United States Department of the Interior
Fish and Wildlife Service
Arizona Ecological Services Office
9828 North 31st Avenue, Suite C3
Phoenix, Arizona 85051
Telephone: (602) 242-0210 Fax: (602) 242-2513

In reply refer to:
AESO/SE
Ecosphere # 2023-0090763

June 10, 2024

Kerwin S. Dewberry, Forest Supervisor
Coronado National Forest
ATTN: Hermosa Critical Minerals Project
300 West Congress Street
Tucson, Arizona 85701

RE: Notice of Intent to Prepare an Environmental Impact Statement for the Hermosa Critical Minerals Project and Mine Plan of Operations, Santa Cruz County, Arizona

Dear Mr. Dewberry:

The U.S. Fish and Wildlife Service (Service) appreciates this opportunity to comment on the USDA Forest Service Coronado National Forest notice of intent to prepare an Environmental Impact Statement (EIS) for the authorization of the Hermosa Critical Minerals Exploration and Mine Plan of Operations (MPO). The purpose of the proposed mine is to expand operations of an underground polymetallic development. The Forest Service (FS) is the lead federal agency for this project, through the issuance of a final Record of Decision.

The Service is submitting these scoping comments to assist with identification of issues that may involve potential effects to Endangered Species Act (ESA)-listed species and their habitats caused by implementing the proposed action, and that therefore may warrant analysis in the EIS and/or possible adjustments or alternatives to the mine plan (40 CFR 1501.8, 43 CFR 46.230).

The Service is available to fulfill our role as a cooperating agency and to work through the ESA Section 7 Consultation process once a preferred alternative is in place. We recognize that at the scoping level within the NEPA process, all the necessary information to evaluate effects is not yet available. The Service is also available to assist in identifying information needed for the EIS and for the ESA consultation. The early coordination and consultation process is ongoing and as a cooperating agency we are providing input at this time of scoping to help identify issues early in the scoping process.

Issues

Habitat removal and fragmentation, noise and vibration, lighting, groundwater pumping and depletion, water discharge and pollution, dust (including dust from surface soil disturbance and fugitive dust from tailings), and vehicular traffic are stressors that may have negative impacts to listed species and their habitats. The overall mine operations described in the MPO are anticipated to occur for 24 hours per day, 365 days per year for the duration of the (approximately 80-year) span of expected mining operations, which could lead to pervasive and long-term effects to species. The threatened, endangered, and candidate species expected in the project area include the following 15 species: jaguar (*Panthera onca*), ocelot (*Leopardus pardalis*), Mexican grey wolf (*Canis lupus baileyi*), Mexican spotted owl (*Strix occidentalis lucida*), western yellow-billed cuckoo (*Coccyzus americanus*), Chiricahua leopard frog (*Rana chiricahuensis*), Sonoran tiger salamander (*Ambystoma tigrinum stebbinsi*), northern Mexican gartersnake (*Thamnophis eques megalops*), monarch butterfly (*Danaus plexippus*), Gila topminnow (*Poeciliopsis occidentalis*), Gila chub (*Gila intermedia*), beardless chinchweed (*Pectis imberbis*), Bartram's stonecrop (*Graptopetalum bartramii)*, Huachuca water-umbel (*Lilaeopsis schaffneriana* var. *recurva*), Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*), plus the recently delisted lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*). Each of the stressors identified above is discussed below in individual sections. We recommend a full analysis of these stressors on the threatened and endangered species and associated critical habitats within the project area.

Habitat Removal and Fragmentation

Temporary disturbance is estimated at 121.3 acres and encompasses multiple wells, drill pads, Rapid Infiltration Basins (RIBs), and roads, with permanent disturbance affecting 336.3 acres, including the Tailing Storage Facility 2 (TSF2) footprint adjacent to the mine footprint (236 acres) and the construction of a Primary Access Road on FS land (7.5 miles long with a typically 100-foot corridor).

More than 450 acres of disturbance will result in habitat removed for Mexican spotted owl, jaguar, and western yellow-billed cuckoo critical habitat. We recommend analysis of these impacts for these threatened and endangered species and their critical habitats.

The project footprint contains a population of beardless chinchweed (estimated at 25 plants) that was recently discovered during biological surveys. There are 6 U.S. populations of beardless chinchweed and 5 of the 6 extant beardless chinchweed populations contain fewer than 50 individuals. Population loss due to such a mining action may result in effects to this species due to small population sizes and lack of ecological resiliency. Given the small number and small sizes of beardless chinchweed populations, we request full analysis of the possible impacts and coordination with the Service to identify avoidance and minimization measures for this population.

Noise, Vibration, and Light

There are numerous activities described in the MPO that create substantial noise and ground vibration for continued lengths of time, including: construction and maintenance of roads and drilling pads; drilling and testing of 50 wells, mostly exploration wells with each exploration having the capacity to have up to 10 boreholes drilled; geotechnical investigation including 17 boreholes; possible seismic refraction testing for Primary Access Road construction; surface blasting, explosives, and drilling during mine operations; ore processing involving crushing; ongoing noise from generators; and increased traffic in the forest (estimated 295 roundtrips per day). These sources of noise and ground vibration may have effects to listed species and we request a full analysis of possible impacts.

Specifics regarding lighting are not detailed in the MPO, but the project is likely to emit a large amount of light. Publicly available satellite imagery information (https://lighttrends.lightpollutionmap.info/) shows the current mine site to already have higher light radiance than the town of Patagonia.

A thorough analysis of the levels of noise, vibration, and light resulting from mine operations, including how these factors vary with distance and over time and the likely responses of species, is necessary because these continuous and long-lasting environmental stressors may have effects to listed species.

Groundwater and Surface Water Quantity

The Service is concerned about the effects to wildlife, plants, and habitat from surface water loss due to groundwater drawdown. Water in the mountain aquifer beneath the surface of the mine would have to be removed to a depth of at least 4,600 feet below the surface were it to be cleared from the deepest targeted ores. The associated drawdown in surrounding areas (the cone of depression) might be predicted with hydrological groundwater modeling. There is also uncertainty about long-term potential changes in hydrology due to an altered fractured bedrock system backfilled with impermeable tailing cement paste.

The EIS should include an analysis of streams, springs, and seeps across the local watersheds and determine how the predicted groundwater drawdown will affect these surface waters and whether surface-water-sourced features will become dewatered as water infiltrates more rapidly due to a lack of groundwater. Analysis is needed to understand how drawdown will impact associated plant communities and habitats, including upland and riparian areas, as the loss of vegetation equates to loss of habitat for species. Effects of drying and increased fire risk and invasive non-native vegetation should also be analyzed. Changes to groundwater and surface water quantity may have effects to listed species and we request a full analysis of possible impacts.

Groundwater and Surface Water Quality

The tailings generated during the processing of the sulfide ores would be stored in a lined, dry-stack facility, TSF2, with stormwater and seepage collected downhill from it in a large collection pond (UDCP, under drain collection pond). TSF2 has a planned 236-acre footprint on FS land

and will be 300 feet tall with the capacity to store up to 26.2 million cubic yards of tailings. In general, tailings generated during the processing of sulfide ores could pose a substantial risk to water resources because of their ability to leach sulfuric acid and release heavy metals and sulfates into the environment (Lindsay et al. 2015; Furnell et al. 2022). The dewatered tailings would contain potential acid generating (PAG) waste rock. They would also hold the left-over reagents that were mixed in during the sulfide beneficiation and flocculants that were used to help separate water out. The geochemical stability of dry-stacked tailings of sulfide ores as well as local methods to manage for intense rains require analysis in terms of potential threats to water quality. The MPO states that TSF2 will be armored with non-potentially acid generating rock (NPAG sections 2.5.7.4, 3.4.3 WQ3, 5.3.3.2, etc.). More information and analysis are needed to understand when and how this could be accomplished. The buried TSF2 will likely remain in the environment long after the mine operations are concluded and the mine is closed, and we are concerned about the long-term water quality of the drainage downstream of the TSF2. Chemical byproducts entering and persisting in the natural system may have effects to listed species and we request a full analysis of possible impacts.

Approximately 50% of the tailings filter cake will be directed to a paste plant where it will be mixed with thickener and cement binder to make cemented paste backfill. This mixture would be used to fill completely mined stopes to minimize the possibility of subsidence. An estimated 50 million metric tons of tailings would be stored underground with this method (MPO 2.5.7.1.1). Analysis is needed to understand the long-term effects of stoping and cement paste backfilling to groundwater quality and quantity.

We would also appreciate information on how metals leached from the underground Hermosa Mine workings contaminate groundwater as the water table rises after mine closure, and if the development of Hermosa Mine will increase the potential for groundwater contamination from the mine drainage from the abandoned mines in the area.

Harshaw Creek is identified in the MPO as the receiving stream for up to 4,200 gallons per minute of treated mine wastewater which is being discharged from Water Treatment Plant 2 (WTP2) from an outfall on private land just upstream of the border of the National Forest land. This water that is treated at WTP2 and then discharged will also include water from other mine operations-related wastewater sources, not only the groundwater. Listed species could be chronically affected by the Harshaw Creek discharge water, even if the water samples taken from the outfall pipe are in compliance with the state permit. We request an analysis of changes in the aquatic ecosystem due to produced water discharge to support analyses of potential effects to listed species and their supporting natural communities.

The natural flow in Harshaw Creek is small, intermittent or ephemeral, fluctuating according to natural cycles, and is perennial only on one reach. Discharge resulting from mine operations will greatly alter the annual hydrograph of Harshaw Creek. Increased and sustained artificial flow into channels that are limited in their capacity to handle perennial discharge can lead to substantially increased bank and streambed erosion, turbidity/sediment suspension, and downstream sediment deposition. The aquatic macroinvertebrate community that inhabits the creek is adapted to the natural cycles in flow and water chemistry (seasonal, diel) typical of such a small stream in an arid environment. The life history strategies of aquatic organisms evolved in

the context of natural flow regimes (Bunn and Arthington 2002), and the life cycles of many species are timed to benefit from (or avoid) natural changes in flow (Poff et al. 1997). We request an analysis of the effects of changing water chemistry and flow regimes to the biotic community to support analyses of potential effects to listed species and their critical habitats.

The Service has concerns about the quantity and quality of water remaining available to wildlife and plants in the streams of this historically mined area, in addition to the impacts on wildlife and listed species from consumption of, or interaction with, waters that are contaminated as a result of mine operations. Flowing streams are rare in the Southwest, and during drought water sources diminish and their contents become more concentrated, potentially having more potent effects to species. There is evidence that Alum Gulch and Flux Canyon are impacted by historical mine inputs causing extremely low pH and elevated metals (Eddleman 2012). Wildlife may use whatever water is available, but the impacts on their long-term health from ingestion water of poor quality (such as acidified or with elevated metals) are not well understood. The Service requests an analysis of the long-term effects of contaminated water to habitats and water sources and how this could affect trust resource species and their prey.

Dust

The Service has concerns about the effects of project-generated dust (including dust from construction, traffic, and a drying landscape, in addition to toxic fugitive dust from ore processing and tailing stacks) to listed species and their habitats. Levels of dust particles from mining ore and waste materials can be elevated in metals and other contaminants, which then have the potential to harm flora and fauna that contact or ingest them via many pathways.

Potential sources of dust from the project include (but are not limited to): land clearing and road construction; mine dewatering and lowering of the water table that may contribute to the drying out of soils, which can generate dust (and lead to increased sedimentation and turbidity in waterways); high volumes of traffic on dirt roads; handling and crushing of ore; and the interactions of the tailing stacks TSF2 (and TSF1) with the environment (and the trucks and other equipment that move on the surface of it). The extent and effects of each of these should be analyzed in the EIS and minimization methods considered.

Fugitive mining dust can pollute waterways, not only by increasing turbidity but also by depositing contaminants such as metals into the waterway. Many metals tend to build up in the sediments of stream channels over time. The Service requests further analysis of the bioaccumulation of metals in individuals and the capacity for biomagnification up the food chain over time.

All species likely would be affected by dust, but we have particular concerns about the Bartram's stonecrop. The Primary Access Road would undergo construction along stretches of Flux Canyon and Alum Gulch, which, as of the last complete count in 2014, contained 123 and 52 adult individuals, respectively. We are concerned that the dust or debris from that road construction may enter the stream area where the Bartram's stonecrop are located. Additionally, if contamination of individuals by heavy metals and/or fugitive dust generated by mining operations occurs, plant growth and vigor may be reduced as a result of changes in physiological

and biochemical processes (e.g., photosynthesis, respiration, transpiration, water use efficiency, leaf conductance, growth rate, vigor, and gas exchange) and reduced pollination (Phillips et al. 1982, Chibuike and Obiora 2014, Ferguson 2014, Waser et al. 2017).

Traffic

The MPO estimates 295 roundtrips per day during peak mining operations with 231 being large trucks or buses. There will also be increased use on about a dozen Forest Service roads, some of which will be upgraded, and on additional temporary access roads (long-term and short-term) to be constructed. Aside from introducing noise, human presence, dust, and volatile organic compounds into the wilderness, these increased traffic levels increase the chance of harm or vehicular mortality to listed species individuals (and their prey).

Response to Existing Environmental Protection Measures

The MPO Chapter 3 provides the environmental protection measures implemented or planned to reduce or eliminate adverse effects on resources that may result from Plan Operations on NFS land. We appreciate the design elements that create less direct habitat removal, habitat fragmentation and risk of traffic/wildlife conflicts such as MPO 3.7.4 FW1 (TSF2 Siting close to existing disturbance), FW3 (Underground mining), and FW4 (Use of lined dry-stack tailings).

Siting TSF2 out of drainages (MPO 3.7.4 FW2). The Service is concerned about the placement of TSF2 in terms of affects to drainages. While we understand the advantages to the location (proximity to mine, containment topographically, distance from public and residences), we request further discussion regarding statements that TSF2 was sited to avoid dredge and fill of surface water features, reducing potential impacts to habitat. The selected location is at the top of an apparently productive intermittent stream which is an important source of water and habitat for wildlife in the area. In an arid region like southern AZ, intermittent and ephemeral streams are vital to local hydrology and support biodiversity (Acuña et al. 2017). Given the historical mining in the area, this stream (referred to as the Greater Silver drainage) may be one of the few clean freshwater streams remaining in the area. Nearby Alum Gulch and Flux Canyon are highly acidic, have elevated metals, and are classified as impaired by the state. TSF2 and its seepage collection pond also appear to be in western yellow-billed cuckoo breeding habitat (WestLand Engineering & Environmental Services, 2024) and may bury one of the few small extant populations of beardless chinchweed in the U.S. The Service requests further discussions about TSF2.

Water management, recycling, and filtration and use of RIBs (MPO 3.7.4 FW6 and FW7). Water is filtered and recycled within the project (MPO Figure 2-18). Water treatment is completed before the water is returned to the environment. Discharge is into Harshaw Creek, Alum Gulch, or into RIBs, but the amount, locations, and depth of recharge are unknown, as is the effect on the hydrological cone of depression. Our current understanding regarding the discharge into Harshaw Creek is that most of it may not infiltrate into the ground/groundwater until it reaches the deep basin fill, which is deep alluvium around Patagonia and Sonoita Creek. We have not seen formal information regarding the recharge outcome; however, we understand

the groundwater model for the project is still under review and the Service looks forward to continued discussions on this important topic.

To actively recharge regional groundwater in key areas to reduce drawdown effects and potential impacts on groundwater-dependent ecosystems, some of the treated groundwater may be transported to RIBs. It is not clear whether all the water placed in the RIBs is returned to the aquifer it originated from (or some flows underground into an adjacent sub-basin). Visual presentation from the modeling may be helpful. The Service is interested in discussing the use of additional, perhaps smaller, strategically located RIBs integrated into the hydrology and ecosystem of the Forest to achieve an even broader distribution of recharge locations while providing surface water to wildlife in a manner similar to the functions provided by tanks.

Biodiversity management (MPO 3.7.4 FW9A-FW9G). The Service appreciates the inclusion of FW9A-FW9G and believes they are good first steps to identify measures to avoid or minimize impacts to sensitive fish and wildlife resources from the Hermosa Critical Minerals mine project. However, the Service believes they are not yet clearly defined or fully developed. Descriptive details of these important avoidance, minimization, and mitigation measures will be critical for the Service's consultation and analysis. Regarding the ongoing monitoring of baseline conditions prior to operations, given the ongoing history of Hermosa Mine, the current conditions in the area are still dynamic and effects to wildlife resources are likely already occurring in the project area. To fully analyze effects to species and habitats, the Service is interested in survey data conducted prior to mine activity on the private land where the mine is now installed, or any information regarding changes in wildlife, especially sensitive species, that have been observed prior to mining activity.

The Service looks forward to discussions on avoidance, minimization, and mitigation measures that will address the potential impacts of mine construction and operations on listed species and habitats (some of which are outlined in the Issues section). We are encouraged to build on South32's sustainability standards in these discussions. As stated in the MPO (3.7.4 FW9), South32 Hermosa has policies that call for evaluating potential impacts to biodiversity and identifying controls and best management practices to avoid, minimize, rehabilitate, and offset those impacts as well as goals of preventing long-term loss of biodiversity.

Reclamation practices (MPO FW10). We support the methods for seeding in accordance with Coronado National Forest guidelines, along with monitoring, reporting, and treatment for removal of non-natives or invasives. We also agree that concurrent reclamation (i.e., performing reclamation where practicable during operations) would not only reduce impacts to ecosystems, but also help to restore species and prey habitat as quickly as possible. South32 plans to conduct concurrent reclamation where practicable during operations to restore habitat sooner for cover and prey species. The Service would like to discuss whether concurrent reclamation could potentially also be applied underground to restore hydrology.

Mitigation

Research has shown that effects of individual stressors can be altered in complex and sometimes surprising ways in the presence of other stressors (Paine et al. 1998), and these factors are all

likely to be affected further by climate change. There are many possible ways to mitigate adverse effects. The Service has a long-standing practice of working with federal action agencies and applicants to incorporate voluntary conservation measures into their proposed actions through technical assistance, informal consultation, participating as a cooperator in the NEPA process, participating in section 7 Level 1 meetings, and Habitat Conservation Plans, as applicable. Partnering in mitigation would also be aligned with South32's own internal standards regarding nature and biodiversity. **"***We recognise the importance of protecting biodiversity and ecosystem services and aim to achieve no net loss for all new projects and major expansions. It is our responsibility to minimise the impacts to the environment and to rehabilitate land disturbed by our activities"* (https://www.south32.net/sustainability/environment/biodiversity). The MPO (section 1.3.2) puts forth that the project design and operations at the Hermosa mine will *"represent a new generation of modern mining*" and will follow South32's Sustainability Policy (South32 2022a) (MPO 1.3.2 and 3.2). The general commitments complement the International Council on Mining and Metals (ICMM) Sustainable Development Principles and Performance Expectations (MPO 3.2, https://www.icmm.com/en-gb/our-principles/mining-principles/mining-principles#ftn10).

The biodiversity policies and principles held by ICMM and Hermosa can align with the Service's policies. We expect effects to listed species from the proposed action will be mitigated to the greatest extent possible. Under the Service's mitigation policy (USFWS 2023a), mitigation includes: avoiding the impact altogether by not taking the action or parts of the action; minimizing the impact by limiting the degree or magnitude of the action and its implementation; rectifying the impact by repairing, rehabilitating, or restoring the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and compensating for the impact by replacing or providing substitute resources. As a practical matter, the mitigation elements are categorized into three general types: avoidance, minimization, and compensatory mitigation for remaining unavoidable (also known as residual) impacts. Compensatory mitigation means "compensation or offsets for remaining unavoidable impacts after all appropriate and practicable avoidance and minimization measures have been applied, by replacing or providing substitute resources or environments through the restoration, establishment, enhancement, or preservation of resources and their values, services, and functions" (USFWS 2023b).

Closing

In conclusion, the Service looks to the South32 Hermosa project to set a new standard for protection of species, habitat, and biodiversity in critical mineral mining. We seek the conservation, protection, and enhancement of biodiversity for listed species in the project area and the support of ecosystem services. For a project of this importance and size, with significant potential for adverse environmental impacts in a biologically rich (diverse) and sensitive area, we believe there are additional opportunities for mitigation, beyond those proposed in the MPO. We seek complete and thorough analyses of effects to species and their habitats in the EIS, but moreover, planning in the alternative(s) that results in meaningful mitigation and addresses the issues outlined above. Innovative thinking has been demonstrated in work South32 and other companies have done, such as eradication of invasive species, cleaning up old mining leakage, and many other examples from the ICMM website (https://nature.icmm.com/working-for-

nature/articles/what-is-no-net-loss). We believe the goal of ICMM (that South32 has adopted) to "*assess and address risks and impacts to biodiversity and ecosystem services by implementing the mitigation hierarchy, with the ambition of achieving no-net-loss of biodiversity*" (https://www.icmm.com/en-gb/our-principles/mining-principles/mining-principles#ftn10) is aligned with the U.S. Fish and Wildlife Service process, and we can offer technical assistance to achieve those goals.

The Service continues to prefer that the federal action agency (and applicant) work with us early in the consultation process to ensure that the proposed action includes conservation measures that benefit or promote the recovery of listed species and that avoid, minimize, or compensate for effects to listed species and designated critical habitat. We believe the best time to achieve goals protecting biodiversity is now, in the project planning. We invite you and the proponent to meet with us to collaborate on identifying ways to reduce the environmental impacts on wildlife and habitat, particularly listed species, within the project to meet Federal regulations under the ESA. The Service has already engaged with the FS with our ESA-related letter of March 15, 2024. We look forward to continuing to work with you in this process.

Thank you for your continued coordination and commitment to conservation of threatened and endangered species. We are available to meet to discuss our comments. Please refer to project number, 2023-0090763 in future correspondence concerning this project. Should you require further assistance or if you have any questions, please contact Erin Fernandez (erin_fernandez@fws.gov) or Keli Kringel (keli_kringel@fws.gov) of the Arizona Ecological Services Office.

Sincerely,

HEATHER WHITLAW

Digitally signed by HEATHER WHITLAW
Date: 2024.06.10 17:37:33 -07'00'

Heather Whitlaw,
Field Supervisor

cc:
Deputy Forest Supervisor, Coronado National Forest
Natural Resources Staff Officer, Coronado National Forest
Environmental Coordinator, Coronado National Forest
Wildlife, Fish, and Rare Plants Program Manager, Coronado National Forest
National Hydropower Program Coordinator, U.S. Fish & Wildlife Service
Environmental Review Section 1, Environmental Protection Agency
Senior Regulatory Program Manager, U.S. Army Corps of Engineers
Gila District Manager, Bureau of Land Management
Environmental Planning Lead, Customs and Border Protection
Manager, Cultural Affairs, Tohono O'Odham Nation
Director, Natural Resources Department, Tohono O'Odham Nation
Tribal Historic Preservation Officer, Pasqua Yaqui Tribe
Director, Natural Resources, Pasqua Yaqui Tribe
Director, Cultural Preservation Office, Hopi Tribe

Director, Natural Resources Department, Hopi Tribe
Director, Arizona Game and Fish Department
Air Quality Division Unit Manager-Permits, Arizona Department of Environmental Quality
Water Quality Division Unit Manager-Permits, Arizona Department of Environmental Quality
Chief of Operations, San Rafael Natural Area, Arizona State Parks
Hermosa EIS Record
South32 Project Manager, Hermosa Mine

Literature Cited

Acuña, V., M. Hunter, and A. Ruhí. 2017. Managing temporary streams and rivers as unique rather than second-class ecosystems. Biological Conservation 211:12–19.

Bunn S., and A. Arthington. 2002. Basic principles and ecological consequences of altered flow regimes for aquatic biodiversity. Journal of Environmental Management 30(4):492–507.

Chibuike G., and S. Obiora. 2014. Heavy metal polluted soils: Effect on plants and bioremediation methods. Applied and Environmental Soil Science. 12 pp.

Eddleman, K. 2012. Bioaccumulation of heavy metals from soils to plants in watersheds contaminated by acid mine drainage in SE Arizona. M.S. Thesis, Department of Chemistry and Biochemistry, University of Arizona. 197 pp.

Ferguson, G. 2014. *Graptopetalum bartramii* habitat assessment and census inventory in Arizona, 2013-2014; selected populations on Coronado National Forest and adjacent lands. A report submitted to the United States Forest Service. Contract AG-8197-P-13-0029. 76 pp.

Furnell E., K. Bilaniuk, M. Goldbaum, M. Shoaib, O. Wani, X. Tian, Z. Chen, D. Boucher, and E. Bobicki. 2022. Dewatered and stacked mine tailings: a review. ACS ES&T Engineering 2(5):728-745.

Lindsay, M., M. Moncur, J. Bain, J. Jambor, J. Ptacek, and D. Blowes. 2015. Geochemical and mineralogical aspects of sulfide mine tailings. Applied Geochemistry 57:157-177.

Paine, R., M. Tegner, and E. Johnson. 1998. Compounded perturbations yield ecological surprises. Ecosystems 1(6):535–545.

Phillips, A., B. Phillips, N. Brian, J. Mazzoni, and L. Green. 1982. Status report on *Graptopetalum bartramii* Rose. Report by the Museum of Northern Arizona for the Office of Endangered Species, Fish and Wildlife Service. 15 pp.

Poff , N., J. Allan, M. Bain, J. Karr, K. Prestegaard, B. Richter, R. Sparks, and J. Stromberg. 1997. The natural flow regime. Bioscience 47(11):769–784.

South32. 2022a. Sustainability Policy. Available at: https://www.south32.net/docs/default-source/generallibrary/corporate-governance/2017/sustainability-policy-(english).pdf?sfvrsn=31407225_23. Accessed May 2023.

U.S. Fish and Wildlife Service (USFWS). 2023a. Mitigation Policy Appendix 1, 501 FW 2, May 2023. https://www.fws.gov/policy-library/A1501fw2.

U.S. Fish and Wildlife Service (USFWS). 2023b. Endangered Species Act Compensatory Mitigation Policy Appendix 1, 501 FW 3, May 2023, as amended July 3, 2023. https://www.fws.gov/sites/default/files/policy/pdfs/FWS-ESA-Compensatory-Mitigation-Policy-amend_1.pdf

Waser, N., M. Price, G. Casco, M. Diaz, A. Morales, and J. Solverson. 2017. Effects of road dust on the pollination and reproduction of wildflowers. International Journal of Plant Science. 178(2):85-93.

WestLand Engineering & Environmental Services. 2024. Presentation: ESA Species Baseline for the South32 Hermosa, Inc. Critical Minerals Exploration and Mine Plan of Operations and UNS Electric, Inc. Rio Rico to Harshaw138KV Transmission Line Project (NSF Land).