditions as currently written. Our comments call for greater deployment of permit conditions and standard technologies for minimizing pollution.

Authorization

1. The permit is premature. Hudbay has not yet applied for Bureau of Land Management (BLM) permissions for the construction of the tailing slurry pipeline, the tailings seepage return pipeline, and re-construction of the tailing facility roadway across federal land as shown in the APP and air quality permits. The ponding caused by the waste and tailings facilities may also impinge federal lands. A state right-of-way permit has been issued, but it is not clear if it is legally valid for the pipelines. Federal or state requirements may affect the location, design or permissibility of these facilities.

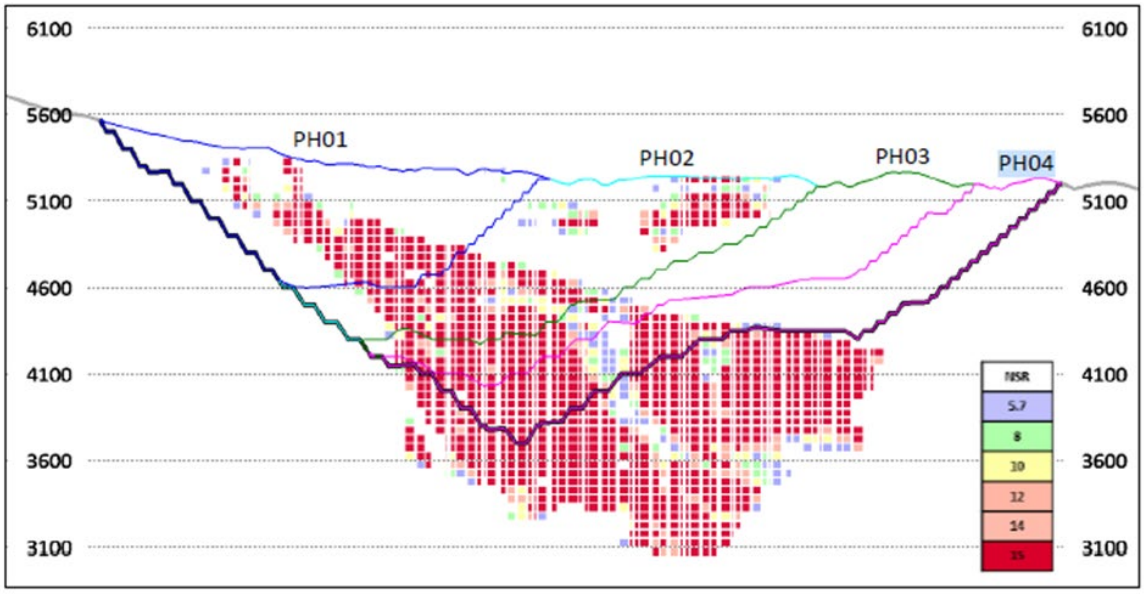
   Given licensing timeframes, Pima County understands Arizona Department of Environmental Quality (ADEQ) must respond to the application, however we request that if a state permit is granted, the permit be contingent on receipt of all applicable federal and state permits, and the initial term be restricted to Phase 1. Further, we request that the permit be restricted to the operation of the concentrator, not the heap leach facility, of Phase 1 alone. Hudbay representatives indicate to Pima County that the heap leach is not part of their current plan of operation, consistent with their 2023 Pre-Feasibility Study (PFS). An amendment could be used to add the heap leach later.

Facility Site Description

2. Pima County believes that it is intentionally and inappropriately misleading to say this is a permit for a 15-year project, when the actual term of the permit is valid until suspended or revoked by ADEQ. The entire Copper World project has an extended 30+ year Phase 2 to begin once Hudbay can acquire the necessary federal permits that have so far impeded their progress towards permitting of the original Rosemont Copper project. While a two-phased

approach was presented in the 2022 Preliminary Economic Analysis (PEA), their 2023 PFS claims that Hudbay has redesigned their plan into a single 20-year plan with four smaller phases. However, the APP application discusses a mine life of 15 years, indicating that their plan is once again for this Phase 1 and Phase 2 as presented in the PEA. The figure below is from Section 16.2.3.2 of the PFS and although Hudbay claims that the bold purple line represents their final phase of their 20-year mine life, it is clear and obvious that they are simply positioning the pit to go back and process the remaining ore body as modeled by red. It is difficult to believe that Hudbay will do all this work, construct these facilities, and then leave the remaining ore body unmined. As mentioned earlier, the only reason they cannot do it from the beginning is because their resultant pit would be too wide and the extra waste would need to be deposited onto federal lands. The private lands they currently hold are not large enough for the waste material. In granting the permit, ADEQ should acknowledge to the public that this permit, as amended, could be active for at least 45 years.

FIGURE 16-7: SECTION A-A' – EAST PIT MINE PHASES



3. Pima County requests the addition of the East Pit as an APP-regulated facility under the Copper World permit. ADEQ is obligated to evaluate whether or not the East pit is a discharging facility under A.R.S.§49-241.A. It is claimed in the application and supported by studies that the Rosemont Pit will eventually become a hydraulic sink, and is therefore not a discharging facility. However, this behavior of hydraulic sink will take time to establish. During initial pit construction and operation, the pit may not act as a hydraulic sink. The applicant has not demonstrated that the discharged pollutants will be captured and hydrologically isolated in the depressed water table around the pit at early timeframes. Additionally, the use of the dewatering volume used to maintain the hydraulic sink during closure and post-closure have not been addressed.

4. Pima County requests that any east-side discharge of water from the East Pit dewatering wells be considered an APP-regulated facility with monitoring. Such discharges to the land surface are proposed in the APP application on page 45. For comparison, Pima County operates its smallest water reclamation facility (WRF), the Mount Lemmon WRF, on bedrock outside an aquifer and discharges a miniscule volume compared to Copper World's proposed discharges, yet is required to get APP permit coverage. It is inconsistent with APP requirements to exempt Copper World's discharge activities from permit coverage.

5. The Rosemont pit dewatering analysis (Neirbo 2016) and Final Environment Impact Statement called for 18,500 acre-feet of dewatering to assure pit stability, mostly in the first two years of construction. The Copper World Site Water Management Plan identifies the groundwater discharge at 296 gallons per minute, and this far exceeds dust control requirements. Because the pit is located outside the Tucson Active Management Area (TAMA), water derived from dewatering cannot be conveyed to the mine facilities on the western side of the mountains. Please have the applicant identify the location of any discharge to a watercourse and acknowledge that the discharge may be contingent on federal land permissions and compliance with their Multi-Sector General Permit (MSGP; see AZMSG2019-002, section 1.1.3.1.10).

6. The geology is complex and it can't be assumed that the pumped groundwater has the same water quality as surface water at the discharge point. A water quality monitoring plan and action to control downstream erosion and sediment discharge should be provided.

7. Pima County requests that ND-GS-05 Tailings Slurry Pipeline(s) be included as APP facilities. No design has been submitted, and the location is unclear. The APP application merely states it will be double-walled and operated so as not to discharge.

8. Pima County requests that the return pipeline from Tailing Storage Facility (TSF)-1 be included as an APP-regulated facility. A design should be submitted for review. The pipeline is shown to cross BLM land for which no permission has been secured. Both the tailing slurry pipeline and return pipeline have the potential to create large discharges to the aquifer.

9. Pima County requests that exemptions not be granted for the following facilities: NP-PS-20-Bulk Cu/Mo thickener, ND-PS-23-Tailings Thickeners, and ND-PS-26-Concentrate Leach Fine Grinding Plant. As noted by ADEQ in their letter of April 21, 2023 on page 6 of 43, these facilities have the potential to overflow or discharge.

10. The upstream ponding areas for the stormwater drains should be evaluated in a stormwater management plan to determine if ponding will result in "contact". If so, they should be considered APP facilities.

11. The description of the discharging facilities needs clarification of what goes into each facility, where overflows/upsets go, transport method (pipeline, spillway, etc.) and at what rate. For example, 2.1.1.1. describes that tailings will be place there using a started dam, the centerline method and hydro-cyclones, and an underdrain seepage collection system; however, it does not say that the reclaimed water goes to the PSP nor does it identify how water from TSF-1 is transported to AR-TF-03. Figures 4 and 5 (Application, Appendix A) show a buried tailings

pipeline (ND-GS-05) that takes materials to TSF-1. Is there another pipeline transporting the reclaimed water from a lower elevation to the invert of AR-TF-03? Given that the recovery system is essential to prevent oversaturation resulting is tailings failure or runoff of contaminated water, this information mut be added to the draft permit. The rate, or range of rates, is important to verify the design components are sized to function properly.

12. The Processing Stormwater Pond has a capacity of 18.8 acre-feet to hold runoff from the plant site (~110 acres from the switchyard to the crusher dump pad) for the 100-year, 24-hour storm event. Using the Helvetia Santa Rita Range station (ID 02-3981), this storm event is 4.64 inches. The runoff generated from this event is (4.64/12x110=) 42.5 acre-feet, which is larger than the capacity of the Processing Stormwater Pond. Something is not adding up with this calculation and draft permit and the Application, Appendix E , Site Water Management Plan (Wood, June 24, 2022). Please explain.

13. Pima County requests that ADEQ correct their identification of a sulfuric acid solution as a weak acid. The fourth paragraph of Section 2.1 of the Copper World Draft APP Permit refers to the acidic leaching solution (dilute sulfuric acid) as a "weak acid solution" that percolates through the stockpiled material. Sulfuric acid (H_2SO_4) is a strong acid, regardless of concentration, and it is inappropriate to call it a weak acid solution. In Chemistry, a strong acid such as sulfuric acid undergoes complete disassociation in an aqueous solution, releasing all of its hydrogen ions (H^+) into solution. In contrast a weak acid has very different chemical characteristics, and only partially disassociates in water and therefore releases only some of its hydrogen ions.

Financial Capability

No comment.

Best Available Demonstrated Control Technology (BADCT)

14. Pima County requests that reference to site-specific geology as BADCT should be stricken. Site-specific geological characteristics are cited as BADCT in the draft permit. The applicant characterizes the site geology as limiting and compartmentalized, therefore long-distance groundwater transport should be minimal. This expectation is contradicted by studies referenced in the Rosemont EIS and subsequent isotope studies indicating that recharge in the mountains contributes to discharge at distant springs and streams downgradient in the Cienega valley. Long-distance transport of seepage from Copper World on the westside is also expected based on the particle analysis.

15. Pima County requests verification of the flow model used to demonstrate the East Pit's hydraulic sink can be maintained through construction, operation and closure, not just monitoring and reporting of aquifer levels. Model verification was formerly required as part of the Rosemont Project's safeguards.

16. Pima County requests that ADEQ consider how sustained discharges of pit water to the washes may affect the development and maintenance of the hydraulic sink conditions at the East Pit.

17. When passive containment is used, the statutes still require the facility to employ "additional processes, operating methods, or other alternatives to minimize discharge." Instead, Copper World proposes to discharge excess water from the East Pit to watercourses if there is too much to be fully used in dust control. While there could be some value to this in terms of supporting wildlife habitat in washes downstream, it is not demonstrated that surface water quality standards could be protected. Pima County therefore requests that additional measures be considered in addition to passive containment and discharge to washes, especially if the dewatering discharge water chemistry shows contaminants are present above surface water quality standards.

18. ADEQ should analyze and disclose the advantages and disadvantages of backfilling the East, Peach and Elgin pits and should include the opportunity for water conservation due to reduction of evaporative loss in their BADCT analysis. The assumption that contaminants will not move from the East pit to the aquifer is based on modelled parameters that may not be real or achieved.

19. Incomplete surveys for shafts, adits, and previous boreholes threaten the integrity of the waste and tailings disposal systems. Pima County requests that the APP permit require a complete survey to identify adits, shafts and other voids. Pima County appreciates that ADEQ's proposed compliance schedule requires closure report for each shaft and adit within the HLF and TSF footprints, but without a complete survey of voids including previous boreholes and including the waste disposal sites, some opportunities to reduce pollutant movement to the aquifer will be overlooked.

20. We share ADEQ's concern that the water in the Elgin pit lake could become elevated above water quality standards for arsenic, antimony, cadmium, and thallium. We request backfilling the pit with NAG waste rock to reduce the risk. This would also reduce the perpetual waste of water that pit lakes represent.

21. Pima County requests that ADEQ require a Stormwater Management Plan which clearly contains, within a single document, the design calculations and design plans for perimeter drainage channels, stormwater collection galleries under TSF and HLF, perimeter containment areas, retention / detention basins and pools on the Tailings and Waste Rock Disposal Facilities final cover system and disposal mound side slopes, and all planned perimeter containment areas where surface water will be trapped against the base slope of the tailings and waste rock disposal mounds.

22. Pima County has specific concerns about the stormwater collection galleries to be used under the tailings storage and heap leach facilities. Given the length and size of these pipelines there are concerns about:
    - Maintenance and long-term performance;
    - Potential cross contamination by tailings water seepage and associated downstream surface water quality impacts should there be cracks or ruptures due to settling;

- Performance of the upstream stormwater collection system and the potential for long-term ponding against the sides slopes of the TSF and HLF creating the slope instabilities should portion of the pipelines fail; and
- Upstream and downstream impacts to federal, state and private properties.

23. Pima County requests that ADEQ require routing of non-contact water around the tailing and heap leach facilities, without reliance of underground conveyances.

24. If drains for storm water are used under the tailings, then the design consideration must include calculation of upstream ponding impacts should the storm drains fail and cease to function. This analysis should include whether the potential ponding results in contact with tailings or heap leach materials and whether the ponding be significant enough to result in stormwater developing a new flow path or impact other property owners.

    ADEQ voiced similar comment, Item 12, about the clogging of the proposed 36-inch collection pipes and the collection galleries. Hudbay's April 21, 2023, response was that protection inlet grates would be used and design gradients will aid in flushing debris. Their letter further noted such design has been in use at the Carlota Mine in Miami, Arizona, since 2007. This is a short time period given the lifetime of both operations and post-closure, and does nothing to assure safety of a design.

    Hudbay's response (in the same April letter to ADEQ) did not mention potential impacts from upstream stormwater ponding onto adjacent lands at their proposed stormwater collection sites which includes at one location a small dam. Analysis of upstream impacts should be included in their Stormwater Management Plan.

25. The Dam Break Analysis memorandum maps of incremental impacts at each TSF cell contain the note stating: *The information shown is approximate and should be used for emergency preparation and response.* We think it should read "should *not* be used for emergency preparation and response". Please verify whether this information is intended to be used for these purposes.

26. Given potential impacts to downstream properties, utilities, roads, and other facilities and improvements, Hudbay's *Contingency Action Plan* mentions local authorities should be contacted immediately and emergency services should be arranged. In the case of potential failure or a breach at a TSF, we advise that the closest downstream residences (residents) should be notified.

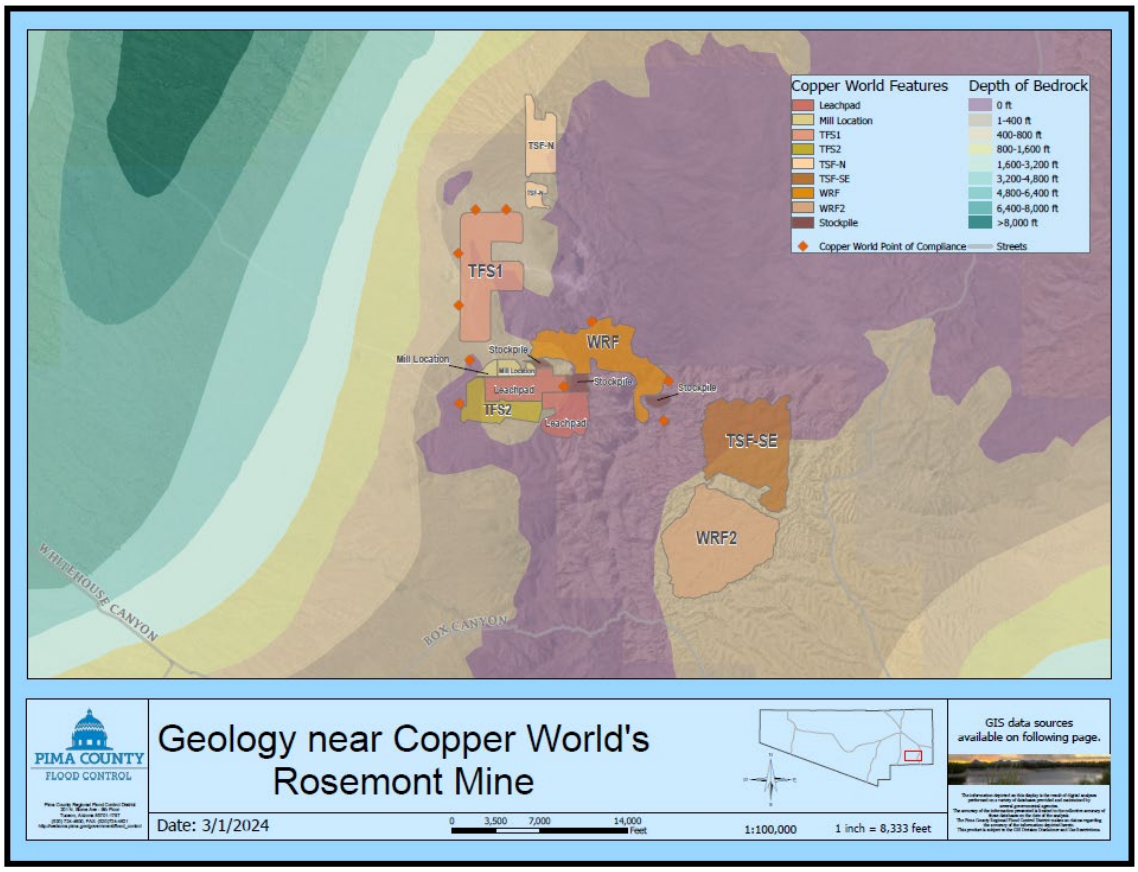
27. In Hudbay's E*mergency Preparedness and Response Plan* for the Tailings Storage Facilities for TSF failure response, "authorities" must be notified. There are no details on which local authorities should be notified. Both of these plans require more detail on notification actions including identifying the Fire District and Pima County's Office of Emergency Management.

28. The TSFs and associated seepage collection system must be lined. We offer two supporting reasons: 1) Hudbay's individual BADCT justification is based on inaccurate site descriptions. The suggestion that the groundwater is limited and discontinuous and that there is no appreciable groundwater flow or travel over distances is proven false by Figure 70-1 from Attachment 31 of Hudbay's response to ADEQ's initial Request for Additional Information (RAI). 2) It is inappropriate for ADEQ to approve an individual BADCT plan for the TSFs that is less protective than the prescriptive BADCT. It is clear that lining the TSFs is more protective of the aquifer. Text below provides more detail on the flawed justifications for individual BADCT.

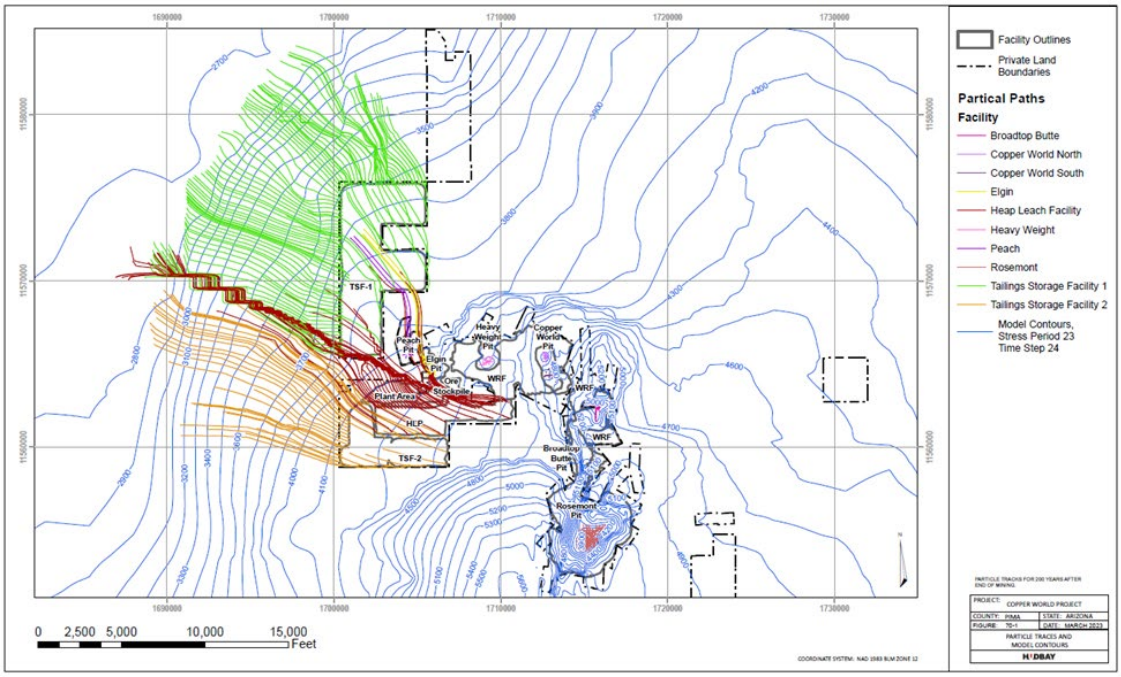
    Inaccurate Site Descriptions
    The site description In Section 10.4.1.2 of the application does not accurately represent the site description in the Hydrogeological Characterization Study (Appendix F.1). Section 4.3.9 for Appendix F.1 says that the TSF sites are underlain by thin Piedmont, Holocene, and Pleistocene alluvial deposits, and that these sections are no more than 400 feet (ft) thick. A 2023 isopach map based on additional borings and field observations of outcrops and test pits show that the alluvium under the TSFs mostly ranges from 0-30 feet in thickness, and is underlain by granitic rock and limestone, some of which is "highly fractured". Appendix F.1. says that Alluvium units have high hydraulic conductivity, and "The depth to water measured at six monitoring locations at TSF-1 ranges from 20 to 90 ft bgs" (below ground surface,) and "The depth to water measured at three monitoring locations at TSF-2 ranges from 48 to 272 ft bgs". Appendix F.1 clearly remarks that both TSF-1 and TSF-2 are on alluvial deposits with high hydraulic conductivity, and a minimum depth to water of 20 and 48 bgs, respectively.

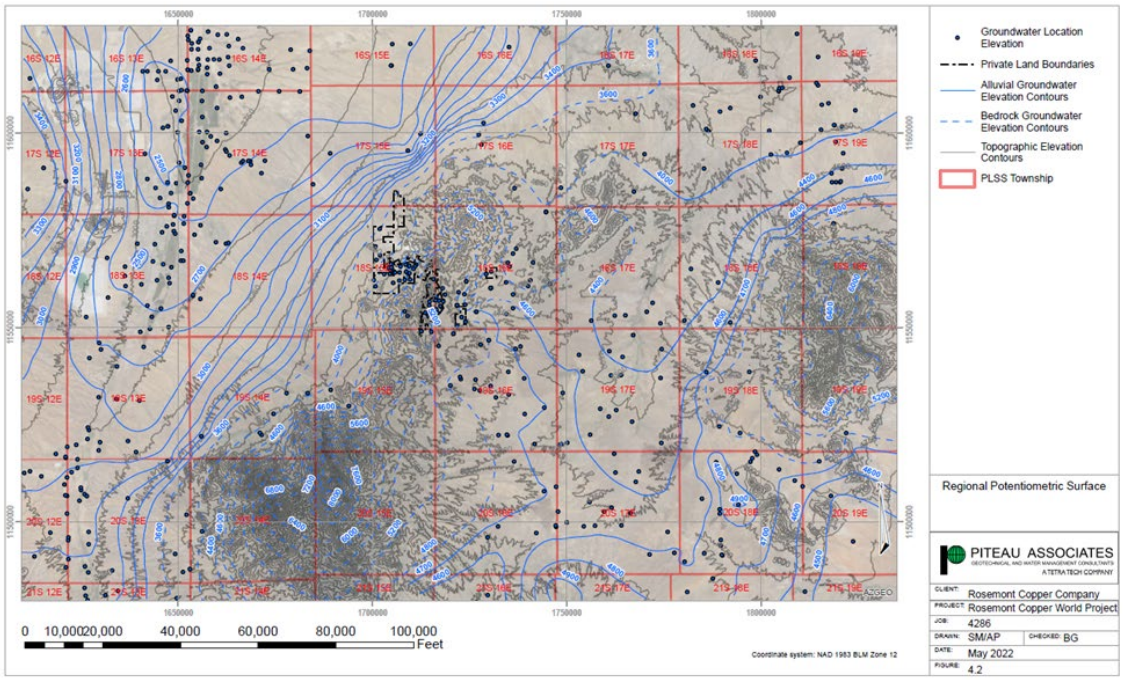
    This inappropriate site description is perpetuated further in Section 2.2.2 (Site Specific Characteristics) of the draft APP. This four-sentence description is intended to be a summary of Pages 52 through 62 of Appendix F.1, in which Piteau Associates spent approximately 10 pages describing 9 different facilities, over a geographic area of several thousand acres, and across several geographic features such as mountain ranges and alluvial plains. It is completely inappropriate to imply that there is a single set of site characteristics that can accurately describe the entire Pollution Management Area.

    The figure below provided by Pima County Regional Flood Control District shows the depth to bedrock. There is a large drop off in the bed rock which goes to 400-800 feet. This demonstrates the varied site conditions and the possibility for leakage through the bedrock and directly into the aquifer. The site-specific conditions given in the draft permit are inappropriate and are inadequate in managing pollution in the TSFs.



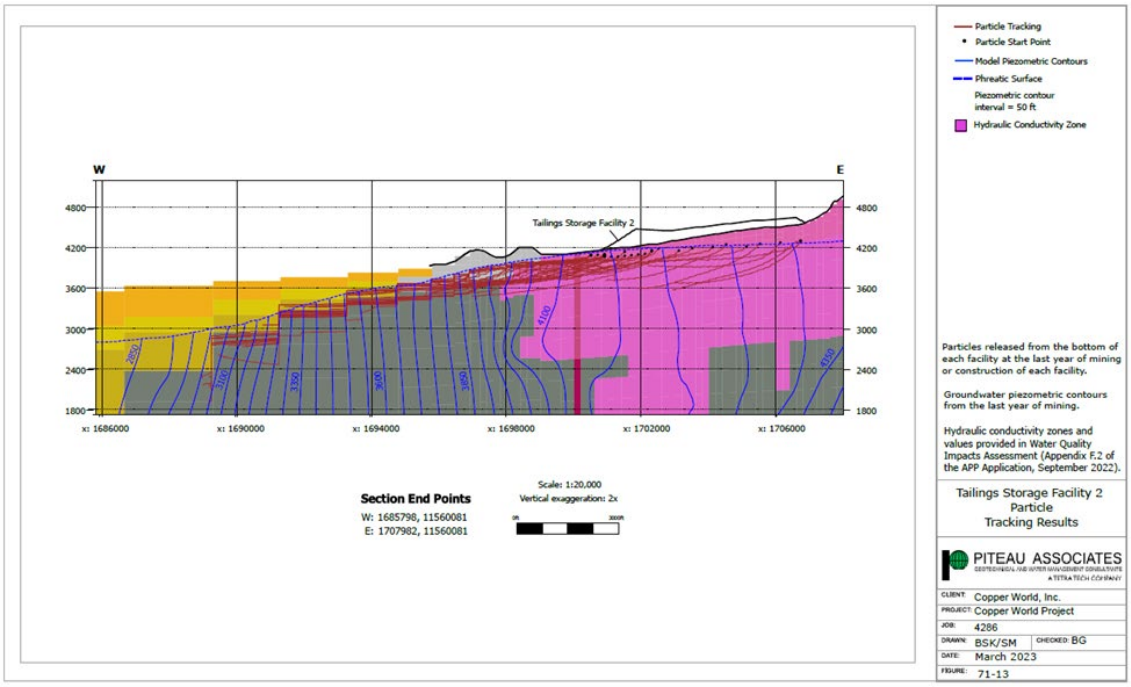
The particle traces and groundwater model contours as displayed in Figure 70-1 (below) from Attachment 31 of Hudbay's response to ADEQ's initial RAI is useful in demonstrating the hydraulic gradient and the mobility of pollutants discharged at certain points within the PMA. Not only does this figure demonstrate a clear hydraulic gradient to the northwest of the TSFs with the blue contour lines, but it also confirms via the particle traces (in red and green) that there is significant pollutant mobility for the TSFs and the HLP. The hydraulic gradient is again confirmed by Figure 4.2 (below) of Appendix F.1.

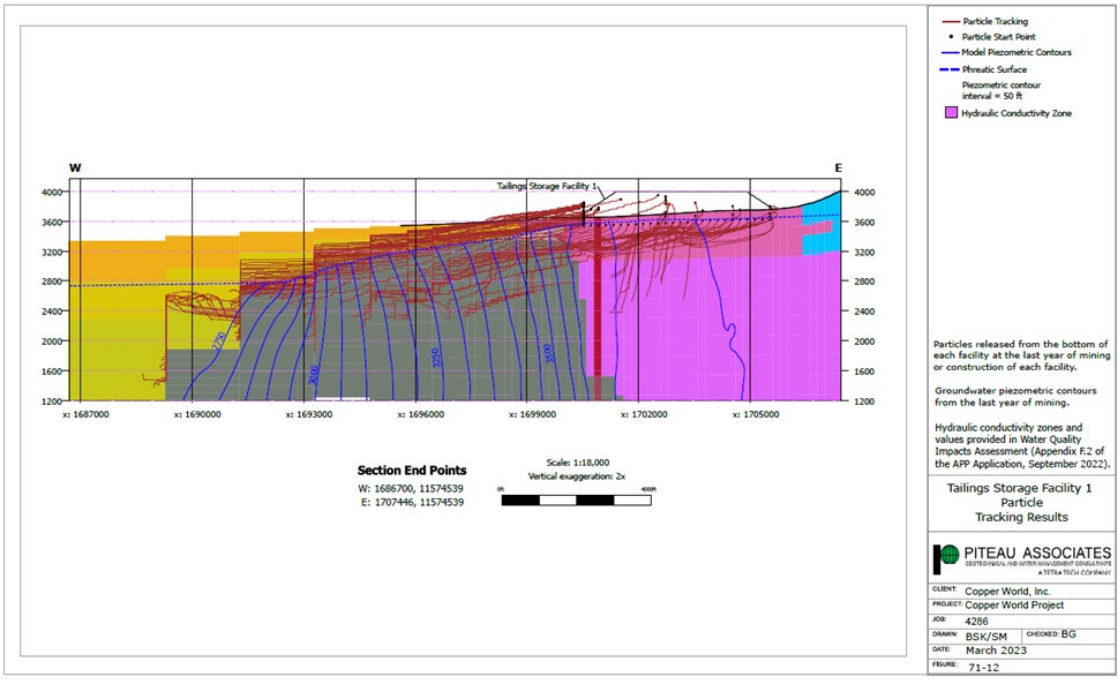




Additionally, Figures 71-12 and 71-13 (below) from Attachment 32 to Hudbay's response to ADEQ's initial RAI show the cross-sectional particle traces for TSF-1 and TSF-2, respectively, and further demonstrate the high mobility of pollutants downward and laterally. In the traces

below, the model shows pollutants moving down and through the alluvium unit towards the Tucson Basin aquifer. The dashed line in these documents is the phreatic surface, and it represents the depth to water. When a particle tracking line has passed below the phreatic surface, it has effectively entered the aquifer. This should be no surprise, as it was previously stated that the depth to water above the TSFs is only 20 to 48 feet. It can be seen that particle tracing lines nearly immediately cross the phreatic surface, and thus nearly immediately enter the aquifer. Another potential direction of movement would be in the alluvium just above the bedrock contact until it reaches the adjacent basin fill units. The model did not represent thin alluvial unit which underlies the TSFs, which eliminated any consideration of this potential.





Individual BADCT is less protective than Prescriptive BADCT

The Tailings Storage Facilities have among the largest potential for aquifer pollution, and yet are prescribed among the least amount of protection. The TSFs will be receiving tailings slurry that will inevitably produce seepage that will reach the aquifer, and it is unclear why ADEQ has approved a plan in which the TSFs and associated seepage collection system are not lined, when the prescriptive BADCT (Section 2.5.2.4 ADEQ BADCT Guidance Manual) for a TSF is to use a 60 mil HDPE liner above 12 inches of compacted native soil. If Hudbay has decided that a their HLP and PLS should be lined (so they don't lose their valuable leach solutions), then the same level of liners should be used to prevent pollution into the environment from the TSFs.

The Tailing Storage Facilities are the only facilities in Hudbay's application in which they applied for individual BADCT instead of using the prescribed BADCT. Section 10.4.1.3 of the Copper World Application lists the three BADCT alternatives for construction of the TSF as Alternative 1 – TSF with No Underdrain, Alternative 2 – TSF with Underdrain, and Alternative 3 – TSF with Geomembrane Underliner. Hudbay's application reports that Alternative 1 would have an approximate 759 gallons per minute (gpm) and 377 gpm seepage from TSF-1 and TSF-2 respectively, for a combined seepage of 1136 gpm. In comparison, the total seepage for Alternative 2 was estimated to be 17.4 gpm. While this is a significant improvement at 98% reduction of seepage, Alternative 3 would have a combined seepage of only 0.43 gpm.

This 0.43 gpm relates to an additional 98% reduction in seepage compared to Alternative 2, and an approximate 99.96% reduction compared to Alternative 1. Item 15 of Hudbay's

response to ADEQ's initial RAI, Hudbay estimates that the amount of seepage from the TSFs using Alternative 2 would be 5,794 acre-feet, which will relate to a "base case" value total mass loading of approximately 6,362 tons of sulfate polluted into the aquifer, with a standard deviation of 11,543 tons. As the standard deviation is larger than their base case value, there exists a high level of uncertainty in the delivered number. These given values represent only the seepage that bypasses the seepage collection system, which is estimated to be about 2% of the total. A further 98% reduction of this value, as represented by the lined TSFs in Alternative 3 would lead to 99.96% overall reduction, with an expected 115.9 acre-feet of seepage, with base case total mass loading of 127.24 tons of sulfate, and a standard deviation of 230.86 tons of sulfate.

Practicality of lining the TSFs

At the February 20, 2024 Community Meeting held at Corona Foothills Middle School, ADEQ staff indicated that the requirement for a TSF to be lined as prescribed in Section 2.5.2.4 of the ADEQ BADCT Guidance Manual only applies to the water fraction of a tailings facility, and that because Hudbay plans to thicken their tailings prior to deposition, this section no longer applies. Pima County would like to emphasize that the thickened tailings is estimated by Table 11.01 of the permit application to have a water content of approximately 31.8% by weight and that stormwater will be stored within the TSF impoundments (Section 2.1, paragraph 5). Pima County disagrees that this section should not apply, and requests complete explanation along with sections of Arizona Administrative Code or statute that make this distinction.

ADEQ staff also said that it is not practical to line the TSFs because the excess water content needs to go somewhere (i.e. the ground) or else stability issues and liquefaction become a problem. These stability and liquefaction issues only occur when a thickened slurry is deposited on a lined TSF. The concerns of practicality are eliminated when the tailings are filtered or pressed dry prior to deposition and do not receive site stormwater flows. Pima County would like to return to Hudbay's original design of dry stacked tailings as a demonstration of environmental stewardship.

ADEQ's decision that the appropriate resolution to this issue is approval of a cheaper design that is less protective of the environment occurred because of the perceived hardship on Hudbay that would be caused by construction of appropriately protective facilities. This is an unfair compromise between environmental protection and practicality, and one that Pima County disagrees with. It is not acceptable that the excess water from the TSF be allowed to seep into the ground as a compromise in practicality. If the design of an unlined TSF is not environmentally protective, then it should not be approved. If the design of a lined TSF to receive a 30% water content slurry is not practical or safe due to stability, then it should not be approved. A reasonable solution is to line the TSF and to stack dry tailings, which clearly accomplish the goals of environmental protection.

Additional Research Required

Pima County requests that a complete economic and practical evaluation of TSF alternatives be completed by Hudbay, to include a lined and dry-stacked facility, among other potential redesigns. As the current design also uses the TSF to hold stormwater run-on that is not

diverted by the diversion channels, the evaluation will also need to include stormwater containment designs. Pima County requests that construction of the TSFs include consideration of the Global Industry Standard on Tailings Management (GISTM) specific to Topic III, and Principles 4 through 7. The ADEQ BADCT Guidance manual is 20 years old, and considerable advancements have been made in mining technology. It would be short-sighted of ADEQ to not incorporate new design practices or techniques that lead to a safer mine that is more environmentally protective. Pima County request that ADEQ update its BADCT requirements to more recent and proven practices. The BA in BADCT stands for Best Available, and as such should not be restricted to old practices that have better alternatives.

Consequences of not lining the TSFs

We share ADEQ's concern that seepage may be above Aquifer Water Quality Standards for beryllium, cadmium, fluoride, selenium and zinc. Under the current proposal, about 5000 acre-feet of tailing seepage is expected to be lost. Some of the material under TSF-1 is limestone, some of it "highly fractured".

This mine has the potential to pollute a considerable amount of sulfate and other materials into the Sahuarita and Green Valley regional aquifers. If sulfate is being transported into the aquifers, as demonstrated by the Hudbay application and supporting documentation, then so are other contaminants. Southern Arizona is already dealing with the after-effects of the Sierrita Mine sulfate plume. It has been clearly demonstrated that water is present below the surface of the TSFs, that there is high hydraulic conductivity, and that the aquifer is in danger of being polluted. In the countries with the highest copper production, Chile and Peru, research has shown that contamination by mine tailings is significant for the health and environment of the surrounding communities due to a lack of adequate management of tailings and mine closures [https://pubmed.ncbi.nlm.nih.gov/34089446/]. The prescriptive BADCT for a TSF is to line the facility, yet the TSFs are among the only facilities in Hudbay's application that are not lined. Therefore, it is inappropriate for ADEQ to approve an individual BADCT plan for the TSFs that is less protective than the prescriptive BADCT. Lining the TSFs is the solution which is more protective of the aquifer.

29. Pima County requests that ADEQ carefully review construction plans and timelines to ensure that the appropriate environmental protection structures are appropriately in place prior to operation of a discharging facility that rely on such structures. Hudbay's response to Item 13 of the Feb 27, 2023 RAI says that "As development occurs over the first 5 years, there will be no period where an APP-regulated mine feature is constructed prior to completion of a permanent diversion feature upgradient of that feature." However in Figures 6 and 7 of the Site Water Management Plan (Appendix E in the September 2022 APP application), it is indicated that tailings are already being added to TSF-1, though one of the drains (indicated by green dashed line) in Cell 2 is not in place in Figure 6. This drain should be in place before any tailings are added to TSF-1 in order to satisfy Hudbay's claim that all upgradient permanent diversion structures are in place prior to operation and construction of the APP facility.

<u>Discharge Limitations</u>

30. Pima County requests that any east-side discharge of water from the East Pit dewatering wells be subject to applicable surface water quality standards established under baseline surface-water monitoring for the Rosemont Copper Project. Such discharges are proposed in the APP application on page 45.

31. Pima County requests that any east-side discharge of water from the East Pit and Broadtop dewatering wells be monitored for compliance with state surface water quality standards. We note that Broadtop Butte pit is mostly outside the Tucson AMA and therefore pit water export is subject to the same restrictions as at the East Pit.

32. The proposed mining facility is required to obtain Arizona Pollutant Discharge Elimination System (AZPDES) permits for construction and industrial activities under state statute ARS §49-255 that protects surface water quality and was which was adopted under section 402 of the CWA. Mining facilities are a category of industrial operations required to obtain AZPDES permit coverage for stormwater discharges. Rosemont Copper Operations obtained AZPDES Multi-sector permit coverage in 2013 and renewed the permit in 2020 under AZMS81296, in contradiction of the permit application Appendix A page 45.

33. The draft APP inappropriately refers to stormwater ponds for non-diverted stormwater run-on when all ponds are non-stormwater ponds as identified in Table 1 of the permit. They are non-stormwater ponds because they can contain contact water, process solutions or upset events, however brief the periods may be. Pima County requests ADEQ properly rename them to non-stormwater ponds and modify the draft permit to clarify that waters entering these ponds are unauthorized non-stormwater discharges.

34. Pima County requests that the monitoring frequency be adjusted in Table 20 from biennial (once every two years) to semi-annually (twice per year). Section A.A.C. R18-9-A206(A)(2) says: “If monitoring is required, the Director shall specify to the permittee: a. The type and method of monitoring; b. The frequency of monitoring.” It is well within the right of the Director to increase the frequence of this monitoring, and not only would this increase in required monitoring frequency be more protective of the aquifer, but this increase would also be consistent with APPs from Wastewater Reclamation Facilities (WRFs). WRFs have regular quarterly requirements for metals and nutrients, as well as semi-annual requirements for the analysis of organic pollutants. The current draft permit has Hudbay sampling and reporting metal and nutrient pollutants on a quarterly basis, and sampling and reporting organic pollutants and radioisotopes of Radium and Uranium biennially. In order to fulfill the requirement of ambient groundwater conditions for organics and radionuclides, biannual sampling will allow the collection of the 8 sampling rounds of data needed prior to the expiration of the estimated 15-year mine life.

35. Pima County requests that all one-time effluent characterization as defined by Section 2.5.1 and Tables 15 and 16, be instead changed to regular periodic discharge monitoring. Pima County believes that a one-time effluent characterization for the PLS pond, Raffinate Pond, Reclaim Pond, and Primary Settling Pond is not sufficient. These ponds will be receiving leaching solution from (at least) 6 different pits over the course of the mine’s lifetime (40+ years). There should be continuous effluent characterization as is the case for other entities with APP permits, such as wastewater treatment facilities. Pima County recommends the same

parameters and frequency as prescribed in Tables 19 and Table 20 for groundwater monitoring. This approach is consistent with other types of industry with APP permits. Monitoring a facility's discharge is important to evaluate and identify potential problems early. Monitoring only the groundwater will only discover a problem after it's a problem.

Point of Compliance

36. Pima County is concerned about the limited extent of POC wells to monitor impacts to the aquifer from the Copper World mine. ADEQ has required the county to have POC wells up to 7 miles downstream of discharge locations of water reclamation facilities. For municipal landfills POC wells are also located down gradient, not just at the boundary of the solid waste facility. Yet proposed POC wells for Copper World are placed no farther than the perimeter of discharging facilities, such as TSF-1. Pima County requests that ADEQ review the GPS coordinates of POC1. The coordinates given in the draft permit indicate that this POC well is to be located on a parcel of land that is currently owned by the State of Arizona. Pima County requests additional west-side POC wells located farther downgradient from the outermost discharging facilities. There are dozens of domestic water wells downstream and less than five miles of discharging facilities, and with the Tucson Basin being a sole source aquifer, these drinking water resources must be protected.

37. Even if it is not an APP facility, the Pollutant Management Area for Copper World's Phase 1 should include the entire East Pit and the headwaters of small streams near the Broadtop Butte and Copper World pits to provide the best chance of detecting contaminants.

38. Pima County requests that POC wells around the TSFs be screened in both the alluvial and bedrock aquifers. It is not clear that the proposed screen intervals in Table 50-1 of the RAIS provides this opportunity, and the text elsewhere refers to screening only in the bedrock.

39. We share ADEQ's concern that POCs 7-10 may not be downgradient of the facilities. If the POCs remain as situated, we request post-installation verification be submitted to ADEQ. In particular, we suggest relocating the POC for Broadtop Butte away from a possible groundwater divide toward 31.84754 degrees North, 110.75290 degrees West.

40. Pima County requests two additional point of compliance wells be established to ensure that the east-side aquifer is not impaired by operations at the East Pit. The applicant has not shown that hydrologic sink conditions will exist during construction and the earliest phase of operations. The proposed location of the first well is on parcel 305-65-003K owned by Rosemont Copper and more specifically outside the Phase 1 pit at 31.83156 degrees North and 110.75103 degrees West. The second well is proposed on parcel 30561007H owned by Rosemont Copper at 31.82620 N and 110.76518 W outside both the Phase 1 and Phase 2 pits.

Monitoring Requirements

41. Pima County requests repeated water-quality monitoring of the stormwater collection galleries to ensure they are not capturing seepage during operation and post-closure of the Tailings

facility. Such stormwater monitoring is needed to ensure no contaminants are being discharged into downstream drainage systems.

42. Pima County requests biannual rather than biennial monitoring of the expanded list of parameters listed in Table 20. The more frequent monitoring will aid detection of pollutants that may otherwise go undetected too long and thereby delay an investigation and implementation of a remedy.

43. Pima County thanks ADEQ for inclusion of a Hydrologic Sink Monitoring Plan (CSI 16)at the East (Rosemont) Pit. However, as written the plan is not required until cessation of pit dewatering. Rather than at cessation of dewatering, Pima County requests that monitoring plan be submitted for ADEQ before issuance of the permit. Dewatering will begin during construction. ADEQ should be aware of how Hudbay plans to monitor the hydraulic sink before it becomes a hydraulic sink, as this is essentially an irreversible process. It is imperative that Hudbay has a plan in place before they single-handedly alter the hydrogeological characteristics of the area.

44. Pima County requests that ADEQ require Hudbay to monitor the volumes of pit dewatering and report this periodically to ADWR as well as ADEQ.

45. Pima County requests quarterly visual monitoring for areas of dry-weather seepage or ponding in natural wash bottoms around the tailing storage facilities to detect unauthorized discharges.

46. Pima County requests quarterly visual monitoring and reporting for areas of dry-weather seepage or ponding in perimeter ditches and inside backfilled pits.

47. The behavior of hydraulic sink will take time to establish. Therefore, there will be some period of time that the East Pit will be a discharging facility, and as such there must be POC wells established that are hydrologically downgradient of the Rosemont Pit and along the Backbone fault to verify the assumptions presented in the application by Hudbay. Monitoring must occur at these POC wells as required at all other POC wells. Additionally, these new POCs should be monitored even after the point at which the Rosemont Pit becomes a hydraulic sink and continually until the end of the post-closure period. See comment 33 above for some possible locations.

48. Pima County requests that a minimum frequency of waste rock acid content analysis be defined for continued operations following the first year. The Waste Rock Handling Plan (Appendix G.3 to the application) lists in Section 4.0 that “The minimum required testing is as follows: During the first year of operation: Once per month; or 500,000 tons of waste rocks mined.” There is no requirement listed in the plan for any waste rock analysis after the first year of the mine, and instead the document says that “testing will vary thereafter based on the trend that is identified and proven by our model.” Pima County recommends that a minimum frequency be required for analysis of waste rock even after the first year of operation. Each blasting pattern will produce approximately 250,000 tons of blasted material. Relating this back to the requirement in Appendix G.3, section 4.0, this would imply that a

waste rock will be analyzed for NAG, PAG, or AG material every other blasting, or every month, whichever is more.

Contingency Plan Requirements

49. In the event of dry-weather ponding or seepage being observed in washes on the perimeter of tailing storage facilities, efforts to monitor the discharge and correct drainage must be undertaken.

50. In the event of ponding in backfilled pits, we request additional back-filling with NAG waste rock.

Reporting and Record-Keeping

51. At 2.7.4.3. of the permit, ADEQ proposes to receive the annual hydrologic sink reports during post-closure. We request that the hydrologic sink reporting begin during construction and continue during any temporary cessations of operations. Longer-term trend analysis will facilitate understanding the evolution of the sink and be more protective of the sink condition.

Temporary Cessation

No comment.

Closure

52. Pima County requests that the soil cover be at least 1 meter on the TSF and the HLF, as this is the minimum thickness tested (tests were between 1-2 meters) in the 2017 Global Cover System Design Technical Guidance Document written by the International Network for Acid Prevention. Per Hudbay's response to Item 19 of the Feb 27, 2023 RAI, "Approximately 5 million cubic yards of growth media cover are needed for the HLF and TSFs." A quick calculation of the expected areas of the HLF, TSF-1, and TSF-2 provides a total area of approximately 1589 acres, or 7,690,760 square yards. These rough values indicate that Hudbay plans to cover the facilities with less than 2 feet of alluvium material. This is confirmed in Sections 16.2.3.2 and 16.2.4.4, in which Hudbay says the tops will receive an 18-inch soil cover, and the embankments will receive a 24-inch cover. Pima County questions the sources that determined that this is an appropriate amount of material to support growth of vegetation. It is understood that there will be some loss of the soil covering due to wind and precipitation, leaving even less material to support vegetative growth. As there are many potential goals when designing a soil covering of a waste pile, it is important to understand Hudbay's methodology in this effort in order to then understand whether their claim that 5 million cubic yards of growth media will be sufficient. If the thickness of the soil covering is too thin, then not only will the media not support vegetation establishment, but it will fail in its roles of contaminant migration and erosion control.

53. Hudbay says in Section 10.3.1.7 that "The waste rock [facility] will be revegetated directly without the placement of a soil cover." Pima county requests clarification and explanation as to how Hudbay plans to revegetate a pile of waste rock without any further soil amendments. With no soil, Hudbay will not achieve its ranching and wildlife habitat objectives for mine land

reclamation. Lack of cover on waste rock also exposes the material to more weathering and generation of seepage. Closure should include achieving a soil cover on the waste rock piles to support future uses for ranching and wildlife habitat.

54. Pima County shares ADEQ's concern that APP closure costs are underestimated. We are concerned about the adequacy of funding to obtain soil cover for reclamation of the two tailings facilities, the waste rock landforms, the backfilled pits, and the heap leach. The extant data provided demonstrate there is adequate soil cover for reclamation of only the tailings and heap leach. The closure costs do not include any funding for purchase and transport of any off-site soils needed to achieve a stable cover on the waste rock or backfilled pits. Pima County requests that ADEQ require the applicant demonstrate that adequate soil cover can be derived from on-site locations to achieve waste rock reclamation. If on-site soil cover is inadequate, closure costs should include off-site purchase and transfer costs for covering and closing the APP facilities.

Post-Closure

55. The 2023 Pre-Feasibility Study at page 20-5 notes that sulfate treatment cells are anticipated to be needed in post-closure period. Our preceding comments, if implemented, might be reduce the need for such, but given that Hudbay anticipates needing them under the current design, ADEQ should account for maintaining them in the permit.

Compliance Schedule

56. We request additions be made to the compliance schedule as needed to support the requests made in our preceding comments.

References and Pertinent Information

No comment.

Notification

See comment 19 regarding emergency notifications.