



United States Department of Agriculture

DRAFT Environmental Impact Statement Resolution Copper Project and Land Exchange



Forest Service

Tonto National Forest

MB-R3-12-07

Volume 1

August 2019

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotope, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at http://www.ascr.usda.gov/complaint_filing_cust.html and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by:

- (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410;
- (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

USDA is an equal opportunity provider, employer and lender.

Front Cover photo captions:

Top: Oak Flat Federal Parcel;

Bottom Left: Oak Flat Federal Parcel;

Bottom Right: Headframe of Shaft 10 at East Plant Site

Back Cover photo captions:

Top left: Shaft 9 and 10 at East Plant Site;

Top center: MARRCO corridor;

Top right: Picket Post mountain;

Bottom left: Oak Flat Federal Parcel ;

Bottom right: Overlooking West Plant Site, Town of Superior and Picket Post mountain

Resolution Copper Project and Land Exchange

DRAFT

Environmental Impact Statement

Pinal County, Arizona

August 2019

LEAD AGENCY:

USDA Forest Service

**COOPERATING
AGENCIES:**

Arizona Department of Environmental Quality, Arizona Department of Water Resources,
Arizona Game and Fish Department, Arizona State Land Department, Arizona State
Mine Inspector, Bureau of Land Management, Pinal County Air Quality Control District,
U.S. Army Corps of Engineers, U.S. Environmental Protection Agency

**RESPONSIBLE
OFFICIAL:**

Neil Bosworth, Forest Supervisor
2324 East McDowell Road, Phoenix, AZ 85006

**FOR INFORMATION,
CONTACT:**

John Scaggs, Public Affairs Specialist
2324 East McDowell Road, Phoenix, AZ 85006

ABSTRACT: The purpose of and need for the environmental impact statement includes evaluating the impacts associated with approval of a mine plan, and considering the effects of the exchange of lands between Resolution Copper Mining, LLC, and the United States as directed by Section 3003 of the Carl Levin and Howard P. ‘Buck’ McKeon National Defense Authorization Act for Fiscal Year 2015 (NDAA).

The analysis includes six alternatives: the proposed action, which calls for a new underground mine underneath Oak Flat east of Superior, Arizona, and a tailings storage facility on National Forest System (NFS) lands west of Superior; a no action alternative under which neither the land exchange nor the mine plan would be authorized; an alternative that would allow a modified tailings disposal method at the same Near West tailings storage location as proposed; an alternative that would allow filtered tailings to be stored at another location on NFS lands north of Superior; and two alternatives that would not allow tailings to be stored on NFS lands, but on other agency or private lands. The scoping process identified water quantity, water quality, public health and safety, cultural resources, tribal concerns, and recreation as significant issues.

It is important that reviewers provide their comments at such times and in such a way that they are useful to the Agency’s preparation of the EIS. Therefore, comments should be provided prior to the close of the comment period and should clearly articulate the reviewer’s concerns and contentions. The submission of timely and specific comments can affect a reviewer’s ability to participate in subsequent administrative review or judicial review. Comments received in response to this solicitation,

including names and addresses of those who comment, will be part of the public record for this proposed action. Comments submitted anonymously will be accepted and considered; however, anonymous comments will not provide the respondent with standing to participate in subsequent administrative or judicial reviews.

Send Comments To:

Resolution Copper EIS

P.O. Box 34468

Phoenix, AZ 85067-4468

Date Comments

November 7, 2019

Must Be Received:

Executive Summary

ES-1 INTRODUCTION

This executive summary provides an overview of the draft environmental impact statement (DEIS) for the proposed Resolution Copper Project and Land Exchange (herein called the project). The purpose of the DEIS is to describe the process undertaken by the U.S. Forest Service (Forest Service), a land management agency under the U.S. Department of Agriculture, to evaluate the predicted effects of and issues related to the submittal of a mining General Plan of Operations (GPO) by Resolution Copper Mining, LLC (Resolution Copper), along with a connected, legislatively mandated land exchange of Federal and private parcels in southeastern Arizona (figure ES-1).

This Executive Summary does not provide all details contained in the DEIS. Please refer to the DEIS, its appendices, or referenced reports for more information. The DEIS and supporting documents are available on the project website at <https://www.ResolutionMineEIS.us/>.

ES-1.1 Background

Resolution Copper proposes developing an underground copper mine on unpatented mining claims on National Forest System (NFS) land near the town of Superior in Pinal County, Arizona, approximately 60 miles east of Phoenix. Resolution Copper is a limited liability company that is owned by Rio Tinto (55 percent) and BHP (45 percent). Rio Tinto is the managing member.

Resolution Copper has ties to the century-old Magma Mine located in Superior, Arizona. The Magma Mine began production in 1910. In addition to constructing substantial surface facilities in Superior, the Magma Mine created approximately 42 miles of underground workings.

In 1995, the Magma Copper Company discovered a copper deposit about 1.2 miles south of the Magma Mine through exploration of those underground workings. The ore deposit lies between 4,500 and 7,000 feet below the surface.

In 1996, BHP Copper, Inc., acquired the Magma Copper Company, along with the Resolution Copper Mine deposit. Later that year, BHP

closed operations at the Magma Mine, but exploration of the copper deposit continued.

In 2001, Kennecott Exploration, a subsidiary of Rio Tinto, signed an earn-in agreement with BHP, and initiated a drilling program to further explore the deposit. Based on drilling data, officials believe the Resolution Copper Mine deposit to be one of the largest undeveloped copper deposits in the world, with an estimated copper resource of 1,970 billion metric tonnes at an average grade of 1.54 percent copper.

The portion of the Resolution Copper Mine deposit explored to date is located primarily on the Tonto National Forest and open to mineral entry under the General Mining Law of 1872. The copper deposit likely extends underneath an adjacent 760-acre section of NFS land known as the “Oak Flat Withdrawal Area.” The 760-acre Oak Flat Withdrawal Area was withdrawn from mineral entry in 1955 by Public Land Order 1229, which prevented Resolution Copper from conducting mineral exploration or other mining-related activities. Resolution Copper pursued a land exchange for more than 10 years to acquire lands northeast of the copper deposit.

In December 2014, Congress authorized a land exchange pending completion of the environmental impact statement (EIS), as outlined in Section 3003 of the Carl Levin and Howard P. ‘Buck’ McKeon National Defense Authorization Act for Fiscal Year 2015 (NDAA) for fiscal year 2015. The exchange parcel to be conveyed to Resolution Copper includes not only the Oak Flat Withdrawal Area but also the NFS lands above which the copper deposit is located. This collective 2,422-acre tract of land is known as the “Oak Flat Federal Parcel.”

ES-1.2 Project Overview

Resolution Copper is proposing to develop an underground copper mine at a site in Pinal County, about 60 miles east of Phoenix near Superior, Arizona. Project components include the mine site, associated infrastructure, a transportation corridor, and a tailings storage facility.

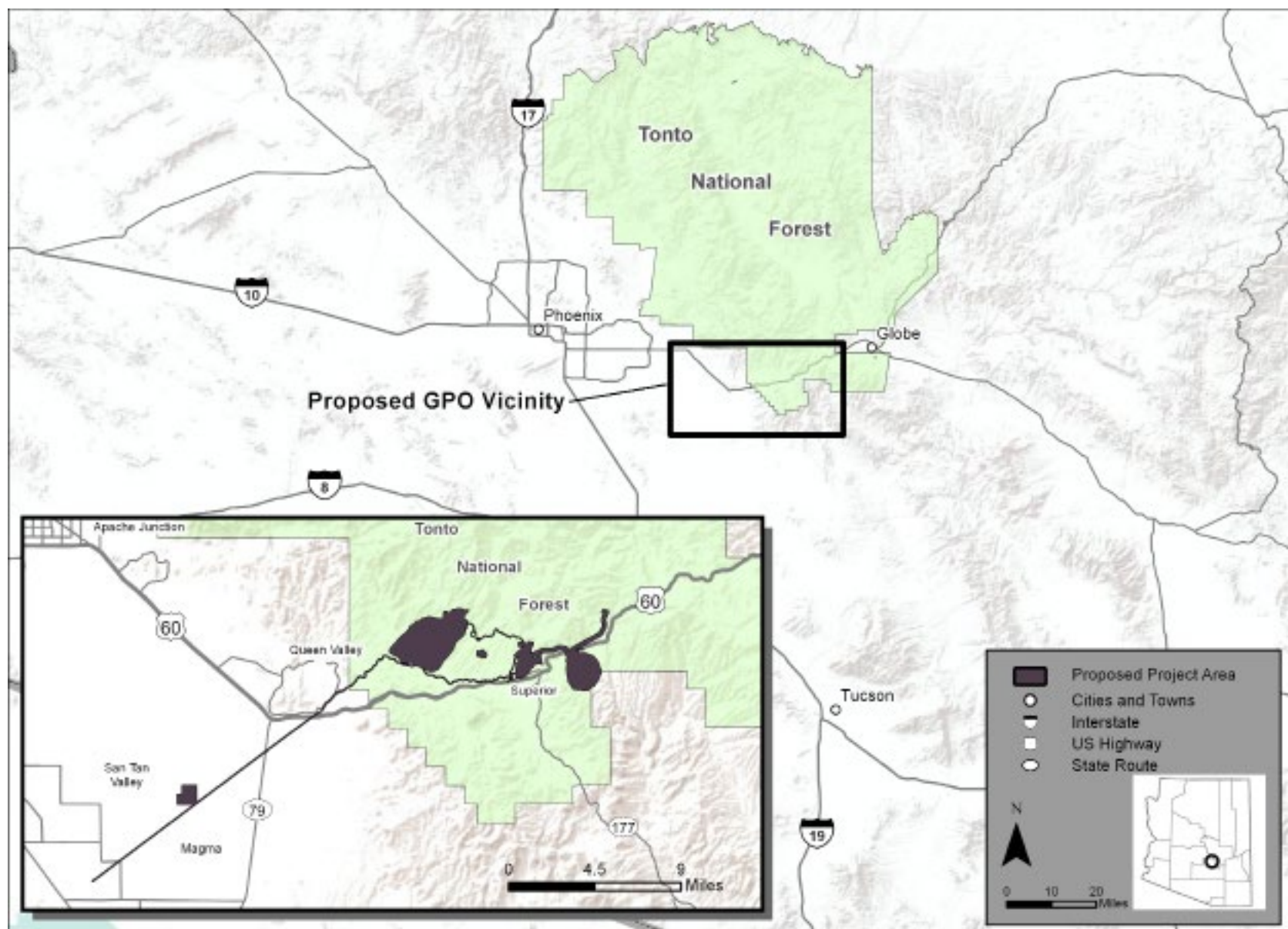


Figure ES-1. Resolution Copper Project vicinity map

The project would progress through three distinct phases: construction (10 years), operations, also referred to as the production phase (40–50 years), and reclamation (5–10 years). At the end of operations, facilities would be closed and reclaimed in compliance with permit conditions.

Operational projections are removal of 1.4 billion tons of ore and production of 40 billion pounds of copper using a mining technique known as panel caving. Using this process, a network of shafts and tunnels is constructed below the ore body. Access to the infrastructure associated with the panel caving would be from vertical shafts in an area known as the East Plant Site, which would be developed adjacent to the Oak Flat Federal Parcel. This area would include mine shafts and a variety of surface facilities to support mining operations. This area currently contains two operating mine shafts, a mine administration building, and other mining infrastructure. Portions of the East Plant Site would be located on NFS lands and would be subject to Forest Service regulatory jurisdiction. Ore processing would take place at the old Magma Mine site in Superior.

Construction of a tailings storage facility would house the waste material left over after processing. The facility footprint would occupy from 2,300 to 5,900 acres, depending on the location and embankment design. Pipelines would be constructed to transport the tailings waste from the ore processing facility to the tailings storage facility.

The estimated total quantity of external water needed for the life of the mine (construction through closure and reclamation) is substantial and varies by alternative (180,000 to 590,000 acre-feet). Resolution Copper proposes to use water either directly from the Central Arizona Project (CAP) canal and/or groundwater pumped from the East Salt River valley. Over the past decade, Resolution Copper has obtained banked water credits for recharging aquifers in central Arizona; the groundwater pumped would be recovery of those banked water credits, or groundwater use authorized by the State of Arizona under a mineral extraction withdrawal permit.

While all mining would be conducted underground, removing the ore would cause the ground surface to collapse, creating a subsidence area at the Oak Flat Federal Parcel. The crater would start to appear in year 6

of active mining. The crater ultimately would be between 800 and 1,115 feet deep and roughly 1.8 miles across. The Forest Service assessed alternative mining techniques in an effort to prevent subsidence, but alternative methods were considered unreasonable.

The workforce during construction/ramp-up is expected to peak at 2,600 personnel in Pinal County and another 1,900 in other areas. During operations, the project would employ an average of approximately 1,900 people annually in Pinal County and another 1,800 in other areas. During the reclamation phase, employment is projected to be 1,700 in Pinal County and 1,300 in other areas.

ES-1.3 Areas of Controversy

The Resolution Copper Project and Land Exchange is controversial for several reasons.

Foremost among them are the expected significant environmental impacts and loss of the Oak Flat area, historically used by Native Americans who hold the land as sacred and use the area for spiritual and traditional uses. Additionally, in March 2016, the Oak Flat area was listed on the National Register of Historic Places (NRHP) as a traditional cultural property (TCP).

There is the potential for some portion of existing yet currently unidentified prehistoric and historic artifacts and resources to be disturbed or destroyed, especially within the Oak Flat subsidence area and the footprint of the tailings storage area. These losses could potentially include human burials within these areas.

Water use is a major concern among the public, other government agencies, and stakeholders. Recycling and reuse would happen extensively throughout the mine operations, but as previously mentioned, additional external water is needed for processing.

There are concerns regarding how public safety may be affected by the project. This includes the physical safety of persons in areas of subsidence and adjacent communities, as well as increased traffic and effects on air and water quality.

There is public apprehension over the creation, and type, of a tailings embankment for the tailings storage facility. The catastrophic collapse of the Brumadinho tailings dam in Brazil in January 2019, resulting in over 100 fatalities, has heightened concerns.

In January 2019, Representative Raul Grijalva, a Democrat from Arizona, and Senator Bernie Sanders, an Independent from Vermont, introduced legislation that would overturn the land exchange described in Section 3003 of the NDAA. Representative Grijalva cited the need to protect Oak Flat and restore some balance to the country's natural resource policies.

ES-1.4 Lead and Cooperating Agency Roles

In compliance with the National Environmental Policy Act (NEPA), the Forest Service is the lead agency preparing this EIS. The Forest Supervisor, Tonto National Forest, is the primary deciding official for the proposed mining plan of operations submitted by Resolution Copper.

The Forest Service's role as lead agency includes the following:

- Analyzing and disclosing environmental effects of the proposed mine and the land exchange on private, State, and NFS lands or other Federal lands
- Conducting government-to-government consultations with potentially affected Indian Tribes
- Developing mitigations to protect surface resources of the Tonto National Forest and recommending mitigations for lands not under Forest Service jurisdiction

Authorization of more than 25 permits and plans from various jurisdictions are required for this mine project. Representatives from Federal, State of Arizona, and county governments are serving as cooperating agencies with the Forest Service in developing this EIS. Cooperating agencies have jurisdiction over some part of the project by law or have special expertise in the environmental effects that are

addressed in the EIS. Monthly calls and meetings between the lead and cooperating agencies have occurred since November 2017. The nine cooperating agencies are as follows:

- U.S. Army Corps of Engineers (USACE)
- U.S. Department of the Interior Bureau of Land Management (BLM)
- U.S. Environmental Protection Agency
- Arizona State Land Department
- Arizona Department of Environmental Quality
- Arizona Department of Water Resources
- Arizona Game and Fish Department
- Arizona State Mine Inspector
- Pinal County Air Quality Control District

Pursuant to Section 404 of the Clean Water Act, Resolution Copper has asked for authorization to discharge fill material into waters of the U.S. for the construction of a tailings storage facility at certain proposed locations. Because Congress directed that a single EIS is to support all Federal decisions related to the proposed mine, the USACE is relying on this EIS to support a decision for issuance of a Section 404 permit.

The 404 permitting process includes Resolution Copper's submittal of a document called a "404(b)1 alternatives analysis" to USACE. The purpose of the 404(b)1 alternatives analysis is to identify the least environmentally damaging practicable alternative. Part of USACE's permitting responsibility is to identify the least environmentally damaging practicable alternative, as well as to require adequate mitigation to compensate for impacts to waters of the U.S.

While most of the impacts considered under the USACE process are identical to those considered in this EIS, some impacts considered under the USACE process are specific only to that permitting process, which may have a different scope of analysis than the EIS. Because of these

differences, the 404(b)1 alternatives analysis is a document strongly related to the EIS, but also separate.

Accordingly, the 404(b)1 alternatives analysis is attached to the EIS as appendix C.

ES-1.5 Purpose and Need

The purpose of and need for this project is twofold:

1. To consider approval of a proposed mine plan governing surface disturbance on NFS lands—outside of the exchange parcels—from mining operations that are reasonably incident to extraction, transportation, and processing of copper and molybdenum.
2. To consider the effects of the exchange of lands between Resolution Copper (roughly 5,376 acres of private land on eight parcels located throughout Arizona) and the United States (2,422 acres forming the Oak Flat Federal Parcel) as directed by Section 3003 of the NDAA.

The role of the Forest Service under its primary authorities in the Organic Administration Act, Locatable Minerals Regulations (36 Code of Federal Regulations [CFR] 228 Subpart A), and the Multiple-Use Mining Act is to ensure that mining activities minimize adverse environmental effects on NFS surface resources and comply with all applicable environmental laws. The Forest Service may impose reasonable conditions to protect surface resources.

Through the Mining and Mineral Policy Act, Congress has stated that it is the continuing policy of the Federal Government, on behalf of national interests, to foster and encourage private enterprise in

- development of economically sound and stable domestic mining, minerals, and metal and mineral reclamation industries; and

- orderly and economic development of domestic mineral resources, reserves, and reclamation of metals and minerals to help ensure satisfaction of industrial, security, and environmental needs.

Secretary of Agriculture regulations that govern the use of surface resources in conjunction with mining operations on NFS lands are set forth under 36 CFR 228 Subpart A. These regulations require that the Forest Service respond to parties who submit proposed plans to conduct mining operations on or otherwise use NFS lands in conjunction with mining for part or all of their planned actions.

Compliance with other laws and regulations, such as State of Arizona water and air regulations, the Endangered Species Act, the Clean Water Act, and the National Historic Preservation Act (NHPA), also frames the proposed mining activities.

ES-1.6 Proposed Action

The proposed action consists of (1) approval of a mining plan for operations on NFS lands associated with a proposed large-scale mine, which would be on private land after the land exchange, (2) the NDAA-directed land exchange between Resolution Copper and the United States, and, if needed, (3) amendments to the Tonto National Forest Land and Resource Management Plan (forest plan). The next two sections summarize the proposed GPO and the land exchange actions.

ES-1.6.1 General Plan of Operations

A detailed description of the GPO can be found in section 2.2.2.2. The complete GPO is available on the project website, www.ResolutionMineEIS.us.

The type of copper deposit that would be mined at the East Plant Site is a porphyry deposit, a lower-grade deposit that requires higher mine production rates to be economically viable. The copper deposit that

Resolution Copper proposes to mine averages 1.54 percent copper (i.e., every ton of ore would on average contain 31 pounds of copper).

Mined ore would be crushed underground and then transported underground approximately 2.5 miles west to an area known as the West Plant Site, where ore would be processed to produce copper and molybdenum concentrates. Portions of the West Plant Site would be located on NFS lands and would be subject to Forest Service regulatory jurisdiction.

Once processed, the copper concentrate would be pumped as a slurry through a 22-mile pipeline to a filter plant and loadout facility located near Florence Junction, Arizona, where copper concentrate would be filtered and then sent to off-site smelters via rail cars or trucks. The molybdenum concentrate would be filtered, dried, and sent to market via truck directly from the West Plant Site.

The copper concentrate slurry pipeline corridor would be located along an existing, previously disturbed right-of-way known as the Magma Arizona Railroad Company (MARRCO) corridor. The MARRCO corridor would also host other mine infrastructure, including water pipelines, power lines, pump stations, and groundwater wells. A portion of the MARRCO corridor is located on NFS lands and would be subject to Forest Service regulatory jurisdiction.

Tailings produced at the West Plant Site would be pumped as a slurry through several pipelines for 4.7 miles to a tailings storage facility. The tailings storage area would gradually expand over time, eventually reaching about 3,300 acres in size. A fence constructed around the tailings to exclude public access would enclose approximately 4,900 acres. The proposed tailings storage facility is located on NFS lands and would be subject to Forest Service regulatory jurisdiction.

All power to the mine would be supplied by the Salt River Project. Portions of the proposed electrical infrastructure would be located on NFS land and would be subject to Forest Service regulatory jurisdiction. A Forest Service special use permit would be required to approve construction and operation of new power lines on NFS lands by the Salt River Project.

Access to the mine would be provided by existing roads. The Magma Mine Road would eventually be relocated as a result of expected subsidence.

Water for the process would come from a variety of sources. Filtrate from the filter plant, recycled water from the tailings storage facility, and recovered water from the concentrator complex would be recycled back into the mining process. Additional water would be obtained from dewatering of the mine workings, direct delivery of CAP water, and pumping from a well field along the MARRCO corridor.

Reclamation would be conducted to achieve post-closure land use objectives, including closing and sealing the mine shafts, removing surface facilities and infrastructure, and establishing self-sustaining vegetative communities using local species. The proposed tailings storage facility would be reclaimed in place, providing for permanent storage of mine tailings.

An initial review of the consistency of the proposed GPO with the forest plan indicates that approval of the proposed GPO would result in conditions that are inconsistent with the forest plan. An amendment to the forest plan would address the necessary changes to relevant standards and guidelines for managing visual quality and recreation opportunities as determined by the record of decision for the project.

ES-1.6.2 Land Exchange

Section 3003 of the NDAA directs the conveyance of specified Federal lands to Resolution Copper if Resolution Copper offers to convey the specified non-Federal land to the United States. The following summarizes the land parcels that would be exchanged.

- The United States would transfer the 2,422-acre **Oak Flat Federal Parcel** to Resolution Copper
- Resolution Copper would transfer the following parcels to the U.S. Department of Agriculture:

- 142 acres near Superior in Pinal County, Arizona, known as the **Apache Leap South End Parcel**, to be administered by the Tonto National Forest
- 148 acres in Yavapai County, Arizona, known as the **Tangle Creek Parcel**, to be administered by the Tonto National Forest
- 147 acres in Gila County, Arizona, known as the **Turkey Creek Parcel**, to be administered by the Tonto National Forest
- 149 acres near Cave Creek in Maricopa County, Arizona, known as the **Cave Creek Parcel**, to be administered by the Tonto National Forest
- 640 acres north of Payson in Coconino County, Arizona, known as the **East Clear Creek Parcel**, to be administered by the Coconino National Forest
- Resolution Copper would transfer the following parcels to the U.S. Department of the Interior:
 - Approximately 3,050 acres near Mammoth in Pinal County, Arizona, known as the **Lower San Pedro River Parcel**, to be administered by the BLM as part of the San Pedro Riparian National Conservation Area
 - Approximately 940 acres south of Elgin in Santa Cruz County, Arizona, known as the **Appleton Ranch Parcel**, to be administered by the BLM as part of the Las Cienegas National Conservation Area
 - 160 acres near Kearny in Gila and Pinal Counties, Arizona, known as the **Dripping Springs Parcel**, to be administered by the BLM
- An additional NDAA requirement calls for the United States to transfer the following land to Superior, Arizona, if the Town of Superior requests it:
 - 30 acres associated with the Fairview Cemetery

- 250 acres associated with parcels contiguous to the Superior Airport
- 265 acres of Federal reversionary interest associated with the Superior Airport

As of June 2019, the Town of Superior had not requested this land transfer.

ES-1.7 Nature of Lead Agency Decision

With regard to the proposed GPO, the Forest Supervisor, Tonto National Forest, would make the following decisions using the analysis in the EIS and supporting documentation:

- Decide whether to approve the proposed GPO submitted by Resolution Copper or require changes or additions to the proposed GPO to meet the requirements for environmental protection and reclamation set forth in 36 CFR 228 Subpart A before approving a final GPO. The Forest Service decision may be to authorize use of the surface of NFS lands in connection with mining operations under the GPO composed of elements from one or more of the alternatives considered.
- The alternative selected for approval in the final GPO must minimize adverse impacts on NFS surface resources to the extent feasible and must comply with all Federal and State laws and regulations
- Decide whether to approve amendments to the forest plan, which would be required to approve the final GPO
- Decide whether to approve a special use permit for the Salt River Project to authorize construction and operation of power lines on NFS lands

With regard to the land exchange, Section 3003 of the NDAA directs the Secretary of Agriculture to convey to Resolution Copper all right,

title, and interest of the United States in and to identified Federal land if Resolution Copper offers to convey to the United States all right, title, and interest of Resolution Copper in and to identified non-Federal lands.

The Forest Supervisor, Tonto National Forest, has limited discretion to (1) address concerns of affected Indian Tribes; (2) ensure that title to the non-Federal lands offered in the exchange is acceptable; (3) accept additional non-Federal land or a cash payment from Resolution Copper to the United States in the event that the final appraised value of the Federal land exceeds the value of the non-Federal land; or (4) address other matters related to the land exchange that are consistent with Section 3003 of the NDAA.

ES-1.8 Public Participation

The Forest Service sought public input during several phases of the environmental review process prior to publication of the DEIS.

The public scoping period began on March 18, 2016, with the Forest Service publication of a notice of intent to prepare an EIS in the Federal Register. Scoping is the first step in the NEPA process that seeks input from within the agency, from the public, and from other government agencies in order to define the scope of issues to be addressed in depth in the EIS.

The Forest Service planned for a 60-day public scoping period from March 18, 2016, to May 17, 2016.

Numerous individuals and several organizations requested an extension of the public scoping period, as well as additional public scoping meetings. The Forest Supervisor, Tonto National Forest, accommodated these requests by extending the public scoping period through July 18, 2016, resulting in a total overall scoping period of 120 days.

Between March and June 2016, the Forest Service held five EIS public scoping meetings.

A Scoping Report summarizing 133,396 public comments was completed and made available online on the project website on March 9, 2017.

The Forest Service conducted two public workshops to collect information on public opinion in regard to locating a mine tailings storage facility.

Internal scoping efforts included several meetings and field trips with the NEPA interdisciplinary (ID) team. ID team members include Forest Service resource specialists and planners representing anticipated topics of analysis in the NEPA process, managers, and Tonto National Forest line officers.

Cooperating agency scoping was conducted through a kick-off meeting and through comments submitted by cooperating agencies and tribes during the public scoping comment period.

Between May 2017 and May 2019, the Forest Service participated in numerous informal meetings (one or more per month) with key stakeholders, tribes, and cooperating agencies regarding technical feasibility of the project and alternatives, differing environmental impacts and tradeoffs among the alternatives, and mitigations for reducing expected impacts of the proposed mining plan of operations and land exchange.

Additional detail on scoping conducted during tribal consultation can be found in section 1.6.4 of the DEIS.

ES-1.9 Issues Selected for Analysis

Issues help set the scope of the actions, alternatives, and effects to consider in the Forest Service's analysis (Forest Service Handbook 1909.15.12.4).

Comments submitted during the 2016 scoping period were used to formulate issues concerning the proposed action. An issue is a point of dispute or disagreement with the proposed action based on some anticipated environmental effect.

Table ES-1 presents the social, physical, and biological resources or other concerns that the Forest Service selected for analysis, based on scoping comments.

Section 1.7, Issues, in chapter 1 of the DEIS provides a snapshot of these issues. Detailed information on these issues appears in chapter 3 of the DEIS.

Table ES-1. Issues carried forward for analysis

Social and Cultural Issues	Physical and Biological Issues
<ul style="list-style-type: none">• Cultural Resources	<ul style="list-style-type: none">• Air Quality
<ul style="list-style-type: none">• Environmental Justice	<ul style="list-style-type: none">• Geology, Minerals, and Subsidence
<ul style="list-style-type: none">• Public Health and Safety	<ul style="list-style-type: none">• Livestock and Grazing
<ul style="list-style-type: none">• Recreation	<ul style="list-style-type: none">• Noise and Vibration
<ul style="list-style-type: none">• Socioeconomics	<ul style="list-style-type: none">• Scenic Resources
<ul style="list-style-type: none">• Transportation and Access	<ul style="list-style-type: none">• Soils and Vegetation
<ul style="list-style-type: none">• Tribal Values and Concerns	<ul style="list-style-type: none">• Water Resources
	<ul style="list-style-type: none">• Wildlife and Special Status Species

ES-2 ALTERNATIVES

NEPA requires consideration of a reasonable range of alternatives that can accomplish the purpose of and need for the proposed action. The Forest Service studied a range of alternatives to the Resolution Copper GPO, each of which

- responds to key issues raised during public scoping; project purpose and need; and applicable Federal and State laws and regulations;
- considers input from resource specialists, mining experts (project team), cooperating agency representatives, tribes, and stakeholders; and
- is technically feasible to implement—but with differing environmental impacts and tradeoffs.

The alternatives include five action alternatives (out of 30+ considered) at four separate locations, including one location not on Federal land.

In addition, the Forest Service did the following:

- Assessed alternative mining techniques in an effort to prevent subsidence. No alternative methods were considered reasonable.
- Assessed tailings disposal in brownfield sites (old mine pits). No reasonable brownfield locations were found.
- Identified three separate methods of depositing tailings, including using filtered (dry-stack) tailings.

Environmental impacts and tradeoffs among the five action alternatives vary due to the differences in the tailings embankment design; the tailings deposition method; or the geographic location and affected surroundings of the proposed tailings storage facility (figure ES-2). Ore

extraction and processing activities as proposed in the GPO remain similar between all action alternatives.

Additional alternatives were considered but dismissed from detailed analysis for various reasons; see appendix F of the DEIS for discussion of the other alternatives considered and the rationale for their dismissal.

ES-2.1 No Action Alternative

This alternative is required by regulation (40 CFR 1502.14(d)). Under this alternative, the Forest Service would not approve the GPO, none of the activities in the final GPO would be implemented on NFS lands, and the mineral deposit would not be developed. Additionally, the land exchange would not take place.

However, the nature of the no action alternative for this project was described in the Notice of Intent issued in March 2016, which states:

The EIS will analyze the no action alternative, which would neither approve the proposed GPO nor complete the land exchange. However, the responsible official—the Forest Supervisor, Tonto National Forest—does not have discretion to select the no action alternative, because it would not be consistent with the requirements of 36 CFR 228.5, nor would it comply with the NDAA.

Additional alternatives may be evaluated in the EIS. These alternatives may require changes to the proposed GPO, which are necessary to meet Forest Service regulations for locatable minerals set forth at 36 CFR 228 Subpart A.

Thus, while this alternative cannot be selected by the Forest Service, it serves as a point of comparison for the proposed action and action alternatives.

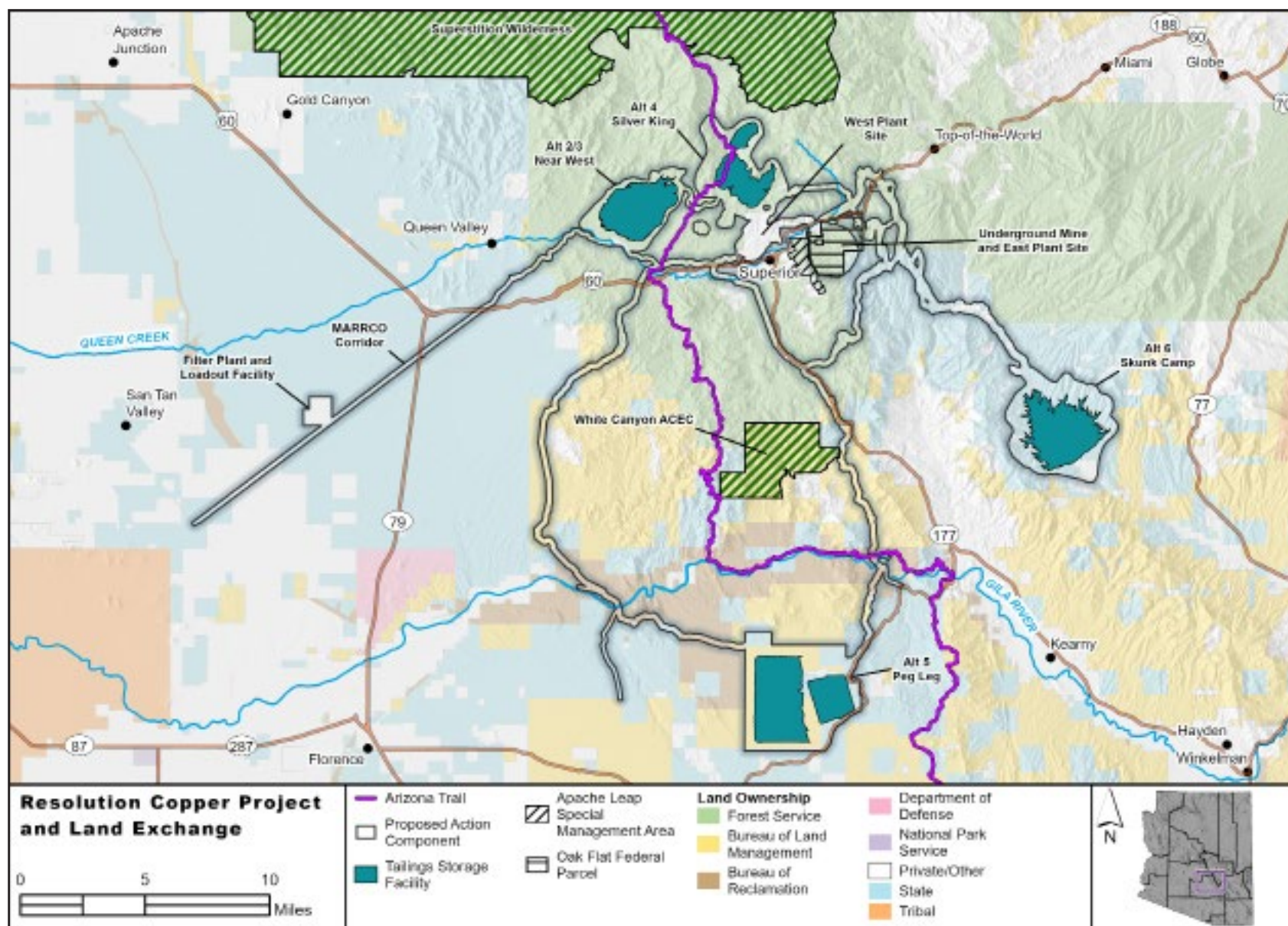


Figure ES-2. Overview of project alternative locations

ES-2.2 Alternative 2 – Near West Proposed Action

This alternative is a variation of the proposed action described in the May 9, 2016, version of the Resolution Copper GPO. In early 2018, Resolution Copper changed its original plan for an “upstream” embankment design to a “modified centerline” configuration for a tailings storage facility.

Alternative 2 would include a split-stream tailings processing method with two tailings types:

- Non-potentially acid generating (NPAG) tailings
- Potentially acid generating (PAG) tailings

PAG tailings have a greater potential to oxidize and generate acidic seepage to groundwater or surface waters. To minimize this potential, PAG tailings would be deposited centrally in the tailings storage facility and surrounded by NPAG tailings. A 5- to 10-foot-deep water cap would keep PAG tailings saturated to reduce exposure to oxygen during tailings storage facility development.

Additionally, the larger NPAG deposit would act as a buffer between the PAG tailings and areas outside the tailings storage facility. Water spigots would keep the NPAG tailings “beach” area wet, ensuring effective dust management during operations.

The modified centerline embankment construction would consist of earthfill and cyclone sand from the NPAG tailings stream. This sand results from tailings processed through one or more dedicated centrifuges to separate larger tailings particles from the finer particles.

n

A suite of engineered seepage controls, including engineered low-permeability liners, compacted fine tailings, and/or a “grouting” process

Alternative 2 Facility Details

Ownership	Tonto National Forest
Tailings facility footprint	3,300 acres
Area excluded from public access during operations	4,900 acres
Embankment height	520 feet
Embankment length	10 miles
Tailings type	Slurry

to seal ground fractures, would limit and contain seepage. Uncontained seepage would be collected in downstream ponds and pumped back to the tailings storage facility. Figure ES-3 provides an overview of Alternative 2.



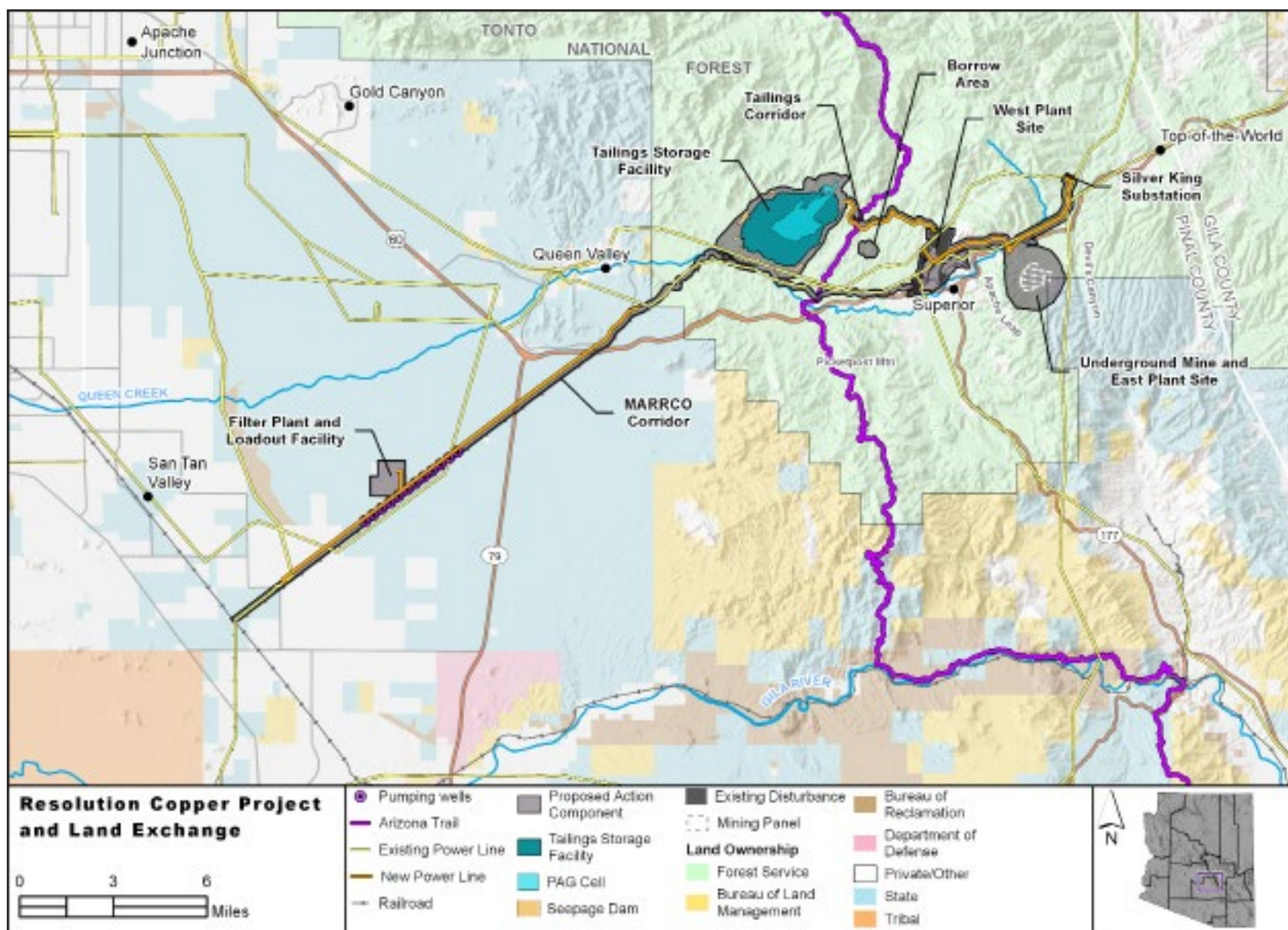


Figure ES-3. Alternative 2 – Near West Proposed Action

ES-2.3 Alternative 3 – Near West – Ultrathickened

ES-2.3.1 Similarities with Alternative 2

This alternative represents a variation of the proposed action described in the May 2016 GPO. It includes a change in embankment design for a tailings storage facility to a “modified centerline” configuration consisting of earthfill and cycloned sand.

Alternative 3 has a split-stream tailings processing method with two tailings types:

- NPAG tailings
- PAG tailings

A suite of engineered seepage controls, including engineered low-permeability liners, compacted fine tailings, and/or a “grouting” process to seal ground fractures, would limit and contain seepage, along with downstream seepage collection ponds.

The location on the Tonto National Forest would be identical. Figure ES-4 provides an overview of Alternative 3.

ES-2.3.2 Differences from Alternative 2

This alternative would use physical barriers to segregate PAG tailings in a separate cell from NPAG tailings. Cycloned sand would be used to build low-permeability “splitter berms” between the two tailings storage areas.

This alternative has a proposal to reduce initial amounts of water retained in NPAG tailings and encourage rapid evaporation, as well as reduce seepage potential, through

Alternative 3 Facility Details

Ownership	Tonto National Forest
Tailings facility footprint	3,300 acres
Area excluded from public access during operations	4,900 acres
Embankment height	510 feet
Embankment length	10 miles
Tailings type	Thickened slurry

- additional on-site thickening of NPAG tailings, which would increase the thickness by 5 percent, reducing the overall amount of water in the facility; and
- possible use of “thin-lift” (also known as thin layer) deposition, to enhance evaporation and further reduce the amount of water in the facility.

Alternative 3 would require less time to close the recycled water pond, compared with Alternative 2. By using ultrathickening methods that reduce water entering the tailings, officials estimate closure in 5 years, compared with 25 years estimated for Alternative 2.

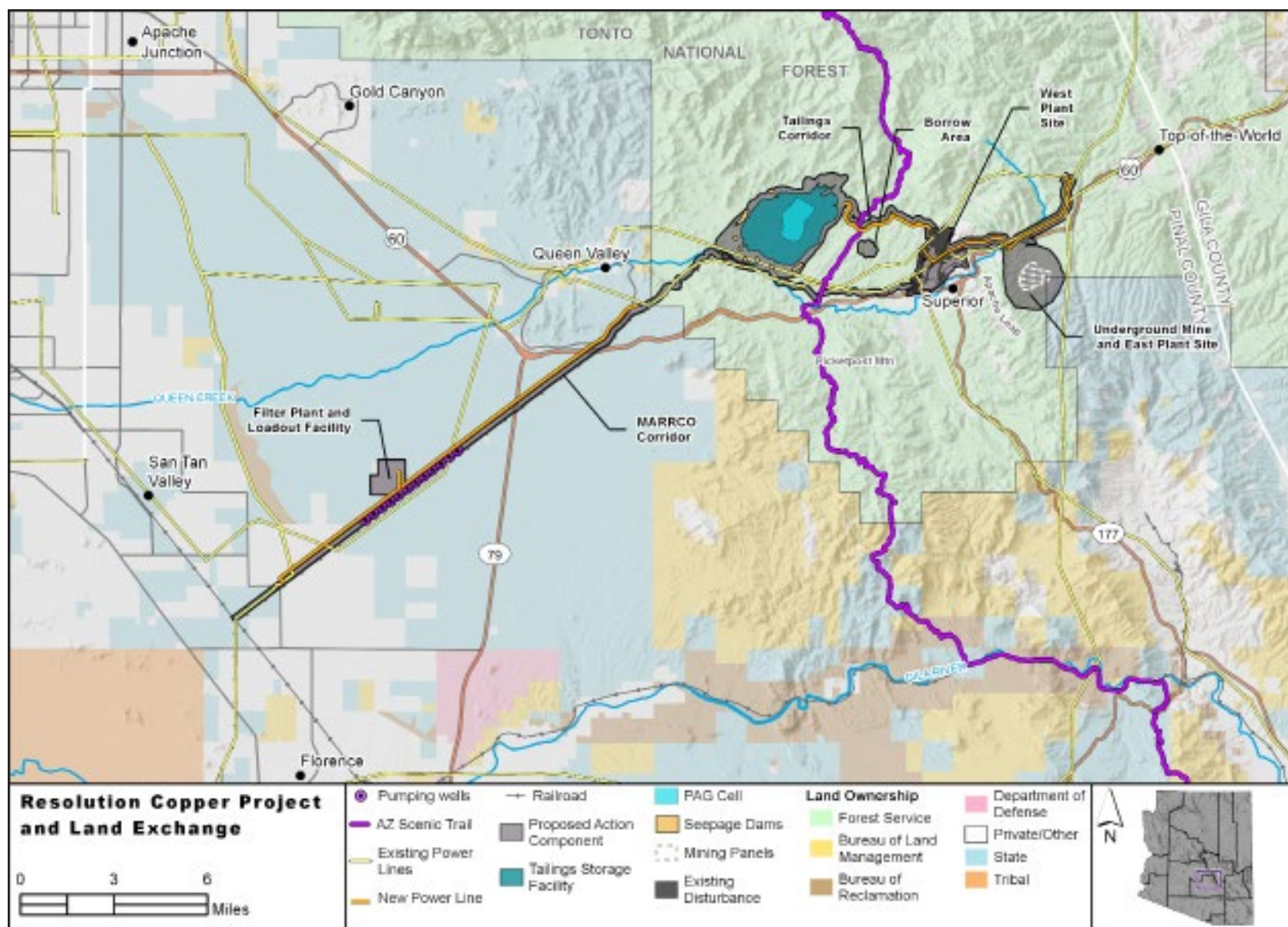


Figure ES-4. Alternative 3 – Near West – Ultrathickened

ES-2.4 Alternative 4 – Silver King

This is the lone alternative proposing to use filtered tailings—instead of slurry tailings—at the tailings storage facility.

As with other alternatives, Alternative 4 would include a split-stream tailings processing method with two tailings types:

- NPAG tailings
- PAG tailings

From the West Plant Site, pipelines would transport the two tailings slurry streams to filter plants at the Silver King location north of the West Plant Site and the town of Superior. Pressure filters would extract about 85 percent of the water from the tailings, resulting in a more solid product and a decrease in water pumped for operations. The water would be recycled in the process water at the West Plant Site.

Conveyors and mobile equipment would mechanically deposit NPAG and PAG tailings in two separate, adjacent tailings storage facilities. Figure ES-5 provides an overview of Alternative 4.

To limit exposure of tailings to water, all runoff would be directed to perimeter ditches, sumps, and/or underdrains. Water coming into contact with exposed tailings would be collected in large ponds located in natural valleys downstream of the tailings storage facility. Large diversions also would be needed to keep upstream stormwater from reaching the tailings storage facility.

ES-2.4.1 Arizona National Scenic Trail

The tailings storage facility and associated auxiliary facilities would impact approximately 5.5 miles of the Arizona National Scenic Trail (Arizona Trail), resulting in the rerouting of that portion of the trail.

Alternative 4 Facility Details	
Ownership	Tonto National Forest
Tailings facility footprint	2,300 acres
Area excluded from public access during operations	5,700 acres
Embankment height	Filtered tailings do not use an embankment to contain tailings; however, for comparison with the other alternatives, the overall height of the facility would be approximately 1,000 feet.
Embankment length	Not applicable
Tailings type	Filtered

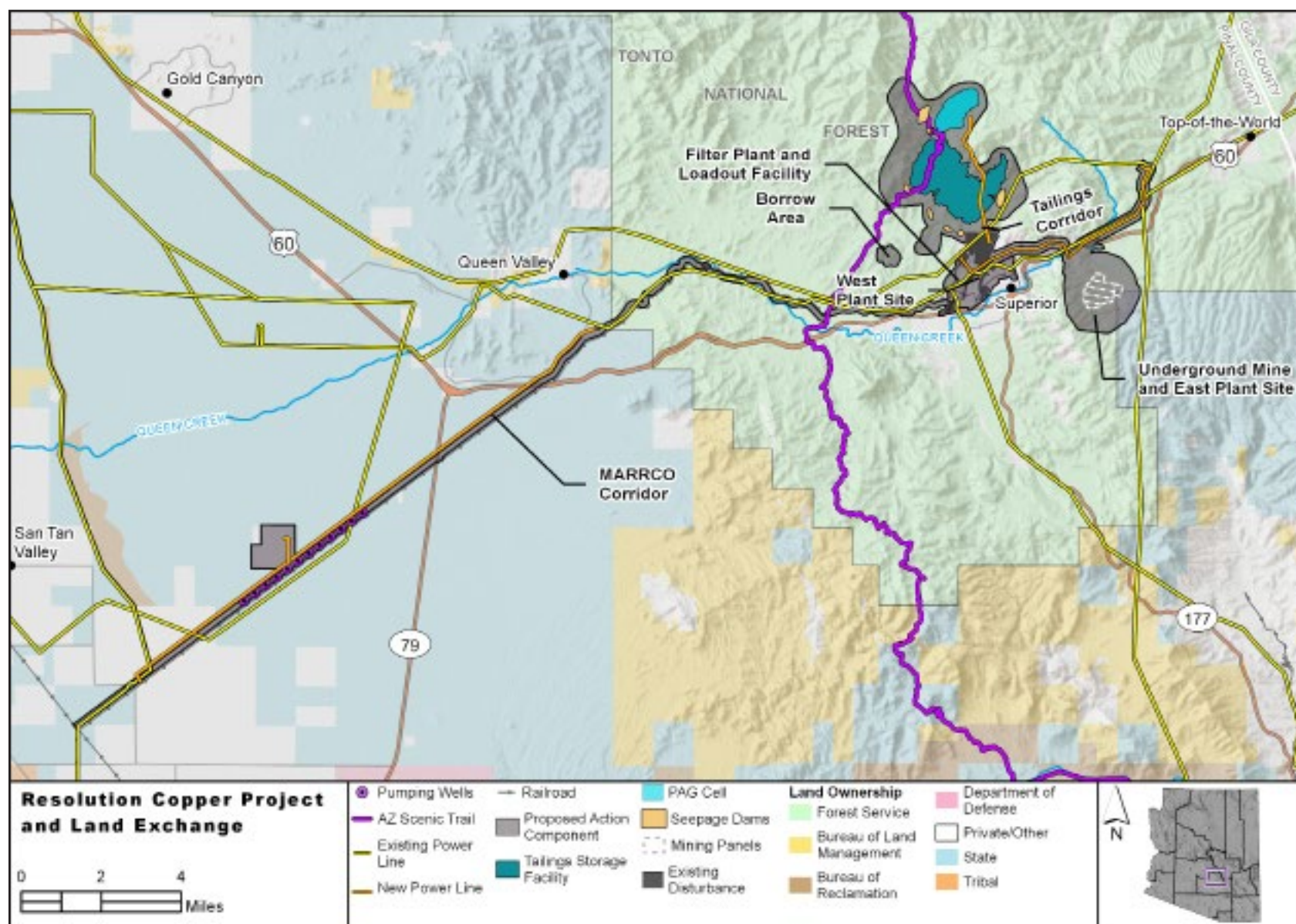


Figure ES-5. Alternative 4 – Silver King

ES-2.5 Alternative 5 – Peg Leg

This alternative allows an evaluation of a tailings site that is more isolated from existing communities while remaining adjacent to areas of active mining on the landscape.

Alternative 5 also provides for a comparison of the impacts of slurry tailings if placed on a flatter, alluvial setting instead of an upland wash or canyon.

As with other alternatives, Alternative 5 would include a split-stream tailings processing method with two tailings types:

- NPAG tailings
- PAG tailings

Two options are analyzed for tailings conveyance from the West Plant Site. Only one option would be selected for use to transport the tailings slurry streams to the Peg Leg tailings storage facility. The west option is approximately 28 miles long, whereas the east option is approximately 23 miles long.

Two separate storage facilities for NPAG and PAG tailings would exist throughout the life of the mine.

The PAG facility would consist of four separate cells. This would reduce the pond size required for operations and allow for progressive reclamation. Only one cell would be operational at a time. A downstream embankment consisting of earthfill and cycloned sand is proposed for the PAG cells.

NPAG tailings would be located primarily on an alluvial soil foundation to the west and slightly downslope from the PAG site. A centerline embankment, also consisting of earthfill and cycloned sand, is proposed for NPAG tailings. Figure ES-6 provides an overview of Alternative 5.

Officials project higher seepage because of the alluvial foundation. A suite of engineered seepage controls, including low-permeability layers

Alternative 5 Facility Details

Ownership	Bureau of Land Management; Arizona State Land Department
Tailings facility footprint	5,900 acres
Area excluded from public access during operations	10,800 acres
Embankment height	310 feet
Embankment length	7 miles
Tailings type	Slurry

at the PAG facility and low-permeability barriers (liners or fine-grained tailings) for the NPAG tailings, would limit and control seepage. A downstream well field would capture seepage and return it to the tailings storage facility.

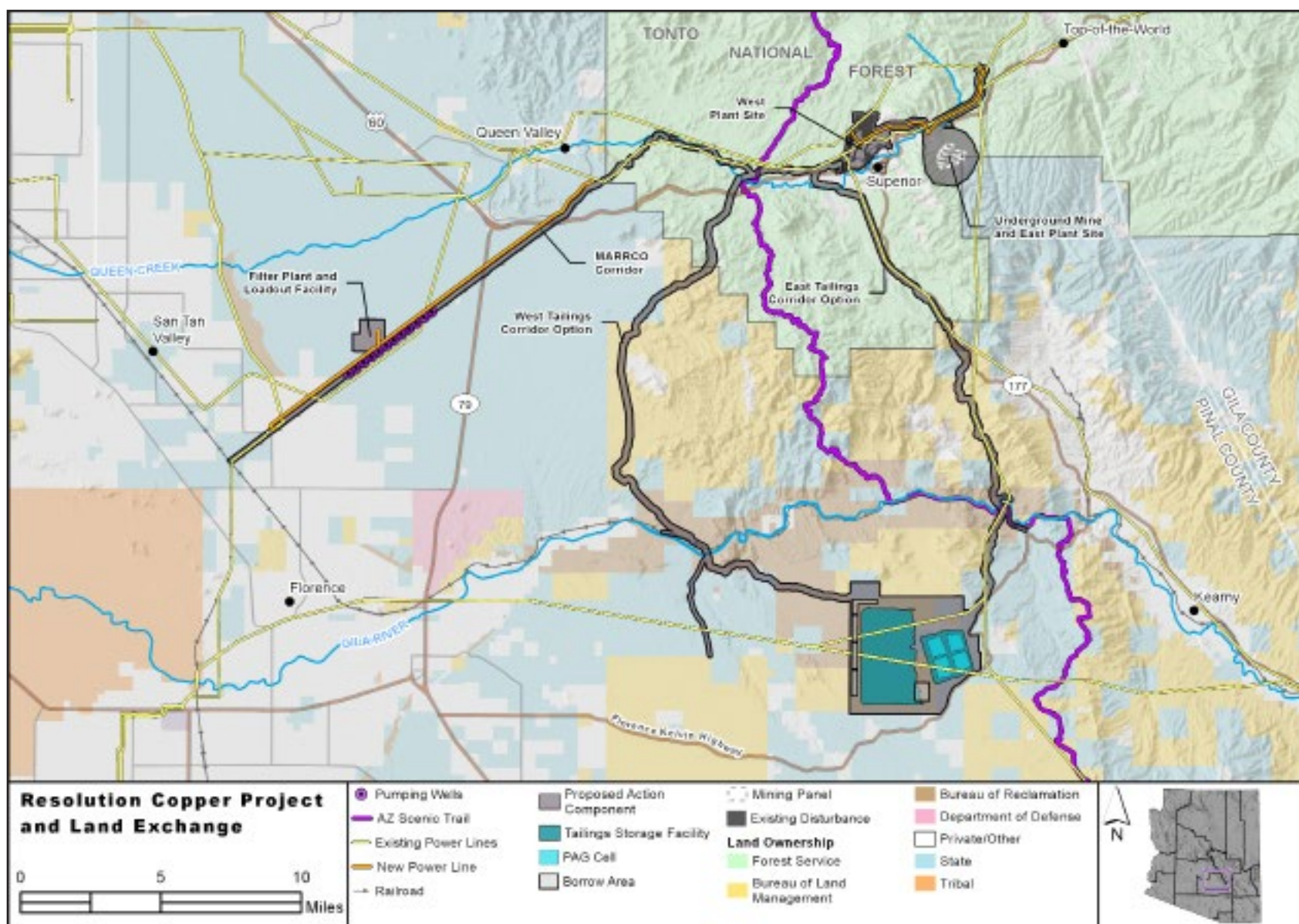


Figure ES-6. Alternative 5 – Peg Leg

ES-2.6 Alternative 6 – Skunk Camp

Preferred Alternative

The Forest Service has identified Alternative 6 (Skunk Camp) – North Option as the Lead Agency's preferred alternative and seeks public feedback during the 90-day comment period regarding this choice.

The north option for tailings conveyance is the preferred route in the DEIS. Development of this alternative centered on three components:

- Its location is largely isolated from human residences and other infrastructure.
- It is adjacent to an existing mine (Ray Mine).
- Its location enables use of cross-valley embankments, requiring less fill to retain tailings, compared with a ring-like impoundment. This, in turn, simplifies construction and operations.

As with other alternatives, Alternative 6 would include a split-stream tailings processing method with two tailings types:

- NPAG tailings
- PAG tailings

Two options are analyzed for tailings conveyance from the West Plant Site. Only one option would be selected for use to transport the tailings slurry streams to the Skunk Camp tailings storage facility. The north option is approximately 20 miles long, whereas the south option is approximately 25 miles long.

NPAG tailings would be cycloned to produce embankment fill with cycloned overflow—the finer particles—thickened at the tailings

Alternative 6 Facility Details

Ownership	Private land; Arizona State Land Department
Tailings facility footprint	4,000 acres
Area excluded from public access during operations	8,600 acres
Embankment height	490 feet
Embankment length	3 miles
Tailings type	Slurry

storage facility before discharge into the impoundment. PAG tailings would be deposited in two separate cells, behind a separate cycloned sand downstream-type embankment, to the north (upstream) end of the facility. Only one cell would be operational at a time, providing for early reclamation of the first cell. The much larger volume of NPAG tailings would be behind its own embankment of compacted cycloned sand and deposited immediately south of (downstream) and adjacent to the PAG tailings.

A suite of engineered seepage controls, including engineered low-permeability liners, compacted fine tailings, and/or a “grouting” process to seal ground fractures, would provide a low-permeability layer to limit and control seepage. A seepage collection pond also would be placed downstream. Figure ES-7 provides an overview of Alternative 6.

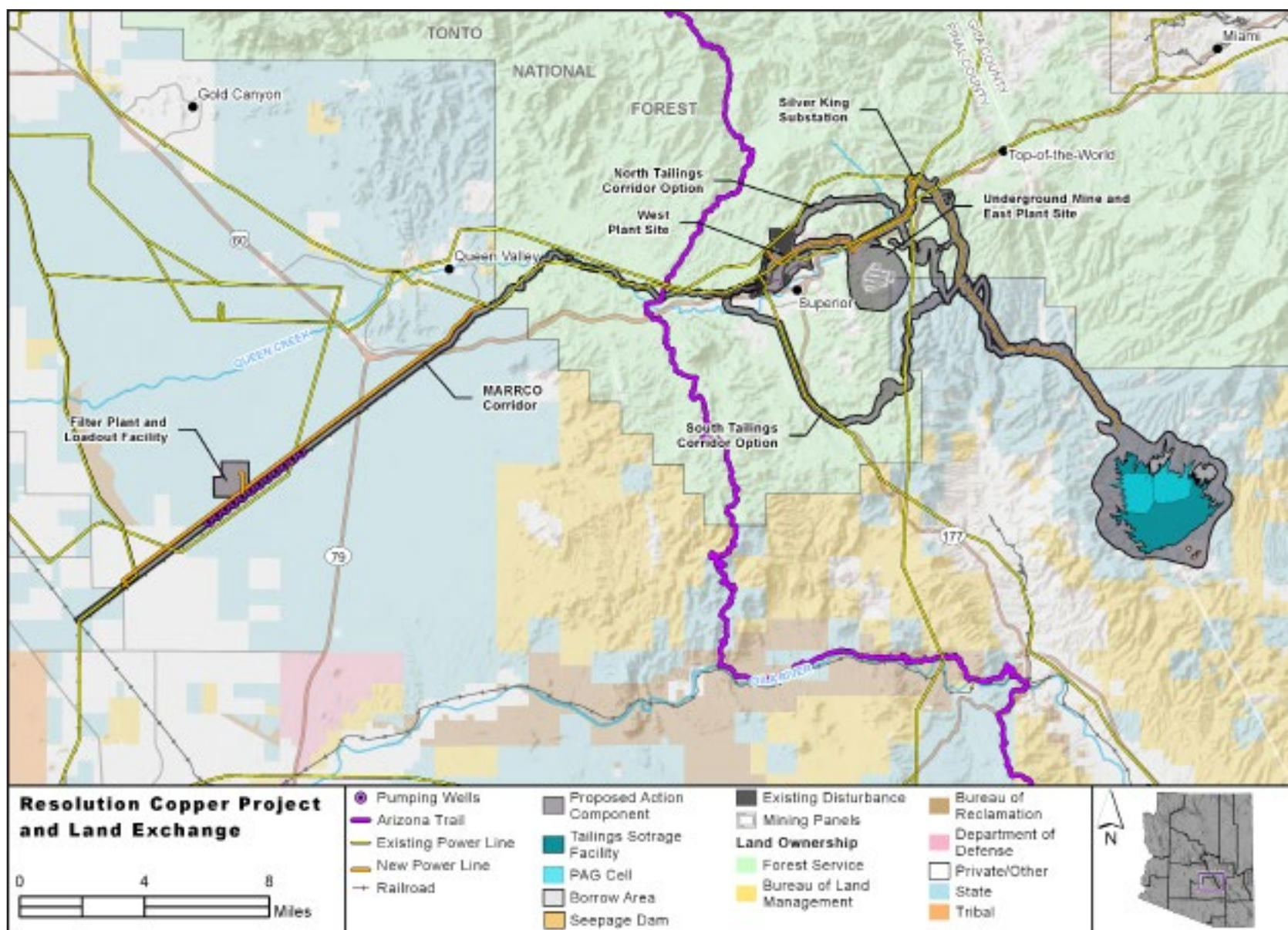


Figure ES-7. Alternative 6 – Skunk Camp (preferred alternative)

ES-3 SUMMARY OF IMPACTS

ES-3.1 Introduction

Information in chapter 3 of the DEIS describes the natural and human environment that may be affected by the proposed action and its alternatives and discloses the direct, indirect, and cumulative impacts that could occur as a result of implementation of the proposed action or alternatives. The effects of the legislated land exchange are also disclosed in the DEIS. Forest Service management regulations would no longer apply on 2,422 acres of the Oak Flat Federal Parcel transferred to Resolution Copper. Approximately 5,376 acres would transfer from private ownership to Federal ownership and regulations.

ES-3.2 Geology, Minerals, and Subsidence

This section describes known geological characteristics at each of the major facilities of the proposed mine—including alternative tailings storage locations—and how the development of the project may impact existing cave and karst features, paleontological resources, area seismicity, and unpatented mining claims. It also outlines subsidence impacts that would result from Resolution Copper’s plans to extract the ore from below the deposit using a mining technique known as “block caving” or “panel caving.” The analysis concludes the following:

- The subsidence crater at the Oak Flat Federal Parcel would break through at mine year 6, would be between 800 and 1,115 feet deep, and would be about 1.8 miles in diameter.
- No damage is expected to Apache Leap, Devil’s Canyon, or U.S. Route 60 because of the subsidence. The mine is also unlikely to induce seismic activity that would cause damage.
- Some unpatented mining claims not belonging to Resolution Copper are located within the project footprint, and access to these claims may be inhibited.

ES-3.3 Soils and Vegetation

This section explains how the proposed mine would disturb large areas of ground and potentially destroy native vegetation, including species given special status by the Forest Service, and encourage noxious or invasive weeds. The analysis concludes the following:

- Between 10,000 and 17,500 acres of soil and vegetation would be disturbed by the project.
- Revegetation success in these desert ecosystems is demonstrated. However, impacts to soil health and productivity may last centuries to millennia, and the ecosystem may not meet desired future conditions. The habitat may be suitable for generalist wildlife and plant species, but rare plants and wildlife with specific habitat requirements are unlikely to return.
- Arizona hedgehog cactus (endangered) may be impacted during operations at the East Plant Site and by ground subsidence. The pipeline corridors associated with Alternative 5 would impact critical habitat for acuña cactus (endangered).
- Reclamation of disturbed areas would decrease but not eliminate the likelihood of noxious weeds becoming established or spreading.

ES-3.4 Noise and Vibration

This section provides a detailed analysis of estimated impacts from noise and vibration under the GPO-proposed mine plan and each of the alternatives. The analysis concludes the following:

- Noise impacts were modeled for 15 sensitive receptors representing residential, recreation, and conservation land uses. Under most conditions, predicted noise and vibration during construction and operations, for both blasting and non-blasting activities, at sensitive receptors are below thresholds of concern; rural character would not change due to noise.

- One exception is that noise along Dripping Springs Road (Alternative 6) is above thresholds of concern; however, mitigation to change the access road would remedy this. After mitigation, no unavoidable adverse impacts are anticipated from noise or vibration from any alternative.

ES-3.5 Transportation and Access

This section discusses how the proposed Resolution Copper Mine would increase traffic on local roads and highways and likely alter local and regional traffic patterns and levels of service. This section also examines NFS road closures, along with accelerated deterioration of local roadways as a result of increased use. The analysis concludes the following:

- Approximately 6.9 miles of NFS roads are expected to be decommissioned or lost from the East Plant Site, West Plant Site, or subsidence area.
- An additional 21.7 miles of NFS roads would be lost as a result of the Alternative 2 and 3 tailings storage facility, and 17.7 miles of NFS roads would be lost as a result of the Alternative 4 tailings storage facility. Approximately 29 miles of BLM inventoried roads would be lost as a result of the Alternative 5 tailings storage facility. The Alternative 6 tailings storage facility would impact only about 7 miles of private roads.
- NFS roads lost to the subsidence area provide access to areas that include Apache Leap and Devil's Canyon; access would still be available to these areas but would require using routes that are not as direct or convenient. Alternative 4 would also change access to the highlands north of Superior, as well as to private inholdings in the Tonto National Forest.

ES-3.6 Air Quality

This section analyzes potential impacts from an increase in dust, wind-borne particulates, and transportation-related emissions as a result of construction, mining, and reclamation activities at the mine and along transportation and utility corridors. The analysis concludes the following:

- Neither daily nor annual maximum impacts for fugitive dust (PM_{2.5} and PM₁₀) would exceed established air quality thresholds.
- None of the predicted results are anticipated to exceed the National Ambient Air Quality Standards (NAAQS) at the project fence line (where public access is excluded).
- Impacts on air quality-related values (deposition and visibility) at Class 1 and other sensitive areas would be within acceptable levels.

ES-3.7 Water Resources

This section analyzes how the Resolution Copper Project could affect water availability and quality in three key areas: groundwater quantity and groundwater-dependent ecosystems (GDEs); groundwater and surface water quality; and surface water quantity. The analysis concludes the following:

- Between 14 and 16 GDEs are anticipated to be impacted: six of these are springs that are anticipated to be impacted by groundwater drawdown under the no action alternative as a result of ongoing dewatering by Resolution Copper; when block-caving occurs, groundwater impacts expand to overlying aquifers, and two more springs are impacted; direct disturbance within the project footprint would impact another two to five springs; and, depending on the alternative, GDEs associated with Queen Creek, Devil's Canyon, and the Gila River would

be impacted as a result of reductions in surface runoff. The loss of water would be mitigated for some GDEs, but impacts to the natural setting would remain.

- Groundwater supplies in Superior and Top-of-the-World could be impacted by groundwater drawdown but would be replaced through mitigation.
- Over the mine life, 87,000 acre-feet of water would be pumped from the mine, and between 180,000 and 590,000 acre-feet of makeup water would be pumped from the Desert Wellfield in the East Salt River valley. Alternative 4, which uses filtered (dry-stack) tailings, requires the least amount of makeup water. The wellfield pumping would incrementally contribute to the lowering of groundwater levels and cumulatively reduce overall groundwater availability in the area.
- After closure, the reflooded block-cave zone could have poor water quality; however, a lake in the subsidence crater is not anticipated, and no other exposure pathways exist for this water.
- Stormwater runoff could have poor water quality, but no stormwater contacting tailings or facilities would be released during operations or post-closure until reclamation is successful.
- All of the tailings facilities would lose seepage with poor water quality to the environment, and all are dependent on a suite of engineered seepage controls to reduce this lost seepage. Modeling indicates that seepage from Alternatives 2 and 4 would result in water quality problems in Queen Creek; Alternative 3 would not, but requires highly efficient seepage control to achieve this (99.5 percent capture). Seepage from Alternatives 5 and 6 does not result in any anticipated water quality problems; these alternatives also have substantial opportunity for additional seepage controls if needed.
- There would be a reduction in average annual runoff as a result of the capturing of precipitation by the subsidence crater and tailings facilities, varying by alternative: 3.5 percent at the mouth of Devil's Canyon, between 6.5 and 8.9 percent in Queen

Creek at Whitlow Ranch Dam, and between 0.2 and 0.5 percent in the Gila River. Alternative 4 also would result in an almost 20 percent loss of flow in Queen Creek at Boyce Thompson Arboretum.

- Under the Clean Water Act, Alternatives 2, 3, and 4 impact zero acres of jurisdictional waters, based on a decision by the USACE that no such waters exist above Whitlow Ranch Dam. Alternative 5 impacts about 180 acres, and Alternative 6 impacts about 120 acres of potentially jurisdictional waters.

ES-3.8 Wildlife and Special Status Wildlife Species

This section describes how impacts to wildlife can occur from habitat loss and fragmentation, as well as from artificial lighting, noise, vibration, traffic, loss of water sources, or changes in air or water quality. The analysis concludes the following:

- Habitat would be impacted in the analysis area for 50 special status wildlife species. General impacts include a high probability of mortality or injury with vehicles or from grading, increased stress due to noise, vibration, and artificial light, and changes in cover. Changes in behavior include changes in foraging efficiency and success, changes in reproductive success, changes in growth rates of young, changes in predator-prey relationships, increased movement, and increased roadkill.
- There would be loss and fragmentation of movement and dispersal habitats from the subsidence area and tailings storage facility. Ground-clearing and consequent fragmentation of habitat blocks for other mine-related facilities would also inhibit wildlife movement and increase edge effects.
- For Tonto National Forest and BLM sensitive wildlife species, the proposed project may adversely impact individuals but is not likely to result in a loss of viability in the analysis area,

nor is it likely to cause a trend toward Federal listing of these species as threatened or endangered.

- Western yellow-billed cuckoo (endangered) could be impacted by general removal of vegetation and increased activity. The potential changes in stream flow and associated riparian vegetation along Devil's Canyon are specific concerns.
- Southwestern willow flycatcher (endangered) could be impacted by pipeline crossings of the Gila River under Alternative 5, including removal of vegetation and increased activity.
- Critical habitat for Gila chub occurs in Mineral Creek above Devil's Canyon. However, no individuals have been identified here during surveys, and this area is not expected to be impacted by groundwater drawdown.

ES-3.9 Recreation

This section quantifies, when possible, anticipated changes to some of the area's natural features and recreational opportunities as a result of infrastructure development related to the project. The analysis concludes the following:

- Public access would be eliminated permanently on 4,900 to 10,800 acres. Alternatives 2, 3, and 4 would result in 4,900 to 5,700 acres of access lost on Tonto National Forest land. Alternative 5 would primarily impact access to 10,800 acres of BLM land, and Alternative 6 would primarily impact access to 10,100 acres, of which 7,700 is Arizona State land.
- There would be changes to the recreation opportunity spectrum acres within the Globe Ranger District, ranging from 13 to 17 percent of semi-primitive non-motorized, 16 to 17 percent of semi-primitive motorized, and 5 to 7 percent of roaded natural.

- Visitors to the Superstition Wilderness, Picketpost Mountain, and Apache Leap would have foreground and background views of the tailings facilities from trails and overlooks, and the recreation setting from certain site-specific views could change. Three miles of the Arizona Trail would be impacted by Alternative 4 and require rerouting, whereas pipeline corridor crossings for Alternatives 2 and 5 would impact the trail.
- The exchange of the Oak Flat Federal Parcel would remove world-recognized rock climbing areas from public access, as well as Oak Flat Campground. Both of these would be partially mitigated by replacement areas.
- The number of Arizona hunting permits that are issued in individual Game Management Units would not change as a result of implementation of any of the action alternatives.

ES-3.10 Public Health and Safety

This section addresses three areas of interest: tailings embankment safety, fire risks, and the potential for releases or public exposure to hazardous materials. The analysis concludes the following:

- The risk of embankment failure for all alternatives would be minimized by required adherence to Federal and Arizona design standards and by applicant-committed environmental protection measures.
- The consequences of a catastrophic failure and the downstream flow of tailings would include possible loss of life and limb, destruction of property, displacement of large downstream populations, disruption of the Arizona economy, contamination of soils and water, and risk to water supplies and key water

infrastructure like the CAP canal. The highest population is downstream of Alternative 2.

- All alternative designs are built to the same safety standards, but they have inherent differences in their resilience when unexpected events or upsets happen. Alternatives 2 and 3 are the least resilient because they use modified-centerline embankments, have long (10-mile) freestanding embankments, and do not use separately contained PAG storage cells. Alternative 6 is the most resilient, using a centerline embankment that is only 3 miles long and anchored on each side, with separate PAG storage cells using downstream embankments.
- Alternative 4, using filtered (dry-stack) tailings, would have the fewest consequences if a failure occurred, collapsing as a slump or landslide, and impacting the local vicinity only.
- With respect to other public safety risks, the risk of inadvertent ignition and resulting wildland fire is considered quite low. However, Alternative 4 includes areas classified with shrub fuels that burn with high intensity in the event of an ignition. As Mine Safety and Health Administration and other regulations and standards govern the transport and storage of explosives and hazardous chemicals, risks of spills or releases are therefore considered possible, but unlikely, with appropriate response plans in place.

ES-3.11 Scenic Resources

This section addresses the existing conditions of scenic resources (including dark skies) in the area of the proposed action and alternatives. It also addresses the potential changes to those conditions from construction and operation of the proposed project. The analysis concludes the following:

- All tailings facilities would be visible from long distances, and the change in contrast caused by land disturbance and vegetation removal, dust, and equipment would strongly impact viewers, including recreationists on scenic highways.
- Alternatives 2 and 3 would impact Arizona Trail users and off-highway vehicle users, as would Alternative 4. Alternative 4 would be the tallest facility when viewed (1,000 feet in height); it would dominate the scene and be viewable from sensitive locations (like Picketpost Mountain). Alternative 5 would also be highly visible and would impact Arizona Trail and off-highway vehicle users. Alternative 6 would be visible from within the valley of Dripping Spring Wash but otherwise would not be as visible on the landscape as the other alternatives.

ES-3.12 Cultural Resources

This section analyzes potential impacts on all known cultural resources within the project area. The analysis concludes the following:

- The NRHP-listed *Chi'chil Bildagoteel* Historic District TCP would be directly and permanently damaged by the subsidence area at the Oak Flat Federal Parcel.
- All alternative areas would have 100 percent pedestrian surveys; the majority of surveys have been completed. From surveyed areas, the number of NRHP-eligible sites are as follows: Alternatives 2 and 3 (101 sites); Alternative 4 (122 sites); Alternative 5 (114–125 sites, depending on pipeline route); and Alternative 6 (318–343 sites, depending on pipeline route).
- Additional sites would be directly impacted but have undetermined eligibility, would be indirectly impacted, or are within a 6-mile buffer area and would be impacted by the change in the landscape as a result of the proposed mine.

ES-3.13 Socioeconomics

This section examines the social and economic impacts on the quality of life for neighboring communities near the proposed mine. The analysis concludes the following:

- On average, the mine is projected to directly employ 1,500 workers, pay about \$134 million per year in total employee compensation, and purchase about \$546 million per year in goods and services. Including direct and multiplier effects, the proposed mine is projected to increase average annual economic value added in Arizona by about \$1 billion.
- The proposed mine is projected to generate an average of between \$88 and \$113 million per year in State and local tax revenues and would also produce substantial revenues for the Federal Government, estimated at more than \$200 million per year. There would be a loss of hunting revenue as a result of the tailings storage facilities; the loss would be highest in the Superior area with Alternatives 2, 3, and 4.
- Construction and operations of the proposed mine could affect costs for both the Town of Superior and Pinal County to maintain street and road networks. A number of agreements between Resolution Copper and the Town of Superior would offset impacts to quality of life, education, and emergency services.
- Property values are expected to decline in close proximity to the tailings storage facilities.

ES-3.14 Tribal Values and Concerns

This section discusses the high potential for the proposed mine to directly, adversely, and permanently affect numerous cultural artifacts, sacred seeps and springs, traditional ceremonial areas, resource gathering localities, burial locations, and other places and experiences of high spiritual and other value to tribal members.

- Development of the Resolution Copper Mine would directly and permanently damage the NRHP-listed *Chi'chil Bildagoteel* Historic District TCP. One or more Emory oak groves at Oak Flat, used by tribal members for acorn collecting, would likely be lost. Other unspecified mineral or plant collecting locations and culturally important landscapes are also likely to be affected.
- Between 14 and 16 GDEs, mostly sacred springs, would be anticipated to be impacted by dewatering. Although mitigation would replace water, impacts would remain to the natural setting of these places.
- Burials are likely to be impacted; the numbers and locations of burials would not be known until such sites are detected as a result of project-related activities.

ES-3.15 Environmental Justice

This section examines issues in the context of the Resolution Copper Project and Land Exchange that have the potential to harm vulnerable or disadvantaged communities. The analysis concludes the following:

- There are five environmental justice communities in the area, as well as Native American communities, that would be impacted by cultural impacts described above. Economic effects from the mine would be most apparent in the town of Superior (an environmental justice community). Housing shortages, pressure on municipal services and schools, and price increases would potentially adversely affect low-income and minority individuals.

ES-3.16 Livestock and Grazing

This section discloses the impacts to currently authorized livestock grazing on lands managed by the Forest Service, BLM, or Arizona State

Land Department that are located within the project area. The analysis concludes the following:

- There would be a reduction in available allotment acreage (BLM, Forest Service, and Arizona State land) ranging from 7,500 to 16,000 acres and a proportional reduction in livestock capacity from 1,300 to 5,300 animal-unit months. The water sources and grazing infrastructure associated with these allotment areas would also be lost.

ES-3.17 Impact Avoidance, Minimization, and Mitigation

The DEIS serves in part to inform the public and review agencies of design features, best management practices, and mitigation measures that are included with the project to reduce or avoid impacts. The Forest Service views these elements as part of the project and considers Resolution Copper's proposed mitigation measures, described in appendix J of the DEIS, as inherent to the proposed alternative, as well as other action alternatives' applicable components.

To the extent possible, these measures, including any potential impacts associated with these measures, were considered when assessing the impacts of the project on the resources. Where there is insufficient detail to determine whether an impact can be avoided or minimized, the measure cannot be incorporated into the impact analysis but serves to inform the public of Resolution Copper's plans.

Additional mitigation measures identified or recommended to date during the NEPA process have been compiled and would be considered by the Forest Service and cooperating agencies as part of their permit decisions to further minimize project impacts. This list will be updated after public review of the DEIS for a comprehensive list of all measures identified during the NEPA process.

All measures will be assessed with the goal of disclosing the likelihood that the measures would be adopted by the applicant or implemented

as a condition in a State, Federal, or local permit by the responsible agencies as part of their permit decisions following completion of the NEPA process. Specific mitigation conditions would be determined following completion of the environmental review and would be included in the record of decision for any permit that may be issued.

Compensatory mitigation for unavoidable impacts to aquatic resources may be required to ensure that activities requiring a permit comply with 404(b)(1) guidelines. Compensatory mitigation is the restoration (reestablishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources to offset unavoidable adverse impacts.

Resolution Copper has developed a draft Conceptual Compensatory Mitigation Plan outlining its proposed approach for compensatory mitigation. The draft Conceptual Compensatory Mitigation Plan would be amended in the future to include proposed mitigation plans. In addition, Resolution Copper proposes to use monitoring measures through construction, operation, and closure of the project to assess predicted project impacts and the effectiveness of mitigation measures.

The draft Conceptual Compensatory Mitigation Plan submitted to the USACE by Resolution Copper is included in the EIS as appendix D.

ES-4 DEIS APPENDICES

The final section of the DEIS provides detailed information on 15 subjects. These appendices are as follows:

- Appendix A: Section 3003 of the NDAA
- Appendix B: Existing Conditions of Offered Lands
- Appendix C: Draft Practicability Analysis in Support of Clean Water Act 404(B)(1) Alternatives Analysis
- Appendix D: Draft Resolution Copper Project Clean Water Act Section 404 Conceptual Compensatory Mitigation Plan
- Appendix E: Alternatives Impact Summary

- Appendix F: Alternatives Considered but Dismissed from Detailed Analysis
- Appendix G: Further Details of East Plant Site, West Plant Site, MARRCO Corridor, and Filter Plant and Loadout Facility Infrastructure
- Appendix H: Further Details of Mine Water Balance and Use
- Appendix I: Summary of Effects of the Land Exchange
- Appendix J: Mitigation and Monitoring Plan
- Appendix K: Summary of Content of Resource Analysis Process Memoranda
- Appendix L: Detailed Hydrographs Describing Impacts on Groundwater-Dependent Ecosystems
- Appendix M: Water Quality Modeling Results for Constituents of Concern
- Appendix N: Summary of Existing Groundwater and Surface Water Quality
- Appendix O: Draft Programmatic Agreement Regarding Compliance with the NHPA on the Resolution Copper Project and Southeast Arizona Land Exchange

This page intentionally left blank

TABLE OF CONTENTS

VOLUME 1

EXECUTIVE SUMMARY

ES-1	Introduction	ES-1	ES-2.5	Alternative 5 – Peg Leg	ES-18
ES-1.1	Background	ES-1	ES-2.6	Alternative 6 – Skunk Camp	ES-20
ES-1.2	Project Overview	ES-1	ES-3	Summary of Impacts	ES-22
ES-1.3	Areas of Controversy	ES-3	ES-3.1	Introduction	ES-22
ES-1.4	Lead and Cooperating Agency Roles	ES-4	ES-3.2	Geology, Minerals, and Subsidence	ES-22
ES-1.5	Purpose and Need	ES-5	ES-3.3	Soils and Vegetation	ES-22
ES-1.6	Proposed Action.	ES-5	ES-3.4	Noise and Vibration	ES-22
ES-1.6.1	General Plan of Operations	ES-5	ES-3.5	Transportation and Access	ES-23
ES-1.6.2	Land Exchange	ES-6	ES-3.6	Air Quality	ES-23
ES-1.7	Nature of Lead Agency Decision	ES-7	ES-3.7	Water Resources	ES-23
ES-1.8	Public Participation	ES-8	ES-3.8	Wildlife and Special Status Wildlife Species	ES-24
ES-1.9	Issues Selected for Analysis	ES-8	ES-3.9	Recreation	ES-25
ES-2	Alternatives	ES-10	ES-3.10	Public Health and Safety	ES-25
ES-2.1	No Action Alternative	ES-10	ES-3.11	Scenic Resources	ES-26
ES-2.2	Alternative 2 – Near West Proposed Action.	ES-12	ES-3.12	Cultural Resources	ES-26
ES-2.3	Alternative 3 – Near West – Ultrathickened	ES-14	ES-3.13	Socioeconomics.	ES-27
ES-2.3.1	Similarities with Alternative 2	ES-14	ES-3.14	Tribal Values and Concerns.	ES-27
ES-2.3.2	Differences from Alternative 2	ES-14	ES-3.15	Environmental Justice	ES-27
ES-2.4	Alternative 4 – Silver King	ES-16	ES-3.16	Livestock and Grazing	ES-27
ES-2.4.1	Arizona National Scenic Trail.	ES-16	ES-3.17	Impact Avoidance, Minimization, and Mitigation	ES-28
			ES-4	DEIS Appendices.	ES-28



TABLE OF CONTENTS

CHAPTER 1

PURPOSE OF AND NEED FOR ACTION

1.1	Introduction	1	1.5.5	Financial Assurance for Closure and Post-closure Activities	15
1.1.1	Document Structure	3	1.6	Public Involvement	20
1.1.1.1	Volume 1	3	1.6.1	Scoping	21
1.1.1.2	Volume 2	4	1.6.2	Project Update and Alternatives Development Workshop	22
1.1.1.3	Volumes 3 and 4	4	1.6.3	Cooperating Agencies	22
1.2	Background	5	1.6.4	Tribal Consultation	22
1.3	Purpose of and Need for Action	6	1.7	Issues	24
1.4	Proposed Action	8	1.7.1	Issue 1 – Tribal Values and Concerns	24
1.4.1	General Plan of Operations	8	1.7.2	Issue 2 – Socioeconomics	25
1.4.2	Land Exchange	10	1.7.3	Issue 3 – Environmental Justice	25
1.4.2.1	Appraisal	10	1.7.4	Issue 4 – Cultural Resources	25
1.4.3	Forest Plan Amendment	10	1.7.5	Issue 5 – Public Health and Safety	25
1.5	Decision Framework	11	1.7.6	Issue 6 – Water Resources	25
1.5.1	Forest Service	11	1.7.7	Issue 7 – Biological Resources	26
1.5.1.1	General Plan of Operations	13	1.7.8	Issue 8 – Air Quality	26
1.5.1.2	Land Exchange	13	1.7.9	Issue 9 – Long-term Land Suitability	26
1.5.2	Bureau of Land Management	14	1.7.10	Issue 10 – Recreation	26
1.5.3	U.S. Army Corps of Engineers	14	1.7.11	Issue 11 – Scenic Resources	26
1.5.4	Required Permits, Licenses, and Authorizations	15	1.7.12	Issue 12 – Transportation and Access	27
			1.7.13	Issue 13 – Noise and Vibration	27
			1.7.14	Issue 14 – Land Ownership and Boundary Management	27

TABLE OF CONTENTS

1.8	Other Proponent-Related Activities on National Forest System Lands	27	2.2.5.1	Alternative 3 Mine Plan Components	75
1.8.1	Plan of Operations for Baseline Hydrological and Geotechnical Data-Gathering Activities	27	2.2.6	Alternative 4 – Silver King	81
1.8.2	Apache Leap Special Management Area	28	2.2.6.1	Alternative 4 Mine Plan Components	81
CHAPTER 2			2.2.7	Alternative 5 – Peg Leg	88
ALTERNATIVES, INCLUDING THE PROPOSED ACTION			2.2.7.1	Alternative 5 Mine Plan Components	88
2.1	Introduction	29	2.2.8	Alternative 6 – Skunk Camp	94
2.2	Alternatives Considered in Detail.	30	2.2.8.1	Alternative 6 Mine Plan Components	94
2.2.1	Forest Service Preferred Alternative	30	2.2.9	Alternative GPO Components Common to All Action Alternatives.	100
2.2.2	Elements Common to All Action Alternatives	30	2.2.9.1	Relocation of Process Water Pond within West Plant Site	100
2.2.2.1	Land Exchange	30	2.2.9.2	Redesign and/or Improvement of Vehicle Access to and from the West Plant Site.	100
2.2.2.2	General Plan of Operations Components	36	2.3	Mitigation Common to All Action Alternatives	100
2.2.3	Alternative 1 – No Action Alternative	65	2.3.1	Mitigation and Monitoring.	102
2.2.3.1	Need for Inclusion of Land Exchange in Document	66	2.3.1.1	Authority.	102
2.2.4	Alternative 2 – Near West Proposed Action – Mine Plan Components	67	2.3.1.2	Applicant-Committed Environmental Design Measures.	103
2.2.4.1	Water Use	67	2.3.1.3	Monitoring and Evaluation	103
2.2.4.2	Tailings Storage Facility and Tailings Pipeline Corridor	67	2.3.1.4	Financial Assurances.	104
2.2.4.3	Closure and Reclamation	72	2.4	Effects of the Land Exchange	104
2.2.5	Alternative 3 – Near West – Ultrathickened	75	2.5	Comparison of Alternatives	105



TABLE OF CONTENTS

CHAPTER 3

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1	Introduction	127
3.2	GEOLOGY, MINERALS, AND SUBSIDENCE	130
3.2.1	Introduction	130
3.2.2	Analysis Methodology, Assumptions, and Uncertain and Unknown Information	130
3.2.2.1	Analysis Area	130
3.2.2.2	Surface Subsidence Review	130
3.2.2.3	Geological Hazards	134
3.2.2.4	Paleontological Resources	134
3.2.2.5	Caves and Karst Resources	134
3.2.2.6	Unpatented Mining Claims	134
3.2.3	Affected Environment	134
3.2.3.1	Relevant Laws, Regulations, Policies, and Plans	134
3.2.3.2	Existing Conditions and Ongoing Trends	135
3.2.4	Environmental Consequences of Implementation of the Proposed Mine Plan and Alternatives	148
3.2.4.1	Alternative 1 – No Action Alternative	148
3.2.4.2	Impacts Common to All Action Alternatives	148
3.2.4.3	Alternative 2 – Near West Proposed Action	156

3.2.4.4	Alternative 3 – Near West – Ultrathickened	156
3.2.4.5	Alternative 4 – Silver King	156
3.2.4.6	Alternative 5 – Peg Leg	157
3.2.4.7	Alternative 6 – Skunk Camp	157
3.2.4.8	Cumulative Effects	157
3.2.4.9	Mitigation Effectiveness	159
3.2.4.10	Other Required Disclosures	160
3.3	SOILS AND VEGETATION	161
3.3.1	Introduction	161
3.3.2	Analysis Methodology, Assumptions, and Uncertain and Unknown Information	161
3.3.2.1	Analysis Area	161
3.3.2.2	Soils Analysis	164
3.3.2.3	Revegetation Analysis	164
3.3.2.4	Vegetation Communities, Noxious Weeds, and Special Status Plant Species Analysis	165
3.3.3	Affected Environment	165
3.3.3.1	Relevant Laws, Regulations, Policies, and Plans	165
3.3.3.2	Existing Conditions and Ongoing Trends	166
3.3.4	Environmental Consequences of Implementation of the Proposed Mine Plan and Alternatives	183
3.3.4.1	Alternative 1 – No Action Alternative	183

TABLE OF CONTENTS

3.3.4.2	Impacts Common to All Action Alternatives . . .	183	3.4.4.1	Alternative 1 – No Action	222
3.3.4.3	Alternative 2 – Near West Proposed Action . . .	201	3.4.4.2	Impacts Common to All Action Alternatives . . .	222
3.3.4.4	Alternative 3 – Near West – Ultrathickened . . .	202	3.4.4.3	Alternatives 2 and 3 – Near West – Modified Proposed Action	223
3.3.4.5	Alternative 4 – Silver King	202	3.4.4.4	Alternative 4 – Silver King	225
3.3.4.6	Alternative 5 – Peg Leg	205	3.4.4.5	Alternative 5 – Peg Leg	233
3.3.4.7	Alternative 6 – Skunk Camp	205	3.4.4.6	Alternative 6 – Skunk Camp	233
3.3.4.8	Cumulative Effects	205	3.4.4.7	Cumulative Effects	233
3.3.4.9	Mitigation Effectiveness	208	3.4.4.8	Mitigation Effectiveness	242
3.3.4.10	Other Required Disclosures	210	3.4.4.9	Other Required Disclosures	243
3.4	NOISE AND VIBRATION	211	3.5	TRANSPORTATION AND ACCESS	244
3.4.1	Introduction	211	3.5.1	Introduction	244
3.4.2	Analysis Methodology, Assumptions, and Uncertain and Unknown Information . . .	211	3.5.2	Analysis Methodology, Assumptions, and Uncertain and Unknown Information	244
3.4.2.1	Analysis Area	211	3.5.2.1	Analysis Area	244
3.4.2.2	Noise Analysis Methodology	211	3.5.3	Affected Environment	246
3.4.2.3	Vibration Analysis Methodology	215	3.5.3.1	Relevant Laws, Regulations, Policies, and Plans	246
3.4.3	Affected Environment	215	3.5.3.2	Existing Conditions and Ongoing Trends . . .	248
3.4.3.1	Relevant Laws, Metrics, Regulations, Policies, and Plans	215	3.5.4	Environmental Consequences of Implementation of the Proposed Mine Plan and Alternatives	254
3.4.3.2	Selected Thresholds	216	3.5.4.1	Alternative 1 – No Action	254
3.4.3.3	Existing Conditions and Ongoing Trends . . .	216	3.5.4.2	Impacts Common to All Action Alternatives	254
3.4.4	Environmental Consequences of Implementation of the Proposed Mine Plan and Alternatives	222			



TABLE OF CONTENTS

3.5.4.3	Alternative 2 and Alternative 3 – Near West	261	3.6.4.4	Mitigation Effectiveness	293
3.5.4.4	Alternative 4 – Silver King	265	3.6.4.5	Other Required Disclosures	294
3.5.4.5	Alternative 5 – Peg Leg	268	3.7	Water Resources	295
3.5.4.6	Alternative 6 – Skunk Camp	269	3.7.1	Groundwater Quantity and Groundwater- Dependent Ecosystems	295
3.5.4.7	Cumulative Effects	269	3.7.1.1	Introduction	295
3.5.4.8	Mitigation Effectiveness	273	3.7.1.2	Analysis Methodology, Assumptions, and Uncertain and Unknown Information	296
3.5.4.9	Other Required Disclosures	273	3.7.1.3	Affected Environment	303
3.6	AIR QUALITY	275	3.7.1.4	Environmental Consequences of Implementation of the Proposed Mine Plan and Alternatives	317
3.6.1	Introduction	275			
3.6.2	Analysis Methodology, Assumptions, and Uncertain and Unknown Information	275			
3.6.2.1	Analysis Area	275			
3.6.2.2	Methodology	275			
3.6.3	Affected Environment	280			
3.6.3.1	Relevant Laws, Regulations, Policies, and Plans	280			
3.6.3.2	Existing Conditions and Ongoing Trends	280			
3.6.4	Environmental Consequences of Implementation of the Proposed Mine Plan and Alternatives	282			
3.6.4.1	Alternative 1 – No Action	282			
3.6.4.2	Direct and Indirect Effects Common to All Action Alternatives	282			
3.6.4.3	Cumulative Effects	292			

TABLE OF CONTENTS

VOLUME 2

3.7.2	Groundwater and Surface Water Quality	346
3.7.3	Surface Water Quantity	422
3.8	Wildlife and Special Status Wildlife Species	448
3.9	Recreation	482
3.10	Public Health and Safety	515
3.11	Scenic Resources	585
3.12	Cultural Resources	622
3.13	Socioeconomics	640
3.14	Tribal Values and Concerns	658
3.15	Environmental Justice	672
3.16	Livestock and Grazing	687
3.17	Required Disclosures	703

CHAPTER 4

CONSULTED PARTIES	715
--------------------------------	------------

CHAPTER 5

LIST OF PREPARERS	721
--------------------------------	------------

CHAPTER 6

LITERATURE CITED	727
-------------------------------	------------

CHAPTER 7

GLOSSARY, ACRONYMS, AND ABBREVIATIONS	777
--	------------

CHAPTER 8

INDEX	787
--------------------	------------

VOLUME 3

APPENDIX A: Section 3003 of the NDAA

APPENDIX B: Existing Conditions of Offered Lands

APPENDIX C: Draft Practicability Analysis in Support
of Clean Water Act 404(B)(1) Alternatives
Analysis

APPENDIX D: Draft Resolution Copper Project Clean Water
Act Section 404 Conceptual Compensatory
Mitigation Plan

APPENDIX E: Alternatives Impact Summary



TABLE OF CONTENTS

VOLUME 4

- APPENDIX F:** Alternatives Considered but Dismissed from Detailed Analysis
- APPENDIX G:** Further Details of East Plant Site, West Plant Site, MARRCO Corridor, and Filter Plant and Loadout Facility Infrastructure
- APPENDIX H:** Further Details of Mine Water Balance and Use
- APPENDIX I:** Summary of Effects of the Land Exchange
- APPENDIX J:** Mitigation and Monitoring Plan
- APPENDIX K:** Summary of Content of Resource Analysis Process Memoranda
- APPENDIX L:** Detailed Hydrographs Describing Impacts on Groundwater-Dependent Ecosystems
- APPENDIX M:** Water Quality Modeling Results for Constituents of Concern
- APPENDIX N:** Summary of Existing Groundwater and Surface Water Quality
- APPENDIX O:** Draft Programmatic Agreement Regarding Compliance with the NHPA on the Resolution Copper Project and Southeast Arizona Land Exchange

FIGURES

ES-1.	Resolution Copper Project vicinity map	ES-2	2.2.2-9.	West Plant Site facilities overview	49
ES-2.	Overview of project alternative locations	ES-11	2.2.2-10.	Range of tailings types based on solids content	50
ES-3.	Alternative 2 – Near West Proposed Action	ES-13	2.2.2-11.	Graphical display of pipeline arrangements used in tailings conveyance corridor design	52
ES-4.	Alternative 3 – Near West – Ultrathickened	ES-15	2.2.2-12.	MARRCO corridor facility layout (1 of 2)	53
ES-5.	Alternative 4 – Silver King	ES-17	2.2.2-13.	MARRCO corridor facility layout (2 of 2)	54
ES-6.	Alternative 5 – Peg Leg	ES-19	2.2.2-14.	Filter plant and loadout facility detailed layout.	55
ES-7.	Alternative 6 – Skunk Camp (preferred alternative)	ES-21	2.2.2-15.	Proposed new and upgraded transmission lines	57
1.1-1.	Resolution Copper Project vicinity map	2	2.2.2-16.	Alternative 2 – Near West Proposed Action water supply and water use diagram	60
1.2-1.	The Copper Triangle map	7	2.2.4-1.	Overview of Alternative 2 – Near West Proposed Action tailings storage facility	68
2.2.2-1.	Land exchange parcels overview	33	2.2.4-2.	Diagram illustrating various embankment designs	70
2.2.2-2.	Alternative 2 – Near West Proposed Action overview	37	2.2.4-3.	Alternative 2 – Near West Proposed Action tailings storage facility detailed layout	71
2.2.2-3.	Mine phases, time frames, and mine activities by phase	39	2.2.5-1.	Alternative 3 – Near West – Ultrathickened overview	76
2.2.2-4.	Overview of the mining process at full operation	40	2.2.5-2.	Alternative 3 – Near West – Ultrathickened tailings storage facility	77
2.2.2-5.	Predicted mining subsidence areas and the East Plant Site area	43	2.2.6-1.	Alternative 4 – Silver King overview	82
2.2.2-6.	Cross section and aerial photograph simulations of the predicted subsidence areas	45	2.2.6-2.	Relocation of filter plant and loadout facility	83
2.2.2-7.	East Plant Site detailed facilities layout	46	2.2.6-3.	Alternative 4 – Silver King tailings storage facility	85
2.2.2-8.	Redesign and/or improvement of vehicle access to and from the West Plant Site	48			



FIGURES

2.2.7-1. Alternative 5 – Peg Leg overview	89	3.3.3-2. Vegetation communities and land cover types	177
2.2.7-2. Alternative 5 – Peg Leg tailings storage facility	91	3.3.3-3. Designated and proposed critical habitat for ESA-listed plant species	181
2.2.8-1. Alternative 6 – Skunk Camp overview.	95	3.3.4-1. Meta-analysis summary.	189
2.2.8-2. Alternative 6 – Skunk Camp tailings storage facility	96	3.4.2-1. Noise and vibration analysis area	212
2.2.9-1. Relocation of process water pond within West Plant Site	101	3.4.3-1. Land use, sensitive areas/receptors identification, and measurement locations	217
3.2.2-1. Geology, minerals, and subsidence analysis area	131	3.4.4-1. Locations of buildings analyzed for selected vibration threshold near Wes Plant Site and underground tunnel	223
3.2.2-2. Conceptual cross section of the block-cave and subsidence zone	133	3.4.4-2. Predicted noise contours associated with Alternatives 2 and 3 (1 of 2)	229
3.2.3-1. Generalized geological map of Superior Basin and Oak Flat	137	3.4.4-3. Predicted noise contours associated with Alternatives 2 and 3 (2 of 2)	230
3.2.3-2. Generalized geological cross section	138	3.4.4-4. Predicted noise contours associated with operations, Alternative 4	232
3.2.3-3. Generalized geological map of Peg Leg and Skunk Camp locations	143	3.4.4-5. Predicted noise contours associated with operations, Alternative 5	237
3.2.4-1. Evolution over time of the crater, fracture, and continuous subsidence limits predicted to exist (reproduced from Garza-Cruz and Pierce (2017))	152	3.4.4-6. Predicted noise contours associated with operations, Alternative 6	240
3.2.4-2. Final anticipated subsidence crater boundaries at end of mine life	153	3.5.2-1. Transportation and access analysis area	245
3.3.2-1. Soils analysis area	162	3.5.3-1. Commonly used NFS roads in the project area	250
3.3.2-2. Vegetation analysis area	163	3.5.3-2. Key intersections and road segments analyzed through traffic counts	252
3.3.3-1. Soil map units as delineated from SSURGO	167		

FIGURES

3.5.4-1. Access roads for alternative tailings storage facilities	259	3.7.1-4. Conceptual cross section of the groundwater systems	305
3.6.2-1. Analysis area showing proposed action and alternatives, sensitive areas, and meteorological monitoring sites	276	3.7.1-5. Characterization wells for the shallow, perched groundwater, the Apache Leap Tuff aquifer, and the deep groundwater system	307
3.6.3-1. Monitoring results for PM10, PM2.5, NO2, SO2, and ozone relative to standards under 40 CFR 50	281	3.7.1-6. Apache Leap Tuff aquifer water-level elevations and general flow directions	308
3.6.4-1. Maximum 1-hour 98th percentile NO2 impacts at receptors near East Plant Site and West Plant Site for Alternative 2 – Near West Proposed Action	286	3.7.1-7. Groundwater-dependent ecosystems of concern	315
3.6.4-2. Maximum 24-hour 98th percentile PM2.5 impacts at receptors near the tailings storage facility for Alternative 2 – Near West Proposed Action	287	3.7.1-8. Modeled groundwater drawdown—no action	323
3.6.4-3. Near-field visibility of plume blight based on the absolute contrast threshold, $ C $, of 0.02 and a color contrast for gray terrain, ΔE , of 1.0.	291	3.7.1-9. Summary of impacts on GDEs by alternative	324
3.7.1-1. Overview of groundwater modeling analysis area	297		
3.7.1-2. Desert Wellfield modeling analysis area and maximum (Alternative 2, left) and minimum (Alternative 4, right) modeled pumping impacts	298		
3.7.1-3. Modeled groundwater drawdown—proposed action, 200 years after start of mine	302		



TABLES

ES-1.	Issues carried forward for analysis	ES-9	2.2.6-1.	Summary of Alternative 4 – Silver King tailings storage facility	87
1.4.2-1.	Summary of land exchange parcels	11	2.2.7-1.	Summary of Alternative 5 – Peg Leg tailings storage facility	93
1.4.3-1.	Forest plan amendments for the Resolution Copper Project and Land Exchange	12	2.2.8-1.	Summary of Alternative 6 – Skunk Camp tailings storage facility	99
1.5.4-1.	Permits, licenses, and authorizations required for the Resolution Copper Project	16	3.3.3-1.	Estimated locations and amounts of available reclamation cover material	170
1.6.1-1.	Scoping meeting locations, dates, and attendance numbers	21	3.3.3-2.	Predominant soils by alternative	171
1.6.1-2.	Distribution of submittals by sender type.	22	3.3.3-3.	Vegetation communities and land cover types in the analysis area	176
1.6.3-1.	Cooperating agencies participating in the EIS process	23	3.3.3-4.	Special status plant species with the potential to occur in the analysis area	179
2.2-1.	Tailings storage facility comparison.	31	3.3.3-5.	Existing disturbance acreage by alternative (calculated within the project footprint)	182
2.2.2-1.	Summary of project surface disturbance by proposed action.	38	3.3.4-1.	Disturbance response groups	191
2.2.2-2.	Description of underground tunnel levels	41	3.3.4-2.	Disturbance, reclamation, and revegetation outcomes by facility and tailings alternative	192
2.2.2-3.	Underground mobile equipment	42	3.3.4-3.	Acres of vegetation communities to be disturbed within each action alternative footprint	202
2.2.2-4.	Characteristics and acreages of subsidence subareas	44	3.3.4-4.	Acres of modeled habitat for special status plant species potentially occurring within each action alternative footprint	203
2.2.2-5.	Existing and proposed mine access roads and traffic	58	3.4.3-1.	Background measured noise levels and expected ranges for sensitive receptors based on land use	220
2.2.2-6.	Proposed new and upgraded transmission line summary	59	3.4.3-2.	Background vibration measurement summary	221
2.2.4-1.	Summary of Alternative 2 – Near West Proposed Action tailings storage facility	73			
2.2.5-1.	Summary of Alternative 3 – Near West – Ultrathickened tailings storage facility	80			

TABLES

3.4.3-3. East Plant Site noise data comparison (with blasting and no-blasting activities)	221	3.5.3-1. Level of service criteria for unsignalized intersections	254
3.4.4-1. Calculated explosive loading at sensitive receptor samples based on selected vibration threshold	223	3.5.3-2. Existing peak hour level of service and delay . . .	255
3.4.4-2. Calculated explosive loading at sensitive receptor samples based on airblast selected threshold	224	3.5.4-1. Intersections impacted by all action alternatives	260
3.4.4-3. Predicted non-blasting vibration impacts during operations, Alternatives 2 and 3	225	3.5.4-2. Site-generated trips during peak hour	260
3.4.4-4. Estimated noise levels from construction activities.	226	3.5.4-3. Level of service and delay during peak construction (2022) and normal operations (2027)	262
3.4.4-5. Predicted noise impacts during operations, Alternatives 2 and 3, Leq(h) metric	227	3.5.4-4. Miles of NFS roads decommissioned and lost for East Plant Site, West Plant Site, and filter plant and loadout facility	264
3.4.4-6. Predicted noise impacts during operations, Alternatives 2 and 3, Ldn metric	228	3.5.4-5. Footprint and intersections impacted by each tailings storage facility location	264
3.4.4-7. Predicted noise impacts during operations, Alternative 4, Leq(h) metric	231	3.5.4-6. Site-generated trips during peak hour for each alternative	265
3.4.4-8. Predicted noise impacts during operations, Alternative 4, Ldn metric	234	3.5.4-7. Level of service and delay for tailings storage facility alternate locations during peak construction (2022) and normal operations (2027)	266
3.4.4-9. Predicted noise impacts during operations, Alternative 5, Leq(h) metric	235	3.5.4-8. Miles of NFS roads decommissioned and lost for Alternatives 2 and 3 tailings storage facility	267
3.4.4-10. Predicted noise impacts during operations, Alternative 5, Ldn metric	236	3.5.4-9. New access roads for tailings storage facility alternatives	268
3.4.4-11. Predicted noise impacts during operations, Alternative 6, Leq(h) metric	238	3.5.4-10. Miles of NFS roads decommissioned and lost for Alternative 4 tailings storage facility	270
3.4.4-12. Predicted noise impacts during operations, Alternative 6, Ldn metric	239		



TABLES

3.6.2-1.	Total annual controlled emissions for proposed action (tons/year)	277	3.7.1-5.	Summary of potential impacts on groundwater-dependent ecosystems from surface flow losses	330
3.6.2-2.	Total annual indirect emissions for proposed action caused by employee traffic and deliveries (tons/year)	279	3.7.1-6.	Summary of water right filings associated with GDEs impacted by groundwater drawdown	333
3.6.4-1.	Maximum air quality impacts for proposed operations and Alternative 2 – Near West Proposed Action	285	3.7.1-7.	Primary differences between alternative water balances	336
3.6.4-2.	Maximum ambient air quality impacts at identified sensitive areas	289			
3.6.4-3.	Maximum deposition analysis impacts at sensitive areas	289			
3.6.4-4.	Annual total and percentage of daylight hours of perceptible plume blight at observer locations in sensitive areas, Superstition Wilderness, and White Canyon ACEC	290			
3.6.4-5.	Impacts of 98th percentile daily regional haze extinction levels in Class I areas	290			
3.7.1-1.	Changes in groundwater head in the deep groundwater system due to dewatering	309			
3.7.1-2.	GDEs identified as having at least a partial connection to regional groundwater	314			
3.7.1-3.	Summary of potential impacts on groundwater-dependent ecosystems from groundwater drawdown	318			
3.7.1-4.	Summary of potential impacts on groundwater supplies from groundwater drawdown.	326			

Overview

On March 18, 2016, the Tonto National Forest issued a Notice of Intent to prepare an environmental impact statement for the Resolution Copper Project and Land Exchange.

Three separate but related components would be analyzed in the EIS:

- Approval of a proposed mine plan governing surface disturbance on NFS lands outside of the exchange parcels from mining operations that are reasonably incident to extraction, transportation, and processing of copper and molybdenum that was submitted to the Tonto National Forest in November 2013
- Approval of an amendment to the Tonto National Forest Plan, if needed.
- Resolution Copper increased the offered parcel by an additional 32 acres of privately held land that is adjacent to the 110 acres presented in the NDAA as part of the Apache Leap Special Management Area. The additional land was provided to allow for a more contiguous parcel and for ease of surveying.

PURPOSE OF AND NEED FOR ACTION

1.1 Introduction

The U.S. Forest Service (Forest Service) is a land management agency under the U.S. Department of Agriculture. The Forest Service's mission is to sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations. The Tonto National Forest, a unit of the Forest Service located in south-central Arizona, prepared this environmental impact statement (EIS) to disclose the potential environmental effects of the Resolution Copper Project and Land Exchange (project). The project includes (1) the Southeast Arizona Land Exchange (land exchange), a congressionally mandated exchange of land between Resolution Copper Mining, LLC (Resolution Copper) and the United States; (2) approval of the "General Plan of Operations" (GPO)¹ for any operations on National Forest System (NFS) land associated with a proposed large-scale underground mine (Resolution Copper Project); and (3) amendments to the "Tonto National Forest Land and Resource Management Plan" (forest plan) (1985, as amended).

Resolution Copper is a limited liability company that is owned by Rio Tinto (55 percent) and



Historical Magma Mine workings and the smelter complex

BHP (45 percent). Rio Tinto is the managing member. In November 2013, Resolution Copper submitted a proposed GPO to the Forest Service for development and operation of a large-scale mine near Superior, Arizona (figure 1.1-1).² The proposed GPO sought authorization for surface disturbance on NFS lands for mining operations and processing of copper and molybdenum. The proposed mine would be located in the Globe and Mesa Ranger Districts. The Forest Service determined the proposed GPO to be complete in December 2014 (U.S. Forest Service 2014c). As

1. The GPO, as amended, is available online at www.resolutioncopper.com and at the Tonto National Forest Supervisor's Office, 2324 East McDowell Road, Phoenix, AZ 85006.
2. The maps contained in this EIS are based on a variety of sources of electronic and geographic data. Every effort has been made to ensure the correctness of these data coverages; however, the U.S. Department of Agriculture Forest Service makes no warranty, expressed or implied, about the accuracy, reliability, completeness, or utility of geospatial data not developed specifically for the Resolution Copper Project and Land Exchange EIS.

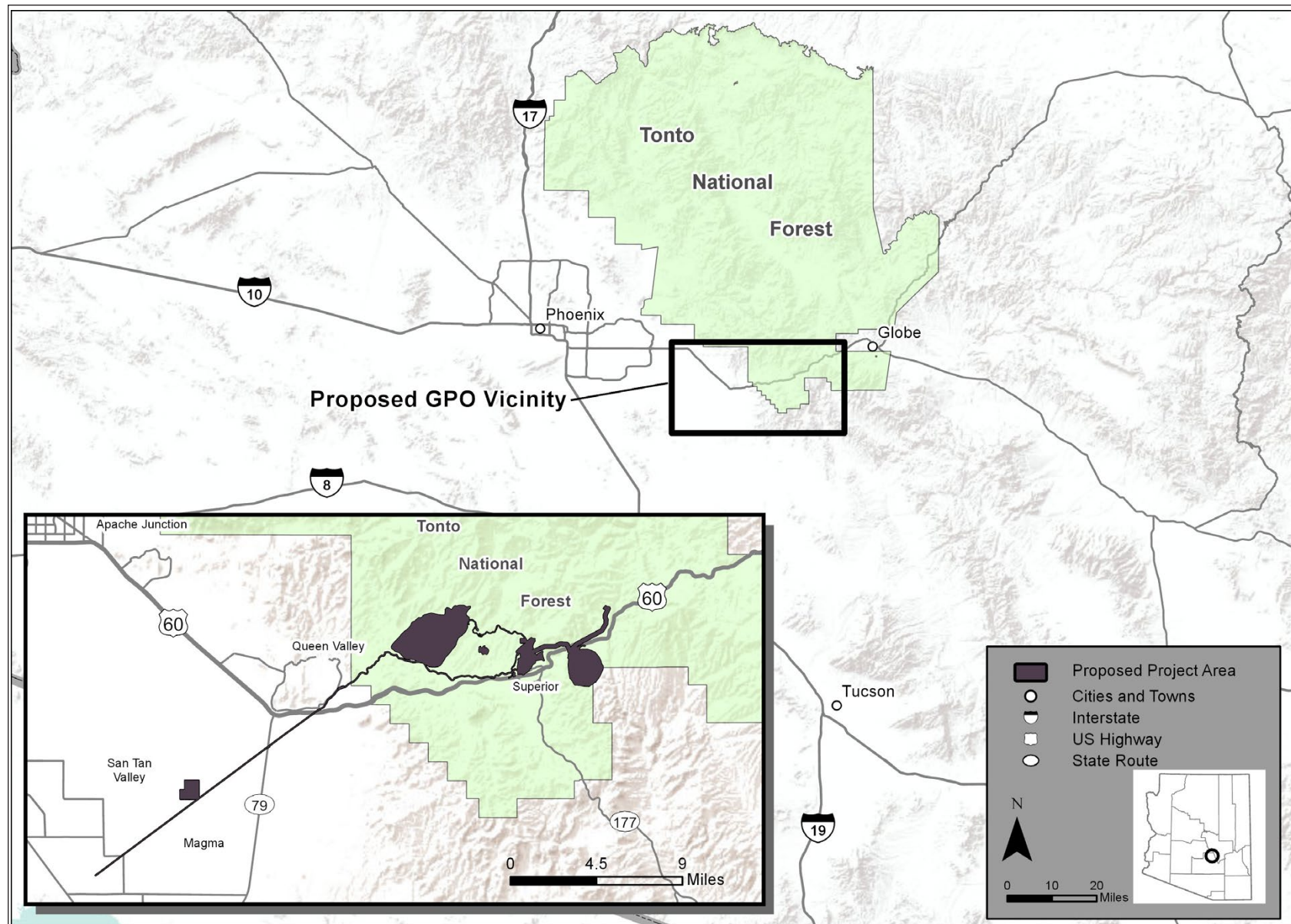


Figure 1.1-1. Resolution Copper Project vicinity map

proposed in the GPO, the mining portion of the project would occur on a mixture of private, State, and NFS lands.

However, in December 2014, Congress passed the Carl Levin and Howard P. ‘Buck’ McKeon National Defense Authorization Act for Fiscal Year 2015 (NDAA). Section 3003 of this law (appendix A) authorizes and directs the Secretary of Agriculture to administer an exchange of NFS lands, which would convey 2,422 acres of NFS land in the area of the proposed mine to Resolution Copper in exchange for approximately 5,344 acres³ of private land on eight parcels located elsewhere in eastern Arizona (see section 1.4.2).

The offered private lands would be transferred from Resolution Copper to the United States, to be administered by the Forest Service and the U.S. Department of the Interior Bureau of Land Management (BLM). Upon completion of the land exchange, it is expected that one of the largest copper mines in the United States would be established on the exchange parcel, with an estimated surface disturbance of 6,951 acres⁴ (approximately 11 square miles). It would also be one of the deepest mines in the United States, with mine workings extending 7,000 feet beneath the surface.

Section 3003 of the NDAA explicitly requires the Secretary of Agriculture to prepare an EIS prior to conveying the Federal land. This EIS shall be used as the basis for all decisions under Federal law related to the proposed mine, the GPO, and any related major Federal actions, including the granting of permits, rights-of-way, or the approvals for construction of associated power, water, transportation, processing, tailings, waste disposal, or other ancillary facilities.

Section 3003 of the NDAA requires this EIS to assess the effects of mining and related activities on such cultural and archaeological resources that may be located on the NFS lands conveyed to Resolution Copper, and identify measures that may be taken, to the extent

practicable, to minimize potential adverse impacts on those resources, if any. The Secretary of Agriculture is further directed to engage in government-to-government consultation with affected Indian Tribes regarding issues of concern to the affected tribes related to the land exchange and, following such consultation, consult with Resolution Copper and seek to find mutually acceptable measures to address affected tribes’ concerns and “minimize the adverse effects on the affected Indian Tribes resulting from mining and related activities on the Federal land conveyed to Resolution Copper” (see 16 United States Code [U.S.C.] 539p(c)(3)).

1.1.1 Document Structure

The Tonto National Forest prepared this EIS in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. This EIS discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives.

This document has four volumes: volume 1, which contains an executive summary and chapters 1, 2, and the first portion of chapter 3; and volume 2, which contains the remainder of chapter 3 and chapters 4–8. Appendices are presented in volumes 3 and 4. The general contents of each volume follow.

1.1.1.1 Volume 1

- *Executive Summary*: Provides a brief overview of the contents of chapters 1 through 3 of the EIS.
- *Chapter 1. Purpose of and Need for Action*: Focuses on the underlying need to which the lead agency (Forest Service) is responding in proposing the action and alternatives, the

3. Resolution Copper increased the offered parcel by an additional 32 acres of privately held land that is adjacent to the 110 acres presented in the NDAA as part of the Apache Leap Special Management Area. The additional land was provided to allow for a more contiguous parcel and for ease of surveying.

4. This acreage includes a number of different facilities. See section 2.2.4 for full details.

framework in which decisions would be made, and the significant issues associated with the proposed action.

- *Chapter 2. Alternatives, Including the Proposed Action:* Describes the proposed action and four additional action alternatives considered in detail. These alternatives were developed based on significant issues raised by the public, Forest Service resource specialists, and other agencies. The no action alternative is included in the range of alternatives considered in detail. The chapter concludes with a summary that compares the environmental consequences of each alternative, based on the effects disclosed in chapter 3.
- *Chapter 3. Affected Environment and Environmental Consequences:* Describes the affected environment and the environmental consequences associated with the proposed action and the alternatives. The resources described under the affected environment headings represent baseline environmental conditions, incorporating past and present actions. Environmental consequences are the potential direct and indirect effects of each alternative on the affected environment. Reasonably foreseeable future actions (RFFAs) are considered in combination with the effects of each alternative to define the potential for cumulative effects. Any required mitigation measures are assessed, along with their effectiveness to reduce or offset impacts. Irreversible and ir retrievable commitments of resources, the relationship between short-term uses and long-term productivity of the environment, and adverse environmental impacts that cannot be avoided are disclosed for each resource as well as in a section at the end of chapter 3. Chapter 3 provides the analyses for the comparison summary presented in chapter 2.

1.1.1.2 Volume 2

- *Chapter 3. Affected Environment and Environmental Consequences:* Continuation of Chapter 3 sections.

- *Chapter 4. Consulted Parties:* Identifies the Native American tribes, organizations, and Federal, State, and local government agencies and other parties consulted during the development of the EIS.
- *Chapter 5. List of Preparers:* This chapter lists the individuals who, under the supervision of the Forest Service, contributed to the preparation of the document and includes their organization, education, years of experience, and project role.
- *Chapter 6. Literature Cited:* Provides a list of literature cited in this document.
- *Chapter 7. Glossary; Acronyms and Abbreviations:* Provides definitions of terms used in this document.
- *Chapter 8. Index:* Indicates where keywords can be found within the document.

1.1.1.3 Volumes 3 and 4

- Each part of the appendix provides detailed information in support of the analyses and conclusions reported in the EIS. Volumes 3 and 4 contain the following appendices:
 - Appendix A: Section 3003 of the NDAA
 - Appendix B: Existing Conditions of Offered Lands
 - Appendix C: Draft Practicability Analysis in Support of Clean Water Act 404(B)(1) Alternatives Analysis
 - Appendix D: Draft Resolution Copper Project Clean Water Act Section 404 Conceptual Compensatory Mitigation Plan
 - Appendix E: Alternatives Impact Summary
 - Appendix F: Alternatives Considered but Dismissed from Detailed Analysis

- Appendix G: Further Details of East Plant Site, West Plant Site, MARRCO Corridor, and Filter Plant and Loadout Facility Infrastructure
- Appendix H: Further Details of Mine Water Balance and Use
- Appendix I: Summary of Effects of the Land Exchange
- Appendix J: Mitigation and Monitoring Plan
- Appendix K: Summary of Content of Resource Analysis Process Memoranda
- Appendix L: Detailed Hydrographs Describing Impacts on Groundwater-Dependent Ecosystems
- Appendix M: Water Quality Modeling Results for Constituents of Concern
- Appendix N: Summary of Existing Groundwater and Surface Water Quality
- Appendix O: Draft Programmatic Agreement Regarding Compliance with the NHPA on the Resolution Copper Project and Southeast Arizona Land Exchange

Additional project documentation, including more detailed analyses of project area resources, may be found in the project planning record, located at the Tonto National Forest Supervisor's Office, 2324 East McDowell Road, Phoenix, Arizona 85006.

1.2 Background

The area around Superior, Arizona, has a long mining history, starting with sporadic production of silver and gold from claims in the 1870s. The Silver King Mine, a few miles north of Superior, was the richest silver mine in Arizona, producing over 6 million dollars' worth of silver between 1877 and 1886. In 1902, George Lobb, Sr., a former level boss at the Silver King Mine, sold his group of claims to the



Main Street, Superior, ca. 1920, is paved but still without sidewalks. Photo courtesy of the Superior Sun.

Lake Superior and Arizona Mining Company and laid out the townsite which was named Superior. Later, William Boyce Thompson acquired the former Silver Queen mining property and organized the Magma Copper Company in 1910. The merger of Lobb's Golden Eagle claims with Thompson's Silver Queen claims allowed development of the Magma Copper Company mine. The original concentrator was built in 1914, and in 1915, the Magma Arizona Railroad went into operation to transport high-grade ore and concentrates to connect with the Phoenix & Eastern Railroad near Webster (later Magma Junction) and on to a smelter in Hayden. By 1920, the mine had increased in size and production to support construction of a smelter in Superior. The smelter began operating in 1924, including a roaster plant and a 300-foot stack. The highway through Queen Creek Gorge, providing direct travel between Superior and Globe, was completed by the Arizona Highways Department at about the same time.

The Magma Mine boomed in the late 1920s, producing more than 40 million pounds of copper in 1929. The Magma Mine survived the Great Depression on reduced workers' hours but returned to full production during World War II. Dewatering of the mine workings was required to allow access and production from the deeper underground shafts. Superior became one corner of Arizona's "Copper Triangle"—which stretched between the towns of Superior and Globe/Miami to the north and Hayden/Winkelman to the southeast—and which is the general location of more than 30 historical and active copper mines (figure 1.2-1). Mines and smelters in the area included ASARCO's Ray Mine, the Hayden Smelter, the Christmas Mine north of Winkelman, and a number of large open-pit mines in the Globe/Miami area (see figure 1.2-1).

The Magma Mine operated consistently until copper prices fell in the 1980s but reopened in the late 1980s before closing for good in 1996. In addition to substantial surface facilities in Superior, the Magma Mine left approximately 220,000 feet (42 miles) of underground workings.

Exploration from those underground workings led to the discovery of the Resolution deposit—deeper than the historic Magma Mine and a few miles south. The Resolution deposit is not exposed at the surface but lies between 4,500 and 7,000 feet below the surface. Existing workings from the Magma Mine have been repurposed to allow exploration of and access to the copper deposit.

According to the available geological data, the ore body is one of the largest undeveloped copper deposits in the world with an estimated copper resource of 1.787 billion metric tonnes at an average grade of 1.54 percent copper.

The portion of the copper deposit explored to date is located primarily on NFS lands. The ore body likely extends underneath a 760-acre area of NFS land identified in the NDAA as the "Oak Flat Withdrawal Area." The Oak Flat Withdrawal Area was withdrawn from mineral entry in 1955 by Public Land Order 1229; consequently, the GPO does not propose to extract minerals from or conduct mining operations on these lands.

However, for more than 10 years, Resolution Copper pursued a land exchange to acquire adjacent lands northeast of the copper deposit. In December 2014, Congress authorized a land exchange pending completion of the EIS; the exchange parcel to be conveyed to Resolution Copper includes not only the Oak Flat Withdrawal Area but also the NFS lands above which the copper deposit is located. This collective 2,422-acre area of land is known as the "Oak Flat Federal Parcel."

The land ownership of the project area includes surface land administered by the Forest Service or BLM with Resolution Copper-controlled unpatented mining and/or mill site claims; Resolution Copper-owned private land; lands where Resolution Copper controls the patented mining claims; as well as lands with unpatented lode claims not controlled by Resolution Copper. Additional information on claims can be found in section 3.2.3.2.

The land surface overlying the copper deposit is located in an area that has a long history of use by Native Americans, including the Apache, O'odham, Puebloan, and Yavapai people currently represented by the following federally recognized tribes: Fort McDowell Yavapai Nation, Gila River Indian Community, Hopi Tribe, Mescalero Apache Tribe, Pueblo of Zuni, Salt River Pima-Maricopa Indian Community, San Carlos Apache Tribe, Tonto Apache Tribe, White Mountain Apache Tribe, Yavapai-Apache Nation, and Yavapai-Prescott Indian Tribe. The Forest Service maintains formal and informal consultations with these tribes and other interested and affected parties to better understand the historical, cultural, and religious importance of the area.

1.3 Purpose of and Need for Action

The purpose of and need for this project is twofold:

1. To consider approval of a proposed mine plan governing surface disturbance on NFS lands outside of the exchange parcels from mining operations that are reasonably incident to extraction, transportation, and processing of copper and molybdenum.

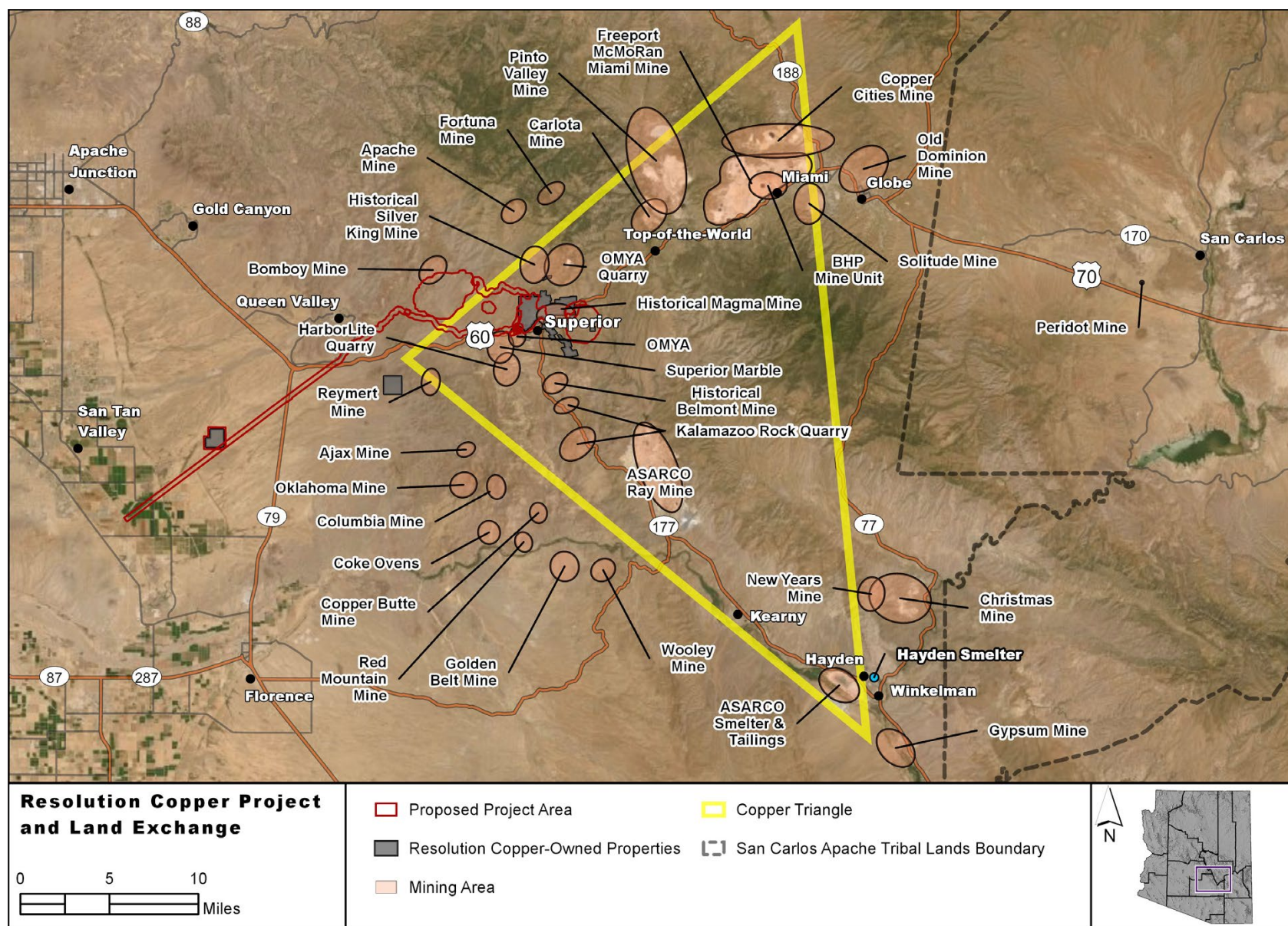


Figure 1.2-1. The Copper Triangle map

2. To consider the effects of the exchange of lands between Resolution Copper and the United States as directed by Section 3003 of the NDAA.

The role of the Forest Service under its primary authorities in the Organic Administration Act, Locatable Minerals Regulations (36 Code of Federal Regulations [CFR] 228 Subpart A), and the Multiple-Use Mining Act is to ensure that mining activities minimize adverse environmental effects on NFS surface resources and comply with all applicable environmental laws. The Forest Service may also impose reasonable conditions to protect surface resources. Through the Mining and Mineral Policy Act, Congress has stated that it is the continuing policy of the Federal Government, in the national interest, to foster and encourage private enterprise in

- the development of economically sound and stable domestic mining, minerals, and metal and mineral reclamation industries; and
- the orderly and economic development of domestic mineral resources, reserves, and reclamation of metals and minerals to help ensure satisfaction of industrial, security, and environmental needs.

The Southeast Arizona Land Exchange and Conservation Act was included in a large public lands package containing 68 bills which was amended to the NDAA during the 113th Congress. The NDAA was signed into law by President Obama on December 19, 2014. Under the Southeast Arizona Land Exchange and Conservation Act, Resolution Copper would receive 2,422 acres of Federal land at the site of the future underground copper mine in exchange for 5,376 acres of privately owned conservation and recreation lands throughout Arizona after the completion of a final EIS (FEIS). While the mine itself would be located on private land after the exchange is completed, ancillary mining operations would need to occur on NFS land, and possibly other Federal and non-Federal land, outside of the exchange parcel.

1.4 Proposed Action

The proposed action consists of (1) approval of a mining plan of operations on NFS land associated with a proposed large-scale mine, which would be on private land after the land exchange, (2) the NDAA-directed land exchange between Resolution Copper and the United States, and, if needed, (3) amendment of the forest plan.

It should be noted that the proposed action is one of several alternatives considered in the draft EIS (DEIS). The proposed action should not be confused with the preferred alternative. The preferred alternative is identified in the executive summary and chapter 2 and is the agency's preference for implementation based on the alternatives evaluated and the current analysis.

1.4.1 General Plan of Operations

The following is a brief summary of the mining proposal components. A detailed description of the GPO can be found in section 2.2.2.2. The complete GPO is available on the project website, www.ResolutionMineEIS.us.

Resolution Copper proposes to conduct underground mining of a copper-molybdenum deposit located 4,500 to 7,000 feet below the ground surface within the exchange parcel. Resolution Copper estimates that the mine would take approximately 10 years to construct, would have an operational life of approximately 41 years (mine years 11 to 51), and would be followed by 5 to 10 years (mine years 52 to 57 or 62) of reclamation activities.

The mining operation would include the following facilities and activities analyzed in the EIS, which would be conducted on a mixture of NFS, private, and State lands:

- The mining itself would take place under the Oak Flat Federal Parcel, which is to be transferred to Resolution Copper

pursuant to Section 3003 of the NDAA. Mining would use an underground mining technique known as panel caving. Resolution Copper would use this process to construct a network of shafts and tunnels below the ore body. They would access the tunnels from vertical shafts in an area known as the East Plant Site. The panel caving technique fractures ore with explosives; gravity moves the ore downward, and then Resolution Copper removes it from below the ore deposit. As the ore moves downward and is removed, the land surface above the ore body also moves downward or “subsides.” Analysts expect a “subsidence” zone to develop near the East Plant Site; there is potential downward movement to a depth between 800 and 1,115 feet. Resolution Copper projects the subsidence area to be up to 1.8 miles wide at the surface.

- An area known as the East Plant Site would be developed adjacent to the Oak Flat Federal Parcel. The East Plant Site is the location of the Magma Mine #9 Shaft and #10 Shaft and associated surface mining support facilities. This area would include mine shafts and a variety of surface facilities to support mining operations. This area currently contains two operating mine shafts, a mine administration building, and other mining infrastructure. Existing roads would provide access to the mine. Magma Mine Road would eventually be relocated as a result of the expected subsidence.⁵
- Resolution Copper would crush the mined ore underground and then transport it underground approximately 2.5 miles west to an area known as the West Plant Site. There, operations would process the ore to produce copper and molybdenum concentrates. The West Plant Site is the location of the old Magma Mine processing and smelter facilities in Superior. Portions of the West Plant Site would be located on NFS lands and would be subject to Forest Service regulatory jurisdiction. A flotation process would process the ore; no heap leach processing is proposed.
- The molybdenum concentrate would then be dried, bagged, and transported to market from the West Plant Site.
- Resolution Copper would then pump the copper concentrate as a slurry through a 22-mile-long pipeline to a filter plant and loadout facility located near Magma Junction near San Tan Valley, Arizona. They would then filter the copper concentrate and send it to off-site smelters via rail cars or trucks.
- The copper concentrate slurry pipeline corridor would be located along an existing, previously disturbed right-of-way known as the Magma Arizona Railroad Company (MARRCO) corridor. The MARRCO corridor would also host other mine infrastructure, including water pipelines, power lines, pump stations, and a number of wells for groundwater pumping and recovery of banked Central Arizona Project (CAP) water. A portion of the MARRCO corridor is located on NFS, Arizona State Land Department (ASLD), and private lands and would be subject to corresponding regulatory jurisdiction.
- Several pipelines would transport the tailings as slurry produced at the West Plant Site for 4.7 miles to a tailings storage facility. The tailings storage facility would gradually expand over time and eventually reach about 4,900 acres in size. The proposed tailings storage facility is on NFS lands and would be subject to Forest Service regulatory jurisdiction.
- The Salt River Project (SRP) would supply all power to the mine. Portions of the proposed electrical infrastructure would be on NFS land and would be subject to Forest Service regulatory jurisdiction. The Forest Service can approve SRP’s construction and operation of new power lines on NFS lands by either a special use permit or as part of the GPO. As analyzed in the EIS, access to the power lines would use existing roads.
- Reclamation would be conducted to achieve post-closure land use objectives, including closing and sealing the mine shafts,

5. A full description of subsidence can be found in section 2.2.2.2.

removing surface facilities and infrastructure, and establishing self-sustaining vegetative communities using local species. The proposed tailings storage facility would be reclaimed in place, providing for permanent storage of mine tailings. A bond conditioned on compliance is required prior to approval of a mining plan of operations. In determining the amount of the bond, consideration would be given to the estimated cost of stabilizing, rehabilitating, and reclaiming the area of operations.

- Water for the process would come from a variety of sources. Resolution Copper would recycle (1) filtrate from the filter plant, (2) reclaimed water from the tailings storage facility, and (3) recovered water from the concentrator complex, back into the mining process. They would obtain additional water from dewatering of the mine workings, possible direct delivery of CAP water, and pumping of water from a well field along the MARRCO corridor. The State of Arizona would authorize the water pumped from the well field either as banked CAP water or as groundwater under a mineral extraction withdrawal permit.

1.4.2 Land Exchange

Following Section 3003 of the NDAA, the Federal Government would convey 2,422 acres of specified NFS lands at Oak Flat to Resolution Copper if Resolution Copper offers to convey approximately 5,376 acres⁶ of private lands to the United States. Table 1.4.2-1 provides a brief summary of the land exchange parcels. A detailed description of the land exchange parcels can be found in section 2.2.2.1 and appendix B. The complete text of Section 3003 of the NDAA is provided in appendix A.

1.4.2.1 Appraisal

The exchange of Federal lands is subject to a formal appraisal for all tracts of land included in an exchange. Additionally, the NDAA requires

that exchanged private lands be of equal value to the Federal lands. The NDAA requires the joint selection of an appraiser who is determined by both parties (the Federal Government and Resolution Copper) to be qualified to complete appraisals supporting the exchange. The appraisals are completed under the direction of the Forest Service.

If an appraisal indicates that the value of the Federal lands exceeds the value of the private lands, Resolution Copper must either provide more private land or provide cash to the Federal Government to make up the difference. If a cash payment is used to equalize the values, that money would be placed in a special account to be used for acquisition of additional NFS land in Arizona or New Mexico. An additional provision of the NDAA requires Resolution Copper to make annual payments to the Federal Government during mine production in the event that the appraisal undervalues the copper resource on the lands Resolution Copper is acquiring.

1.4.3 Forest Plan Amendment

Forest plans provide broad, program-level direction for management of NFS lands and resources. As directed by Forest Service regulations at 36 CFR 219.13 forest plans can be amended as needed to accommodate situations in specific project decisions or to reflect changes in social, economic, or ecological conditions.

A consistency review between the GPO and the current forest plan indicates that approval and eventual implementation of the GPO would result in changed conditions that are inconsistent with existing forest plan direction. Approval of the GPO would therefore require a project-specific forest plan amendment to modify one or more plan components, i.e., standards and guidelines. The scope and scale of the necessary forest plan amendment would be narrow in scope and scale, i.e., limited to the GPO project area; and limited to the substantive rule provisions at §219.10 that are directly related to the amendment.

6. Resolution Copper increased the offered parcel of 5,344 acres by an additional 32 acres of privately held land. See table 1.4.2-1.

Table 1.4.2-1. Summary of land exchange parcels

Parcel Land Ownership	Description of Parcels to Be Exchanged
Parcels transferred from the United States to Resolution Copper	2,422 acres near Superior in Pinal County, Arizona, known as the <u>Oak Flat Federal Parcel</u> , to become private lands
Parcels transferred from Resolution Copper to the Secretary of Agriculture, for land to be administered by the Forest Service	142 acres* near Superior in Pinal County, Arizona, known as the <u>Apache Leap South End Parcel</u> , to be administered by the Tonto National Forest
	148 acres in Yavapai County, Arizona, known as the <u>Tangle Creek Parcel</u> , to be administered by the Tonto National Forest
	147 acres in Gila County, Arizona, known as the <u>Turkey Creek Parcel</u> , to be administered by the Tonto National Forest
	149 acres near Cave Creek in Maricopa County, Arizona, known as the <u>Cave Creek Parcel</u> , to be administered by the Tonto National Forest
Parcels transferred from Resolution Copper to the Secretary of the Interior, for land to be administered by the BLM	640 acres north of Payson in Coconino County, Arizona, known as the <u>East Clear Creek Parcel</u> , to be administered by the Coconino National Forest
	3,050 acres† near Mammoth in Pinal County, Arizona, known as the <u>Lower San Pedro River Parcel</u> , to be administered by the BLM as part of the San Pedro Riparian National Conservation Area
	940 acres† south of Elgin in Santa Cruz County, Arizona, known as the <u>Appleton Ranch Parcel</u> , to be administered by the BLM as part of the Las Cienegas National Conservation Area
	160 acres near Kearny in Gila and Pinal Counties, Arizona, known as the <u>Dripping Springs Parcel</u> , to be administered by the BLM

*Resolution Copper increased the offered parcel by an additional 32 acres of privately held land adjacent to the 110 acres presented in the NDAA as part of the Apache Leap Special Management Area. The additional land was provided to allow for a more contiguous parcel and for ease of surveying.

† Final cadastral surveys have not been finalized for either the Lower San Pedro River Parcel or the Appleton Ranch Parcel as of July 2019.

A review of all components of the 1985 forest plan, as amended through 2017, was conducted to identify the need for amendment due to the effects of the project, including both the land exchange and the proposed mine plan. Specific findings on the effects of the forest plan amendment are summarized under the environmental consequences section for each resource in chapter 3.

Summarily, the outcomes of the 1985 forest plan consistency review indicate that amendments would be needed under any alternative to reconcile the Visual Quality Objective (VQO) and recreation opportunity spectrum (ROS) management classes for two standards and guidelines in Management Areas 2F and 3I (table 1.4.3-1). Information specific to the 184 forest plan components that were identified as applicable are detailed in Shin (2019).

The plan components that would need to be amended to comply with the existing 1985 forest plan are described in table 1.4.3-1.

1.5 Decision Framework

Given the purpose and need, the deciding official(s) reviews the proposed action, the other alternatives, and the environmental consequences in order to make the following decisions.

1.5.1 Forest Service

As the lead agency tasked with completion of a single EIS, the Forest Service has management responsibility for the following:

- The NFS lands that would be affected by the proposed GPO
- Executing the land exchange that was mandated by Congress
- Approve necessary amendments to the forest plan (see section 1.4.3).

Table 1.4.3-1. Forest plan amendments for the Resolution Copper Project and Land Exchange

Forest Plan Section	1985 Forest Plan Page Number	Existing Forest Plan	Proposed Forest Plan Amendment
Section 4. Management Direction Management Prescriptions – Globe Ranger District (Management Area 2F)	85	Manage for VQOs ranging from “Retention” to “Maximum Modification” according to the following guidelines: Retention = 8%, Partial Retention = 24%, Modification = 34%, and Maximum Modification = 34%.	Manage for VQOs ranging from “Retention” to “Maximum Modification” according to the following guidelines: Retention = 9%, Partial Retention = 35%, Modification = 31%, Maximum Modification = 21%, and Not Rated = 4%.
Section 4. Management Direction Management Prescriptions – Globe Ranger District (Management Area 2F)	86	Manage ROS Classes (see appendix E of the forest plan) according to existing inventory as follows: Semi-Primitive = 35%, Semi-Primitive Motorized = 39%, Roaded Natural = 24%, Rural = 1%, and Urban = 1%.	Manage ROS Classes (see appendix E of the forest plan) according to existing inventory as follows: Semi-Primitive = 17%, Semi-Primitive Motorized = 55%, Roaded Natural = 23%, Rural = 2%, and Urban = 3%.
Section 4. Management Direction Management Prescriptions – Mesa Ranger District (Management Area 3I)	112	Manage for VQOs ranging from “Retention” to “Maximum Modification” according to the following guidelines: Retention = 15%, Partial Retention = 40%, Modification = 35%, and Maximum Modification = 10%.	Manage for VQOs ranging from “Retention” to “Maximum Modification” according to the following guidelines: Retention = 23%, Partial Retention = 45%, Modification = 27%, Maximum Modification = 2%, and Not Rated = 3%.
Section 4. Management Direction Management Prescriptions – Mesa Ranger District (Management Area 3I)	113	Manage ROS Classes (see appendix E of the forest plan) according to existing inventory as follows: Primitive = 1%, Semi-Primitive = 42%, Semi-Primitive Motorized = 36%, Roaded Natural = 21%.	Manage ROS Classes (see appendix E of the forest plan) according to existing inventory as follows: Semi-Primitive = 26%, Semi-Primitive Motorized = 48%, Roaded Natural = 26%, Rural = 0%, and Urban = 0%.

1.5.1.1 General Plan of Operations

The Forest Supervisor, Tonto National Forest, is the deciding official and has discretion to determine whether changes in the proposed GPO would be required prior to approval.

Regulations that govern the use of surface resources in conjunction with mining operations on NFS lands are set forth under 36 CFR 228 Subpart A. These regulations require that the Forest Service respond to parties who submit proposed plans to conduct mining operations on or otherwise use NFS lands in conjunction with mining. Compliance with other laws and regulations, such as State of Arizona water and air regulations, the Endangered Species Act (ESA), Clean Water Act (CWA), and National Historic Preservation Act (NHPA), also frames the proposed mining activities.

The Forest Supervisor would use analysis in this EIS along with supporting documentation to make the following decisions regarding the proposed GPO:

1. Approve the proposed GPO submitted by Resolution Copper or require changes or additions to the proposed GPO to meet the requirements for environmental protection and reclamation set forth at 36 CFR 228 Subpart A before approving a final GPO. The Forest Service decision may be to authorize use of the surface of NFS lands in connection with mining operations under the GPO composed of elements from one or more of the alternatives considered. The alternative(s) that is/are selected for approval in the final ROD must minimize adverse impacts on NFS surface resources to the extent feasible.
2. Whether to approve amendments to the forest plan, which may be required to approve the final GPO.
3. Whether to approve a special use permit for SRP to authorize construction and operation of power lines on NFS lands.

The Forest Supervisor would then release a draft ROD in conjunction with the FEIS that would address these three decisions. The draft

ROD would be subject to 36 CFR 218, “Project-Level Pre-decisional Administrative Review Process” and 36 CFR 219, “Planning-Level Pre-decisional Administrative Review Process.”

Once objections to the draft ROD are resolved, the Forest Supervisor would issue a final ROD. Resolution Copper may have an opportunity to appeal the decisions as set forth at 36 CFR 214, “Post decisional Administrative Review Process for Occupancy and Use of National Forest System Lands and Resources.”

The remaining step would be approval of a final GPO, which may require Resolution Copper to modify the proposed GPO to align it with (1) the description of the selected alternative in the final ROD, and (2) changed conditions mandated by Section 3003 of the NDAA. Additionally, the Forest Supervisor, Tonto National Forest, would require Resolution Copper to submit a reclamation bond or other financial assurance to ensure that NFS lands and resources involved with the mining operation are reclaimed in accordance with the approved GPO and Forest Service requirements for environmental protection (36 CFR 228.8 and 228.13). After the Forest Service has determined that the GPO conforms to the ROD and that the reclamation bond is acceptable, it would approve the GPO. Implementation of mining operations that affect NFS lands and resources may not commence until a plan of operations is approved and the reclamation bond or other financial assurance is in place.

1.5.1.2 Land Exchange

With regard to the land exchange, the Tonto National Forest Supervisor, has no decision authority due to the constraints imposed by the NDAA. The Forest Supervisor does have a responsibility to (1) address concerns of affected Indian Tribes and see mutually acceptable resolution of concerns with Resolution Copper; (2) ensure that title to the non-Federal lands offered in the exchange is acceptable in accordance with Section 3003(c)(2)(A) of the NDAA; and (3) accept additional non-Federal land or a cash payment from Resolution Copper to the United States in the event that the final appraised value of the Federal land exceeds the value

of the non-Federal land in accordance with Section 3003(c)(5)(B)(i) of the NDAA.

Environmental effects resulting from the land exchange on private, State, and NFS lands are analyzed in the EIS. Although the Forest Service no longer would have regulatory jurisdiction for those lands, Resolution Copper would still be required to comply with applicable Federal and State environmental laws, which address air quality, hazardous waste management, mine safety, mine reclamation, and other aspects of the proposed mine.

1.5.2 Bureau of Land Management

The NDAA-directed land exchange would transfer ownership of approximately 4,150 acres of Resolution Copper private lands to the BLM. As with the Forest Service, the BLM has no decision authority with respect to the land exchange.

The BLM would incorporate and administer the land acquired for the Lower San Pedro River Parcels into the San Pedro National Conservation Area no later than 2 years after the date on which the land is acquired. The San Pedro Riparian National Conservation Area Resource Management Plan would be updated to reflect the acquired land.

The BLM would incorporate and administer the land acquired for the Dripping Springs Parcel into the Las Cienegas National Conservation Area in accordance with the Federal Land Policy and Management Act of 1976 (FLPMA), laws (including regulations) applicable to the Las Cienegas National Conservation Area, and applicable land use plans.

For purposes of this analysis, the Forest Service has identified an alternative that includes siting mine facilities on BLM-administered land, rather than on NFS lands as proposed by Resolution Copper (see section 2.2.7 for a description of Alternative 5 – Peg Leg). If the Forest Service were to select Alternative 5 – Peg Leg, the Forest Service’s selection of that alternative would not authorize surface use of any BLM-managed public lands. In order to use the public lands identified in Alternative 5 – Peg Leg, Resolution Copper would be

required to obtain surface use authorization under the applicable BLM regulations. BLM would require the submittal of a separate mining plan of operations to determine whether unnecessary or undue degradation would occur (43 CFR 3809.11(a)). BLM would then issue a separate ROD from the Forest Service to approve mine-related actions on BLM-administered lands and would need to conduct any administrative review processes required under BLM regulations; this would include review of conformance with any current management plans. The BLM ROD would not necessarily be issued at the same time as the Forest Service ROD. Additional tribal and public involvement might also be required to satisfy BLM regulations if the Alternative 5 – Peg Leg alternative were selected. To date, Resolution Copper does not have any pending requests for surface use authorization before BLM.

1.5.3 U.S. Army Corps of Engineers

Selection of some, but not all, of the alternatives would require the U.S. Army Corps of Engineers (USACE) to issue a permit under Section 404 of the Clean Water Act, which regulates discharge of dredged and fill within waters of the U.S. The USACE previously evaluated drainages and wetlands in portions of the Superior Basin associated with this project and found these aquatic features were not subject to the USACE’s jurisdiction under current rules. For drainages to be under the jurisdiction of the USACE, they must have a “significant nexus” to a traditionally navigable water. In 2012, the USACE determined that the drainages within the Superior Basin do not have a significant nexus to the closest traditionally navigable water, which is the Gila River between Powers Butte and Gillespie Dam. Ultimately, this determination means that a tailings storage facility sited within these areas in the Superior Basin (Alternative 2, 3, or 4; see section 2.2) would not need a Section 404 permit, whereas other alternatives would require one (Alternative 5 or 6).

Because Congress directed that the EIS serves to support all Federal decisions related to the proposed mine, if Alternative 5 or 6 were ultimately selected, the USACE would rely on this EIS to support issuance of a Section 404 permit. In accordance with the Clean Water

Act, Section 404(b)(1) guidelines (40 CFR 230), the USACE may only permit the least environmentally damaging practicable alternative in light of cost, logistics, and technology. A draft Practicability Analysis has been prepared for the range of alternatives originally considered for this project using the criteria in the Section 404(b)(1) guidelines and has been included with this EIS as appendix C. This document will be refined during this EIS process and used by USACE to select a least environmentally damaging practicable alternative and support USACE's permitting decision.

A permittee is also required to compensate for the loss of waters of the U.S. in accordance with 33 CFR 332. Appendix D of this EIS contains Resolution Copper's draft Conceptual Compensatory Mitigation Plan.

Based on the analysis in this EIS and supporting documentation, the USACE's public interest review, and the determination of the least environmentally damaging practicable alternative in the Section 404(b)(1) alternatives analysis, the USACE would determine whether to do one of the following:

1. Issue Resolution Copper a CWA Section 404 individual permit for the discharge of dredged and/or fill material into waters of the U.S.; or
2. Issue Resolution Copper a CWA Section 404 individual permit with modifications or special conditions; or
3. Deny the CWA Section 404 individual permit.

The USACE would issue a public notice during the DEIS comment period and would consider all comments received in response to the public notice, the DEIS, and public hearings (if applicable) as part of the public interest review. Following issuance of the FEIS, the USACE would prepare a ROD, separate from the Forest Service, regarding the Section 404 permit. The USACE's administrative appeals process allows the applicant to appeal a denied permit or a proffered permit that the applicant has declined. Details on this process are contained in 33 CFR 331, "Administrative Appeals Process."

1.5.4 Required Permits, Licenses, and Authorizations

Other permits, licenses, and authorizations would be required for the mine to be operational. Additional Special Use Permits and rights-of-way may also be needed for power lines built by SRP, access roads, or other features. The EIS would not determine if a permit through another agency would be approved but would disclose impacts for resources analyzed. Table 1.5.4-1 provides the permits and licenses commonly required for this type of project; it is not meant to be a comprehensive list of all possible permit(s), license(s), or authorization(s) needed. A list of existing Resolution Copper permits and licenses currently held for ongoing operations is shown in table 1.4.2 of the GPO.

1.5.5 Financial Assurance for Closure and Post-closure Activities

The Forest Service mission of promoting healthy and resilient forests and grasslands is a key component for ensuring that the lands and resources the Forest Service manages are available for future generations. Mineral development on NFS lands is a temporary use of those lands, although some uses like tailings storage facilities are permanent and remain part of the landscape in perpetuity. Reclamation of mining sites is an integral part of all mine plans considered by the Forest Service, as is the requirement that adequate fiscal resources be available to ensure that reclamation can be conducted.

The primary authority for the Forest Service to require financial assurance is contained in the locatable mineral regulations (36 CFR 228 Subpart A). These include the requirement for a plan of operations to include provisions for reclamation: "The plan of operation shall include . . . measures to be taken to meet the requirements for environmental protection. . . ." (36 CFR 228.4). The regulations include specific requirements for financial assurance: "Any operator required to file a plan of operations shall, when required by the authorized officer, furnish a bond conditioned upon compliance with 228.8(g), prior to approval of such plan of operations" (36 CFR 228.13). The amount of financial

Table 1.5.4-1. Permits, licenses, and authorizations required for the Resolution Copper Project

Type of Permit	Permitting Agency	Permit Use
Aquifer Protection Permit (APP)	Arizona Department of Environmental Quality	<p>An APP is required for any activity that discharges a pollutant to an aquifer, or to the land surface so that there is a reasonable probability that the pollutant would reach an aquifer.</p> <p>General APPs are available for some impoundments and facilities, as long as they have characteristics specified by Arizona regulations (like lining). Resolution Copper currently holds a number of general APPs for wash bays (type 3.02 permits), wastewater treatment discharges (type 3.03 permits), and rock stockpiles (type 2.02 permits).</p> <p>Resolution Copper also currently holds an Individual Industrial Reclaimed Water APP, which allows conveyance of treated water to the New Magma Irrigation and Drainage District (NMIDD) for agricultural application (alfalfa, barley, Bermudagrass, cotton, sorghum, turf, and wheat). A similar permit would be required during operations for any treated water discharged to NMIDD.</p> <p>Resolution Copper also holds an area-wide APP that authorizes the closure of existing APP-regulated facilities at the West Plant Site under a compliance schedule, and an individual APP for a non-municipal solid waste landfill, which is approved to accept construction and demolition debris, non-hazardous mine refuse, vegetative waste, non-tire rubber products, solid waste petroleum-contaminated soil, metal-contaminated soil, empty containers, and nonfriable and friable asbestos-containing material.</p> <p>For operations, Resolution Copper would require an Individual APP that would encompass all mining and processing activities with the potential to discharge, most notably the tailings storage facility. The specific project components requiring permitting through the Individual APP are not yet determined.</p>
Special Waste Facility Generator	Arizona Department of Environmental Quality	Resolution Copper is authorized to handle wastes designated as “special wastes” by the State.
Drinking Water Division Monitoring Assistance Program	Arizona Department of Environmental Quality	Public water system for serving potable groundwater to Resolution Copper employees.

continued

Table 1.5.4-1. Permits, licenses, and authorizations required for the Resolution Copper Project (cont'd)

Type of Permit	Permitting Agency	Permit Use
Arizona Pollutant Discharge Elimination System (AZPDES) Permit	Arizona Department of Environmental Quality	<p>The State of Arizona has received jurisdiction (also known as "primacy") to administer Section 402 of the Clean Water Act, which is accomplished through the AZPDES program. Section 402/AZPDES regulates any discharges of pollutants to waters of the U.S., including potential pollutants in stormwater runoff.</p> <p>Any direct discharge of a pollutant into a water typically requires an individual AZPDES permit. Resolution Copper currently holds an AZPDES permit to discharge treated mine site stormwater runoff (Outfall 001) and treated seepage pumping and mine dewatering effluent (Outfall 002) to Queen Creek. The discharge must be in accordance with effluent limitations, monitoring requirements, and other conditions in the Standard Arizona Pollutant Discharge Elimination System Permit Conditions.</p> <p>The Arizona Department of Environmental Quality (ADEQ) has also issued a multi-sector general permit, which covers stormwater discharges from common industrial activities. Typically, a permittee would apply for coverage under the Multi-Sector General Permit (MSGP) program, and develop a Stormwater Pollution Prevention Plan (SWPPP) detailing how stormwater would be handled to reduce the potential for pollutants, including sediment. Resolution Copper currently is authorized under the MSGP for stormwater discharges from both the West Plant Site and East Plant Site. During operations, stormwater discharges from mine facilities most likely would take place under the MSGP program.</p> <p>Temporary stormwater discharges may also be covered under the construction general permit, which has similar requirements as the MSGP program. Certain temporary discharges (such as pump testing of a well) may also be covered under the de minimis permit program. The specific AZPDES permits required for construction and operation would be determined by ADEQ.</p>
Clean Water Act Section 401 Water Quality Certification	Arizona Department of Environmental Quality	The State must certify, waive, or deny an application for a USACE permit for discharge of dredged or fill material to waters of the U.S. To certify, the State must find that the activities proposed under the 404 permit would not result in a violation of State surface water quality standards. The 401 certification may specify conditions, including reporting requirements.
Solid Waste Plan Approval	Arizona Department of Environmental Quality	Required to meet the requirements of 40 CFR 257, along with other requirements set forth in State statutes (e.g., compliance with location restrictions, recording of a restrictive covenant).
Hazardous Waste Management Program	Arizona Department of Environmental Quality	Governs the management of hazardous waste (including transport and disposal). Requirements differ somewhat, depending on the volume and nature of hazardous waste generated; however, in general, it requires inspection, training, and contingency/emergency planning.
Drinking Water Registration and Regulations	Arizona Department of Environmental Quality	Systems (including nontransient, noncommunity systems) must register with ADEQ and meet substantive requirements. Requires inspection, sampling/analysis, contingency/emergency planning, reporting, and notification.

continued

Table 1.5.4-1. Permits, licenses, and authorizations required for the Resolution Copper Project (*cont'd*)

Type of Permit	Permitting Agency	Permit Use
Groundwater Permits	Arizona Department of Water Resources	<p>Groundwater pumping and use is regulated heavily within Active Management Areas (AMAs), which are areas of intensive water use, originally identified in the Arizona Groundwater Management Act of 1980. The locations of pumping for dewatering (Shafts 9 and 10) and the future makeup water supply (Desert Wellfield) lie within the East Salt River valley subbasin of the Phoenix AMA. Within the AMA, pumping groundwater requires a valid groundwater right, or a valid withdrawal permit.</p> <p>Resolution Copper currently holds several groundwater rights: Type 2 Non-Irrigation Grandfathered Rights/Type II Mineral Extraction Rights, and a dewatering withdrawal permit. Similar rights or permits would be required for any dewatering that occurs during operations.</p> <p>Resolution Copper would be required to permit any wells associated with the Desert Wellfield, which would lie within the MARRCO corridor. Notices of Intent to Drill would be required for any well installation, to ensure proper construction and documentation. Any further permits or rights required would depend on whether water pumped was legally considered recharged or banked water, or regular groundwater. This would be determined by the Arizona Department of Water Resources.</p>
Special Land Use Permit	Arizona State Land Department	Resolution Copper holds several permits for geotechnical and hydrological data gathering, installation of surface water monitoring equipment, and groundwater monitor well installation and access. These permits may or may not be required during operations.
Right-of-Way Permit	Arizona State Land Department	Allows water and electrical supply lines to be placed within a right-of-way. Permit would be issued after the Arizona Corporation Commission approves the electrical supply alignment.
Arizona Mined Land Reclamation Plan Approval	Arizona State Mine Inspector	Applies to reclamation activities at the site. Requires certification, plan updates, annual reporting, and financial assurance. Resolution Copper currently holds a plan authorizing the reclamation of surface disturbances at the East and West Plant Sites.
Certificate of Environmental Compatibility	Arizona Corporation Commission, Line Siting Committee	Ensures compliance with Arizona Revised Statutes (ARS) 40-360 and regulates the placement of electrical transmission lines.
Agriculture Land Clearing Permit	Arizona Department of Agriculture	Authorizes disturbance and clearing of State-protected native plants, as required under the Arizona Native Plant Law.
Right-of-Way Encroachment Permit	Arizona Department of Transportation	Authorizes work within the State right-of-way, such as highways, driveways, grading, fence removal or replacement, surveying, and geotechnical investigation.
Final Mining Plan of Operations (after publication of the FEIS and approval of the ROD)	U.S. Forest Service	A final mining plan of operations would be required to be approved by the Forest Supervisor. Approval of the final mining plan provides the authorization to conduct activities on NFS lands. The final mining plan must reflect requirements specified in the ROD, including mitigation, monitoring, reporting, requirements of all applicable permits and authorizations, and is accompanied by posting of a bond or other financial assurance.

continued

Table 1.5.4-1. Permits, licenses, and authorizations required for the Resolution Copper Project (cont'd)

Type of Permit	Permitting Agency	Permit Use
Baseline Hydrologic and Geotechnical Data Gathering Activities Plan of Operations	U.S. Forest Service	To collect hydrologic, geochemical, and geotechnical data in order to provide baseline information on these aspects of the environment over an area being considered at the Near West site. These activities are complete.
Special Use Permit	U.S. Forest Service	The existing Special Use Permit authorizes Resolution Copper to construct and maintain a water pipeline corridor from the water treatment plant to an irrigation canal operated by the NMIDD. Future activity within the MARRCO corridor potentially could be covered under the final mining plan of operations, rather than a special use permit.
Mining Plan of Operations and Record of Decision	Bureau of Land Management	In the event Alternative 5 – Peg Leg is selected, Resolution Copper's GPO would be denied with respect to the facilities proposed on NFS lands that are identified to be placed on BLM-managed public lands, State lands, or private lands. To use BLM-managed public lands, Resolution Copper would need to obtain surface use authorization from BLM in accordance with BLM's surface management regulations 43 CFR subpart 3809. BLM would then issue a separate ROD from the Forest Service to approve mine-related actions on BLM-administered lands, and would need to conduct any post-decision administrative review processes required under BLM regulations.
Right-of-Way Application	Bureau of Land Management	In the event Alternative 5 – Peg Leg is selected, Resolution Copper's GPO would be denied with respect to rights-of-way proposed on NFS lands that are identified to be placed on BLM-managed public lands, State lands, or private lands. To use BLM-managed public lands for right-of-way purposes, Resolution Copper would need to obtain surface use authorization from BLM for any right-of-way that crosses BLM-managed public lands.
Project-specific (Individual) Section 404 Clean Water Act Permit	U.S. Army Corps of Engineers	This permit is required for the discharge of dredged or fill material into waters of the U.S. This permit may only be applicable to certain alternatives (see section 1.5.3). Individual Section 404 permits typically incorporate a Habitat Mitigation and Monitoring Plan that details the mitigation that would be implemented to compensate for lost aquatic resources.
Biological Opinion	U.S. Fish and Wildlife Service	The Biological Opinion is issued by the U.S. Fish and Wildlife Service at the completion of consultation under Section 7 of the Endangered Species Act. The Biological Opinion ensures that the Tonto National Forest's approval of the revised mining plan of operations would not jeopardize the continued existence of a threatened or endangered species or adversely modify designated critical habitat. Biological Opinions may authorize "take" of a protected species, and would detail the conservation measures committed to by Resolution Copper, as well as other reasonable and prudent measures (and associated terms and conditions) that must be taken by Resolution Copper. Failure to comply with requirements specified in the Biological Opinion could require reconsultation and could also result in civil and criminal penalties.
Hazardous Waste Identification Number	U.S. Environmental Protection Agency	Authorizes facilities to generate and transport off-site hazardous waste in quantities in excess of 100 kilograms per month (or those that generate acute hazardous waste in quantities exceeding 1 kilogram per month). Requires specific employee training, inspections, and contingency planning.
Radio License	Federal Communications Commission	Required for current use of communication network; would be required during operations.
Hazardous Materials Certificate of Registration	U.S. Department of Transportation	Resolution Copper is certified and would be required to keep certification current during operations as required by the U.S. Department of Transportation hazardous materials program procedures in 49 CFR 107, Subpart G.

continued

Table 1.5.4-1. Permits, licenses, and authorizations required for the Resolution Copper Project (*cont'd*)

Type of Permit	Permitting Agency	Permit Use
Hazardous Materials Transportation Permit	U.S. Department of Transportation	Governs the transport of hazardous materials as defined by the U.S. Department of Transportation. Requires specific employee training and security and contingency planning.
Air Quality Control Permit	Pinal County Air Quality Control District	Resolution Copper currently holds an air quality control permit that pertains to the historical mining (reclamation) and development and exploratory mining exploration facilities operated by Resolution Copper. A similar air quality permit would be required for the full operations. Pinal County Air Quality Control District (PACQCD) may also issue dust permits for construction, earthwork, and land development. The Skunk Camp alternative may also fall within the jurisdiction of Gila County for air quality permitting. Gila County relies on ADEQ to issue air permits within the county. Consolidating all air permitting under one authority is likely; it has not yet been determined whether this would be PACQCD or ADEQ.
Meteorological and Ambient Air Monitoring Plan	Pinal County Air Quality Control District	Resolution Copper collects meteorological and air quality monitoring data under a plan approved by PACQCD. Data collection would continue during operations, but possibly under a separate plan.

assurance is also addressed by regulation: “In determining the amount of the bond, consideration would be given to the estimated cost of stabilizing, rehabilitating, and reclaiming the area of operations” (36 CFR 228.13b).

Reclamation and financial assurance requirements are summarized in Forest Service guidance (U.S. Forest Service 2004), which notes that while in the past long-term maintenance, monitoring, and interim management have not been included in bonding or financial assurance estimates, it is now accepted practice to include these items. The Forest Service guidance notes that: “A basic premise of the estimate is that the operator is not available to complete the reclamation and the Forest Service would need to do the reclamation work” (U.S. Forest Service 2004). However, funding of long-term maintenance and monitoring has always posed a logistical problem, because of the long time frames that would be required. In 2015, the Forest Service issued guidance for establishment of long-term trusts for future large mines, with the intent of eliminating the growing mine-related liabilities on NFS lands (U.S.

Forest Service 2015). The guidance allows the Forest Service to accept trust accounts from operators of large mines by establishing a trust with the Forest Service as a benefactor to address long-term liabilities such as water treatment, dam maintenance, and care and maintenance of infrastructure, which may be required for many years (or centuries) beyond a planned or unplanned mine closure. Use of a long-term trust is one method that will be considered to provide fiscal resources to ensure maintenance and monitoring that extend beyond the closure of the mine.

More detail on financial assurances specific to individual resources can be found in Section 3.3, Soils and Vegetation; and Section 3.7.2, Groundwater and Surface Water Quality.

1.6 Public Involvement

The Forest Service sought public input during several phases of the EIS process. A summary of public involvement is outlined in this section.

1.6.1 Scoping

The purpose of the scoping process is to obtain input from agencies and members of the public on the extent of the proposed project, the range of alternatives, and the content of the issue analysis in the EIS. The Forest Service's public participation and public scoping efforts are described in detail in the "Resolution Copper Project and Land Exchange Environmental Impact Statement Scoping Report" (U.S. Forest Service 2017f).

The public scoping period commenced on March 18, 2016, with the Forest Service publication of the Notice of Intent (NOI) to prepare an EIS in the Federal Register. The Forest Service planned for a 60-day public scoping period from March 18, 2016, to May 17, 2016. Numerous individuals and several organizations requested an extension of the public scoping period, as well as additional public scoping meetings. The Forest Supervisor, Tonto National Forest, accommodated these requests by extending the public scoping period through July 18, 2016, resulting in a total overall scoping period of 120 days. The "Notice of Extension of Public Scoping Period for the Resolution Copper Project and Land Exchange EIS" was published in the Federal Register on May 25, 2016.

Tonto National Forest staff held five scoping meetings in the project area that provided the public with an opportunity to ask questions, learn about the proposed project, and provide comments on issues and concerns that should be addressed in the EIS and alternatives that should be valued (table 1.6.1-1).

Internal scoping efforts included several meetings and field trips with the NEPA interdisciplinary (ID) team. ID team members include Forest Service resource specialists and planners representing anticipated topics of analysis in the NEPA process and Tonto National Forest line officers and program managers.

Cooperating agency scoping was conducted through a kick-off meeting and through comments submitted by cooperating agencies and tribes during the public scoping comment period. Additional detail on scoping conducted during tribal consultation can be found in section 1.6.4.

Table 1.6.1-1. Scoping meeting locations, dates, and attendance numbers

Meeting Location	Date	Number of People Who Signed In
Queen Valley, Arizona – Recreation Hall	March 31, 2016	106
Superior, Arizona – Superior High School	April 4, 2016	78
Globe, Arizona – Globe Elks Lodge	April 5, 2016	63
Gilbert, Arizona – Southeast Regional Library	April 6, 2016	88
San Tan, Arizona – Central Arizona College	June 9, 2016	50

Scoping comment submittals on the Resolution Copper Project and Land Exchange EIS were analyzed and categorized using a standard Forest Service process called "content analysis." The goals of the content analysis process are to (1) ensure that every comment is considered, (2) identify the concerns raised by all respondents, (3) represent the breadth and depth of the public's viewpoints and concerns, and (4) present those concerns in a way that facilitates the Forest Service's consideration of comments. All comments were treated evenly and were not weighted by number, organizational affiliation, "status" of the commenter, or other factors. Consideration was on the content of a comment, rather than on who wrote it or the number of submitters who agreed with it.

In total, 133,653 submittals were collected during public scoping, 141 of which were identified as duplicate submittals. Of the non-duplicate submittals received, 131,592 submittals or 98.56 percent were identified as form letters, 683 submittals or 0.51 percent as form letters with additional comments, and 1,237 or 0.94 percent as unique submittals. Approximately 99.89 percent of submittals were from individuals, with

the remaining submittals from non-governmental organizations (NGOs), and governments (table 1.6.1-2).

The contents of the comments received during scoping are summarized in the project record.⁷ The scoping comments were used to develop the issues (see Section 1.7, Issues), alternatives (see Chapter 2, Alternatives, Including the Proposed Action), and mitigation strategies that form the EIS analysis.

1.6.2 Project Update and Alternatives Development Workshop

As part of the EIS process, the Forest Service is required to investigate alternatives to various aspects of the proposed action described in section 2.2.4. During the alternatives development process,⁸ the Forest Service hosted two in-person public workshops and one online workshop to (1) update the public on the status of the EIS process, (2) describe the alternatives development process, and (3) solicit input on the criteria being used to evaluate alternative tailings storage facility locations. The in-person workshops were held in Superior, Arizona, on March 21, 2017, and in Gilbert, Arizona, on March 22, 2017. The online workshop was available on the project website from March 23, 2017, through April 5, 2017. Workshop attendees were asked to provide input regarding the relative importance of a variety of environmental and social criteria regarding the location of the tailings storage facility. The public responses showed Environmental Impacts and Tailings Storage Location as their primary concern, with protection of streams and springs having the highest concern. The Forest Service used the information gathered to inform the evaluation and comparison of alternative tailings storage facility locations during the alternatives development process.

7. See “Resolution Copper Project and Land Exchange Environmental Impact Statement Scoping Report” (U.S. Forest Service 2017f); “Resolution Copper Project and Land Exchange Environmental Impact Statement Public Concern Statements” (U.S. Forest Service 2017e); “Resolution Copper Project and Land Exchange Environmental Impact Statement Final Summary of Issues Identified Through Scoping Process” (SWCA Environmental Consultants 2017b).

8. See “Resolution Copper Project and Land Exchange Environmental Impact Statement Alternatives Evaluation Report” (SWCA Environmental Consultants 2017a).

Table 1.6.1-2. Distribution of submittals by sender type

Sender Type	Submittal Count
Individual	133,368
NGO	66
Government	78
Total	133,512

1.6.3 Cooperating Agencies

The Council on Environmental Quality (CEQ) regulations (40 CFR 1508.5) define a cooperating agency as any Federal agency (other than the lead agency) and any State or local agency or Indian Tribe with jurisdictional authority or special expertise with respect to any environmental impact involved in a proposal. Nine cooperating agencies with jurisdictional authority and/or applicable special expertise cooperated in the development of this EIS (table 1.6.3-1).

The cooperating agencies assisted with EIS preparation in a number of ways, including providing research and baseline data information, reviewing scientific reports, identifying issues, assisting with the formulation of alternatives, and reviewing preliminary DEIS content and other EIS materials.

1.6.4 Tribal Consultation

Federal agencies consult on a government-to-government basis with federally recognized Native American tribes having traditional interests in and/or ties to the lands potentially affected by a proposed action and alternatives. The Forest Service is conducting ongoing consultation with 15 tribes, in accordance with the NDAA and the Forest Service Handbook (FSH) Section 1509.13, Chapter 10, “Consultation with

Table 1.6.3-1. Cooperating agencies participating in the EIS process

Agency	Resource Area of Expertise
Arizona Department of Environmental Quality	Special expertise and jurisdiction under the authority of Arizona Revised Statutes (ARS) Title 49, having jurisdiction to manage environmental resources within the state of Arizona, including protection of air and water resources; aquifer protection; drinking water protection; solid and hazardous waste generation and control; and environmental economics and policy.
Arizona Department of Water Resources	Special expertise in water resources and ensuring technical accuracy and conformance with laws, regulations, and policies within the Arizona Department of Water Resources' special expertise.
Arizona Game and Fish Department	Jurisdiction over wildlife in the state of Arizona. Special expertise with wildlife including endangered, threatened, and special status species, recommendations for mitigation, and assistance with data evaluation and review relative to the department's State Trust responsibilities and jurisdiction.
Arizona State Land Department	Jurisdictional responsibilities and special expertise in matters related to management of, and potential impacts on, State Trust land.
Arizona State Mine Inspector	Jurisdictional responsibilities and special expertise in matters related to protecting the lives, health, and safety of miners and the health and safety of the general public. The Arizona State Mine Inspector is also responsible for oversight of mine closure and reclamation on State and private lands.
Bureau of Land Management	Jurisdiction over lands managed by BLM or parcels that would transfer to BLM ownership. BLM would review the land exchange proposal under 43 CFR 2200. BLM may review and decide on a request for surface use authorization from Resolution Copper, if one is ultimately submitted under the applicable BLM regulations.
Pinal County Air Quality Control Division	Special expertise and jurisdiction to regulate air-polluting activities identified in the Pinal County Air Pollution Control District Code of Regulations and further identified in ARS Title 49, Article 3.
U.S. Army Corps of Engineers	Special expertise pertains to protection of waters of the U.S., and preservation of USACE-constructed public works. <i>Would assist with NEPA review only at this time; if waters of the U.S. would be affected, then the agency would have regulatory jurisdiction under CWA regulations.</i>
U.S. Environmental Protection Agency	Jurisdiction over a number of Federal environmental laws, including the Clean Air Act, the Clean Water Act, and the Safe Drinking Water Act. The U.S. Environmental Protection Agency (EPA) reviews and comments on EISs pursuant to its authority under NEPA, 42 U.S.C. 4371 et seq., Clean Air Act Section 309, 42 U.S.C. 7609, and pursuant to CEQ's "Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act" at 40 CFR 1500–1508. EPA's participation in this EIS does not imply endorsement of the project or preferred alternative and does not abridge the independent review of the EIS, which EPA conducts pursuant to NEPA and Section 309 of the Clean Air Act, 42 U.S.C. 7609.
Arizona State Parks (Arizona State Historic Preservation Office)	Declined status as a cooperating agency; however, they have a consulting role under Section 106 of the NHPA.

Indian Tribes and Alaska Native Corporations” (U.S. Forest Service 2016b). Content discussed in government-to-government consultations is confidentially protected under Subtitle B, “Cultural and Heritage Cooperation Authority,” Sections 8101–8107(5) of Public Law (PL) 110–234, which authorizes the Secretary of Agriculture to protect the confidentiality of certain information, including information that is culturally sensitive to Indian Tribes.

Government-to-government consultation for this land exchange process and EIS process was initiated with a formal letter from Forest Supervisor Neil Bosworth to tribes in August 2015 and April 2016. The Forest Service held meetings and continues to seek tribal input via written correspondence, telephone calls, and in-person meetings. Details of the government-to-government consultation process are summarized in Chapter 4, Consulted Parties.

1.7 Issues

Issues serve to highlight effects or unintended consequences that may occur from the proposed action and alternatives, giving opportunities during the analysis to reduce adverse effects and compare trade-offs. Issues help set the scope of the actions, alternatives, and effects to consider in our analysis (FSH 1909.15.12.4) (U.S. Forest Service 2012a).

Comments submitted during the scoping period were used to formulate issues concerning the proposed action. Issues are statements of cause and effect, linking environmental effects to actions (FSH 1909.15.12.41) (U.S. Forest Service 2012a). The EIS ID team separated the issues into two groups: significant and non-significant. Significant issues were defined as those directly or indirectly caused by implementing the proposed action. Non-significant issues as identified by CEQ regulations include issues that are outside the scope of the proposed action; already decided by law, regulation, forest plan, or other higher level decision;

irrelevant to the decision to be made; or conjectural and not supported by scientific or factual evidence.

The CEQ NEPA regulations state that the EIS should “identify and eliminate from detailed study the issues which are not significant, or which have been covered by prior environmental review (Sec. 1506.3).” A list of non-significant issues and reasons regarding their categorization as non-significant may be found in the project record.⁹

While completing the EIS analysis, some factors and issues formulated during scoping were modified to accurately analyze the resource impacts. Appendix E, Table E-1, Alternatives Impact Summary, documents the issues and issue factors used or modified during the EIS analysis.

The following issue summaries represent brief synopses of the 14 major project issues that were developed from input provided by agencies, tribes, stakeholders, and the public during scoping for this EIS. Many of the identified primary issues were then subdivided into detailed sub-issues in an effort to more fully and accurately capture the concerns expressed. The complete listing of primary issues and sub-issues is included in Appendix E, Table E-1, Alternatives Impact Summary, as well as in the “Resolution Copper Project and Land Exchange Environmental Impact Statement: Final Summary of Issues Identified Through Scoping Process” (Issues Report), available at <https://www.resolutionmineeis.us/documents/usfs-tonto-issues-report-201711>.

1.7.1 Issue 1 – Tribal Values and Concerns

Tribes are concerned about current and future adverse effects on area resources from the Resolution Copper Project, as well as other ongoing mining, transportation, energy transmission, pipeline, and other developments in and around the Superior region. These affected resources may include physical resources such as access routes, air, groundwater and surface water, plant and animal life, and landscapes, as well as less tangible attributes such as sense of place; sense of historical,

9. See “Resolution Copper Project and Land Exchange Environmental Impact Statement FINAL Summary of Issues Identified Through Scoping Process” (U.S. Forest Service 2017f).

spiritual, and tribal identity; opportunities for solitude; and opportunities to continue traditional cultural practices and ceremonies.

1.7.2 Issue 2 – Socioeconomics

Construction and operation of the Resolution Copper Project would result in substantial economic and “quality of life” changes—both beneficial and adverse—in the greater Superior area. A large influx of workers to the area would lead to greater demands for housing and capacity pressures on local schools, hospitals, and other medical service providers, as well as on municipal infrastructure such as roads, water and sewer systems, and electrical and communications systems. Conversely, this same influx of workers would contribute to greater retail spending on goods and consumer services in the area and to increased tax revenues to local, county, and state governments. Residential and commercial property values may increase for some but decline for those whose properties are considered negatively affected by proximity to mine facilities (such as the tailings storage area). Some qualities of rural life may be diminished through increased traffic and a possible decrease in local recreational opportunities.

1.7.3 Issue 3 – Environmental Justice

Economic benefits may not be experienced by all sectors of society equally; historically, minority and low-income communities (including tribal communities) in a given area tend to accrue less benefit from large-scale land development and mining projects than the population of the area as a whole. In addition, it is possible that minority and low-income communities may be disproportionately affected by adverse environmental effects, potentially including greater risks to human health and safety.

1.7.4 Issue 4 – Cultural Resources

Construction and operation of the mine would profoundly and permanently alter the National Register of Historic Places (NRHP)-listed *Chi’chil Bildagoteel* (Oak Flat) Historic District Traditional Cultural

Property (TCP) through anticipated large-scale geological subsidence. Linear facilities, including new pipelines, power lines, and roads, as well as other facilities such as electrical substations, would also be constructed in support of mine operations. In addition, development of the proposed tailings storage facility at any of the four proposed or alternative locations would permanently bury or otherwise destroy many prehistoric and historic cultural artifacts, potentially including human burials. Disturbance of known or unknown cultural resources is an impact that is important to many tribes, regardless of whether data recovery is undertaken.

1.7.5 Issue 5 – Public Health and Safety

Construction and ongoing operation of the mine may have a variety of adverse effects on public health and safety. These concerns have focused principally on possible risks of breach or other failure of the tailings facility embankment; emissions and negative effects on air quality; possible seepage from or other contamination related to the tailings facility fouling local groundwater supplies; the potential for hazardous material/chemical spills; conflicts between mine-related haul truck and employee vehicles and residential traffic (including pedestrians); possible safety issues resulting from the anticipated subsidence in the Oak Flat area; and potentially increased risk of wildfire from mine operations.

1.7.6 Issue 6 – Water Resources

Potential effects on groundwater and surface water resources from construction, operation, closure, and reclamation of the Resolution Copper Mine is a multi-faceted and complex issue. In many ways, groundwater and surface waters are interconnected, and depletions and geochemical or other alterations of one are likely to affect the other, as well as to affect water-dependent resources such as vegetation and wildlife.

This issue is further complicated by the highly complex geological setting in which the Resolution Copper Mine would be constructed,

which would be permanently altered by large-scale ore removal and geological subsidence. The resulting 7,000-foot-deep area of fractured rock and approximately 1.8-mile-wide subsidence crater at the surface of Oak Flat, together with ongoing mine dewatering, would be likely over time to result in measurable reductions in flows in Devil's Canyon and Queen Creek and the long-term loss of some seeps and springs in the Superior area.

In addition, a tailings storage facility at either the proposed (Near West) location or at any of the three alternative sites (Silver King, Peg Leg, and Skunk Camp) would, through necessary stormwater management and seepage control practices, reduce the amount of surface water available in that particular watershed. The tailings storage facility also presents risks to the watershed through the potential for contaminants from metals or chemicals in tailings seepage to escape controls and enter groundwater and/or downstream surface waters, thereby potentially threatening riparian areas and other wildlife habitats, human uses, and waters provided to livestock.

1.7.7 Issue 7 – Biological Resources

Mine development has the potential to adversely affect local flora and fauna, including through direct injury or mortality; habitat alteration and loss; habitat fragmentation; reduction in water available to the ecosystem; disturbance by vehicular traffic, increased noise, and increased light; potential exposure to toxic chemicals or other hazardous substances; introduction and/or propagation of noxious or invasive plant species; and curtailed reproduction, pollination, seed dispersal, and other biological processes.

1.7.8 Issue 8 – Air Quality

Construction, ongoing ore recovery and processing, and other related activities at the mine and along transportation and utility corridors would increase dust, airborne chemicals, and transportation-related (mobile) emissions in the area, which has the potential to result in exceedances of one or more established air quality standards.

1.7.9 Issue 9 – Long-term Land Suitability

The mining proposed in the GPO is expected to cause large-scale surface subsidence in the Oak Flat area, eventually resulting in a subsidence crater up to 1.8 miles in diameter at the surface and between 800 and 1,115 feet deep. In addition, mine-related ground disturbance from clearing vegetation, grading, and stockpiling soils or equipment or other materials has the potential to compact soils, accelerate erosion, and reduce soil productivity. Damage, disturbance, contamination, or removal of soil may result in a long-term loss of soil productivity, physical structure, and ecological function across the proposed mine site as well as on lands downgradient of mine facilities.

1.7.10 Issue 10 – Recreation

Mine development in the Oak Flat area, including within the anticipated subsidence area and, ultimately, at Oak Flat Campground, would eliminate numerous recreational opportunities in this part of the Tonto National Forest. Much of the area would be fenced off and no longer accessible to hikers, rock climbing enthusiasts, cyclists, equestrians, campers, hunters, and other recreational users of these former public lands.

Mine-related linear facilities such as pipelines, power lines, and development within the MARRCO corridor may also sever connectivity of existing roads and trails and further limit recreational access. In addition, construction of a large tailings storage facility somewhere in the greater Superior area is now being evaluated in ongoing environmental and technical studies; ultimately, this facility may be located on either NFS, BLM, or private lands. Wherever constructed, the area of such a facility would be closed to all recreational uses, resulting in displacement of existing recreation in that area to other locations.

1.7.11 Issue 11 – Scenic Resources

Construction and operation of the Resolution Copper Mine would, as a result of anticipated geological subsidence at the East Plant Site, permanently alter the topography and scenic character of the Oak Flat

area. Development of a proposed tailings storage facility at any of the four alternative locations now being considered would ultimately result in a new and permanent landform approximately 3,200 to 5,800 acres in area (depending on the alternative) and several hundred feet higher than the current landscape, thus forever altering the existing viewsheds. New utility lines and construction of other mine facilities and infrastructure at the West Plant Site, East Plant Site, and filter plant and loadout facility would alter existing viewsheds, although some of these facilities may be removed and the associated areas reclaimed following mine closure.

1.7.12 Issue 12 – Transportation and Access

Transportation of personnel, equipment, supplies, and materials related to mine development, operation, and reclamation would increase traffic in and around the town of Superior. Increased mine-related traffic on local roads and highways has the potential to impact local and regional traffic patterns, levels of service, and planned transportation projects and users of NFS roads. Increased mine-associated rail traffic along the MARRCO corridor also has the potential to impact traffic patterns in the local area.

Mine development is likely to result in permanently altered, added, or decommissioned NFS roads or to temporarily restrict access to NFS roads and lands, which could impact recreational users, visitors, and permittees.

1.7.13 Issue 13 – Noise and Vibration

Development, operation, and reclamation of the mine would result in an increase in noise and vibration in the immediate vicinity of mine facilities. Activities that could increase noise and vibration include blasting, underground conveyance of ore, processing operations, operations at the filter plant and loadout facility, and, in the Oak Flat area, episodic land subsidence events. Increases in traffic associated with worker commuting, material delivery, and mine product shipment could also contribute to an overall increase in noise and vibration on area roads and highways.

1.7.14 Issue 14 – Land Ownership and Boundary Management

Changes in land ownership could have impacts as a result of the loss of public lands from the land exchange and mine proposal, including impacts on recreational access and to ranching in the area resulting from changes in easements, rights-of-way, fencing, and/or livestock access, or through special land or resource conservation agreements. Effects on current boundary management of Federal, State, and private lands in the area may include removal or other loss of survey markers, corner monuments, fences, and similar features, particularly in the area of the proposed or alternative tailings storage facility locations.

1.8 Other Proponent-Related Activities on National Forest System Lands

The Tonto National Forest has reviewed and approved multiple other analyses and NEPA documents completed in support of the project. A list of additional projects that have been analyzed can be found in table 1.4-1 of the GPO.

1.8.1 Plan of Operations for Baseline Hydrological and Geotechnical Data-Gathering Activities

Several plans of operation for the copper deposit have been processed during the exploration and development phases to authorize surface-disturbing activities. Currently, Resolution Copper is conducting development drilling in accordance with the approved “Pre-feasibility Plan of Operations,” which was authorized in 2010 (U.S. Forest Service 2010c).

In 2013, Resolution Copper submitted the proposed “Plan of Operations for Baseline Hydrological and Geotechnical Data Gathering Activities” (Resolution Copper 2016e). The purpose of this proposal was to collect hydrological, geochemical, and geotechnical data at the location of

a potential tailings storage site. The hydrologic, geochemical, and geotechnical data are being used to support detailed design of the facility and the environmental analysis contained in this EIS.

Baseline activities affected approximately 75 acres located on public lands managed by the Tonto National Forest approximately 4.5 miles west of Superior, Arizona. Activities included construction of temporary access roads and drilling/trenching sites; improvement of existing access roads; and installation of groundwater monitoring wells, geotechnical bore holes, and trenches.

1.8.2 Apache Leap Special Management Area

The Carl Levin and Howard P. ‘Buck’ McKeon National Defense Authorization Act for Fiscal Year 2015 (NDAA) (Section 3003(g)) designated Apache Leap a special management area for the purpose of preserving the natural character of Apache Leap, allowing traditional uses by Indian Tribes, and protecting and conserving the cultural and archaeological resources of the area. The Forest Service designated the 839-acre Apache Leap Special Management Area (SMA) and developed a management plan to adopt long-range direction for managing natural and cultural resources and human uses of the area (pursuant to terms set forth in the NDAA).

In December 2017, the Tonto National Forest finalized the environmental review process and the management plan. The plan establishes a comprehensive framework for managing the Apache Leap SMA, with an emphasis on the preservation of the three primary purposes outlined in the previous paragraph.

The forest plan was amended on December 26, 2017, to include the Apache Leap SMA as a designated management area and to incorporate

plan components specific to the Apache Leap SMA that follow NFS land management planning regulations adopted in 2012.

As related to the Resolution Copper Project and Land Exchange, the NDAA Section 3003(g)(4)(B) specifically authorized the following activities in the Apache Leap SMA:

- installation of seismic monitoring equipment on the surface and subsurface to protect the resources located within the special management area;
- installation of fences, signs, or other measures necessary to protect the health and safety of the public; and
- operation of an underground tunnel and associated workings, as described in the GPO, subject to any terms and conditions the Secretary of Agriculture may reasonably require.

Overview

The Forest Service developed reasonable and feasible alternatives to the proposed action to resolve, minimize, or reduce impacts on people and resources by identified issues while meeting the purpose of and need for the proposed action.

Alternatives are a mix of strategies that meet the purpose of and need for the proposed action and resolve or address key issues identified during scoping.

Alternatives for this EIS include the proposed action and no action alternative, along with a range of reasonable action alternatives.

ALTERNATIVES, INCLUDING THE PROPOSED ACTION

2.1 Introduction

Council on Environmental Quality regulations describe the alternatives section as the “heart of the Environmental Impact Statement,” and require Federal agencies to “rigorously explore and objectively evaluate all reasonable alternatives and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated” (40 CFR 1502.14).

Chapter 2 summarizes the alternatives development process, summarizes alternatives eliminated from further consideration, and describes the alternatives carried forward for detailed analysis in the EIS.

This chapter presents the range of alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for comparison and choice among options by the decision maker and the public. The differences between alternatives include changes in the location, design, or engineering of the alternative (e.g., acreage required for the footprint of each tailings storage facility); these are discussed in section 2.2. Other differences between alternatives are based on the environmental effects (e.g., the amount of dust caused by different tailings processing methods), social effects (e.g., the miles of roads used for recreation that are lost), and economic effects (e.g., the reduction in property values near the tailings storage facility) of implementing each alternative. Section 2.5 and appendix E include a summary of these effects;

chapter 3 provides a more detailed analysis of these effects.

The alternatives development process included comments provided during the scoping period for alternatives that should be considered in the EIS. Alternatives consist of a mix of strategies that meet the purpose of and need for the proposed action and resolve or address key issues identified during scoping. The additional alternatives that were determined to be outside the scope of the project, duplicative of the alternatives already being considered in detail, or technically or economically infeasible or that were determined to include components that would cause unnecessary environmental harm, are further described in Appendix F, Alternatives Considered but Dismissed from Detailed Analysis.

Alternatives considered but dismissed from detailed analysis in this EIS include the following:

- Alternative mining techniques,
- Brownfield tailings disposal, and
- Other alternative tailings disposal locations.

The Forest Service developed the following six alternatives for analysis in the EIS, which include the no action and proposed action alternatives, in response to issues raised by the public, the Tonto National Forest, or cooperating agencies (see section 1.7).

For reference in reviewing this chapter and the EIS in general, a comprehensive glossary of technical mining terminology is included in chapter 7.

2.2 Alternatives Considered in Detail

- **Alternative 1 – No Action Alternative.** The land exchange would not occur, and the GPO would not be approved. Existing activities occurring on private land would continue as permitted (see section 2.2.3).
- **Alternative 2 – Near West Proposed Action.** This alternative is a variation of the proposed action described in the May 9, 2016, version of the GPO. Alternative 2 would include a split-stream tailings processing method with two tailings types deposited at a facility at the “Near West” location with a modified centerline embankment (see section 2.2.4).
- **Alternative 3 – Near West – Ultrathickened.** Alternative 3 proposes to reduce the amount of water retained in the non-potentially acid generating (NPAG)¹⁰ tailings as well as reduce seepage potential through on-site ultrathickening of NPAG tailings at a facility at the “Near West” location with a modified centerline embankment (see section 2.2.5).
- **Alternative 4 – Silver King.** This is the only alternative that proposes to use filtered tailings instead of slurry tailings at a facility located north of Superior and the West Plant Site. After filtering, conveyors and mobile equipment would mechanically deposit potentially acid generating (PAG)¹¹ and NPAG tailings in two separate, adjacent storage facilities (see section 2.2.6).
- **Alternative 5 – Peg Leg.** This alternative allows for a comparison of the impacts of slurry tailings if placed in a flatter alluvial setting instead of in an upland wash or canyon. The tailings would be placed behind a centerline embankment at a location approximately 20 miles south of Superior. Two different corridors for tailings transportation are under consideration (see section 2.2.7).

- **Alternative 6 – Skunk Camp (Lead Agency Preferred).** This alternative uses a centerline, cross-valley embankment at a location approximately 20 miles southeast of Superior. This location requires less fill material to retain tailings, compared with a ring-like impoundment, simplifying construction and operations. Two different corridors for tailings transportation are under consideration (see section 2.2.8).

The tailings storage facility and type of tailings processing and placement formed the most substantial differences between alternatives, as shown in table 2.2-1.

2.2.1 Forest Service Preferred Alternative

The Forest Service has identified Alternative 6 – Skunk Camp North Tailings Corridor Option as the Lead Agency’s preferred alternative and seeks public feedback during the 90-day comment period for the DEIS regarding this choice.

2.2.2 Elements Common to All Action Alternatives

Elements that are common to the proposed action and action alternatives are described in this section. Later sections in chapter 2 describe specific features or changes that are particular to each individual alternative. The elements that are common to all alternatives include the land exchange process, a GPO, and amendments to the Forest Plan (see section 1.4.3).

2.2.2.1 Land Exchange

Section 3003 of the NDAA authorizes and directs the Secretary of Agriculture to administer a land exchange between Resolution Copper and the Forest Service. The NDAA also directs the Forest Service

10. *Scavenger* is another term found in reference documents and is synonymous with NPAG.

11. *Pyrite* and *cleaner* are other terms found in reference documents and are synonymous with PAG.

Table 2.2-1. Tailings storage facility comparison

Alternative	Tailings Storage Facility and Tailings Corridor (acres)	Embankment Length and Type	Separate PAG Cell?	Distance for Tailings Slurry (miles)	Tailings Type	Total Groundwater Pumped from Desert Wellfield (acre-feet)
Alternative 2 – Near West Proposed Action	4,981	10-mile-long modified centerline embankment	Not separated	5.3	Thickened slurry (NPAG and PAG)	600,000
Alternative 3 – Near West –Ultrathickened	4,981	10-mile-long modified centerline embankment	Separate cell using an internal splitter berm	5.3	Ultrathickened NPAG slurry; thickened PAG slurry	500,000
Alternative 4 – Silver King	5,691	Not applicable – compacted structural zone	Separated, 1 cell	0.2	Filtered	180,000
Alternative 5 – Peg Leg West Tailings Corridor Option	12,455	7-mile-long centerline embankment	Separated, 4 cells	28.1	Thickened slurry (NPAG and PAG)	550,000
Alternative 5 – Peg Leg East Tailings Corridor Option	12,122	7-mile-long centerline embankment	Separated, 4 cells	22.7	Thickened slurry (NPAG and PAG)	550,000
Alternative 6 – Skunk Camp North Tailings Corridor Option	10,112	3-mile-long centerline embankment	Separated, 2 cells	19.8	Thickened slurry (NPAG and PAG)	550,000
Alternative 6 – Skunk Camp South Tailings Corridor Option	10,591	3-mile-long centerline embankment	Separated, 2 cells	25.2	Thickened slurry (NPAG and PAG)	550,000

to carry out the land exchange in accordance with the requirements of NEPA with a single EIS. The land exchange is not a discretionary decision, but required by the NDAA; therefore, no decision will be issued for the land exchange process. As detailed in the NDAA, the land exchange would convey 2,422 acres of NFS land (selected lands) to Resolution Copper. The land being transferred to Resolution Copper is located east of the town of Superior in an area known as Oak Flat.

In exchange for the transfer of the Oak Flat Federal Parcel out of Federal ownership, Resolution Copper would convey private land parcels to the Federal Government consisting of approximately 5,376 acres of private land (offered lands) on eight parcels located elsewhere in Arizona.

The selected and offered land exchange parcels are listed in the legislation authorizing the land exchange (figure 2.2.2-1 and Appendix B, Existing Conditions of Offered Lands). See table 1.4.2-1 in chapter 1 for a summary of the land exchange components. Detailed figures for each of the land exchange parcels are provided in Appendix B.

Selected Lands

The selected lands include 2,422 acres of NFS lands, known as the Oak Flat Federal Parcel, located east of Superior in Pinal County, Arizona. The lands transferred from the NFS to Resolution Copper would become private lands (both surface and subsurface mineral estate).

The Oak Flat Withdrawal Area includes a 50-acre campground with 16 campsites, known as the Oak Flat Campground. The Oak Flat Campground would be conveyed to Resolution Copper during the land exchange. As a condition of conveyance of the Federal land, Resolution Copper must agree to provide access to the surface of Oak Flat Campground to members of the public until such a time that mine operations preclude access for safety reasons.

The Oak Flat Federal Parcel is adjacent to and surrounding Resolution Copper private land on which the existing East Plant Site mining facilities are located. The underground mining operations would take place beneath the Oak Flat Federal Parcel, and additional infrastructure

would be located on the Oak Flat Federal Parcel after approval of the final GPO and execution of the land exchange.

Offered Lands

The offered lands include approximately 5,376 acres of Resolution Copper private land on eight parcel groups located throughout Arizona. The parcels of offered lands would be transferred to the United States, for administration by either the Forest Service or BLM.

FOREST SERVICE

Land exchange parcel locations are shown in figure 2.2.2-1. Five of the eight parcels Resolution Copper would transfer to the Federal Government would administratively fall under the Forest Service.

Apache Leap South End Parcel. The Apache Leap South End Parcel consists of 142 acres located near the eastern edge of the town of Superior in Pinal County, Arizona. The Apache Leap South End Parcel would become part of the Apache Leap SMA, administered by the Tonto National Forest, Globe Ranger District. Upon completion of the land exchange, Resolution Copper would surrender all mining claims and interests to this parcel.

The parcel includes lands located above and below Apache Leap, an escarpment of sheer cliff faces, hoodoos, and buttresses that forms the scenic backdrop to the town of Superior. Vegetation on the parcel includes shrubs, cacti, and trees such as mesquite, palo verde, and ironwood below the escarpment and woody evergreens and shrubs such as oaks above the escarpment. Current land uses on the parcel include informal recreation and livestock grazing. Additionally, there are multiple historic mining features and remnants of old mining-related roads located throughout the parcel. The acreage of this parcel was updated based on a cadastral survey completed by the BLM in 2018.

Tangle Creek Parcel. Located in Yavapai County, Arizona, approximately 35 miles north of the towns of Cave Creek and Carefree, the Tangle Creek Parcel is a 148-acre private inholding within the Tonto

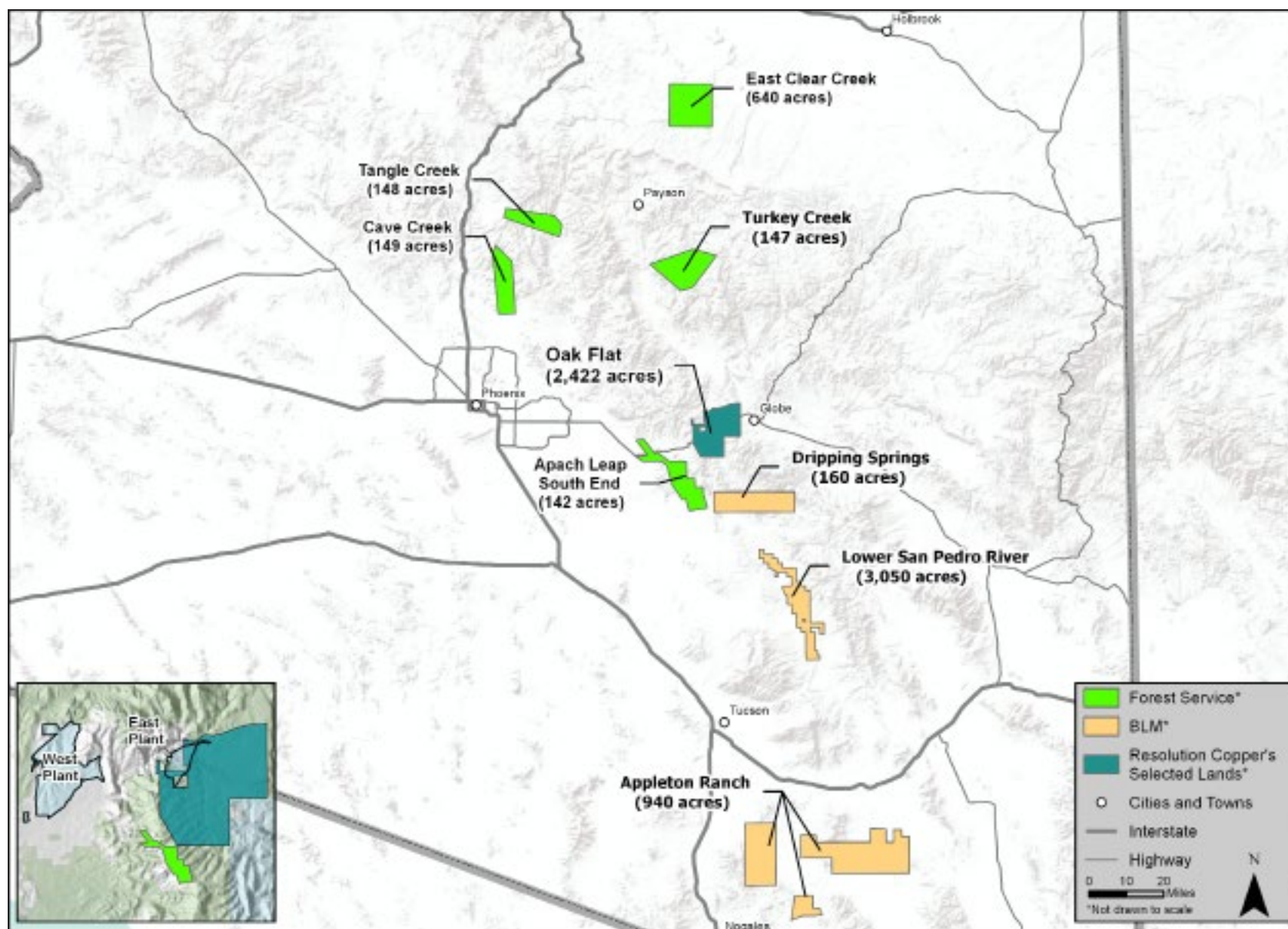


Figure 2.2.2-1. Land exchange parcels overview

National Forest. The parcel would be administered by the Tonto National Forest, Cave Creek Ranger District.

The Tangle Creek Parcel is located in Bloody Basin, a rugged and scenic basin in central Arizona with abundant hiking, camping, and hunting opportunities. The parcel was homesteaded in the 1890s by the Babbitt family. The historically cultivated farm fields are in the process of reverting to open woodlands and thickets of hackberry, mesquite, and catclaw acacia. Features of the Tangle Creek Parcel include Tangle Creek (an intermittent stream) and associated riparian habitat, as well as mature netleaf hackberry, mesquite, ash, and sycamore trees, which provide habitat for migratory birds and nesting songbirds. The parcel also contains a power line transmission corridor.

Turkey Creek Parcel. The Turkey Creek Parcel is a 147-acre parcel located approximately 8 miles southeast of the community of Pleasant Valley in Gila County, Arizona. The Turkey Creek Parcel is a private inholding within the Tonto National Forest and would be administered by the Tonto National Forest, Pleasant Valley Ranger District.

The parcel includes a historic 1880s-era homestead, including the cabin site foundation, hand-dug well, and fruit trees. Turkey Creek (an intermittent stream) and associated riparian habitat also provide varied wildlife habitat for elk, mule deer, and native fish and proposed critical habitat and two protected activity centers for Mexican spotted owl.¹²

Cave Creek Parcel. The Cave Creek Parcel is a 149-acre parcel located approximately 7 miles north of Cave Creek in Maricopa County, Arizona. The Cave Creek Parcel is a private inholding surrounded by Tonto National Forest lands. Upon completion of the land exchange, the parcel would be administered by the Tonto National Forest, Cave Creek Ranger District.

The Cave Creek Parcel includes Cave Creek (an intermittent stream) and its riparian habitat corridor, with stands of cottonwood and mesquite

trees. Perennial waters provide wildlife habitat for migratory songbirds, raptors, amphibians, javelina, mule deer, and coyotes. The parcel also encompasses numerous archaeological sites, including petroglyphs, structure ruins, and grinding sites.

East Clear Creek Parcel. The East Clear Creek Parcel is a 640-acre private inholding within the Coconino National Forest, located north of Payson in Coconino County, Arizona. The parcel would be administered by the Coconino National Forest, Mogollon Rim Ranger District. The East Clear Creek Parcel is located in a transitional zone between the upper plateau and riparian ecosystems on the Mogollon Rim. The parcel includes portions of East Clear Creek Canyon and several secondary side canyons, which provide riparian wildlife habitat and raptor nesting and roosting sites.¹³ East Clear Creek is a perennial stream.

BUREAU OF LAND MANAGEMENT

The BLM would administer the remaining three parcels of land to be transferred from Resolution Copper to the Federal Government.

Lower San Pedro River Parcel. The Lower San Pedro River Parcel is approximately 3,050-acre parcel located near Mammoth in Pinal County, Arizona. In November 1988, Congress designated 40 miles and approximately 56,000 acres of the upper San Pedro corridor as the San Pedro Riparian National Conservation Area. The parcel, which includes approximately 7 miles of the Lower San Pedro River (an intermittent stream at this location), would be administered by the BLM Gila District, Tucson Field Office, as part of the San Pedro Riparian National Conservation Area. The parcel is non-contiguous to, and roughly 60 miles northwest of, the existing BLM-administered San Pedro Riparian National Conservation Area. The riparian corridor in the parcel includes more than 800 acres of mesquite woodland that features a spring-fed wetland. The parcel's riparian areas and woodlands provide habitat for a wide variety of wildlife, including many migratory bird species and

12. The Bear Fire (July 2018) had minimal burn effects on the Turkey Creek Parcel.

13. The Tinder Fire (April 2018) did burn a large portion of the East Clear Creek Parcel, with vegetation burned from grass through crown level.

lowland leopard frogs. This parcel acreage is approximate and would be updated after BLM completes a cadastral survey in 2019.

Appleton Ranch Parcel. The Appleton Ranch Parcel includes approximately 940 acres of non-contiguous private lands south of Elgin in Santa Cruz County, Arizona. The parcels are within the Appleton-Whittell Research Ranch and Las Cienegas National Conservation Area acquisition area. The parcels are to be administered by the BLM Gila District, Tucson Field Office, as part of the Las Cienegas National Conservation Area. The Las Cienegas National Conservation Area, established in 2000, is a 45,000-acre conservation area containing cottonwood-willow riparian forests and marshlands associated with Cienega Creek, rolling grasslands, and woodlands. The Appleton-Whittell Research Ranch was established in 1969 by the Appleton family in partnership with the National Audubon Society, Forest Service, and BLM as a sanctuary for native plants and animals and a research facility for the study of grassland ecosystems. The ranch, currently managed by the National Audubon Society, contains more than 90 species of native grass and 480 native plant species and is used by more than 200 species of birds for wintering, breeding, or migratory habitat. This parcel acreage is approximate and will be updated after BLM completes a cadastral survey in 2019.

Dripping Springs Parcel. The Dripping Springs Parcel is a 160-acre parcel located northeast of Kearny in Gila and Pinal Counties, Arizona. The parcel, situated in the Dripping Spring Mountains near Tam O'Shanter Peak, is almost completely surrounded by BLM-administered lands, with some adjacent ASLD-administered State Trust land. The parcel would be administered by the BLM Gila District, Tucson Field Office. Vegetation on the parcel includes shrubs, cacti, and desert trees such as palo verde, ironwood, and mesquite, as well as areas of semidesert grassland with desert grasses and shrubs. The parcel's abundant rock formations are known for offering recreational rock-climbing opportunities.

Land Exchange Appraisal

NDAA Section 3003(c)(5) requires that the private lands to be exchanged also be of equal monetary value to the Federal lands; however, the NDAA specifically waives the Federal Land Policy and Management Act (FLPMA)-mandated 25 percent cap, allowing a larger percentage of cash payment on the differences in exchange values, if any exist, for the Resolution Copper project. This allows the Secretary of Agriculture to accept a payment in excess of the FLPMA-mandated 25 percent cap in order to achieve a parity in overall exchange values.

APPRAISAL PROCESS

The appraisal will use the Uniform Standards of Professional Appraisal Practice, the Uniform Appraisal Standards for Federal Land Acquisitions, and Federal regulations under 36 CFR 254.9 (Forest Service appraisal procedures). The Uniform Standards of Professional Appraisal Practice are the industry standard for real estate appraisals. The Uniform Appraisal Standards for Federal Land Acquisitions are an additional set of appraisal standards for Federal land acquisitions and exchanges. The appraisal process began with the Notice of Exchange Proposal Land-For-Land Exchange published on December 12, 2017.

The NDAA requires the joint selection of a qualified appraiser by both parties (the Federal Government and Resolution Copper). The appraiser was selected and began work in 2019. The completed appraisal reports will be reviewed by a Forest Service review appraiser. The review appraiser will ensure that the appraisal follows the appraisal instructions, Uniform Standards of Professional Appraisal Practice and Uniform Appraisal Standards for Federal Land Acquisitions standards, Federal regulations, and the special requirements found in the NDAA. The review appraiser will ensure that the values concluded by the appraiser are sound and well supported.

The NDAA specifies “a detailed income capitalization approach analysis of the market value of the Federal land which may be utilized, as appropriate, to determine the value of the Federal land.” The income

capitalization approach is one of three commonly used approaches used for real property appraisals.

The NDAA specifies that the appraisal reports (or a summary thereof) supporting the land exchange will be made available for public review prior to completion of the land exchange. The appraisal information will be made available after it is reviewed and approved by the Forest Service review appraiser.

2.2.2.2 General Plan of Operations Components

The proposed action consists of three main components: (1) the Southeast Arizona Land Exchange, a congressionally mandated exchange of land between Resolution Copper and the United States; (2) approval of the GPO for any operations on NFS land associated with the Resolution Copper Project; and (3) amendments to the forest plan. Because the land exchange and forest plan amendment would be the same under the proposed action and all action alternatives, those aspects of the proposed action are described in Section 2.2.2, Elements Common to all Action Alternatives.

This section summarizes the components of the proposed action as described in detail in the GPO. For a full description of the proposed mining operation, including the construction, operation, closure, and reclamation phases of the proposed mine, please refer to the GPO, as amended, which is available online at <http://www.resolutionmineeis.us/documents/resolution-copper-gpo> or at the Tonto National Forest Supervisor's Office, 2324 East McDowell Road, Phoenix, Arizona 85006.

The description of the GPO is organized as follows:

1. The mine's main facilities (existing and new).
2. The mining processes and activities that would occur during operations of the mine.
3. The closure and reclamation processes that would occur, including financial assurance for reclamation activities.

The proposed action is composed of new mining facilities, existing mining facilities, and existing facilities that are proposed for expansion. The main facilities can be summarized as the East Plant Site, West Plant Site, tailings storage facility, and filter plant and loadout facility (figure 2.2.2-2). In addition, detailed information is provided for several linear corridors, including the ore conveyor/infrastructure corridor and the MARRCO corridor. Surface subsidence is also expected above the underground mine, and this subsidence area is described in relation to the underground mining process (see "Predicted Subsidence Area" later in this section). Table 2.2.2-1 summarizes the direct surface disturbance areas for each of the main mining facilities.

Mine Phases: Construction, Operation, and Closure and Reclamation Time Frames

The estimated overall life of the mine is 51 to 56 years and would consist of three phases: (1) construction, (2) operations, and (3) closure and reclamation. The time frames for these phases and the general activities that would occur under each phase are summarized in figure 2.2.2-3. The term "mine year" is defined as 1 year after the final ROD has been signed and the final GPO has been approved by the Forest Service.¹⁴ These phases were initially defined in table 1.8-1 in the GPO¹⁵ and showed a 45-year operations phase. Subsequent design work and analysis to support the DEIS refined the length of active mining to be 40 years.

14. Should construction implementation be substantially delayed after the GPO has been approved by the Forest Service (for example, by litigation), the Forest Service would review and update the trigger for tracking mine years. Terminology for mine phases is described further in Rigg (2017).
15. Multiple versions of the GPO exist. See the process memorandum titled "History of Revisions to General Plan of Operations" (Garrett 2016) for full details. The version of the GPO cited here is dated May 9, 2016 (Resolution Copper 2016d).

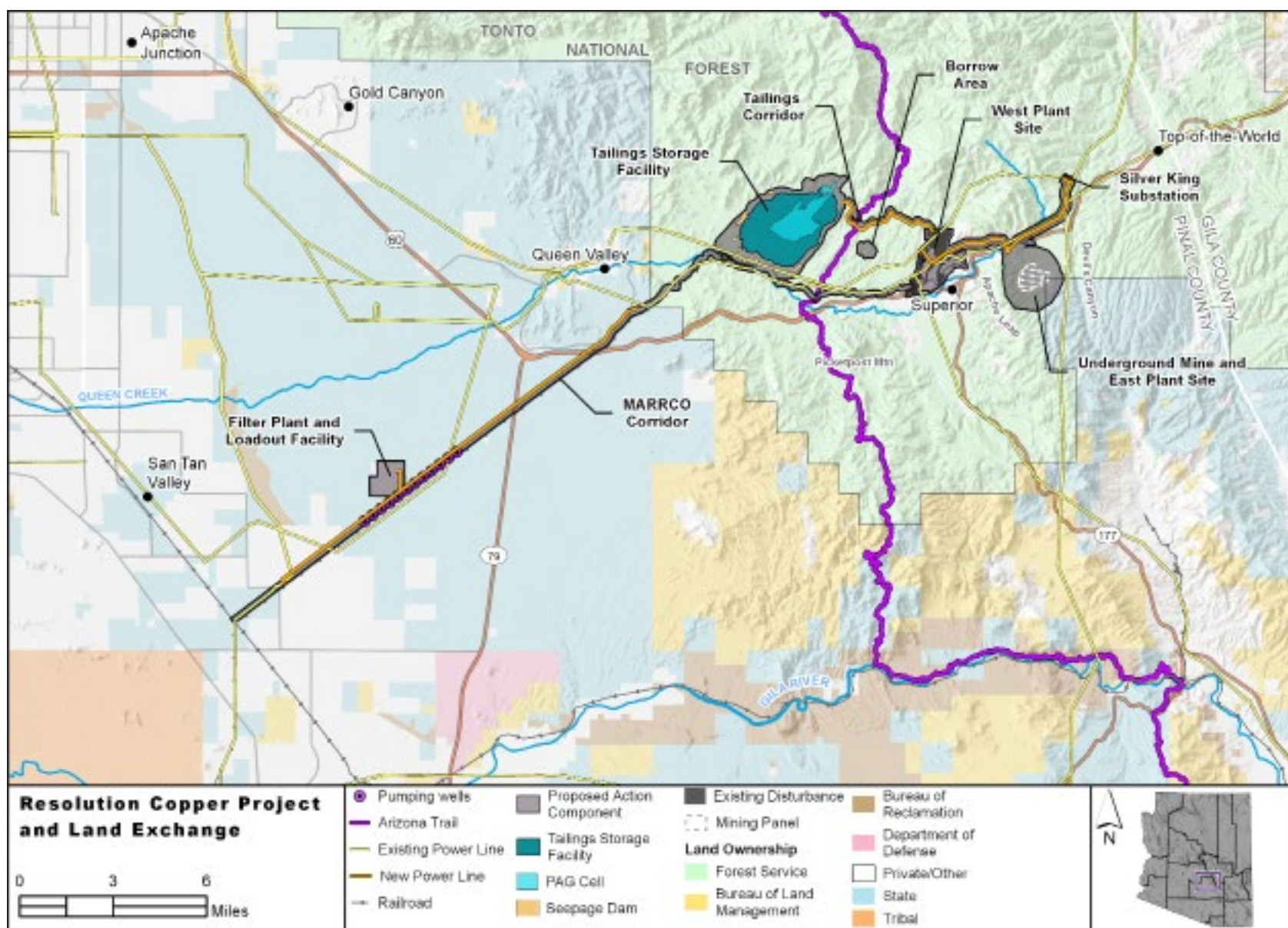


Figure 2.2.2-2. Alternative 2 – Near West Proposed Action overview

Table 2.2.2-1. Summary of project surface disturbance by proposed action

Facility	Total Disturbance (acres rounded to whole numbers)
East Plant Site (includes Magma Mine Road). Note that all NFS acreage shown in the East Plant Site would become private following the land exchange.	189 (140 NFS and 49 private)
West Plant Site	940 (all private)
Tailings storage facility and tailings pipeline corridor	4,986 (4,933 NFS, 53 private)
Filter plant and loadout facility	553 (all private)
Subsidence area. Note that all NFS acreage shown in the subsidence area would become private following the land exchange.	1,686 (1,501 NFS, 145 ASLD, 40 private)
MARRCO corridor	169 (65 NFS, 81 ASLD, 23 private)
Total	8,523 (6,639 NFS, 226 ASLD, 1,658 private)

Mining Process Overview

The Resolution Copper Mine, including all facilities described in this document, would operate 24 hours per day, 365 days per year. Figure 2.2.2-4 shows an overview of the entire mining process that would occur at full operation.

Mining the copper deposit would occur between approximately 4,500 and 7,000 feet below ground. At full operation, underground mining would produce 132,000 to 165,000 tons of ore per day. Ore would be crushed underground before being transported to two production shafts that would hoist the ore to an offloading station approximately halfway to the surface. From the offloading station, a conveyor system would transport the ore underground to the concentrator complex at the West Plant Site, approximately 2.25 miles west of the East Plant Site.

Once arriving at the concentrator complex, the ore would either be processed right away or stockpiled for future processing at a covered stockpile. The ore would then be conveyed into a concentrator building for additional crushing and grinding to a sand-size fraction and then further processed by flotation, whereby copper and molybdenum minerals are separated from non-economic minerals in a water bath with the addition of air and reagents. This process produces two products: molybdenum concentrate and copper concentrate. The molybdenum concentrate would be sent to the molybdenum plant for additional processing, packaging, and delivery to market via truck. Approximately 24,145 tons of molybdenum concentrate would be produced per year and sent to market during the operations phase. The copper concentrate slurry would be partially dewatered and pumped about 21 miles to the filter plant and loadout facility through two 8-inch high-density polyethylene (HDPE)-lined steel pipelines that would be located within the MARRCO corridor.

At the filter plant and loadout facility, copper concentrate would be filtered to remove more water and prepared for transport by railcar to Magma Junction for unloading at the Union Pacific Railroad. During the operations phase, between 6,000 and 7,000 wet tons per day of copper concentrate would be produced and sent out for smelting at an off-site smelter. The final smelter destination is unknown at this time. Water recovered during the filter process would be returned to the process water pond at the West Plant Site through the mine's main water supply pipeline in the MARRCO corridor.

The non-economic sand-like material that remains after the ore has been crushed and the copper and other valuable minerals has been extracted is called tailings. Tailings would be sent to a tailings storage facility approximately 4.7 miles west of the West Plant Site through two pipelines (42-inch pipe for NPAG, 2-inch pipe for PAG; reclaimed water would return to West Plant Site in a 24-inch pipe).

Approximately 1.37 billion tons of tailings would be created during the mining process and would be permanently stored at the tailings storage facility. Tailings leaving the processing plant would be split into

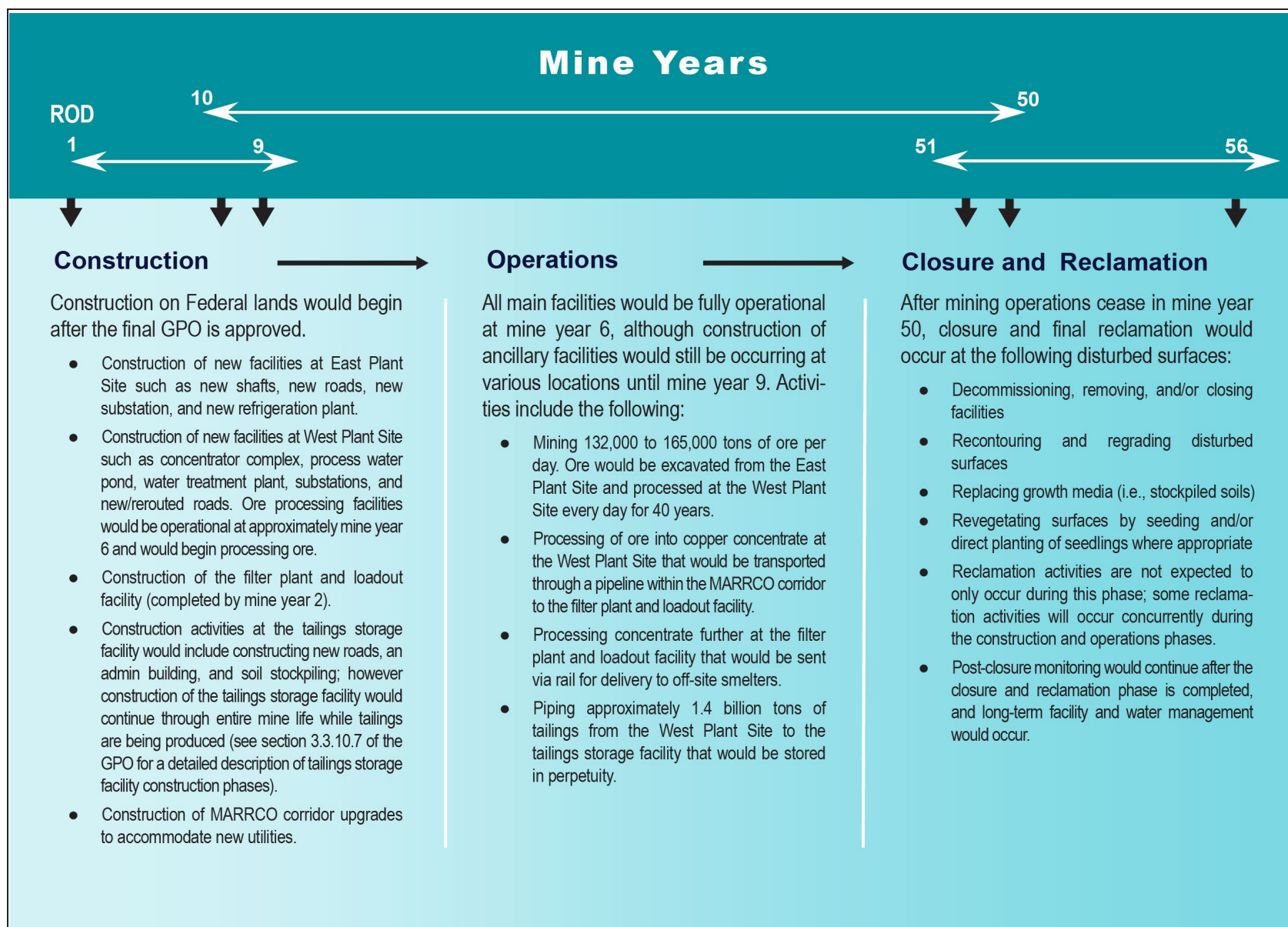


Figure 2.2.2-3. Mine phases, time frames, and mine activities by phase

two separate streams. About 16 percent of the tailings are classified as potentially acid generating, or PAG tailings. These tailings contain much of the sulfides from the ore. The remaining 84 percent of the tailings are classified as non-potentially acid generating, or NPAG tailings.

The PAG tailings and NPAG tailings would arrive at the tailings storage facility separately. The PAG tailings would be deposited in such a way that they are kept submerged beneath water (known as “subaqueous deposition”). This limits oxygen from interacting with the concentration of sulfides in the PAG tailings, minimizing and preventing water quality problems (acid rock drainage). The NPAG are less reactive and would be deposited in a way that would eventually encapsulate the PAG tailings.

UNDERGROUND MINING

Resolution Copper proposes to mine the copper deposit under the Oak Flat Federal Parcel using a method known as panel caving. Panel caving would be the mining method used under all action alternatives. Other mining methods were considered but not analyzed in detail; for additional information, see appendix F. The following sections describe the panel caving method and the various other activities that would occur at the underground mine.

Panel Caving Overview

The type of copper deposit that would be mined at the East Plant Site is a porphyry deposit located between approximately 4,500 and 7,000 feet below the Oak Flat Federal Parcel. The copper deposit that Resolution Copper proposes to mine averages 1.54 percent copper (i.e., every ton of ore would on average contain 31 pounds of copper). The proposed action would use panel cave technology, a type of block caving that is a large-scale mining method.

In general, the panel caving mining system divides the ore into large sections or panels and depends on gravity and internal geological stresses to extract ore from underneath the ore body. After accessing the area below the copper deposit through the construction of vertical shafts, a network of tunnels (vertical shafts and horizontal drifts) is excavated

Table 2.2.2-2. Description of underground tunnel levels

Level	Function	Components
Undercut blasting	Blast ore body directly overlying the undercut blasting level	Drifts, shafts, and mechanical support
Extraction	Collect blasted ore	Drifts, shafts, mechanical support, drawbells, load-haul-dump vehicles, and ore passes and chutes
Exhaust	Circulate cool air from refrigeration system throughout underground mine operations	Drifts, shafts, ductwork, and variable-speed fans
Rail haulage and crushing	Transport ore from drawbells to underground crushing facility and then convey to production shafts	Drifts, shafts, crushing facility, mechanical support, haul trucks, and/or rail cars and rail system

under the copper deposit. The tunnels would be created by standard underground techniques, including drilling, blasting, and removing the blasted rock. The network of tunnels would have four levels, each with different functions, as described in table 2.2.2-2.

Once the tunnels are built below the copper deposit, the ore above is blasted to fracture it. The ore then collapses downward through funnel points known as drawbells.

From the drawbells, the collapsed ore in the extraction level would be transported through the tunnel system to a crushing facility underneath the haulage level, where the ore would be crushed by one of three gyratory crushers. Once crushed, the ore would be conveyed to a production shaft where it would be hoisted approximately halfway to the surface (approximately 3,500 feet below surface) and sent from a loadout facility to the West Plant Site via the inclined underground to surface conveyor system.

After the ore has been blasted and collapsed into the drawbells, an expansion void (or cave) within the ore body would form. Additional fracturing and ore collapsing would occur at the expansion void as a result of internal geological stresses caused by the cave, at times

aided by additional blasting. The continued process of collapsing and excavating the ore would be repeated until the copper deposit is exhausted or the grade of the collapsed ore is no longer economically viable. Over the 40-year operations phase, this process would be applied at six panels adjacent to one another under the Oak Flat Federal Parcel (figure 2.2.2-5). The mining sequence would begin away from Apache Leap in Panel 2; subsequently mined panels would be Panels 3, 1, 4, 5, and 6, as shown in figure 2.2.2-5.

In total, about 600 pieces of mobile equipment would be used at the underground mining operations. This equipment is identified in table 2.2.2-3.

Refrigeration and Ventilation Systems

Heat in the underground mining operations would be generated by numerous man-made and natural thermal sources. The geological formation is naturally hot at the depth of mining, and in addition to this heat, other sources of underground heat and exhaust would be generated by vehicles and mobile equipment (both electric and diesel driven), workshops, warehouses, pump stations, the refrigeration plant, conveyors, the crusher station, and electrical substations. A refrigeration and ventilation system would be constructed at the surface at the East Plant Site to maintain appropriate temperatures in the underground mining operations and protect the health and safety of workers from excessive heat, equipment exhaust, gases, radon, respirable dust, and fibers. At full production, Shafts 11, 12, and 13 would be used as downcast fresh-air intake shafts, while Shafts 9, 10, and 14 would be used as upcast ventilation exhaust shafts, along with the conveyor/infrastructure tunnel exhaust raise. Mine shaft locations are shown in figure 2.2.2-7.

Underground Mine Auxiliary Facilities

Construction of auxiliary facilities within the underground mine workings would support the operations, including the following:

Table 2.2.2-3. Underground mobile equipment

Drilling and Blasting	
	Drilling Jumbos
	Production drills
	Explosives loader unit
Production and Haulage	
	LHD (Load, Haul, Dump Machines)
	LHD generator trucks
	Underground haul trucks
	Railroad locomotives
	Rail bottom dump cars
Secondary breaking fleet	
	Medium reach rigs
	Robust rigs
	Mobile rock breakers
Miscellaneous maintenance and service vehicles	
	Rock and cable bolters
	Shotcrete sprayer and trucks
	Scissor lifts
	Support trucks: fuel/lube, crane, water, shotcrete, Flat Deck, and service
	Graders
	Personnel vans and other vehicles

- Electrical substations, along with transmission and distribution systems, to provide power to the underground facilities and equipment.
- An underground workshop, warehouses, a batch plant, and fuel/tire storage to support mine operations.

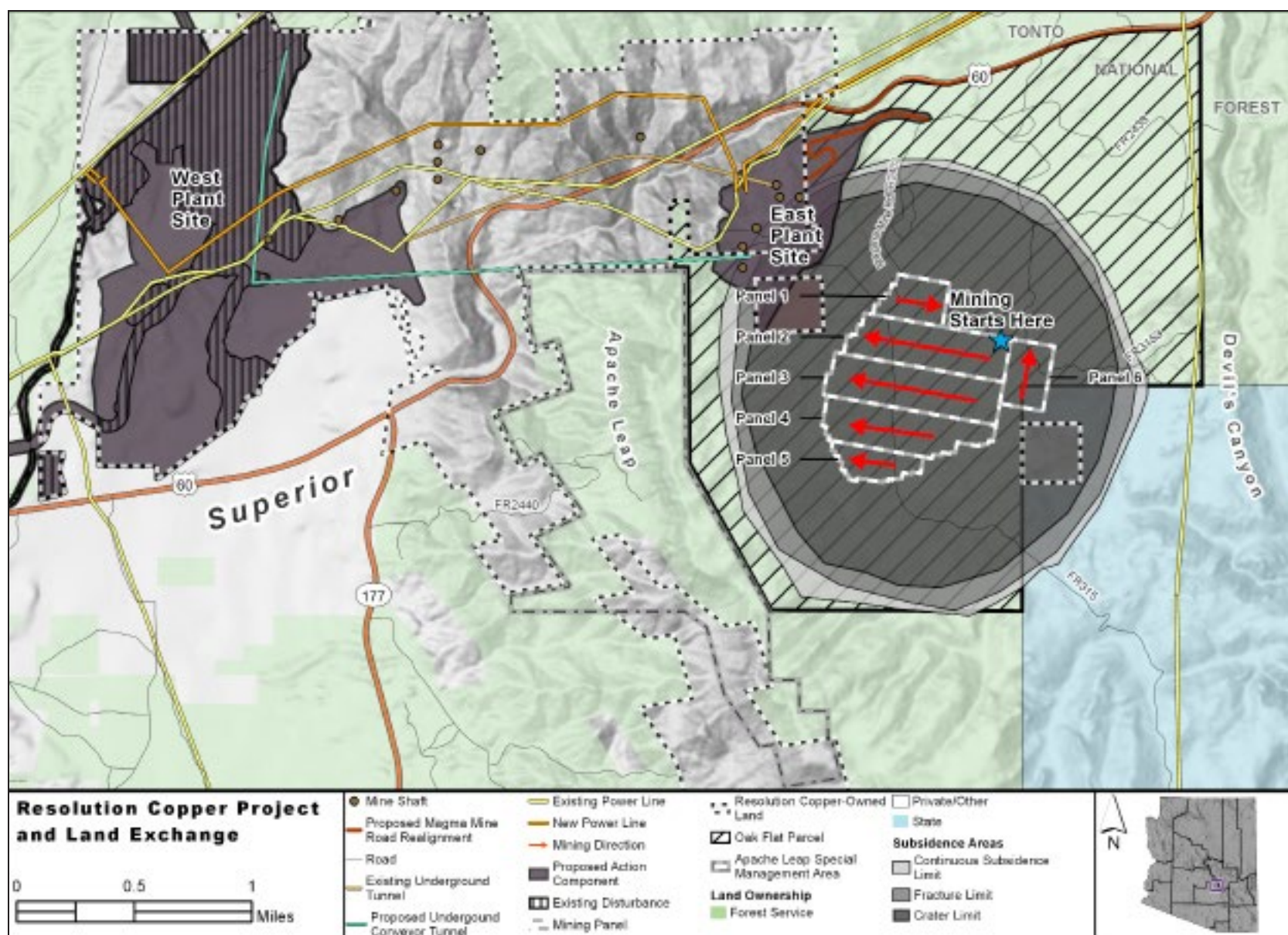


Figure 2.2.2-5. Predicted mining subsidence areas and the East Plant Site area

- Various pump stations, pipelines, and infrastructure necessary for dewatering water from underground mine workings and the transfer of process and cooling water in the mining circuit.

Predicted Subsidence Area

As the panel caving process is repeated, the volume of ore extracted from the underground mine is expected to cause the surface of the Oak Flat Federal Parcel to collapse or subside. The size and depth of the land surface depression is primarily affected by the depth and footprint of the mine.

The analysis of the environmental effects of mining is contained in chapter 3, including a detailed discussion of subsidence. However, the collapse of rock downward is also a fundamental aspect of how the panel caving technique works; therefore, subsidence is described briefly here as part of the proposed action.

Resolution Copper has conducted simulations and modeling to predict the potential area that would subside. The overall subsidence would consist of three areas: (1) the crater limit, (2) the fracture limit, and (3) the continuous subsidence limit. Table 2.2.2-4 identifies the characteristics of each of the three subsidence areas, as well as the acreages of each area that are predicted to occur under the proposed action.

Under the proposed action, mining would not occur within some sections of the 1 percent copper deposit shell nearest Apache Leap to minimize risk of subsidence at Apache Leap. Figure 2.2.2-5 shows a map of the predicted mining subsidence areas, and figure 2.2.2-6 shows a cross section and aerial views of the predicted subsidence areas.

East Plant Site

The East Plant Site includes the surface support facilities for underground mining activities, including the access shafts (figure 2.2.2-7). The East Plant Site would expand from its current size of 39 acres to 189 acres. At present, 4 acres of the existing East Plant Site and 144

Table 2.2.2-4. Characteristics and acreages of subsidence subareas

Subsidence Subarea	Characteristics	Predicted Acreage of Each Area
Crater limit	Large, visible crater with cave angles of 70 to 78 degrees and with a depth between approximately 800 and 1,115 feet at the end of mine life	1,329
Fracture limit	Visible deformation in a conical form between the surface and cave zone; characterized by rotational failures, tension and dislocation cracks, benching, fractured surfaces, and toppling	250
Subsidence limit	Extremely small rock deformations that can only be detected by high-resolution monitoring equipment (would not be visible in the soil or on the ground)	172
Total Area of Subsidence		1,751

Source: Garza-Cruz and Pierce (2017)

acres of the proposed East Plant Site are NFS lands; following the land exchange, all of the East Plant Site would be private. The 4 acres of the existing East Plant Site has been previously disturbed. These acreages do not include several other aspects of the East Plant Site, including the underground infrastructure for the panel caving, the mined panels themselves, or the surface subsidence area.

Details of existing East Plant Site facilities, new East Plant Site facilities, and materials used at the East Plant Site are summarized in appendix G.

Ore Conveyor/Infrastructure Corridor

Partially crushed ore from the East Plant Site underground mine operations would be transported to the West Plant Site concentrator complex via an inclined underground to surface conveyor system (see figure 2.2.2-7). The underground conveyance system would

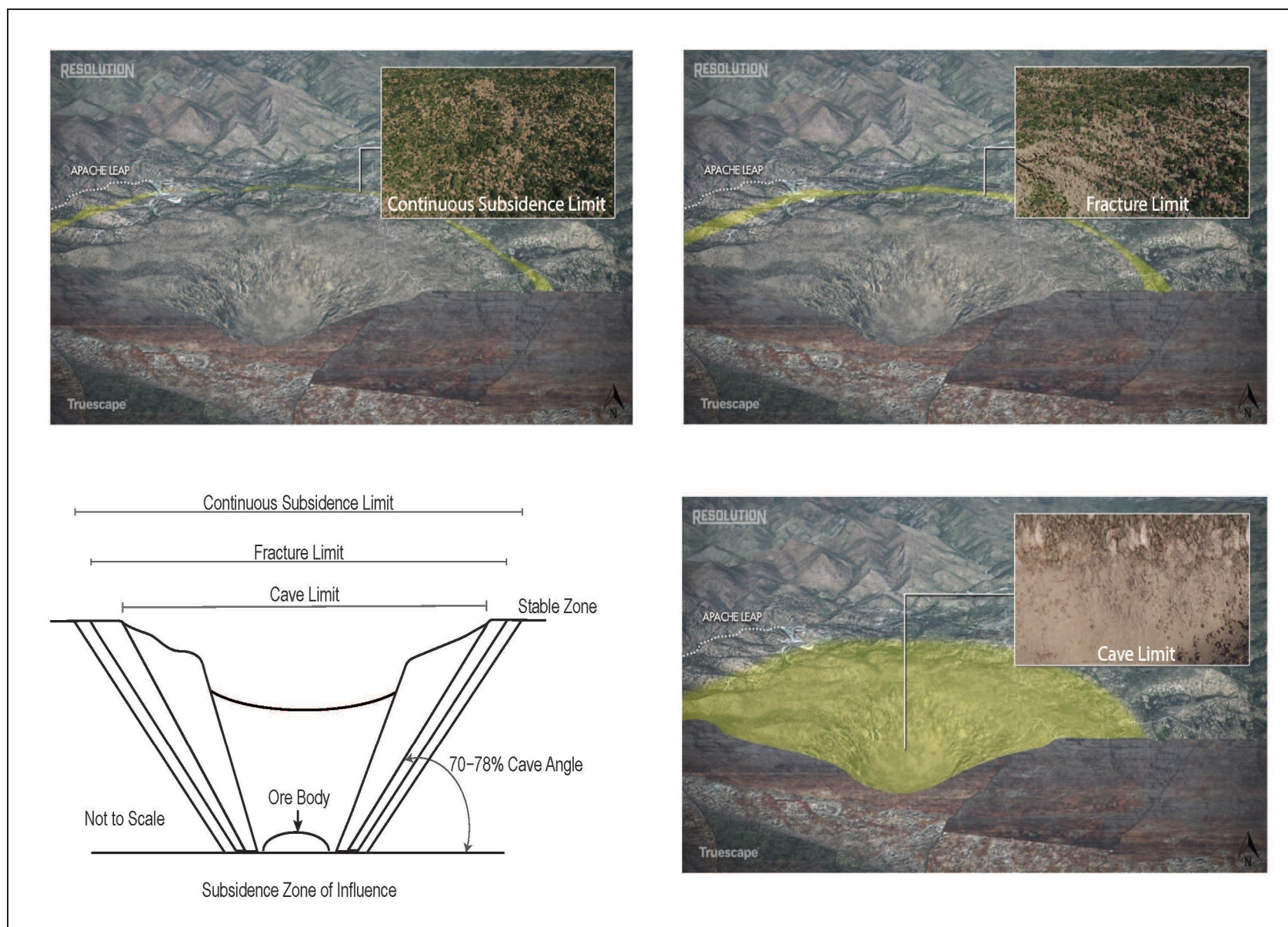


Figure 2.2.2-6. Cross section and aerial photograph simulations of the predicted subsidence areas

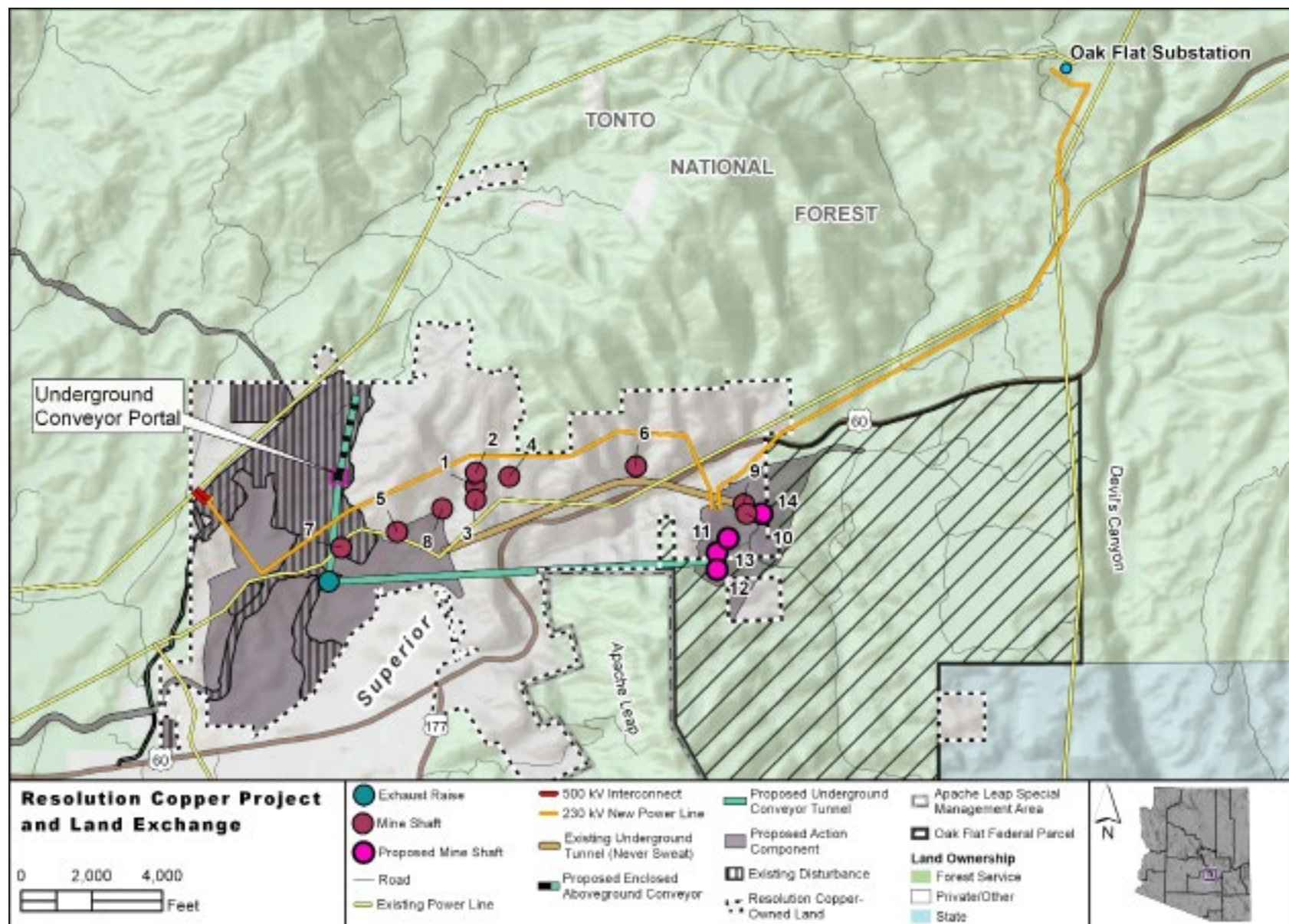


Figure 2.2.2-7. East Plant Site detailed facilities layout

be composed of an underground tunnel with two conveyors that are inclined at approximately 10 degrees for more than 2.5 miles. The alignment of the conveyance system would be under a combination of unpatented mining claims and private lands owned by Resolution Copper. Surface disturbance from the inclined underground to surface conveyor system would be limited generally to the shafts above the conveyor feed at the East Plant Site, an exhaust raise (and ventilation fans) along the conveyor tunnel alignment for ventilation, the tunnel portal at the West Plant Site, and the overland portion of the conveyor at the West Plant Site, all of which would be located on private land owned by Resolution Copper.

West Plant Site

In general, the West Plant Site would be the location where crushed ore material arriving from the East Plant Site would be processed into copper and molybdenum concentrates. The West Plant Site consists of three main facilities: (1) the stockpile, which includes the development rock and intermediate rock stockpiles; (2) the concentrator complex, which includes the process water pond, ore stockpile facility, tailings thickeners, copper molybdenum and copper concentrator thickeners (thickeners), and the molybdenum plant; and (3) the auxiliary facilities, which include the administration building, contractor and warehouse laydown yards, and construction and employee parking (figure 2.2.2-8).

The total footprint of the West Plant Site would be on private lands owned by Resolution Copper; 12 acres of the site are currently disturbed. The GPO had described a process pond on NFS land north of the West Plant Site, but it was determined that moving the process pond onto Resolution Copper private property directly to the west of the current West Plant Site would reduce impacts on NFS resources (see section 2.2.8.1 and figure 2.2.8-1).

Access to the West Plant Site would be via Silver King Mine Road (NFS Road 229), which is on both private and NFS lands. Portions of NFS Road 229 across private land would be reconstructed to Mine Safety and Health Administration (MSHA) specifications and maintained by

Resolution Copper. This road would be used as an alternate road to transport mine personnel, equipment, supplies, and molybdenum and other mine products, to and/or from the West Plant Site. The alignment would generally follow the existing Silver King Mine Road with changes at drainage crossings and tight corners (see figure 2.2.2-8). Public access on NFS Road 229 would be controlled at a security gate where the road crosses private land. Alternative public access to areas north of the West Plant Site can occur on NFS Road 8 and NFS Road 3152 that would reconnect to NFS Road 229 north of the private land.

Details of existing West Plant Site facilities, proposed new West Plant Site facilities, and materials used at the West Plant Site are summarized in appendix G and shown in figure 2.2.2-9.

Tailings Storage Facility and Tailings Pipeline Corridor

Approximately 1.37 billion tons of tailings produced by the mining operation would need to be stored in perpetuity. The tailings corridors have been designed to follow existing roads or disturbance where possible. The proposed action and all alternatives would transport tailings within a corridor that would include multiple pipelines, an access road, and power and communication lines.

All action alternatives handle tailings in separate split streams based on the ore processing at the West Plant Site. PAG and NPAG tailings are transported in separate pipelines as they are split during the ore processing. The pipelines are designed for optimum performance during each mine phase to match flow characteristics of materials and velocity and vary between 10-inch, 22-inch, or 34-inch diameter. Recycled water would be transported back to the West Plant Site from the tailings storage facility via a 16-inch pipeline. The solids content of the tailings streams varies between alternatives; see figure 2.2.2-10 for ranges of tailings types at deposition.

The tailings conveyance corridors used to transport the tailings to the facility and reclaimed water back to the West Plant Site are designed with similar pipeline dimensions. Pipeline installation, spill containment necessary based on pipeline installation method, and access and bypass

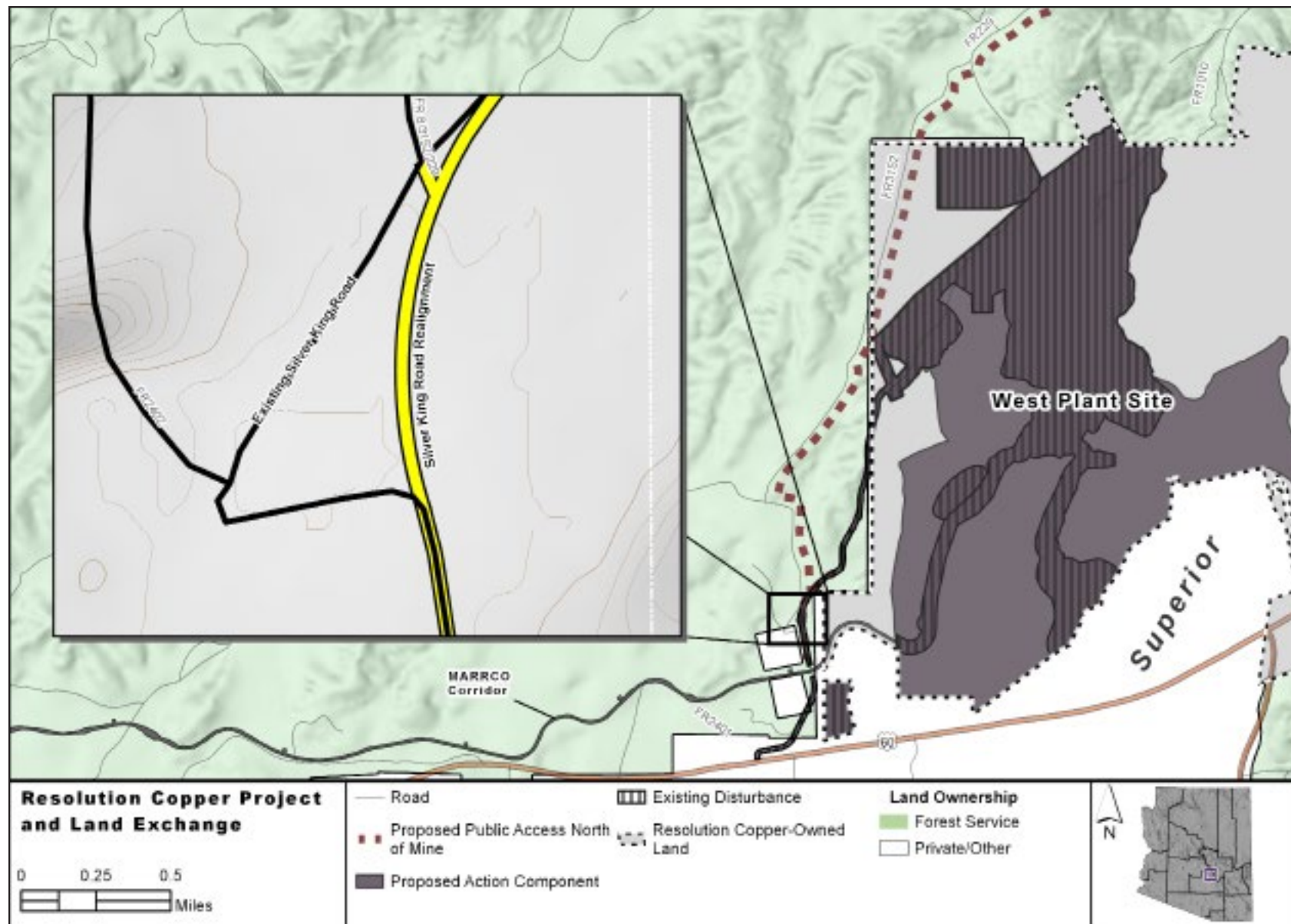


Figure 2.2.2-8. Redesign and/or improvement of vehicle access to and from the West Plant Site

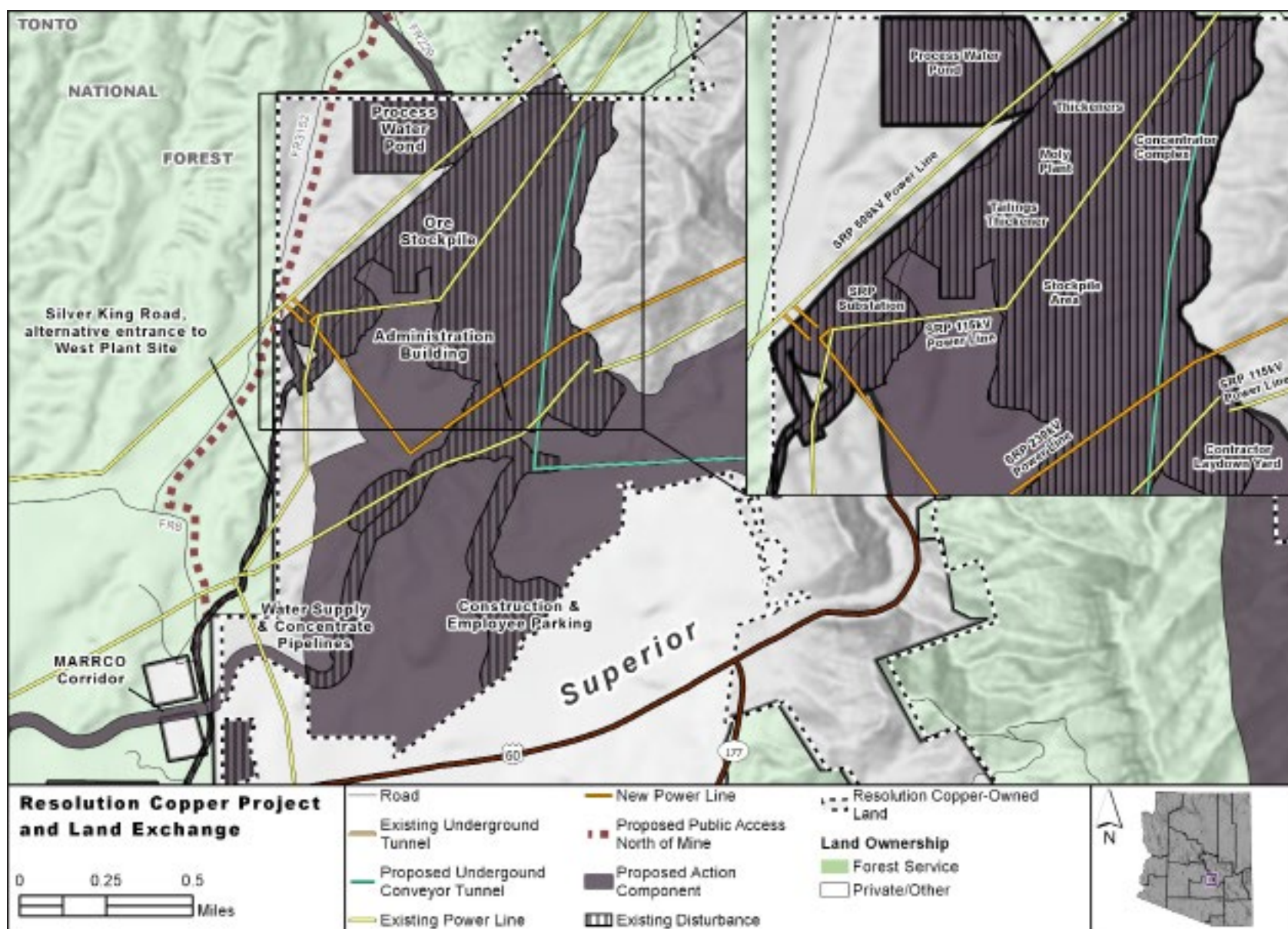


Figure 2.2.2-9. West Plant Site facilities overview

Tailings Disposal Range Based on Solids Content





Filtered tailings		Percentage solids content at disposal in tailings storage facility	>85%	←	Alternative 4 – Silver King
Paste tailings			70–85%		
Thickened tailings			50–70%	←	Alternative 3 – Near West Ultrathickened Alternatives 2, 5, and 6
Conventional slurry tailings			20–50%		

Figure 2.2.2-10. Range of tailings types based on solids content

roads necessary would vary by topography and alternative routing option selected. The pipeline design could include buried, overland secured, horizontal directional drilling (HDD) or micro-tunneling, surface run, cable-stayed bridge or through-truss bridge layouts. The installation designs would vary based on topography throughout each corridor segment and general design configurations are shown in figure 2.2.2-11.

The tailings conveyance corridor averages 110 to 230 feet wide, with the majority of the pipeline buried. In very steep sections of terrain, the corridor could be as wide as 1,000 feet. The pipeline would be equipped with a leak detection system and a modern control system permitting operation of the entire pipeline from a central control room. An access road that followed the pipelines would be used for construction, and maintenance during operations. Where necessary based on topography, other techniques could be used for pipeline construction, such as secured at the surface on overland secured placement, or through HDD or micro-tunneling at water crossings or through high mountain peaks. The pipeline can also span canyons, roadways, or trails such as the Arizona National Scenic Trail with cable-stayed or through-truss bridges. Booster pumps are required if unable to gravity-feed to the tailings storage facility; if necessary for design, the booster pumps would be located at the West Plant Site.

MARRCO corridor

The 30-mile-long MARRCO corridor is a railroad and utility corridor running roughly east-west from Superior to Magma Junction. Hewitt Canyon Road (NFS Road 357) provides access to the MARRCO corridor, which crosses private lands as well as lands administered by the Tonto National Forest and ASLD (figures 2.2.2-12 and 2.2.2-13). Resolution Copper currently owns the MARRCO corridor right-of-way. The corridor generally is 200 feet wide and private parcels along the MARRCO corridor have been developed, particularly east of Queen Station and near Magma Junction. The corridor currently contains multiple utility lines and water pipelines and infrastructure. The existing infrastructure within the corridor includes the following: a buried

fiber-optic line, an overhead transmission line and telephone line, buried natural gas pipelines, Arizona Water Supply pipelines and infrastructure providing water supply to the Town of Superior, and an 18-inch dewatering line transporting water being dewatered from the East Plant Site to the New Magma Irrigation and Drainage District (NMIDD). New corridor facilities would include additional water pipelines, water pumps and recovery wells, and copper concentrate pipelines to transport ore concentrate to the filter plant and loadout facility.

Details of existing and new MARRCO corridor facilities are summarized in Appendix G, Further Details of East Plant Site, West Plant Site, MARRCO Corridor, and Filter Plant and Loadout Facility Infrastructure.

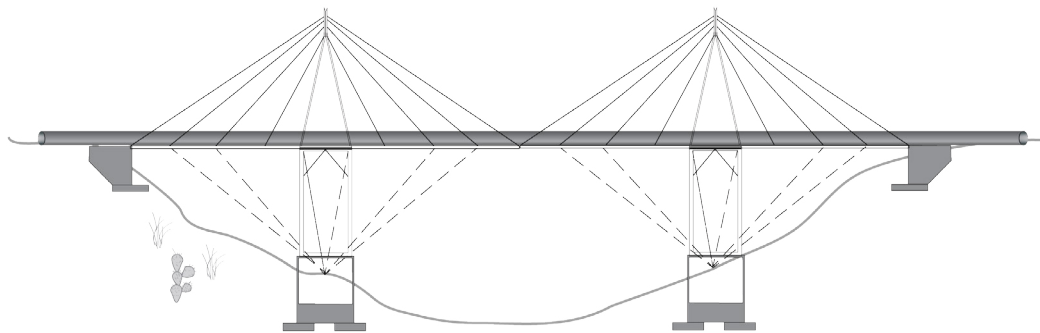
Filter Plant and Loadout Facility

A pipeline within the MARRCO corridor would transport copper concentrate slurry from the concentrator complex at the West Plant Site to the filter plant and loadout facility. The filter plant's primary function would be to filter the copper concentrate to a state that is ready for transportation. The loadout facility's primary function would be to remove water from the copper concentrate to prepare the concentrate for delivery to an off-site smelter and recycle water to be reused in the concentrator. The filter plant and loadout facility would be located on 553 acres of private lands controlled by Resolution Copper near San Tan Valley, Arizona (see figure 2.2.2-14).

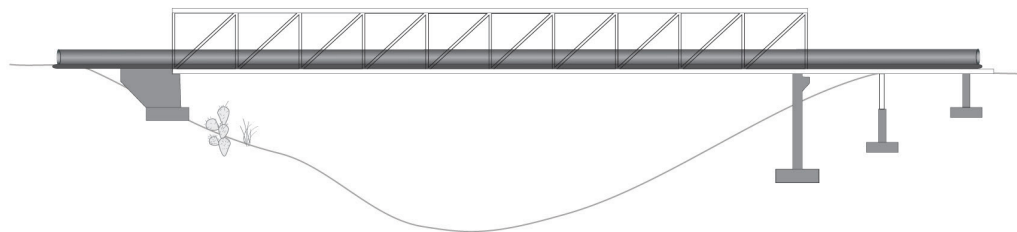
Carbon Steel Pipe Specifications and Use during Mine Life

Year of Operation	10-in. Diameter 0.375-in. Wall	22-in. Diameter 0.375-in. Wall 0.5-in. HDPE* liner	34-in. Diameter 1.25-in. Wall	16-in. Diameter 0.375-in. Wall
1–5 (ramp-up)	PAG	NPAG	–	Reclaim water
6 (ramp up)	PAG	–	NPAG	Reclaim water
7–41 (steady state)	–	PAG	NPAG	Reclaim water

* HDPE:



General arrangement of cable-stayed bridge – used for spanning canyons



General arrangement of a through-truss bridge – used for spanning smaller channels

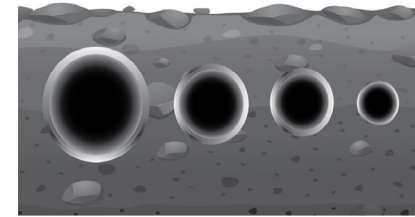
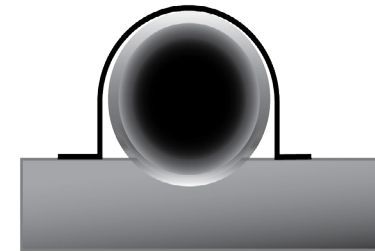
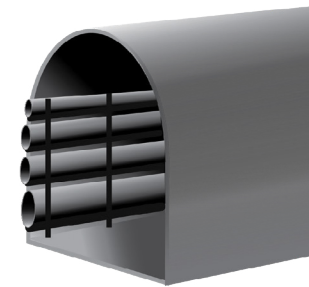
General arrangement
of buried pipelinesOverland secured pipelines where
construction is difficult due to
bedrockHorizontal directional drilling and/or micro
tunneling will be used to undercut roads,
waterways, or for high-point mountain
passes

Figure 2.2.2-11. Graphical display of pipeline arrangements used in tailings conveyance corridor design

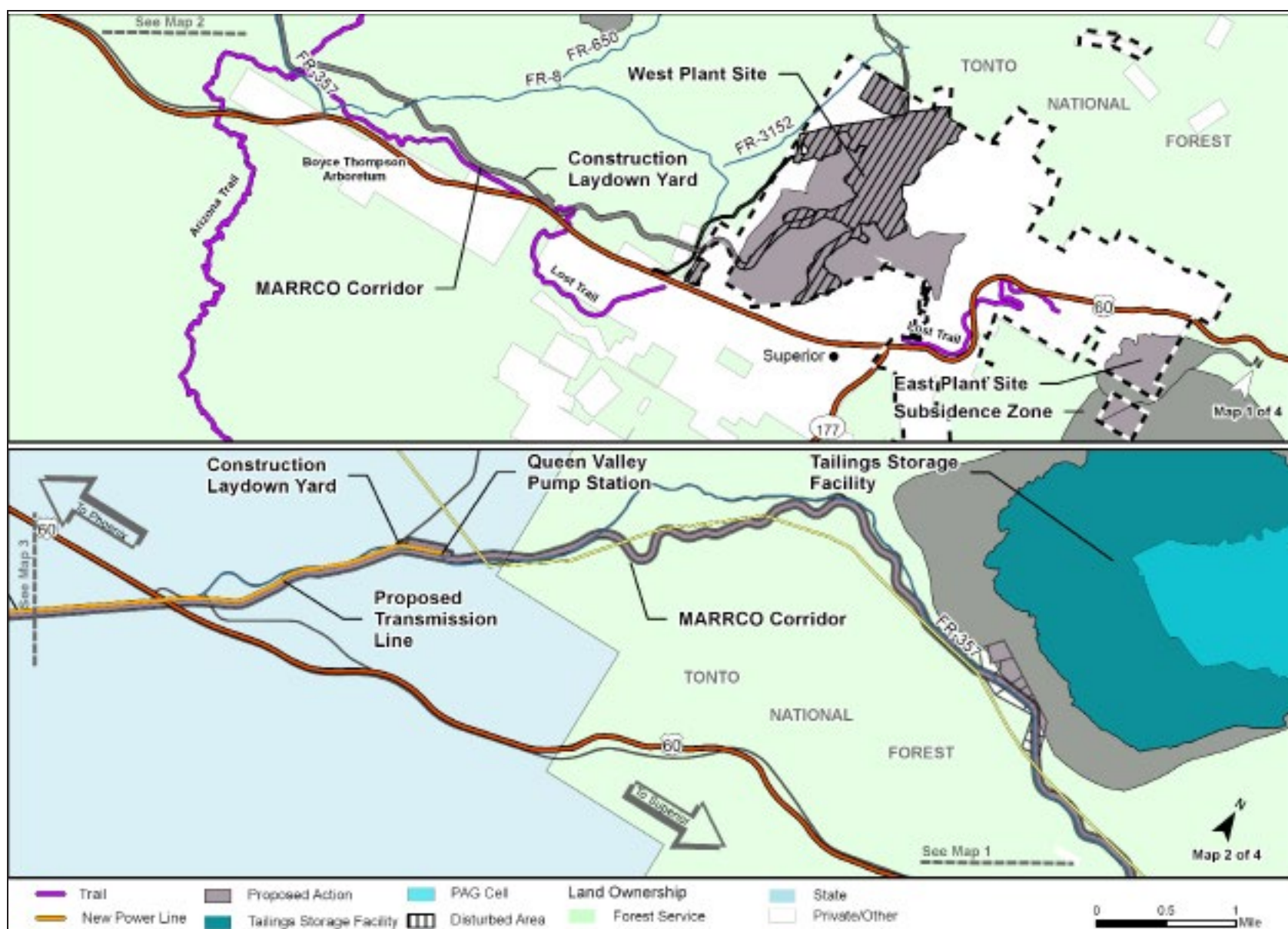


Figure 2.2.2-12. MARRCO corridor facility layout (1 of 2)

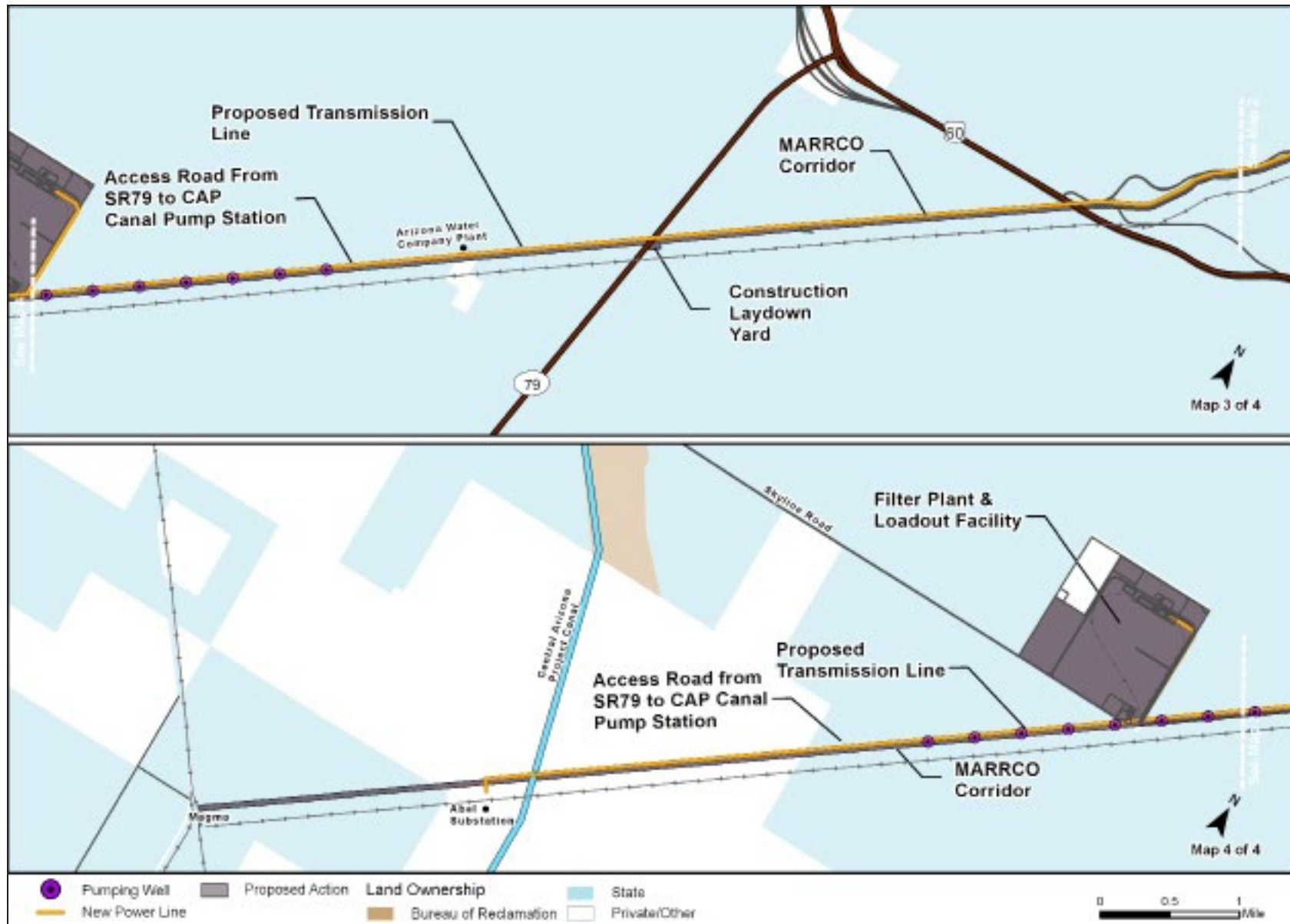


Figure 2.2.2-13. MARRCO corridor facility layout (2 of 2)

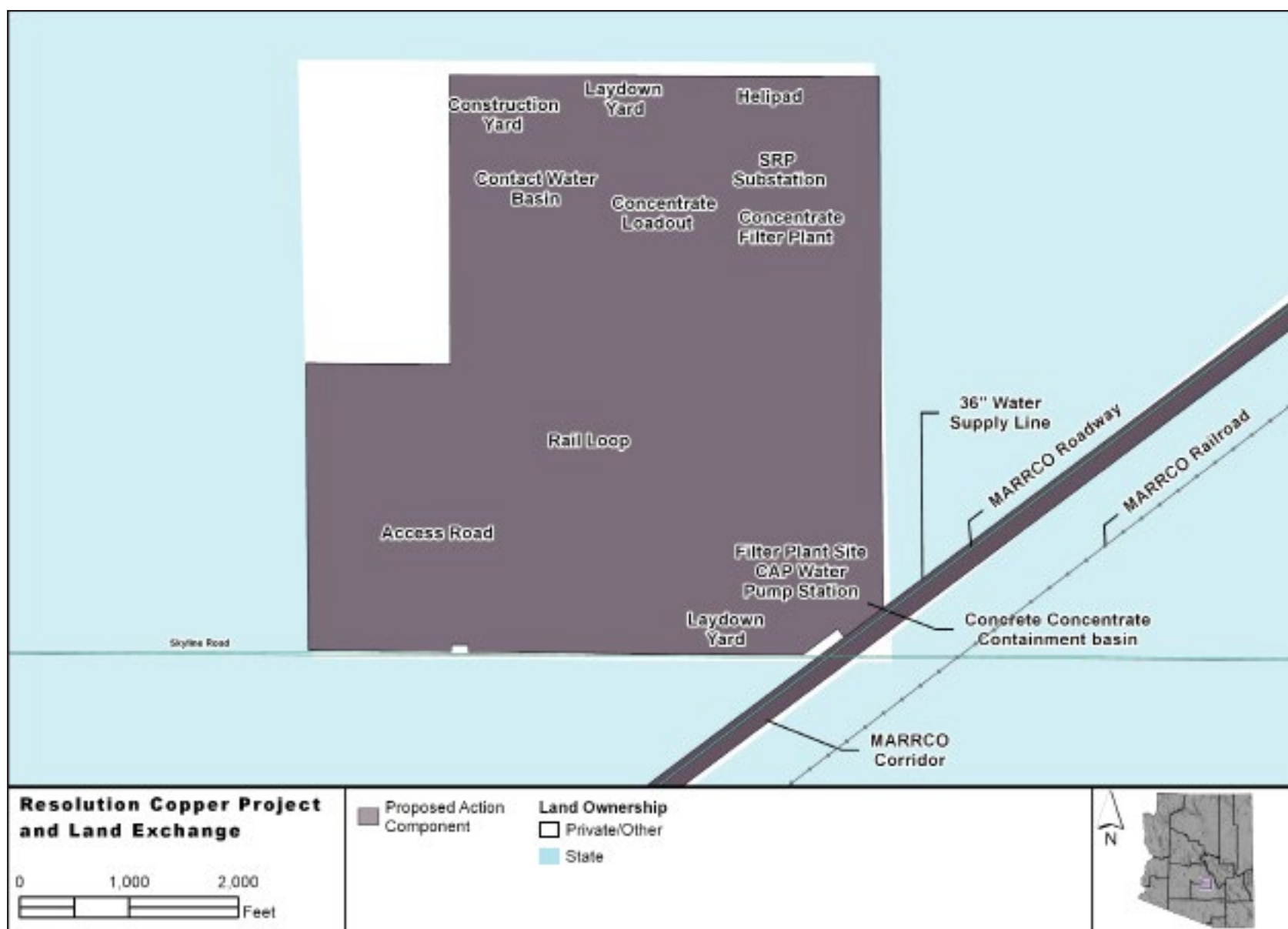


Figure 2.2.2-14. Filter plant and loadout facility detailed layout

Further details of East Plant Site, West Plant Site, MARRCO corridor, and filter plant and loadout facility infrastructure are summarized in appendix G.

Operations Processes and Activities

TRANSPORTATION

Each mine facility would have distinct access routes and traffic volumes during the construction, operations, and reclamation and closure phases. For detailed calculations of predicted traffic volumes that would be generated by the mine, including employee traffic, see the “Transportation and Access” resource section in chapter 3. Table 2.2.2-5 summarizes the access roads that would be used for each of the four main facilities and the materials and equipment deliveries that would occur during the construction and operation phases.

ELECTRICITY SUPPLY AND TRANSMISSION LINES

Electricity is currently supplied to the East Plant Site by an existing 115-kilovolt (kV) SRP transmission line and to the West Plant Site by an existing 500-kV SRP transmission line to existing facility substations. Construction and operation of the proposed mine would require electrical transmission lines between these main facilities to accommodate greater power needs, as well as new transmission lines to power the new tailings storage facility, new filter plant, and loadout facility. Substations also would need to be upgraded and/or new 230-kV substations would need to be constructed to accommodate electricity from the upgraded lines and distribute the electricity throughout the site (see East Plant Site, West Plant Site, tailings storage facilities, and filter plant and loadout facilities descriptions earlier in this chapter for upgraded/new substation descriptions).

Power use by the mine has been estimated (Garrett 2019b) Power use ramps up over time and varies slightly by tailings alternative, but during full operations is estimated to be approximately 250 to 280 megawatts. The primary electricity consumers at the mine site would be as follows:

1. The hoist motors at the East Plant Site that raise the ore out of the mine (roughly 20 to 25 percent of total power use), and underground ore flow (roughly 10 to 15 percent of total power use).
2. The ventilation and cooling systems at the East Plant Site for the underground mine (roughly 10 to 15 percent of total power use).
3. The operation of the grinding and flotation machinery at the concentrator complex at the West Plant Site (roughly 40 to 50 percent of total power use).
4. For Alternatives 5 and 6, pumping of tailings to the tailings storage facility (roughly 5 to 10 percent of total power use). Note that Alternatives 2 and 3 use gravity flow to deliver the tailings to the tailings storage facility, and do not require substantial power for tailings pumping.
5. For Alternative 4, filtering of tailings prior to placement (roughly 5 to 10 percent of total power use).

SRP would provide all electricity used at the mine facilities through the upgraded and new transmission lines. Figure 2.2.2-15 shows the proposed upgraded and new SRP transmission lines that would supply the main facilities with electricity. The Tonto National Forest would use analysis in this EIS to approve any rights-of-way and special use permits needed to construct the upgraded and new power lines.

Easements for the transmission lines would vary between 50 and 100 feet, depending on the size of the line and the requirements for construction, maintenance, and electrical clearances. Transmission lines would be either lattice steel towers or tubular steel poles. The foundations for the transmission line structures would be auger-drilled reinforced concrete piers. A lattice tower typically has four legs, each attached to a concrete foundation set into the ground. Steel pole structure footings are typically composed of a steel-reinforced concrete foundation referred to as an “anchor-bolt foundation,” onto which the steel pole is bolted.

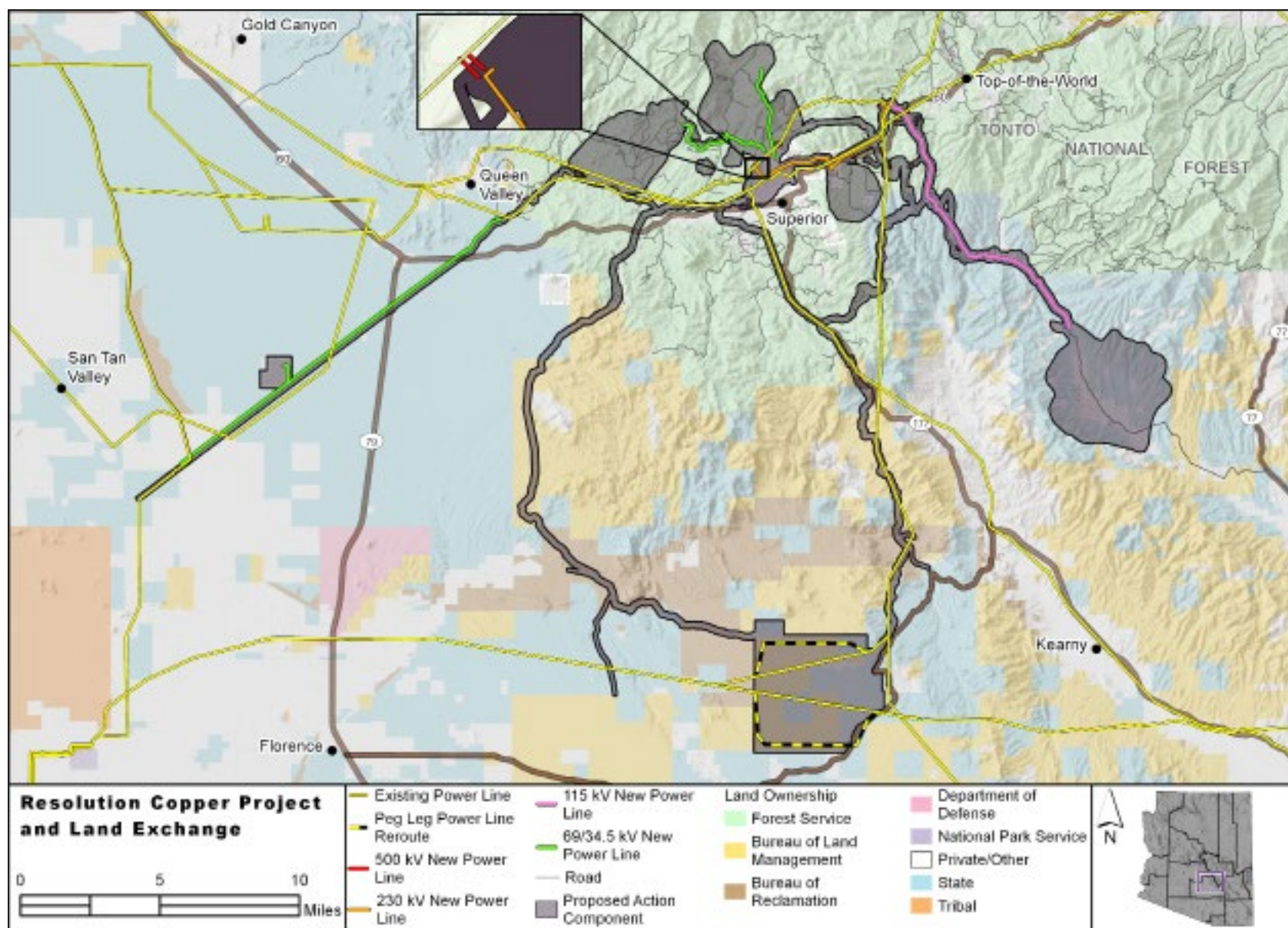


Figure 2.2.2-15. Proposed new and upgraded transmission lines

Table 2.2.2-5. Existing and proposed mine access roads and traffic

Facility	Access Routes	Construction Phase Materials and Equipment Traffic	Operation Phase Materials and Equipment Traffic	Closure and Post-closure Materials and Equipment Traffic
East Plant Site	Magma Mine Road from U.S. Route 60 (U.S. 60)	Materials deliveries would consist of fuel, underground concrete, underground production consumables, construction steel, other construction materials, and construction concrete. Major process equipment would be delivered over a 4-year period during the construction phase and would consist of crushers, conveyors, rail dump station, locomotives and railcars, ventilation equipment, hoisting equipment, dewatering equipment, and batch plants.	Materials deliveries would consist of fuel, underground concrete, and underground production consumables.	Salvageable equipment, unused chemical reagents, instrumentation, or other salvageable materials would be removed from site. Structures and other facilities would be demolished and/or dismantled and removed from site. Any contamination would be disposed of as appropriate. Replacement of growth media for revegetation would be delivered if not enough found within the footprint or stockpile.
West Plant Site	Main entrance: Rerouted Silver King Mine Road (NFS Road 229) from U.S. 60 Existing entrance: Magma Avenue from U.S. 60	Materials deliveries would consist of concrete, rebar, structural steel, handrails/stairs, prefabricated buildings, chutes/launders, tanks, pipe, electrical equipment, overhead transmission line, semi-autogenous grinding mills, ball mills, and flotation cells. These shipments would occur during a 3-year period within the construction phase.	Materials deliveries would consist of semi-autogenous mill balls, ball mill balls, regrind mill balls, lime, sodium hydrosulfide, and miscellaneous reagents. Molybdenum concentrate shipments would leave the site daily from the concentrator complex.	Same as East Plant Site
Tailings storage facility	From U.S. 60 at three locations: service road adjacent to tailings pipeline corridors, Hewitt Canyon Road (NFS Road 357), and NFS Road 8	Materials and equipment deliveries would consist of pipe, valves, concrete, asphalt, and structural steel. These shipments would occur during a 3-year period within the construction phase.	Material deliveries would primarily consist of equipment and replacement equipment to operate spigots, recycle barges and pumps, and seepage collection systems.	Same as East Plant Site
Filter plant and loadout facility	East Skyline Road; rail via MARRCO corridor	Materials and equipment deliveries would consist of pipe, valves, concrete, asphalt, and structural steel. These shipments would occur during a 3-year period within the construction phase.	Filtered copper concentrate would be loaded and shipped 7 miles along the MARRCO corridor by rail car to Magma Junction where the rail line meets the Union Pacific Railroad. Final smelter destination is unknown at this time.	Same as East Plant Site

Table 2.2.2-6. Proposed new and upgraded transmission line summary

Facility	Transmission Line Route	New Alignment or Upgrade	Approximate Distance
East Plant Site	230-kV line from Silver King substation to Oak Flat substation	Upgrade	3.6 miles
West Plant Site	230-kV line from West Plant Site substation to Oak Flat substation	New	3.5 miles
West Plant Site	Double-circuit 230-kV connection from West Plant Site substation to the existing 500-kV and 230-kV lines at the West Plant Site	New	0.5 mile
West Plant Site	500-kV line to West Plant Site substation	No change	N/A
Tailings storage facility	35-kV line from West Plant Site substation to tailings substation	New	5.6 miles
Filter plant and loadout facility	Two 69-kV power lines and one 12-kV power line from Abel substation (near CAP canal crossing of MARRCO corridor)	New (adjacent to MARRCO corridor)	4.7 miles

Table 2.2.2-6 identifies the main transmission lines that would provide power to each mining facility.

Wherever possible, existing roads would be used to construct the transmission facilities. In some areas, access roads would be cleared on an as-required basis to ensure adequate access for construction and maintenance activities. Staging areas immediately surrounding line structures would be necessary, depending on specific site access. Permanent access roads would be constructed along the transmission line alignments that are located in drivable terrain.

WATER USE

Recycling and reuse happen extensively throughout the mine operations, but there are generally three major external sources of water: dewatering from the East Plant Site, direct use of CAP water, and recovery of banked CAP water and/or groundwater from wells located along the MARRCO corridor.

The estimated total quantity of external water needed for the life of the mine (construction through closure and reclamation) varies between alternatives. Resolution Copper proposes to use water either directly from the CAP canal or through wells along the MARRCO corridor in the East Salt River Valley. The water pumped is either considered banked CAP water, or water authorized by the State of Arizona to be pumped under a mineral extraction withdrawal permit, or a Type II non-irrigation grandfathered right. Regardless of the authority for obtaining the water, the water is pumped from the same wells. Currently, Resolution Copper has acquired approximately 313,000 acre-feet of renewable long-term storage credits within the Phoenix and Pinal Active Management Areas (AMAs). These include credits for CAP water banked at the NMIDD, Hohokam Irrigation Drainage District, and Roosevelt Water Conservation District groundwater savings facilities, credits for CAP water directly recharged at the Tonopah Desert Recharge Project, and purchase of renewable long-term storage credits from the Gila River Water Storage LLC. Resolution Copper has also applied for an additional 2,238 acre-feet per year allocation of CAP Non-Indian Agricultural water from the U.S. Department of the Interior Bureau of Reclamation; this application is not yet approved.

Figure 2.2.2-16 shows the general water supply and water use for each of the main facilities during operations of Alternative 2 – Near West Proposed Action. The water balance for the various mine facilities is complicated and varies by alternative. Further detail is included in Appendix H, Further Details of Mine Water Balance and Use.

In order to construct mine infrastructure, Resolution Copper currently removes groundwater from sumps in Shafts 9 and 10, effectively dewatering the deep groundwater system (the bottom of Shaft #10 is

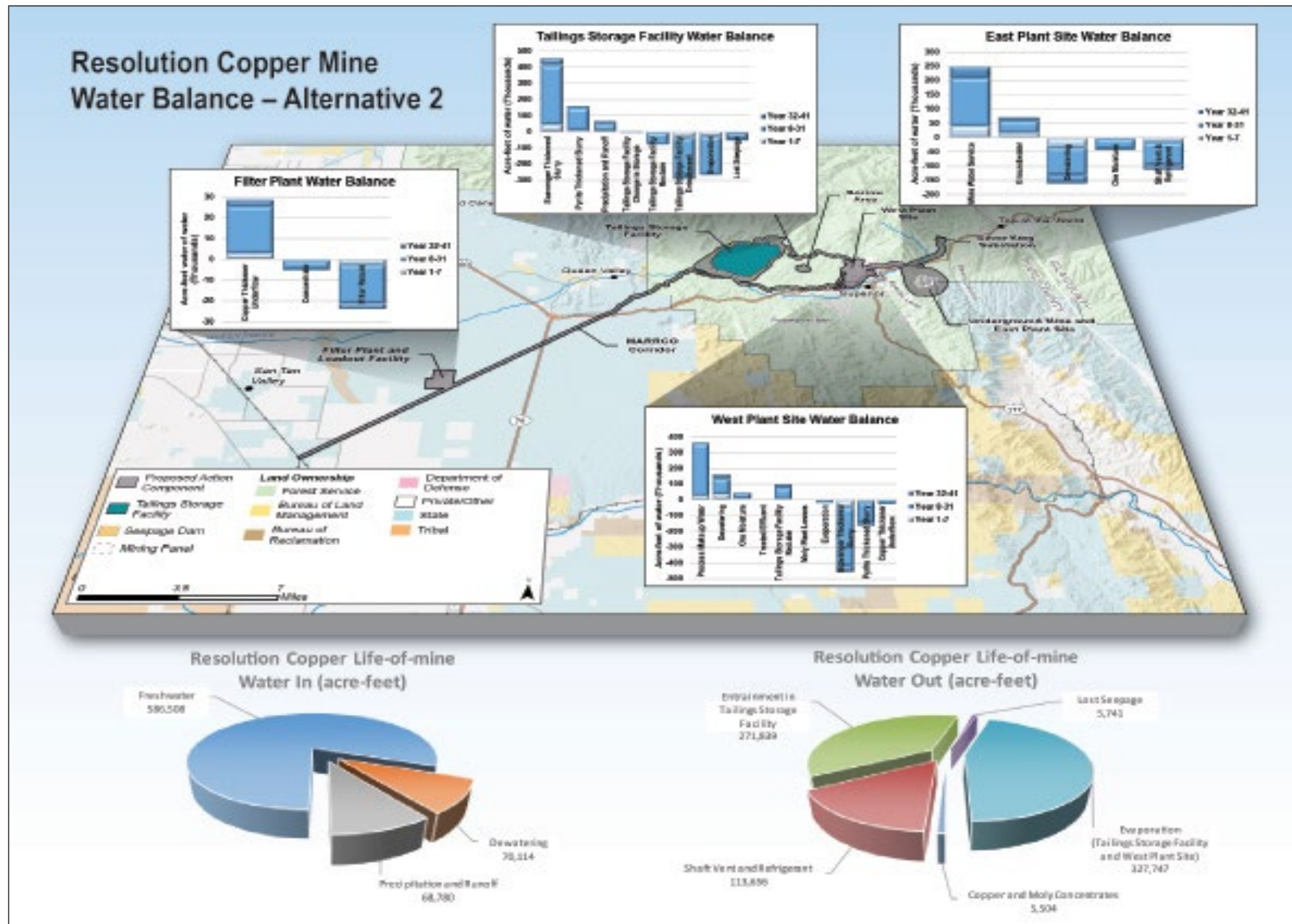


Figure 2.2.2-16. Alternative 2 – Near West Proposed Action water supply and water use diagram

about 7,000 feet below ground level). This dewatering started in 2009 and would continue throughout the mine life. When the mining begins, the block-cave zone would propagate toward the surface and effectively allow the effects of this dewatering to extend to more shallow aquifers as well.

SANITARY AND SOLID WASTE MANAGEMENT

New wastewater treatment plants would be constructed at both the East Plant Site and West Plant Site. Effluent from the East Plant Site wastewater treatment plant would be combined with the mine dewatering system, which would be delivered to the concentrator supply water pipeline for use in the concentrator.

Wastewater from the filter plant and loadout facility would be routed to an on-site septic tank and leach field. Septic solids would be removed and disposed of off-site as needed and in accordance with State laws.

Non-hazardous solid waste and special wastes (e.g., petroleum-contaminated soils) generated by any activities at the mine facilities would be disposed of in a manner consistent with applicable local, State, and Federal regulations. Resolution Copper drafted an environmental materials management plan that identifies the disposal method for each anticipated waste (Resolution Copper 2016b). Recycling programs currently used at the East Plant Site and West Plant Site would continue in an effort to reduce waste.

Waste is currently being disposed of and would continue to be disposed of in the following ways:

- Asbestos- and petroleum-contaminated soils waste streams would be managed in accordance with waste-handling protocols and disposed of at an approved waste facility.
- All trash and garbage would be hauled to State-approved landfills. Trash and garbage would be collected on-site in

containers before being removed for disposal at permitted landfills. No open burning of garbage and refuse would occur at the project site.

- Wood and inert wastes such as concrete would be buried on-site as part of final closure and reclamation in selected areas in accordance with applicable county, State, and Federal regulations.

Closure and Reclamation

The closure and reclamation phase would occur after the 40-year operations phase and would have a duration of approximately 5 to 10 years.¹⁶ A specific time frame for the closure and reclamation phase would not be known until after a final GPO is submitted to the Tonto National Forest and approved. The GPO describes the preliminary closure and reclamation plans that would occur at each of the main facilities and the linear features that connect them, as summarized in this section and within the GPO. The primary goals of reclamation are to

- stabilize areas of surface disturbance;
- prepare those areas for a post-mining land use that is compatible with surrounding uses; and
- ensure long-term protection of the surrounding land, water, and air resources

General Reclamation Procedures and Schedule

Although closure and reclamation would be a distinct phase after the operations phase during which the majority of the reclamation efforts would occur, the proposed action would employ three schedules of

16. Note that the time required for reclamation is heavily dependent on the methods used to construct and manage the tailings storage facility, and therefore reclamation timing varies substantially between alternatives.

reclamation throughout the life of the mine: interim, concurrent, and final reclamation.

INTERIM RECLAMATION

Interim reclamation would be completed on disturbed areas that are not needed, at the time, for active operations. The three main periods of interim reclamation are as follows: after construction, following startup, and during operations. The principal focus of interim reclamation would be to reduce erosion and sedimentation. Interim reclamation would include activities like the reclamation of road or pad cuts and fills and tailings surfaces (e.g., temporary covers, vegetation, or polymers to control wind and water erosion, thus limiting dust). Interim reclamation would allow temporary stabilization of certain sites, such as the tailings storage facilities during operations, for temporary dust control.

Other areas that would be subject to interim reclamation would include construction laydown areas, growth media stockpiles, development rock stockpiles designated for processing through the concentrator, and development rock stockpiles salvaged for beneficial use. Areas would also include access roads used for construction but no longer needed during operations. Additionally, the slope of the tailings storage facility might receive temporary reclamation for dust control measures in advance of concurrent reclamation.

Interim shutdown would include the suspension of mining, production, or other operations, or placing the facility into standby status. Interim shutdown is not anticipated based on the mining method used with all alternatives analyzed in the DEIS. It is unlikely Resolution Copper would have to suspend operations for purely economic reasons during the 10-year ramp-up period or the following 20 years of full production, since the project incurs most capital costs prior to mining and during construction and ramp-up of operations. If interim shutdown were to occur, personnel and processes to ensure compliance with permits and regulations, along with protecting infrastructure, would continue.

In the event of a shutdown, the following activities would still occur:

- Measures to stabilize excavations and workings with inspections and maintenance,
- Measures to maintain the general project area in a safe condition in compliance with MSHA safety regulations,
- Measures to manage regulated materials (hazardous materials) in accordance with applicable requirements,
- Measures to maintain access and utilities would continue to function, and
- Plans for managing water systems and maintaining facilities as required by the Stormwater Pollution Prevention Plan (SWPPP), Aquifer Protection Permit (APP), and Arizona Pollutant Discharge Elimination System (AZPDES). Dewatering and treatment of water from the mine infrastructure would continue, and the water would be discharged.

CONCURRENT RECLAMATION

Reclamation completed during operations is termed concurrent reclamation. Concurrent reclamation differs from interim reclamation in that this reclamation is designed to provide permanent achievement of reclamation goals and performance standards. Resolution Copper would implement concurrent reclamation of the outer slopes of the tailings storage facility, where practicable, as the operation progresses.

FINAL RECLAMATION

Final reclamation efforts would occur for a duration of 5 to 10 years after the operations phase. The general steps to be used in reclaiming disturbed areas at the mine are

- decommissioning facilities,
- removing and/or closing structures and facilities,
- recontouring and regrading,

- replacing growth media (i.e., store and release cover design for tailings), and
- seeding and/or direct seedling plantings where appropriate.

The final reclamation efforts that would occur at each of the main facilities are described in the following text.

EAST PLANT SITE CLOSURE AND RECLAMATION

Reclamation at the East Plant Site would consist of salvaging and demolishing all buildings, except for the headframes and hoists, which would be used for post-closure groundwater monitoring. All salvageable and non-salvageable materials would be disposed of off-site. All disturbed surfaces except those needed for long-term monitoring, including paved and graveled areas, would be regraded and reseeded with appropriate local seed mixes. Contact water basins would be closed in accordance with APP requirements. Shaft collars and subcollars would be permanently sealed by an engineered seal.

Reclamation activities would not occur within the subsidence area. There would be a berm and/or fence constructed around the perimeter of the continuous subsidence area. To the extent practicable, surface water diversions would be constructed to divert stormwater away from the subsidence area and into natural drainages.

During operations, the potential for adverse water quality in the panel caving area involves many factors, due to the potential exposure of mine rock to both oxygen and water; water quality concerns during operations are explored in section 3.7.2. After completion of mining, the underground panel caving area would not be expected to be a continuing source of adverse groundwater quality. There would be a thick overlying layer of rock above the panel caving area, and this rock is generally inert or acid neutralizing (over 80 percent of the samples analyzed of Apache Leap Tuff are non-acid generating; see section 3.7.2). Water percolating through the overlying rock would help neutralize acidity in remaining

non-economic rock in the panel caving area. Rising groundwater levels would eventually flood the panel caving area completely, isolating it from oxygen and controlling further chemical weathering.

WEST PLANT SITE CLOSURE AND RECLAMATION

The West Plant Site facilities would be decommissioned, and the land surfaces would be contoured and graded as necessary to blend into the surrounding topography and terrain and reseeded with appropriate local species seed mixes. The post-closure grading plans for the West Plant Site include the following:

- All fill slopes would be laid back to a maximum of 2.5:1.
- The West Diversion Channel, the East Stormwater Channel, and an on-site channel would remain in place to route flow through a new diversion channel to the Apex Tunnel to existing drainages (e.g., Silver King Wash).
- The process water pond located at the western portion of the West Plant Site would be closed in accordance with APP conditions.
- Contact water basins would be closed in accordance with APP requirements.
- The emergency overflow ditch from Contact Water Basin W1 would remain in place.
- Non-contact water basins would be graded to drain.

Roads that are necessary to support the reclamation and closure efforts would remain to provide access to monitoring stations and remediation areas. All other roads would be reclaimed. All buildings would be salvaged or demolished, and all materials would be disposed of off-site. All portals, ventilation shafts, and tunnel entrances would be decommissioned, capped, and reclaimed at the surface.

TAILINGS STORAGE FACILITY CLOSURE AND RECLAMATION

Closure details differ for each tailings alternative primarily with respect to the length of time needed for closure and with respect to the method for long-term management of seepage. The overall closure process is similar for all tailings facilities. The recycled water ponds on the slurry tailings facilities would gradually be reduced in size as closure occurs, and the PAG tailings would be covered with a layer of NPAG tailings with timing dependent on the surface being dry enough to allow equipment access for reclamation. The seepage and runoff collection ponds generally would remain in place and would not be decommissioned until seepage water quality meets standards for release. Until that time, the ponds primarily would be used to evaporate seepage. Any excess draindown not evaporated from the seepage ponds would require active management. Active management could include pumping to another location, increasing evaporation using spray evaporators, or releasing water to the environment after appropriate treatment. The final method of post-closure management for seepage collection water would be determined as the project progresses through the NEPA process and engineering design. The final post-closure management plan would be based on overall expected volumes, anticipated seepage rates, and duration, in combination with the water chemistry assessment.

Additional final reclamation activities at the tailings would include contouring the tailings, installing riprap and erosion controls, covering the tailings with a combined armor protection (rock) and growth medium as an exterior shell, and revegetating the embankments and top of the covered tailings with a Forest Service–approved seed mix. The minimum depth of the exterior shell on the embankments would be 1.5 feet and would be thicker in areas where erosion protection would be required. Materials used for the exterior shell would be sourced from borrow pits and salvaged soil. The area within the tailing storage facility footprint would be used as a source, as well as an approximately 90-acre parcel 1 mile east of the tailings storage facility and 1.5 miles west of the West Plant Site. Any borrow area not underneath the tailings storage facility that is used for the shell would ultimately be recontoured and revegetated using a Forest Service–approved seed mix.

A perimeter fence or berm would be constructed around the tailings storage facility to prevent access. Some surface water diversion structures would be revegetated to control water and wind erosion, while others would be reconfigured to carry water along topography through and off the site. The diversion structures that would stay in perpetuity would be reconstructed with riprap to minimize erosion. All buildings, including foundations, at the tailings storage facility would be salvaged or demolished, and all salvage materials and demolition debris would be disposed of properly off-site. Roads that would not be required for closure and reclamation activities would be decommissioned, recontoured, and revegetated. All piping and electrical infrastructure connecting the tailings storage facility to the West Plant Site would be removed, leaving only the road and berms.

FILTER PLANT AND LOADOUT FACILITY AND MARRCO CORRIDOR CLOSURE AND RECLAMATION

All buildings, including building foundations, at the filter plant and loadout facility would be salvaged or demolished, and the salvaged material and demolition debris would be disposed of properly off-site. Tanks and ponds would be closed and reclaimed in accordance with APP and AZPDES permit requirements. All disturbed areas would be regraded with the exception of the diversion channel on the north side of the facility that routes surface water flows around the site to existing drainages.

The closure and reclamation of the MARRCO line is undetermined because the intended post-closure use of the railroad and utility lines is not known. Resolution Copper does not foresee a use of the railroad or utility lines for project reclamation or post-closure use, but another entity might buy the facilities and continue use. The concentrate lines, however, would be removed from the MARRCO corridor, and direct surface disturbance areas would be recontoured and revegetated to the extent possible with adjacent utilities. Bridge structures would be assessed and either removed or upgraded.

WATER SUPPLY FACILITIES AND PIPELINES CLOSURE AND RECLAMATION

Facilities associated with fresh water supply and distribution, such as pipelines, pump stations, and water tanks, may have a post-mining use and may be transferred to a third-party utility or community to provide water transport to the Superior Basin. No closure or reclamation activities would occur at these facilities if they were to be transferred to a third party.

Facilities that would not have a post-mining use include the tailings slurry lines, concentrate pipelines, and associated pump station with electrical power. These facilities would all be decommissioned and removed. Buried and aboveground pipelines would be removed and scrapped or salvaged. All disturbed areas would be recontoured and reseeded.

POWER TRANSMISSION FACILITIES CLOSURE AND RECLAMATION

Power transmission facilities, which include electrical substations, transmission lines, and power centers, may be removed as part of the reclamation program, unless a post-mining use is identified. SRP would continue to own the power lines and may have a post-mining use for ongoing power transmission in the area.

RECLAMATION FINANCIAL ASSURANCE

Resolution Copper would be required to establish and maintain sufficient financial assurance in accordance with requirements from the Forest Service, ASLD, BLM, the APP program, and the Arizona Mined Land Reclamation Act. The purpose of financial assurance is to ensure that responsible agencies would be able to continue any remaining reclamation activities if Resolution Copper becomes unable to meet reclamation and closure and post-closure obligations under the terms and conditions of the applicable permits and approvals. Under the Arizona Mined Land Reclamation Act, the Arizona State Mine Inspector would receive financial assurance for reclamation and closure

activities required on private lands, the Forest Service would receive financial assurance for reclamation and closure activities on lands managed by the Forest Service previously described in section 1.5.5, and BLM would receive financial assurance for reclamation and closure activities on BLM-managed lands. The APP program would receive financial assurance for reclamation and closure activities for facilities that have the potential to discharge water into the groundwater (tailings storage facility, process ponds, and stormwater ponds), regardless of the facility's location on private or NFS lands.

The cost estimates for the reclamation financial assurances are based on the final design of the facility, would be developed after the NEPA process, and would not be finalized until the final GPO is approved.

The release of all or a part of the reclamation performance bond would only be made by the appropriate agencies after Resolution Copper's request has been reviewed for completeness and on-the-ground compliance with the predetermined release criteria and monitoring data, and after representatives of the agencies have conducted field and data examinations to ensure that reclamation activities have been implemented. Additional information on post-closure financial assurances can be found in section 1.5.5 and in several resource sections of chapter 3, including sections 3.3 (Soils and Vegetation), 3.7.2 (Groundwater and Surface Water Quality), and 3.10.1 (Tailings and Pipeline Safety).

2.2.3 Alternative 1 – No Action Alternative

Under the no action alternative, current management plans would continue to guide management of the project area. The Forest Service would not approve the GPO, none of the activities in the final GPO would be implemented on NFS lands, and the mineral deposit would not be developed. However, note that certain activities are currently taking place on Resolution Copper private property, such as reclamation of the historic Magma Mine; exploration; monitoring of historic mining facilities such as tailings under existing State programs and permits; maintenance of existing shaft infrastructure, including dewatering;

and water treatment and piping of treated water along the MARRCO corridor to farmers for beneficial use. These types of activities would be expected to continue, regardless of approval of the GPO. These activities are therefore assumed to occur in the no action alternative (Garrett 2018c).

This alternative is required by regulation (40 CFR 1502.14(d)). The nature of the no action alternative was described in the NOI issued for the project in March 2016. The NOI also indicated this alternative cannot be selected by the Forest Service but serves as a point of comparison for the proposed action and action alternatives.

The no action alternative includes the following:

- The final GPO would not be approved, thus, none of the activities in the final GPO would be implemented, and the mineral deposit would not be developed;
- The land exchange would not take place;
- Certain ongoing activities on Resolution Copper private land, such as reclamation of the historic Magma Mine, exploration, monitoring of historic mining facilities such as tailings under existing State programs and permits, maintenance of existing shaft infrastructure, including dewatering, and water treatment and piping of treated water along the MARRCO corridor to farmers for beneficial use, would continue regardless of GPO approval;
- Ongoing trends not related to the proposed project would continue, such as population growth, ongoing impacts on air quality from fugitive dust and vehicle emissions, human-caused fires from recreation, ranching, and a corresponding increase in use of public lands; and
- No agency land and resource management plans would be amended for this project.

2.2.3.1 Need for Inclusion of Land Exchange in Document

Section 3003 of the NDAA directs the Forest Service to prepare a single EIS prior to the final execution of the land exchange to serve as the basis for all Federal decisions related to the proposed mine. The proposed action and action alternatives analyzed in detail in chapter 3 therefore assume that the land exchange would occur as directed by Congress; for this reason, it is included as a component common to all action alternatives (see section 2.2.2.1).

However, even though directed by Congress, the land exchange remains a discretionary decision on the part of Resolution Copper, which may or may not choose to undertake the exchange after receipt of the appraised value. It is possible that mining under the proposed action or action alternatives could also take place without the land exchange occurring. The single EIS must therefore allow for a comparison of potential impacts of mining that occurs on land remaining in Federal ownership with potential impacts that would occur following the land exchange. Whether the land exchange occurs or not, the mine would be developed in accordance with the Federal, State, and local laws governing mining operations. However, these laws could differ, depending on whether or not a land exchange occurred.

The no action alternative provides one baseline against which the proposed action and action alternatives may be compared. The no action alternative assumes no land exchange and no Forest Service approval of a GPO. This baseline allows a direct comparison of the effects of most of the mining impacts that would occur from the proposed action and action alternatives. However, the no action alternative is not sufficient to fully analyze the effects of the exchange of the selected lands.

Two other combinations of no action were considered during analysis:

- A fully executed land exchange, but no approval of the GPO; or

- The land exchange would not occur, Oak Flat would stay in Federal management, and the GPO would be approved with the mining taking place on public land.

The first combination was not carried forward as the Forest Service is unable to refuse approval of the GPO within their regulations and guidance. The second combination was considered because the land exchange is a discretionary action on the part of Resolution Copper. Therefore, an analysis was completed that compared the regulatory framework of mining activity on lands remaining in Federal ownership with the regulatory framework on lands being transferred to private ownership (appendix I). This provides the comparison of no land exchange, but approval of the mining plan of operations. See section 2.4 for more details. The effects of the land exchange are also assessed individually in each resource section of chapter 3.

2.2.4 Alternative 2 – Near West Proposed Action – Mine Plan Components

Alternative 2 – Near West Proposed Action would include approximately 9,789 acres of disturbance, of which 7,195 acres is NFS, 314 acres is ASLD managed, and 2,280 acres is private land.

Based on comments heard in scoping, in February 2018, Resolution Copper formally notified the Tonto National Forest that the company was revising its proposed action in the May 2016 version of the GPO and replacing the plan for an upstream-type tailings embankment at the GPO location with a modified centerline design, which would provide greater overall stability and a more robust design. This change was in response to public scoping comments and supported by internal engineering discussions at Resolution Copper. The revised centerline tailings embankment configuration is described in greater detail in section 2.2.4.2.

This followed Resolution Copper's July 2017 decision to relocate the process pond. The process pond was moved from NFS lands to private property at the West Plant Site to minimize adverse impacts on NFS

surface resources. The process pond is further described in Appendix G, Further Details of East Plant Site, West Plant Site, MARRCO Corridor, and Filter Plant and Loadout Facility Infrastructure.

2.2.4.1 Water Use

This alternative is estimated to need about 590,000 acre-feet of groundwater pumped from the Desert Wellfield through the life of the mine (see appendix H).

2.2.4.2 Tailings Storage Facility and Tailings Pipeline Corridor

Approximately 1.37 billion tons of tailings produced by the mining operation would require storage in perpetuity. The proposed tailings storage facility location, as identified in the GPO, is on lands managed by the Tonto National Forest. The facility would be approximately 3 miles west of the West Plant Site (figure 2.2.4-1).

The GPO proposes a thickened tailings process. Thickening tailings involves the mechanical process of removing some water from the tailings slurry. Thickened tailings can have a solid content ranging from 50 to 70 percent, depending on the degree of thickening. Thickened tailings can be piped to a tailings storage facility and, because they are still a liquid, require storage in an impoundment contained by an embankment. The GPO indicates that the tailings slurry would be thickened to a solids content of approximately 50 to 65 percent for deposition in the impoundment. Overtime the tailings within the impoundment would settle and consolidate to a greater solids content.

NPAG and PAG tailings would be transported in the form of a thickened slurry from the concentrator complex at the West Plant Site to the tailings storage facility via two separate pipelines. To reduce potential water quality issues, PAG tailings would be placed using subaqueous deposition in such a way that they are kept saturated. This limits oxygen from interacting with the sulfides in the PAG tailings, minimizing and preventing water quality problems (e.g., acid rock drainage). The NPAG

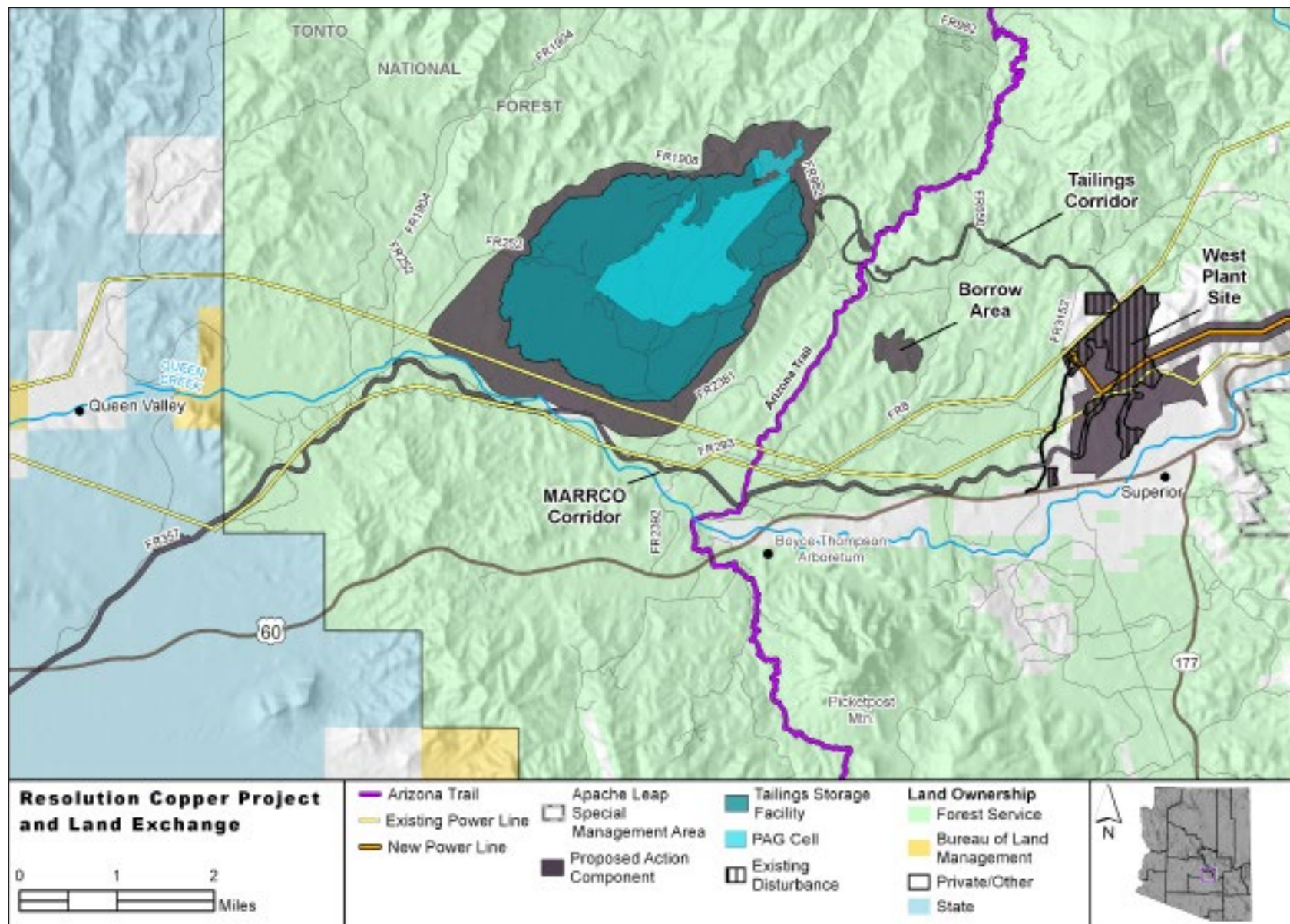


Figure 2.2.4-1. Overview of Alternative 2 – Near West Proposed Action tailings storage facility

would be deposited in a way that would eventually encapsulate the PAG tailings, allowing NPAG tailings to act as a buffer between PAG tailings and areas outside the tailings storage facility.

The modified proposed action tailings facility, Alternative 2 – Near West Proposed Action, would be constructed using a modified centerline embankment design rather than an upstream embankment, as Resolution Copper originally proposed in its GPO submitted to the Tonto National Forest on May 9, 2016. The GPO as amended responds to issues of public health and safety, as a modified centerline type embankment is considered more resilient than an upstream embankment, with less risk of failure. The modified centerline embankment would be constructed from compacted and free-draining cyclone tailings sand and earthen fill. NPAG tailings are processed through hydrocyclones¹⁷ to produce a coarse particle tailings stream (cyclone sand used for construction) and a finer particle tailings stream. The larger tailings particles would drain water freely and would be mechanically compacted during embankment construction to further increase the stability of the embankment. The finer materials would be deposited into the interior of the tailings facility, where they would provide a low-permeability zone between the PAG tailings and the higher permeability perimeter embankment. As the tailings storage facility grows over time, the embankment would progressively be elevated to contain the tailings. A general schematic of the modified centerline design is shown in figure 2.2.4-2. Resolution Copper currently is proposing an overall 4H:1V slope design for the embankment.

Portions of the embankment may be modified to a 3H:1V design to

- reduce the overall amount of cycloned sands required, and
- facilitate an earlier start to concurrent reclamation activities on the embankment (at approximately mine life year 22 vs. year 28 for the 4H:1V design).¹⁸

Auxiliary facilities within the tailings storage facility would include a perimeter fence, private roads, borrow areas, soil stockpile areas, seepage control facilities, diversion channels and seepage containment ponds, groundwater monitoring wells, an office, and an equipment maintenance facility (figure 2.2.4-3).

The tailings facility would include a recycling system and a seepage containment system and stormwater diversions to control tailings seepage and surface runoff. All slurry tailings facilities have a pond on the surface known as the “recycled water pond.” The water collected in the recycled water pond would be recycled and pumped to the mill for reuse in ore processing via an aboveground pipe within the tailings conveyance corridor.

While water is recycled through the recycled water pond, some water also remains within the tailings void space and most of this water would eventually either drain downward or remain entrained within the tailings. The seepage and stormwater containment system would consist of engineered low-permeability layers, cutoff walls, grout curtains, diversion channels, and internal drains directing seepage and runoff to 11 planned downstream collection ponds. The NPAG embankment would contain an underdrain system comprising sand and gravel blanket and finger drains (primarily along main drainages, with some extended beneath the tailings beach) to maintain a low water level in the tailings embankment and to intercept and direct seepage from the impoundment to the downstream seepage collection system ponds.

During facility development, a PAG tailings starter cell would be constructed to maintain pyrite tailings saturation throughout the process and to limit seepage. This would include construction of a separate, earthfill starter dam to contain the initial PAG deposits; this starter dam would be constructed for the first 9 years of PAG tailings and would be lined with an engineered low-permeability layer. A combination of additional seepage collection design features would be implemented

17. Hydrocyclone is a device to classify, separate, or sort particles in a liquid suspension based on particle size and particle density.

18. The specific preferred design may be determined during the NEPA process or may be optimized if and when Alternative 2 becomes the selected alternative in the ROD.

Tailings Embankment Types

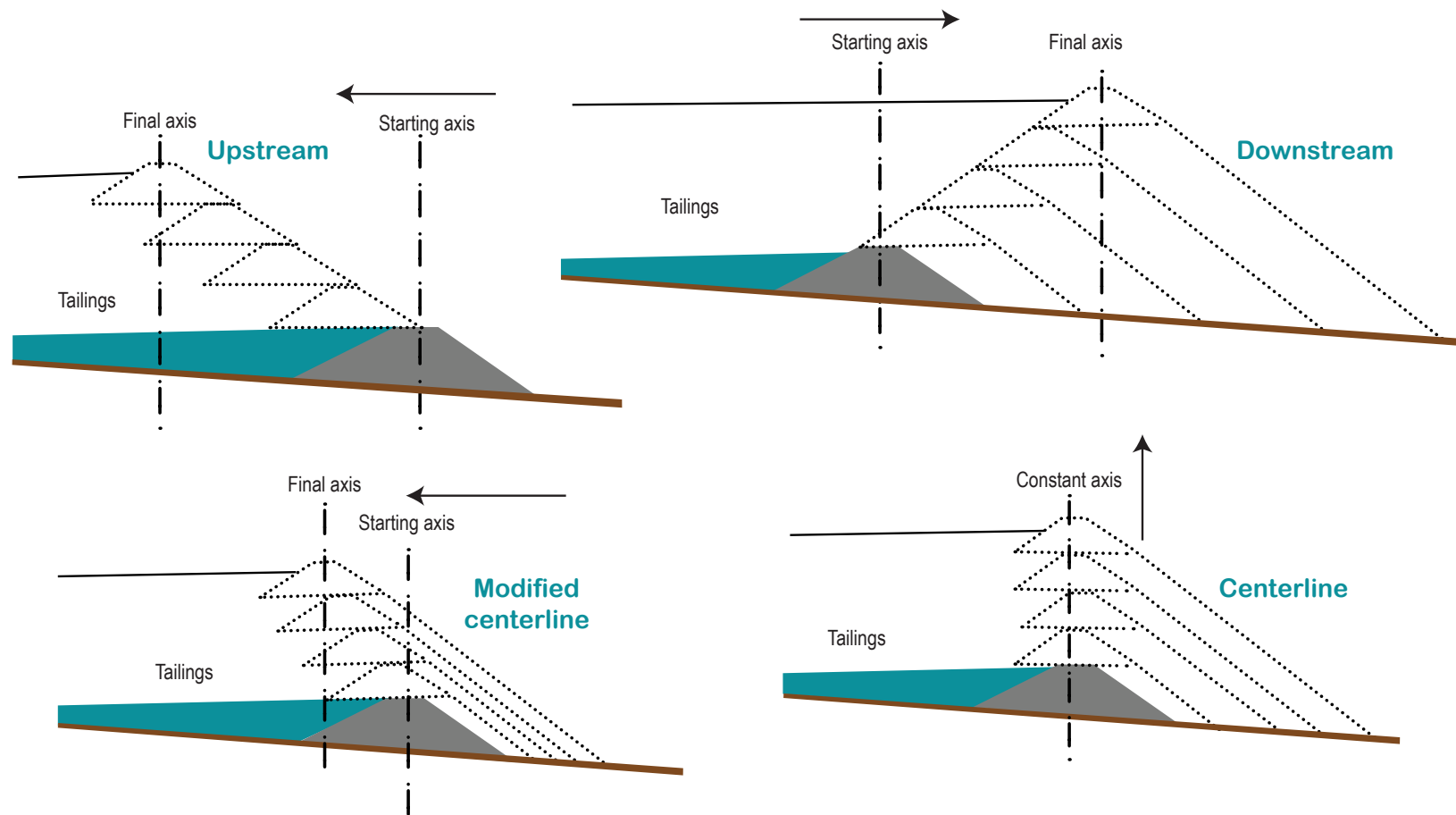


Figure 2.2.4-2. Diagram illustrating various embankment designs

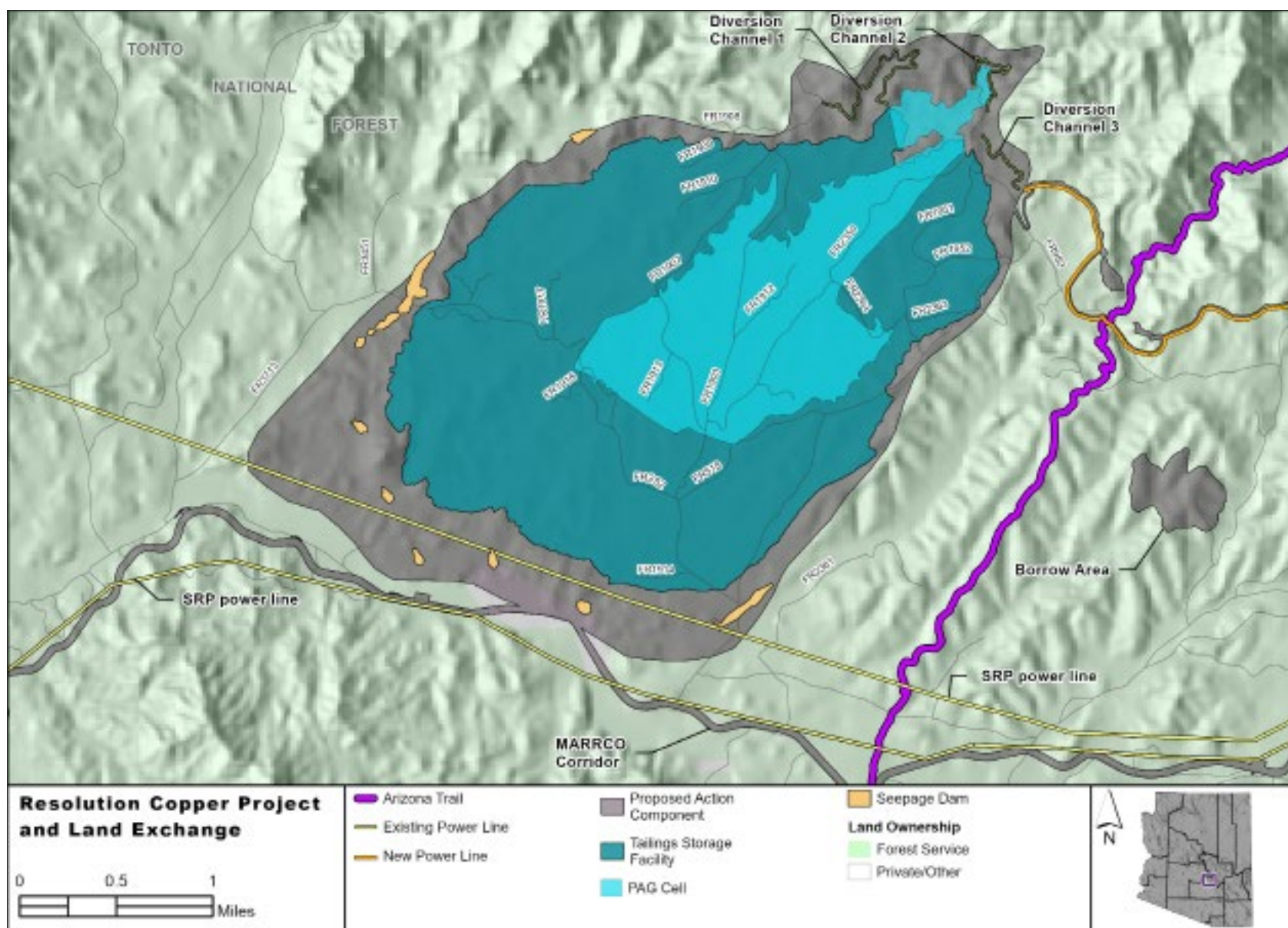


Figure 2.2.4-3. Alternative 2 – Near West Proposed Action tailings storage facility detailed layout

to limit seepage; these may include additional selective placement of engineered low-permeability layers, additional seepage collection dams, lined seepage collection ponds, pumpback systems, and refined stormwater control systems. The exact selection and placement of these features is, at present, still being optimized and would be finalized toward the end of the environmental impact assessment process.¹⁹

A 34.5-kV tailings substation would be constructed near the offices and maintenance facilities and would receive electricity via a 34.5-kV transmission line from the West Plant Site substation.

The GPO identified four borrow areas, all located on NFS lands, that have been targeted for different borrow requirements (i.e., earthfill material for the starter dams and embankments, gravel for blanket underdrains, riprap for erosion control, and soil cover for reclamation). Three of these borrow areas were within the tailings storage facility, and one is located outside the tailings storage facility footprint (see figure 2.2.4-1). However, Resolution Copper recently determined that borrow areas within the proposed tailings footprint would provide adequate volumes of earthfill material.

If needed, material processing plants would be mobile and move to locations within the tailings footprint where borrow material is needed. Borrow material would be used for concurrent reclamation of the tailings storage facility.

The tailings storage facility would be accessible at three locations:

- via a service road adjacent to the tailings pipeline corridor,
- from Hewitt Canyon Road (NFS Road 357), and

- from NFS Road 8.

During tailings storage facility construction, Hewitt Canyon Road and NFS Road 8 would be used by mine construction vehicles/equipment and provide emergency access. Several existing NFS roads within the proposed tailings storage facility would be removed from public access (see the “Transportation and Access” resource section in chapter 3). Several of these NFS roads would be reconstructed to provide access for mine equipment. A separate service road would be constructed around the periphery of the tailings storage facility for access to power distribution, seepage collection ponds, and pumps.

Throughout construction of the tailings facilities, sand and gravels at the tailings site facility would be salvaged and stored at a soil salvage yard for use during construction of the tailings facility and reclamation of the tailings facilities. Upon closure in mine year 46, the total footprint of the tailings storage facility would be approximately 4,909 acres. The tailings structure would be a four-sided perimeter embankment dam with an ultimate crest elevation of 2,751 feet above mean sea level (amsl). Maximum embankment height would be on the southern embankment at approximately 520 feet, with a 4:1 exterior slope angle.

Table 2.2.4-1 summarizes the components of the proposed action tailings storage facility.

2.2.4.3 Closure and Reclamation

The closure and reclamation phase would occur after the 40-year operations phase and would have a duration of approximately 5 to 10

19. The technical documents prepared by Resolution Copper describe a phased approach to seepage control. Level 1 seepage control consists of foundation treatments and barrier layers built into the facility and the 11 initial seepage collection ponds downstream. Level 1 seepage controls would be installed as part of the initial construction. Level 2, 3, and 4 seepage controls were considered in the design to further control seepage. Some of these controls would have to be built into the facility from the start (such as any low-permeability liners), while others would be implemented if real-world observations during operations indicate that seepage controls are not operating as anticipated. The seepage analysis in section 3.7.2 contains further descriptions of these controls and how they were incorporated into the analysis (Klohn Crippen Berger Ltd. 2019d).

Table 2.2.4-1. Summary of Alternative 2 – Near West Proposed Action tailings storage facility

Tailings Storage Facility	Description
Location	3 miles west of the West Plant Site, north of Hewitt Canyon Road (NFS Road 357)
Land ownership	Forest Service
Distance from West Plant Site	3 miles
Tailings type and disposal	Thickened slurry tailings placed subaqueously for PAG tailings from barge, NPAG placed hydraulically from perimeter At disposal, PAG tailings would be 50% solids content; thickened cyclone overflow (NPAG) would be 50% solids content; and NPAG sent directly from the mill would be 65% solids content. See figure 2.2.2-10 for more information on tailings solids content range.
Tailings embankment	Cycloned tailings and earthen starter dam, raised with compacted cyclone sand in a modified centerline construction approach with a 4H:1V slope
Lining and other seepage controls	Engineered, low-permeability layers would be installed prior to start-up. These would be located within the PAG cell starter dam facility and in areas where the foundation may have high permeability. Seepage from the tailings would be recovered in 11 seepage collection ponds downstream of the embankment. The seepage and stormwater collected at the collection ponds would be managed during operations for use in the process water system. Finger and blanket drains would underlie the embankment and part of the NPAG tailings.
Approximate size at fence line of tailings storage facility	4,909 acres
Approximate embankment height	521 feet
Tailings pipelines / conveyance	Thickened slurry pumped in two streams (PAG and NPAG) to the tailings storage facility and recycled water pipeline to return water to processing loop at West Plant Site 5.33 miles of corridor from West Plant Site to tailings storage facility
Auxiliary facilities	Two clusters of 26 cyclones, two high-density thickeners Upstream surface water north, west, and east of the tailings storage facility would be diverted to the extent possible around the facility through constructed diversion channels. This non-contact water would be diverted downstream to Queen Creek.
Other design considerations	The Arizona National Scenic Trail would need to be crossed by the slurry pipeline corridor and associated access road, but not rerouted. 8 miles of NFS roads are expected to be decommissioned or lost.
Closure and reclamation	Concurrent reclamation of tailings facility beginning approximately at mine year 22 or at mine year 28, depending on final slope design, would occur on the modified centerline tailings embankment. Closure of the tailings recycled water pond is estimated to take up to 25 years after the end of operations. Until that time, excess seepage in seepage ponds would be pumped back to the recycled water pond, and reclamation would take place on the embankment and tailings beaches. After the recycled water pond is closed, seepage ponds would be enlarged to allow adequate evaporation of seepage, and the remaining reclamation of the tailings would occur.

years.²⁰ A specific time frame for the closure and reclamation phase would not be known until after a final GPO is submitted to the Tonto National Forest and approved. The GPO describes the preliminary closure and reclamation plans that would occur at each of the main facilities and the linear features that connect them, as summarized in this chapter. The primary goals of reclamation are to

- stabilize areas of surface disturbance;
- prepare those areas for a post-mining land use that is compatible with surrounding uses; and
- ensure long-term protection of the surrounding land, water, and air resources.

General Reclamation Procedures and Schedule

Although closure and reclamation would be a distinct phase after the operations phase during which the majority of the reclamation efforts would occur, the proposed action would employ three schedules of reclamation throughout the life of the mine: interim, concurrent, and final reclamation. Interim and concurrent would be the same as described in Section 2.2.2.2, General Plan of Operations Components.

FINAL RECLAMATION

Final reclamation efforts would occur for a duration of 5 to 10 years after the operations phase as described in Section 2.2.2.2, General Plan of Operations Components.

The final reclamation efforts that would occur at each of the main facilities are described next.

TAILINGS STORAGE FACILITY CLOSURE AND RECLAMATION

In the final years of operations, tailings would be deposited to promote surface water runoff to the north, where runoff would be directed downstream, diverting around the seepage collection ponds, and surfaces throughout the facility would be reshaped as necessary to eliminate any potential for standing water.

A layer of NPAG tailings would be deposited over the PAG tailings as the recycled water pond disappears, in order to continue to isolate the PAG tailings from oxygen. During this time, the embankment and dry tailings beach areas would be reclaimed, with the PAG tailings with the NPAG cover being reclaimed last and covered by a 1- to 2-foot layer of low-permeability, erosion-resistant soil (e.g., Gila conglomerate or equivalent soil, sand, and gravel mix) and revegetated. The timing of reclamation is dependent on the surface being dry enough to allow equipment access for reclamation.

Estimated seepage rates suggest passive closure of the tailings facility may be difficult, and active management may be required up to 100 years after the end of operations. Up to 25 years after closure, excess seepage would be pumped back to the recycled water pond. After 25 years, the recycled water pond is closed, and the seepage ponds would be enlarged to allow for more evaporation. Any excess seepage beyond the evaporation capacity of the seepage collection ponds would need to be actively treated. The sludge containing concentrated metals and salts from evaporation would require cleanup and handling as a solid or hazardous waste.

20. Note that the time required to achieve final reclamation is dependent on how long it takes for the tailings to drain and become accessible, as well as how long seepage from the tailings facility is required to be actively managed. Therefore, reclamation timing varies between alternatives.

2.2.5 Alternative 3 – Near West – Ultrathickened

Alternative 3 – Near West – Ultrathickened would include approximately 9,789 acres of disturbance, of which 7,195 acres is NFS, 314 acres is ASLD managed, and 2,280 acres is private land.

Alternative 3 is a modification of the tailings facility but remaining in the same location as Alternative 2. Alternative 3 was developed to respond to issues of public health and safety and groundwater quality. It addresses these issues by changing the techniques used in the tailings storage facility to reduce potential for seepage and exposure of PAG tailings. This action alternative would not change any plan components described under the proposed action, except for those associated with the tailings storage facility and tailings disposal. East Plant Site infrastructure, panel cave mining, West Plant Site ore processing, slurry copper concentrate delivery to the filter plant, and other utility corridors would remain identical to the proposed action (figure 2.2.5-1).

Alternative modifications to the proposed GPO tailings facility (figure 2.2.5-2) include the following:

- construction of two separate cells within the tailings facility: one for the NPAG and one for PAG tailings (PAG tailings would be kept saturated to prevent oxidation), separated by an internal splitter berm, in order to better control water quality concerns associated with PAG tailings (see figure 2.2.2-12);
- inclusion of engineered low-permeability layers in the PAG tailings cell to limit seepage and maintain PAG tailings saturation, to better control water quality concerns associated with PAG tailings; and
- incorporating further thickening into the NPAG tailings processing prior to deposition in the impoundment (further increasing the solids to water content of the tailings, from 50 to 65 percent in Alternative 2, up to 62 to 70 percent in Alternative 3), in order to reduce the amount of seepage from the NPAG tailings.

The rationale for choosing this alternative for assessment in the EIS is that, compared with the proposed action, it would allow for a direct comparison of the impacts from further thickening and segregating the saturated PAG tailings in an engineered low-permeability layered cell. By contrast, Alternative 2 only uses a separate engineered low-permeability layered PAG tailings cell during the first 9 years of operation and is not optimally located over less-fractured bedrock.

2.2.5.1 Alternative 3 Mine Plan Components

Water Use

This alternative uses the least water of the four conventional tailings alternatives (Alternatives 2, 3, 5, and 6) and is estimated to need about 490,000 acre-feet of groundwater pumped from the Desert Wellfield through the life of the mine (see appendix H). This is about 17 percent less water than the alternative without additional thickening of the NPAG tailings (Alternative 2), primarily as a result of greater recovery of water from the tailings and less evaporation losses from deposited tailings.

Tailings Facility – Tailings Type

The modified proposed action includes a slurry tailings disposal method, with the tailings split into a wet slurry of approximately 84 percent NPAG and 16 percent PAG tailings by total volume. The PAG tailings would be thickened at the West Plant Site to approximately 50 percent solids content and the NPAG tailings to approximately 65 percent solids. The cyclone overflow of the NPAG tailings would be thickened at the tailings storage facility site prior to depositing into the impoundment. Under this alternative both the NPAG tailings and cyclone overflow which is deposited in the impoundment would be high-density thickened at the tailings storage facility site to a higher solids content in comparison to Alternative 2 (NPAG thickened to 70 percent; cyclone overflow of the NPAG tailings thickened to 62 percent).

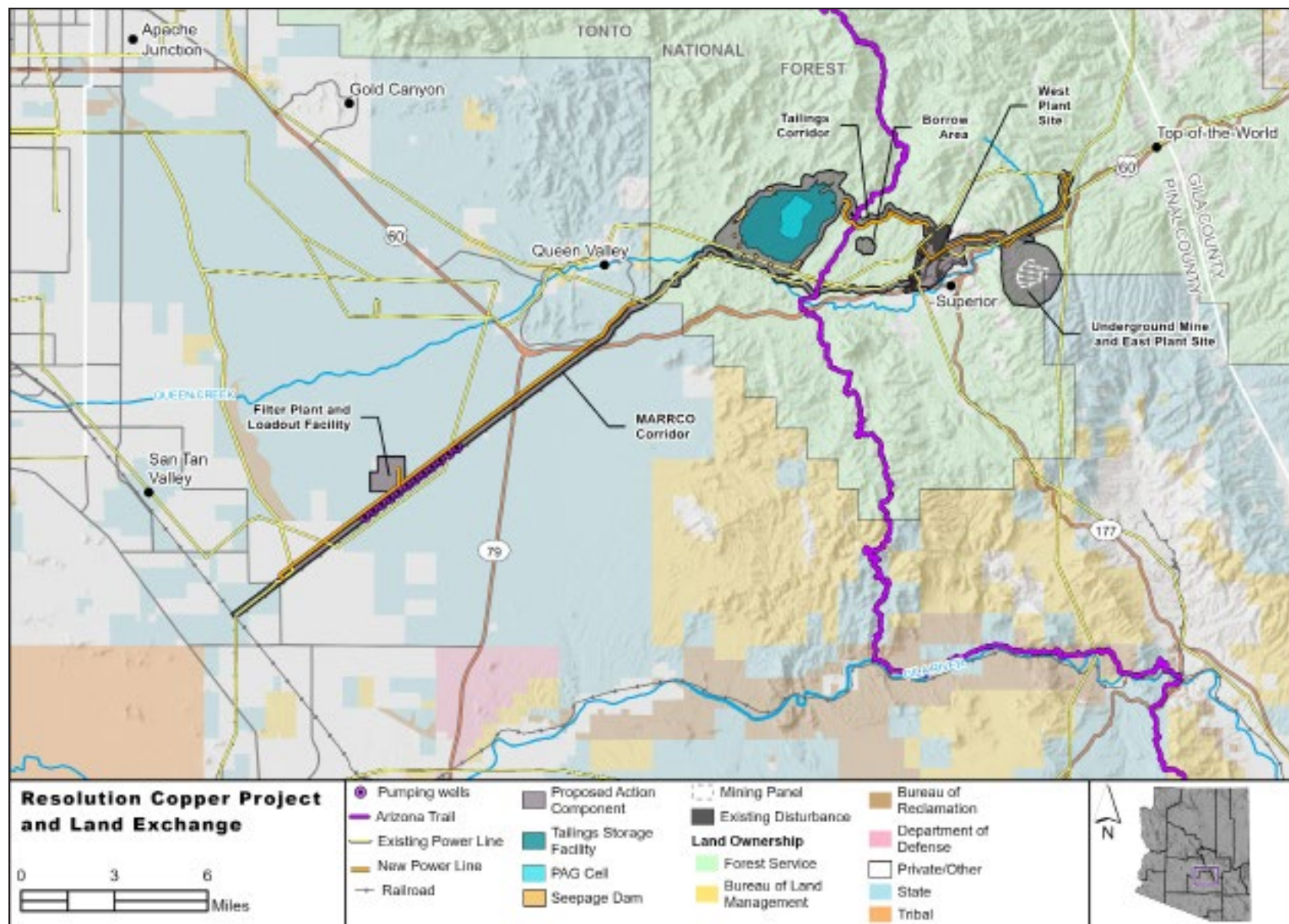


Figure 2.2.5-1. Alternative 3 – Near West – Ultrathickened overview

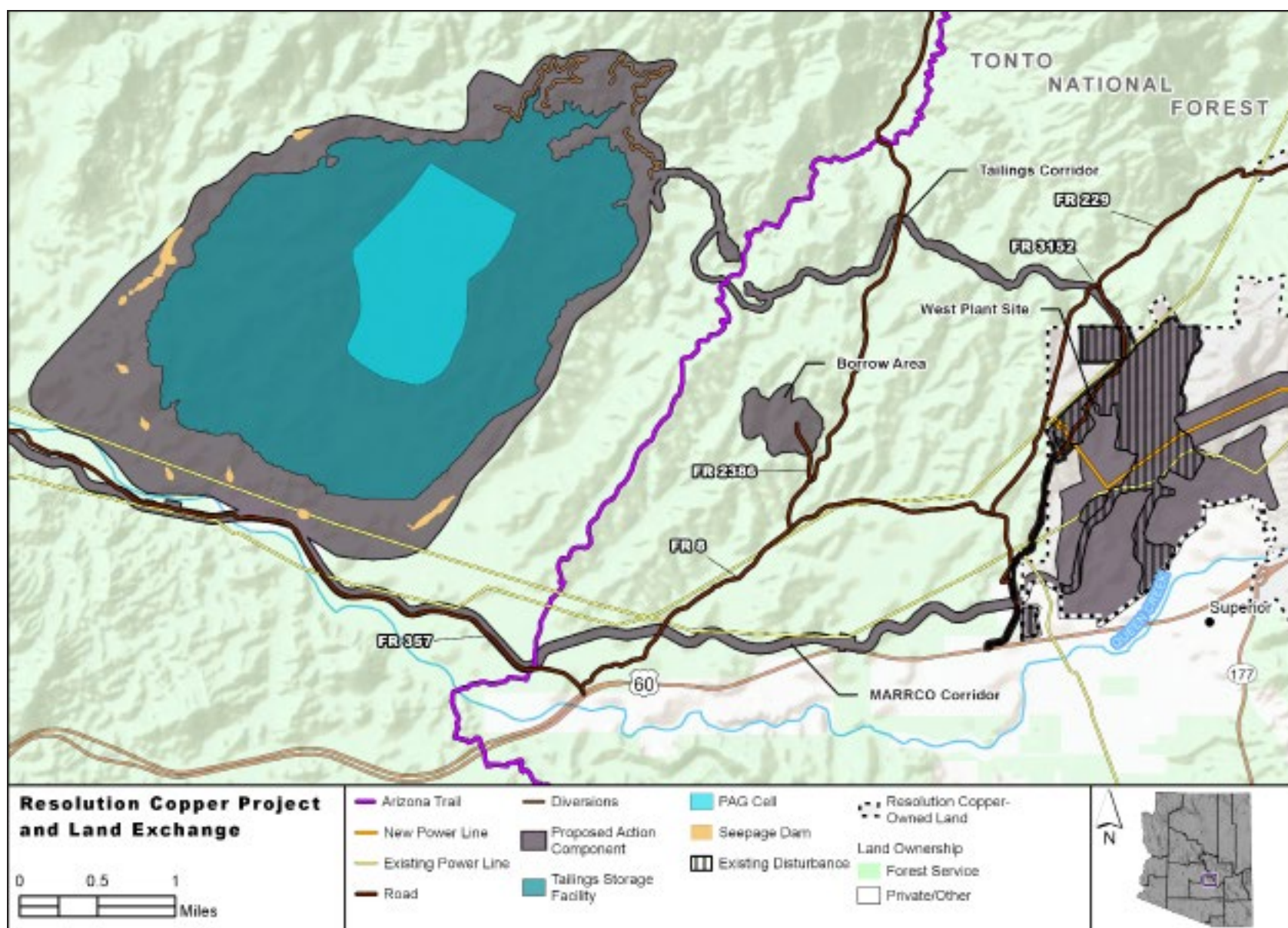


Figure 2.2.5-2. Alternative 3 – Near West – Ultrathickened tailings storage facility

Tailings Facility – Tailings Conveyance

Tailings conveyance via pipeline to the modified proposed action tailings facility would be the same as described in Alternative 2 – Near West Proposed Action.

Tailings Facility – Embankment Type

Alternative 3 would use the same approach, including an earthen starter dam, raised with compacted cyclone sand in a modified centerline construction; however, the downstream slope would be 3H:1. Borrow material would come from the same locations as described in Alternative 2. The PAG tailings cell would be located within the larger NPAG deposit, separated by a splitter berm construction of compacted cycloned sand.

Tailings Facility – Liner

Where NPAG tailings are deposited on potentially high-permeability bedrock, the foundation would be covered with an engineered, low-permeability layers prior to tailings deposition. The PAG tailings cell would be hydraulically contained by engineered, low-permeability layers and deposited over less-fractured bedrock.

Alternative 3 would make use of the same phased approach for control and collection of seepage as Alternative 2, including downstream seepage collection ponds, and additional grouting, collection ponds, or pumping wells if needed.

Tailings Facility – Disposal Method

The PAG tailings would be sent directly to a floating deposition barge for subaqueous deposition located within the PAG cell. The difference to apply high-density thickening of the NPAG tailings would occur prior to placement within the tailings storage facility to further reduce entrained water through evaporation and thereby reduce seepage. There is a potential for even more water to be removed from the tailings through

“thin-lift” deposition techniques (depositing tailings in very thin layers), which would be used if found to be feasible with ultrathickened tailings.

The PAG tailings would be maintained in a saturated condition under a water cover at least 10 feet deep throughout operations. A primary difference between Alternatives 2 and 3 is the location of the recycled water pond. Under Alternative 2 the recycled water pond overlies both a portion of the NPAG and all of the PAG tailings, while under Alternative 3 the recycled water pond would only overlie the PAG tailings cell. Low spots that accumulate water, released from the tailings or stormwater on the NPAG tailings surface, would be pumped and the water would be directed to the PAG tailings cell.

Tailings Facility – Auxiliary Facilities

Access roads and other auxiliary facilities associated with Alternative 3 are similar to those described in section 2.2.4. Stormwater diversion channels would be needed to route upstream storm flows around the facility. Precipitation falling within the facility would be incorporated into the tailings reclaim water. Additional cyclone thickeners would be required to thicken the NPAG tailings to a greater percentage than Alternative 2.

Tailings Facility – Closure and Reclamation

During operations, the cycloned sand embankment slopes would be progressively reclaimed as facility development allowed (i.e., lower slopes would be reclaimed as subsequent lifts added). Channels and other features would be constructed at strategic locations on the closed embankment slopes to convey stormwater away from the facility and seepage ponds, and the slopes would be progressively covered with a low-permeability, erosion-resistant soil layer (e.g., Gila conglomerate) and revegetated.

In the final years of operations, tailings would be deposited to promote surface water runoff to the north, where runoff would then be directed downstream, diverting around the seepage collection ponds, and surfaces

throughout the facility would be reshaped as necessary to eliminate any potential for standing water.

Following closure, the recycled water pond within the PAG cell would gradually be reduced in size and the seepage ponds downstream would be enlarged in order to maximize evaporation. The PAG cell would then be covered with a layer of NPAG tailings topped by a 1- to 2-foot layer of low-permeability, erosion-resistant soil (e.g., Gila conglomerate or equivalent soil, sand, and gravel mix) and revegetated. The remaining NPAG areas would similarly be covered by a 1- to 2-foot layer of low-permeability, erosion-resistant soil (e.g., Gila conglomerate or equivalent soil, sand, and gravel mix) and revegetated. The reclamation timing is dependent on the surface being dry enough to allow equipment access.

Active closure would be required for up to 9 years after the end of operations. Any water collected in the seepage collection ponds beyond the evaporation capacity of the seepage collection ponds would need to be actively treated. The sludge containing concentrated metals and salts from evaporation would require cleanup and handling as a solid or hazardous waste.

Other closure and reclamation measures, such as the removal of buildings, pipelines, electrical equipment and electrical lines, and the recontouring and revegetation of parking areas and other areas of ground disturbance, would be substantially identical to those described for Alternative 2.

Table 2.2.5-1 summarizes the components of the Alternative 3 tailings storage facility.

Table 2.2.5-1. Summary of Alternative 3 – Near West – Ultrathickened tailings storage facility

Tailings Storage Facility	Description
Location	3 miles west of the West Plant Site, north of Hewitt Canyon Road (NFS Road 357); same as Alternative 2 – Near West Proposed Action
Land ownership	NFS
Distance from West Plant Site	3 miles
Tailings type and disposal	Thickened slurry tailings placed subaqueously for PAG tailings from barge, NPAG placed hydraulically from perimeter At disposal—PAG tailings would be 50% solids content; thickened cyclone overflow (NPAG) would be 62% solids content; and additionally thickened NPAG stream sent directly from the mill would be 70% solids content.
Tailings embankment	Cycloned tailings and earthen starter dam, raised with compacted cyclone sand in a modified centerline construction approach with a 3H:1V slope
Lining and other seepage controls	Engineered, low-permeability layers would be installed prior to start-up. These would include the entire PAG cell and in other areas where the foundation may have high permeability. Seepage from the tailings would be recovered in 11 seepage collection ponds downstream of the embankment. The seepage and stormwater collected at the collection ponds would be managed during operations for use in the process water system. Finger and blanket drains would underlie the embankment and part of the NPAG tailings
Approximate size at fence line of tailings storage facility	4,909 acres
Approximate embankment height	510 feet
Tailings pipelines / conveyance	Thickened slurry pumped in two streams (PAG and NPAG) to the tailings storage facility and recycled water pipeline to return water to processing loop at West Plant Site 5.33 miles of corridor from West Plant Site to tailings storage facility
Auxiliary facilities	Two clusters of 26 cyclones, two high-density thickeners Upstream surface water north, west, and east of the tailings storage facility would be diverted to the extent possible around the facility through constructed diversion channels. This non-contact water would be diverted downstream to Queen Creek.
Other design considerations	8 miles of NFS roads are expected to be decommissioned or lost. Arizona Trail would need to be crossed by the slurry pipeline corridor and associated access road, but not rerouted.
Closure and reclamation	Reclamation of the tailings embankment face would occur progressively until about mine year 30 and continue through the end of the mining operations (approximately mine year 46). Dewatering of the tailings recycled water pond is estimated to take up to 5 years after the end of operations. Until that time, excess water collected in seepage ponds would be pumped back to recycled water pond, and reclamation would take place on the embankment and tailings beaches. After the recycled water pond is closed, seepage ponds would be enlarged to allow adequate evaporation of pond inflows, and the remaining reclamation of the tailings would occur.

2.2.6 Alternative 4 – Silver King

Alternative 4 – Silver King would include approximately 10,617 acres of disturbance of which 7,949 acres is NFS, 314 acres is ASLD managed, and 2,354 acres is private land.

The Silver King alternative was developed to respond to issues of water use, air quality, public health and safety, and groundwater quality through the use of filtered tailings instead of thickened slurry tailings (as proposed in the GPO) at an alternative location on Tonto National Forest land in an area known as Silver King. This alternative includes changes to the GPO for the tailings location, tailings processing and storage method, the location of the filter plant and loadout facility, and other emergency storage ponds which would increase the West Plant Site footprint and require different access road realignment along Silver King Mine Road, compared with the GPO and Alternatives 2, 3, 5, and 6. Other plan components of the GPO remain the same as described in Alternative 2 – Near West Proposed Action.

This tailings facility would occupy the lower end of Silver King Canyon, in the Silver King Wash, the lower portion of Whitford Canyon, and Peachville Tank, immediately adjacent to the West Plant Site north of Superior, Arizona (figure 2.2.6-1). The tailings footprint was designed to avoid existing mining operations at the Silver King Mine and a historic cemetery; however, 5.5 miles of the Arizona National Scenic Trail (Arizona Trail) would need to be rerouted and the McGinnel claim, 0.5 mile north of Silver King Mine, would be within the footprint of the tailings pile. Although the conceptual design of this facility is quite high (1,040 feet), the facility would consist of several benches to follow and mimic existing topography.

The use of filtered tailings reduces some concerns with water quality and public safety because removing water from the slurry prior to placement decreases the mobility of the tailings, providing greater stability of these tailings and a substantial reduction in seepage. Filtered tailings would allow progressive reclamation and compaction, but this alternative has large, dry, exposed surfaces that need to be managed to avoid air quality concerns. At this time, filtered tailings have not been used on a facility with a production rate as high as that proposed by Resolution Copper.

Tailings slurry would be delivered in separate tailings pipelines to two filter plants at the Silver King facility (one for PAG and one for NPAG) and filtering would then occur to remove water from the tailings, increasing percent solids generally to about 86 to 89 percent (vs. approximately 50 to 65 percent in the GPO tailings plan). Once filtered, the tailings would be conveyed into place as solids rather than pumped as a semi-liquid in a tailings pipeline, and, once in place, would be compacted in place using earthmoving equipment. The NPAG and PAG filtered tailings would be stacked in separate but nearly adjacent facilities.

Surface water management would include large upstream diversion dams with high-capacity outlets as well as large downstream collection ponds, as there would be no water recycling ponds, compared with slurry facilities to handle contact water. Emergency slurry ponds would be required for temporary storage of slurry in event of a tailings filter plant shutdown.

The rationale for choosing this alternative for detailed analysis is that, compared with the proposed action, it allows for a comparison of the impacts of thickened slurry tailings vs. filtered tailings, and it allows a comparison regarding whether the specific location selected for tailings in the GPO is preferable to other locations in the same general vicinity of Superior.

2.2.6.1 Alternative 4 Mine Plan Components

Relocation of Filter Plant and Loadout Facility

This alternative would relocate the filter plant and loadout facility from the proposed location near Magma Junction to the West Plant Site, near the concentrator on the existing rail line north of U.S. Route 60 (U.S. 60) (figure 2.2.6-2). This modification to the proposed action responds to issues of air quality, noise, and public health and safety associated with locating mining support facilities in the heavily populated East Salt River valley.

The filter plant and loadout facility would continue to pressure-filter the copper concentrate in a way that is similar to the proposed process

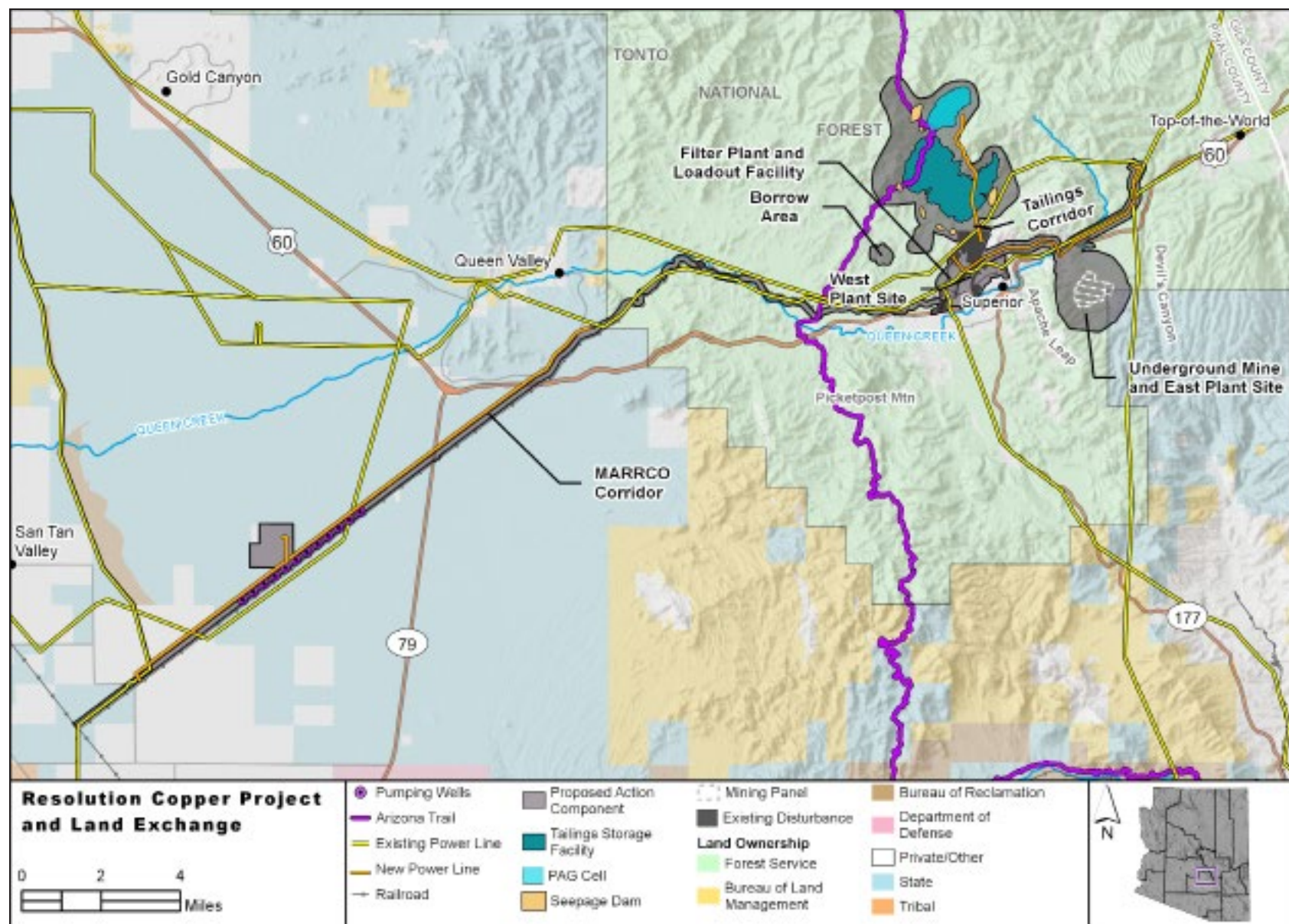


Figure 2.2.6-1. Alternative 4 – Silver King overview



described in the GPO. Pipelines for copper concentrate and filtrate water would be located within the West Plant Site and not within the MARRCO corridor, thereby eliminating 21 miles of concentrate pipelines. This responds to issues of water quality and public health and safety that may be associated with concentrate pipeline ruptures or spills.

Two 50-railcar trains would instead use the MARRCO corridor twice a day to transport copper concentrate to market (concentrate loads would be transferred at Magma Junction to container cars of the Union Pacific Railroad for transport to an off-site smelter). The MARRCO corridor track would require upgrades along the entire length, bridge replacement at Queen Creek Bridge, and significant upgrades for crossings at Queen Creek, U.S. 60, State Route (SR) 79, the Arizona Trail, Hewitt Canyon Road, and other NFS roads. Except for the removal of concentrate pipelines, the dimensions and uses of water pipelines, groundwater wells, pump stations, and 69- and 12-kV power lines within the MARRCO corridor would remain unchanged from how these facilities are described in the GPO.

Water Use

This alternative uses the least amount of water of all the tailings alternatives and is estimated to need about 180,000 acre-feet of makeup water pumped from the Desert Wellfield through the life of the mine (see appendix H). This is about 65 percent less water than Alternative 2, due to recovery of water during filtering and subsequently less evaporative loss from the tailings beaches and recycled water pond.

Tailings Facility – Tailings Type

NPAG and PAG tailings streams would each undergo dewatering to a “filtered” tailings type. Filtering tailings would remove more water from the tailings slurry and result in filtered tailings with approximately 86 to 89 percent solids. At this moisture content, the tailings are referred to as a “dry cake” and must be transported by conveyor or truck to a filtered tailings storage facility. This modification responds to issues of public

health and safety, water quality, and water use by removing water from the tailings. The filtered tailings can be placed and compacted into piles and have less water entrained in the tailings facility (figure 2.2.6-3).

Tailings Facility – Tailings Conveyance

Tailings slurry would be delivered by pipeline from the West Plant Site to the two separate Silver King filter plants, one located on higher ground above and adjacent to the NPAG facility approximately 1.5 miles north of the West Plant Site, and the other on higher ground above and adjacent to the PAG facility approximately 1.4 miles north-northwest of the NPAG site. Situating the filter plants on higher ground would allow for greater efficiency through downhill conveyance of the two types of filtered tailings to their respective storage facilities. Upon arriving at each filter plant, the NPAG and PAG tailings slurries would be pressure filtered to remove water, then subsequently handled as solids and delivered by conveyor and mechanically placed within each of the two tailings facilities.

Unlike a typical slurry tailings facility, where slurry can be emptied directly into the facility in the event of a processing halt, for filtered tailings, one or more emergency slurry storage ponds would be constructed close to the West Plant Site as emergency disposal location(s) for filtered tailings in the event that a filter plant temporarily stops processing. The emergency storage facilities would be constructed behind earthfill embankment(s) and would be lined.

Tailings Facility – Embankment Type

Filtered tailings are treated as solids (not liquids) and therefore do not require storage behind an embankment. No embankment would be required for construction of the Silver King alternative tailings storage facility; however, a compacted zone of tailings around the perimeter of the facility would provide structural support.

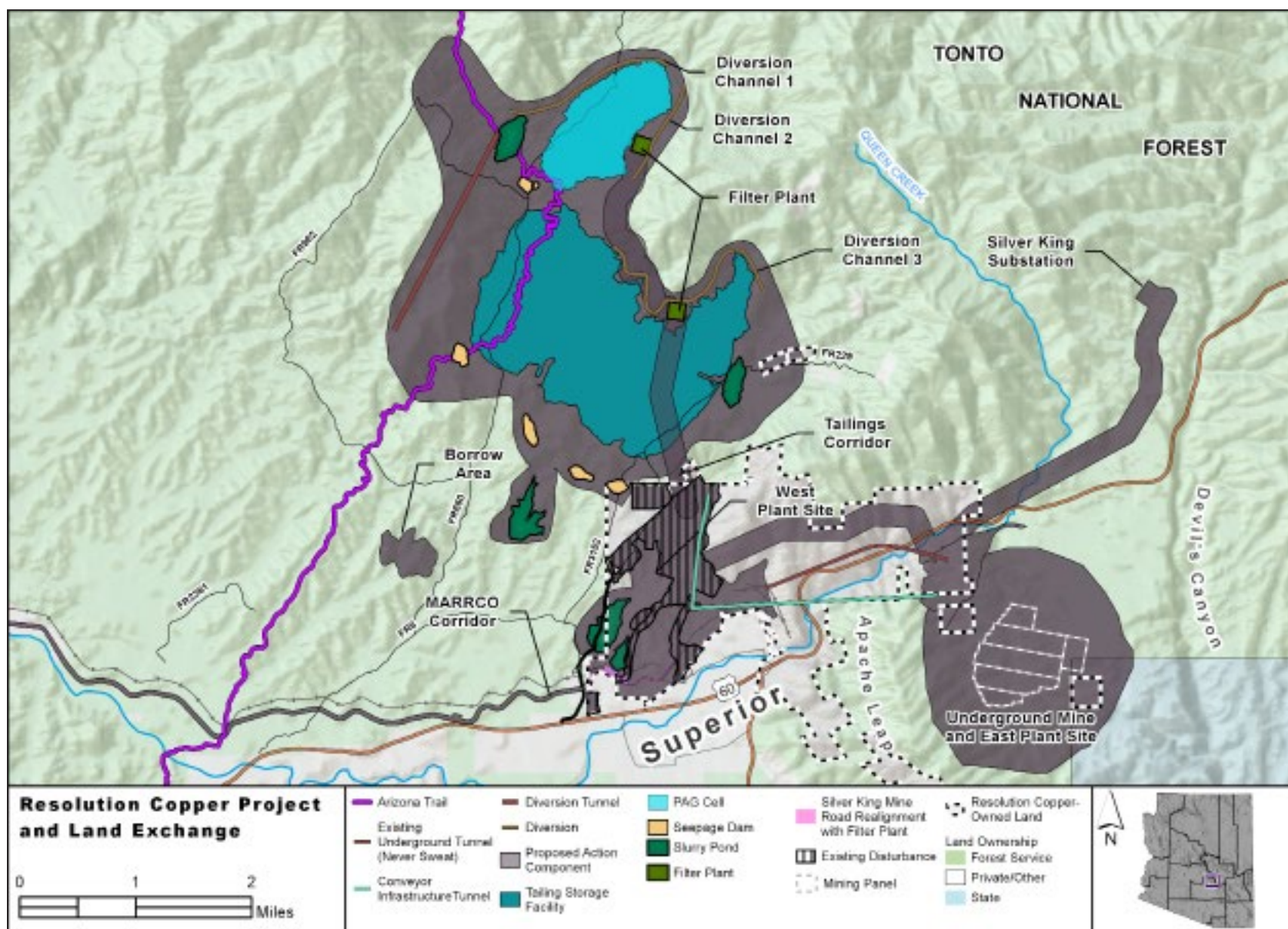


Figure 2.2.6-3. Alternative 4 – Silver King tailings storage facility

Tailings Facility – Liner

The Silver King alternative tailings storage facility would not be lined. As discussed further in section 3.7.2, the use of a full liner was considered during alternatives development and eventually dismissed from detailed consideration due to logistical concerns.

Tailings Facility – Disposal Method

Tailings would be placed using “trains,” which are mechanical conveyors that place tailings in rows. Additional mobile mechanized equipment would be used to spread and compact the tailings. As stated previously, there would be two separate filtered tailings facilities: the NPAG tailings would be stacked closer to the West Plant Site and the PAG tailings farther north and upstream of the NPAG facility. Maintaining two separate facilities provides flexibility in how PAG tailings are managed and reclaimed.

Tailings Facility – Auxiliary Facilities

Unlike a slurry tailings facility, in which precipitation falling on the tailings is directed to the recycled water pond, stormwater must be managed on filtered facilities to prevent ponding on the surface of the tailings. Stormwater diversion channels, diversion tunnels, and retention structures would be needed to divert stormwater runoff from the tailings piles or move runoff quickly off of the facilities. During operations, the tailings surfaces would be sloped to eliminate ponding and direct runoff to perimeter ditches, sumps, and/or underdrains. The top surfaces of the tailings piles would be sloped toward the hillside and surface runoff would be collected in lined ditches and conveyed to lined contact water collection ponds. As described under “Tailings Conveyance” earlier in this section, emergency slurry storage ponds would be needed near the West Plant Site as an emergency disposal location, in the event that the filter plant temporarily shuts down.

Tailings Facility – Closure and Reclamation

The filtered tailings facilities would be constructed in horizontal lifts, thus the external slopes of the stack can be reclaimed starting early in the mine life, unlike slurry facilities that are unlikely to start embankment slope reclamation until after year 20. Because it is important to keep water away from the filtered facility, surface water diversion dams, tunnels, channels, and pipelines would be constructed where needed to direct the large upstream catchment runoff water away from the slopes and to limit erosion, and contact water would be directed to collection ponds for evaporation. After closure, upstream stormwater diversion features such as cutoff walls and channels would remain in place permanently to continue to direct surface water flows around and downstream of the tailings impoundments.

Active closure would be required for 5 years after the end of operations. During this time, reclamation of the exposed tailings would be in progress, and the need to retain stormwater in the collection ponds requires more capacity than the collection ponds can passively evaporate; active treatment may be required. Once stormwater can again be released downstream, after the tailings surface has been reclaimed with a stable closure cover, the collection ponds would be able to passively evaporate collected water. The sludge of concentrated metals and salts from evaporation would likely eventually require cleanup and handling as solid or hazardous waste.

The NPAG and PAG tailings piles would be treated as two separate facilities with separate covering, soil, and revegetation, but both stacks would use a store and release cover design to limit infiltration. At closure, the PAG tailings pile would be covered by an engineered low-permeability layer of compacted NPAG material that would be covered by a 1- to 2-foot layer of low-permeability, erosion-resistant soil (e.g., Gila conglomerate or equivalent soil, sand, and gravel mix) and revegetated. Other closure and reclamation measures, such as the removal of buildings, pipelines, electrical equipment and electrical lines, and the recontouring and revegetation of parking areas and other areas of ground disturbance, would be substantially identical to those described for Alternative 2.

Table 2.2.6-1 summarizes the components of the Silver King tailings storage facility.

Table 2.2.6-1. Summary of Alternative 4 – Silver King tailings storage facility

Tailings Storage Facility	Description
Location	Silver King Canyon (immediately north of and adjacent to the West Plant Site)
Land ownership	NFS
Distance from West Plant Site	1 mile
Tailings type and disposal	Filtered (dry stack) placed mechanically in two separate, but adjacent facilities At disposal—PAG tailings would be 86% solids content; NPAG tailings would be 89% solids content.
Tailings embankment	Perimeter of filtered pile would be compacted into a structural zone to provide physical support. The downstream slope would not exceed 3H:1V
Lining and other seepage controls	No lining of tailings, emergency temporary slurry ponds would be lined and retained by earthfill embankments. Seepage from the tailings would be recovered in five seepage collection ponds downstream of the facilities. Finger and blanket drains would underlie the tailings facilities.
Approximate size at fence line of tailings storage facility	5,661 acres
Approximate embankment height	The approximate maximum height of the filtered NPAG tailings facility is 1,040 feet and PAG tailings facility is 750 feet.
Tailings pipelines / conveyance	Thickened slurry would be pumped in two streams (PAG and NPAG) to the tailings storage facility and a recycled water pipeline would return water to processing loop at West Plant Site. There would be two filter plants (one for NPAG and one for PAG) at the Silver King tailings storage facility. After tailings are pressure filtered, they would then be placed within the facility by conveyor. 0.20 mile of corridor from West Plant Site to tailings storage facility.
Auxiliary facilities	Pressure filters, conveyors, mechanical spreaders, and mobile earthmoving equipment would be used for filtering and depositing the tailings. The filter plant and loadout facility would be relocated from the proposed location near Magma Junction to the West Plant Site. The facility would continue to pressure-filter the concentrate similar to the proposed process described in the GPO. Pipelines for copper concentrate and filtrate water would be located within the West Plant Site and not within the MARRCO corridor. Two 50-railcar trains would use the MARRCO corridor twice a day to transport copper concentrate to market. Permanent diversion channels upslope of the tailings pile would divert non-contact water around the tailings pile and discharge to either the West or East Diversion reservoirs. Multiple temporary slurry storage ponds would be required near the West Plant Site as emergency disposal locations in the event of planned or unplanned shutdowns. The ponds would be lined and retained by earthfill embankments.
Other design considerations	NFS Road 229 would need to be rerouted for private parcel access. 17.7 miles of NFS roads are expected to be decommissioned or lost. Approximately 5.5 miles of the Arizona National Scenic Trail would need to be rerouted. The 230-kV and 115-kV transmission lines would need to be crossed or rerouted between the East Plant Site and the West Plant Site.
Closure and reclamation	Reclamation and contouring of the filtered tailings would occur concurrently during mining operations. Reclamation would begin on outer slopes as early as practicable. Seepage and contact water collection ponds would remain in place until reclamation of tailings surfaces is complete, about 5 years after closure. Seepage ponds would remain in place to evaporate seepage or runoff unless water quality were sufficient to allow discharge.

2.2.7 Alternative 5 – Peg Leg

Alternative 5 – Peg Leg West Tailings Corridor Option would include approximately 17,285 acres of disturbance, of which 2,675 acres is NFS, 7,574 acres is BLM managed, 4,642 acres is ASLD managed, and 2,394 acres is private land.

Alternative 5 – Peg Leg East Tailings Corridor Option would include approximately 16,938 acres of disturbance, of which 2,752 acres is NFS, 7,105 acres is BLM managed, 4,659 acres is ASLD managed, and 2,422 acres is private land.

The Peg Leg alternative was developed to respond to the issues of public health and safety and groundwater quality. This alternative includes changes to the GPO for storing tailings, including the tailings facility location, tailings conveyance route to storage facility, and tailings storage embankment type. Public health and safety is addressed by locating the tailings facility in an area farther from residential populations and using a more resilient and robust embankment type than the upstream embankment proposed in the original GPO. Water quality is addressed by containing and controlling any seepage from the facility, and the greater distance to downstream perennial waters. Other plan components of the GPO remain the same as described in Alternative 2 – Near West Proposed Action.

The Peg Leg alternative tailings facility location is on a mixture of ASLD-administered and BLM-administered and private land south of the Gila River (figure 2.2.7-1). Selection of this alternative by the Forest Supervisor would not automatically approve this alternative, as BLM would require submittal of a mining plan of operations to approve the proposal. Since the other areas are not Federal land, obtaining access to use ASLD-administered trust land and private land is the responsibility of the applicant. The thickened slurry would be pumped from the West Plant Site in a split stream (approximately 84 percent NPAG and 16 percent PAG) via pipeline alternatives extending 28 miles on a western route and 23 miles on a proposed eastern route, and placed behind a centerline embankment retaining the larger NPAG tailings facility; the separate PAG cell would be situated behind a downstream embankment

located adjacent to the NPAG impoundment. The PAG tailings would be kept saturated to prevent oxidation (the same as for the GPO).

This alternative tailings location was selected for its distance from residential areas and other infrastructure. The advantageous characteristics of this site include a greater distance from Superior, Queen Creek, and other communities, along with a gently sloping 4 percent topography on alluvial soils underlain by shallow bedrock on the eastern portion. This alternative also rose from a desire to consolidate mining activities on the landscape—this alternative is geographically close to the ASARCO Ray Mine complex and the planned Ripsey Wash tailings facility.

2.2.7.1 Alternative 5 Mine Plan Components

Water Use

This alternative uses about 540,000 acre-feet of groundwater pumped from the Desert Wellfield through the life of the mine (see appendix H). This is about 8 percent less water than under Alternative 2. This location has greater seepage losses to the aquifer. However, this increased water use is offset by the capture of more precipitation and runoff at this location and greater recovery of reclaimed water.

Tailings Facility – Tailings Type

Tailings types would be the same as described in Alternative 2 – Near West Proposed Action. The thickened tailings would consist of approximately 84 percent NPAG and 16 percent PAG.

The smaller PAG facility would be located on what is primarily granitic and granodiorite bedrock at the eastern portion of the Peg Leg facility footprint and would be constructed in a “four-square” pattern of separate cells as a way to reduce the pond size required for operations (i.e., the water cap needed to prevent airborne oxygen from interacting with the PAG tailings). The NPAG tailings would be located on what is primarily an alluvial material base immediately to the west and slightly downslope

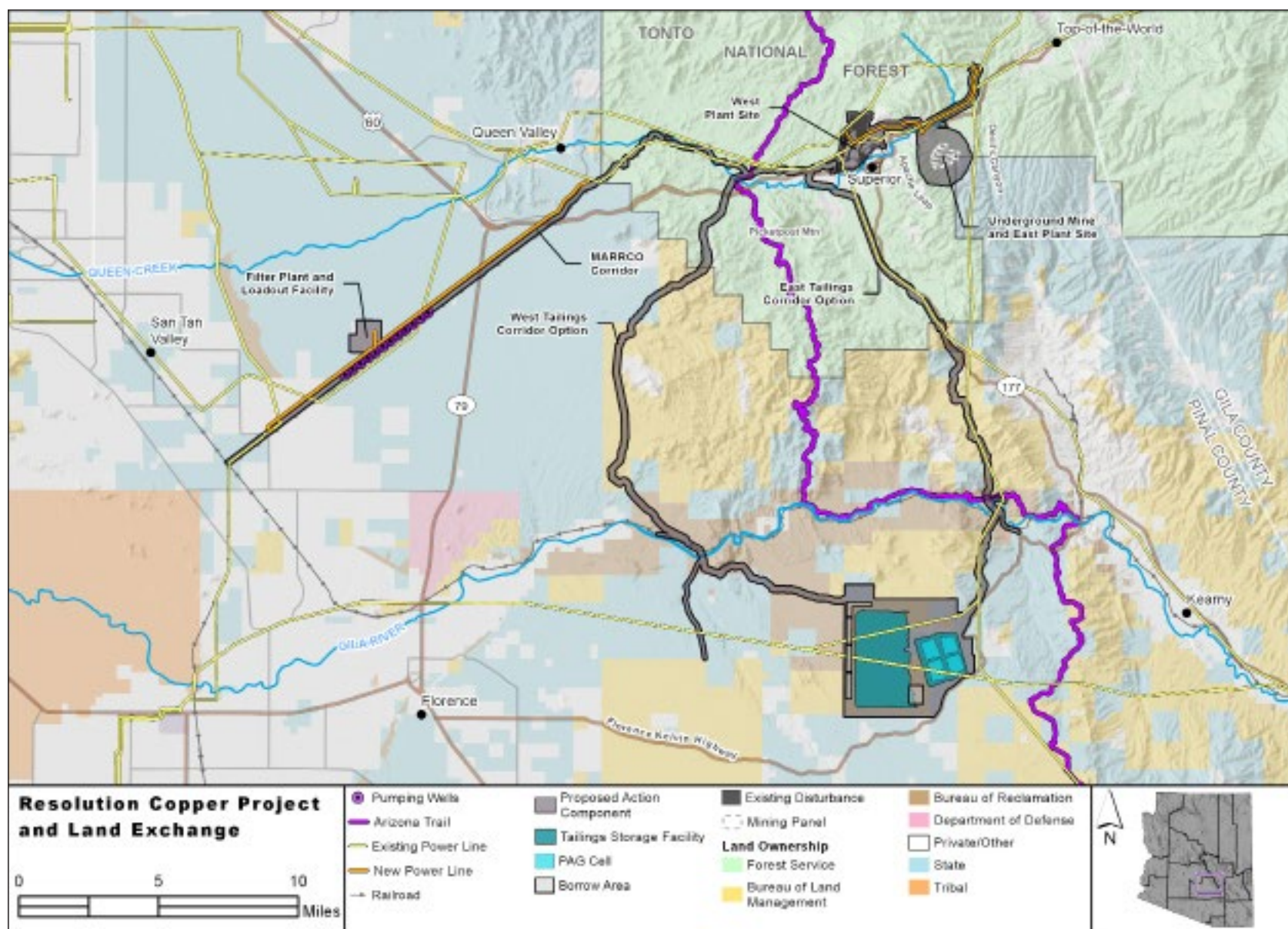


Figure 2.2.7-1. Alternative 5 – Peg Leg overview

from the PAG location. Figure 2.2.7-2 shows the tailings storage facility for this alternative.

Tailings Facility – Tailings Conveyance

The tailings would be pumped as a thickened slurry in two separate pipelines from the West Plant Site to the Peg Leg tailings storage facility approximately 25 miles to the south. Two pipeline corridor routes from the West Plant Site are presently being studied: a western alignment that would initially follow the MARRCO corridor south and then traverse primarily BLM-administered lands before crossing the Gila River and then turning eastward to the Peg Leg site, and an eastern alignment that would initially lie within the SR 177 easement and then shift more directly southward across BLM-administered and private lands before crossing the Gila River west of the Kelvin Bridge area prior to connecting to the Peg Leg facility (see figure 2.2.7-2).

Tailings Facility – Embankment Type

As stated, the Peg Leg tailings facility would comprise two physically separate types of storage facilities: PAG and NPAG. The two facilities would remain segregated throughout the entire life of the mine.

A “downstream” embankment design, which is material-intensive and requires a larger footprint to be designed as a water retaining embankment, is proposed for the PAG cell as it contains a water cover to limit oxidation. This embankment would be constructed using a mixture of earthfill excavated from within the tailings facility footprint and compacted cycloned sand. At the end of mine life, the PAG embankment would be approximately 200 feet in height. The entire PAG facility would include engineered low-permeability layers, or possibly a full synthetic liner.

The NPAG tailings would be retained behind a “centerline” design embankment²¹ just to the west and slightly downstream of the PAG facility. The NPAG embankment would be constructed first using earthfill excavated from within the facility footprint, followed by compacted cycloned sand (underflow). The NPAG facility would be partially lined with an engineered low-permeability lining and other low-permeability layers under the recycled water pond area of the impoundment. At completion, the NPAG main embankment would be approximately 310 feet in height.

Tailings Facility – Liner

A full engineered low-permeability lining or other low-permeability layer would be installed at the PAG facility and partial engineered low-permeability lining positioned along the starter dam and under the recycled water pond within the NPAG impoundment (the full areal extent of the liner needed in the NPAG facility would be assessed and adjusted during operations). Other seepage containment techniques, such as use of low-permeability tailing fines (cyclone overflow), as well as grouting or sealing of fractures in base rock using asphalt or bentonite or other materials, may be used to augment the engineered low-permeability lining within both the PAG and NPAG cells.

Alternative 5 developed in part from the concept of a fully lined tailings facility. In practice, a full engineered low-permeability liner over such a large area would be both impractical and ineffective. However, because this alternative is located on alluvium, the potential water losses are expected to be substantial and a wide variety of seepage containment techniques would need to be employed to limit seepage to the extent possible and recover water for recycling back into the mine process (see section 3.7.2.4).

Embankment seepage would be captured in drains at the toe of the dams at each facility and collected in lined surface water and seepage

21. Care should be taken to not confuse “modified centerline” with “centerline” designs. The modified centerline embankment type still has some resemblance to an upstream embankment, in that the crest of the embankment does move upstream over time and the embankment lifts are still constructed partially over tailings. The true centerline design builds the crest straight upward and retains a solid core that is not underlain by tailings.

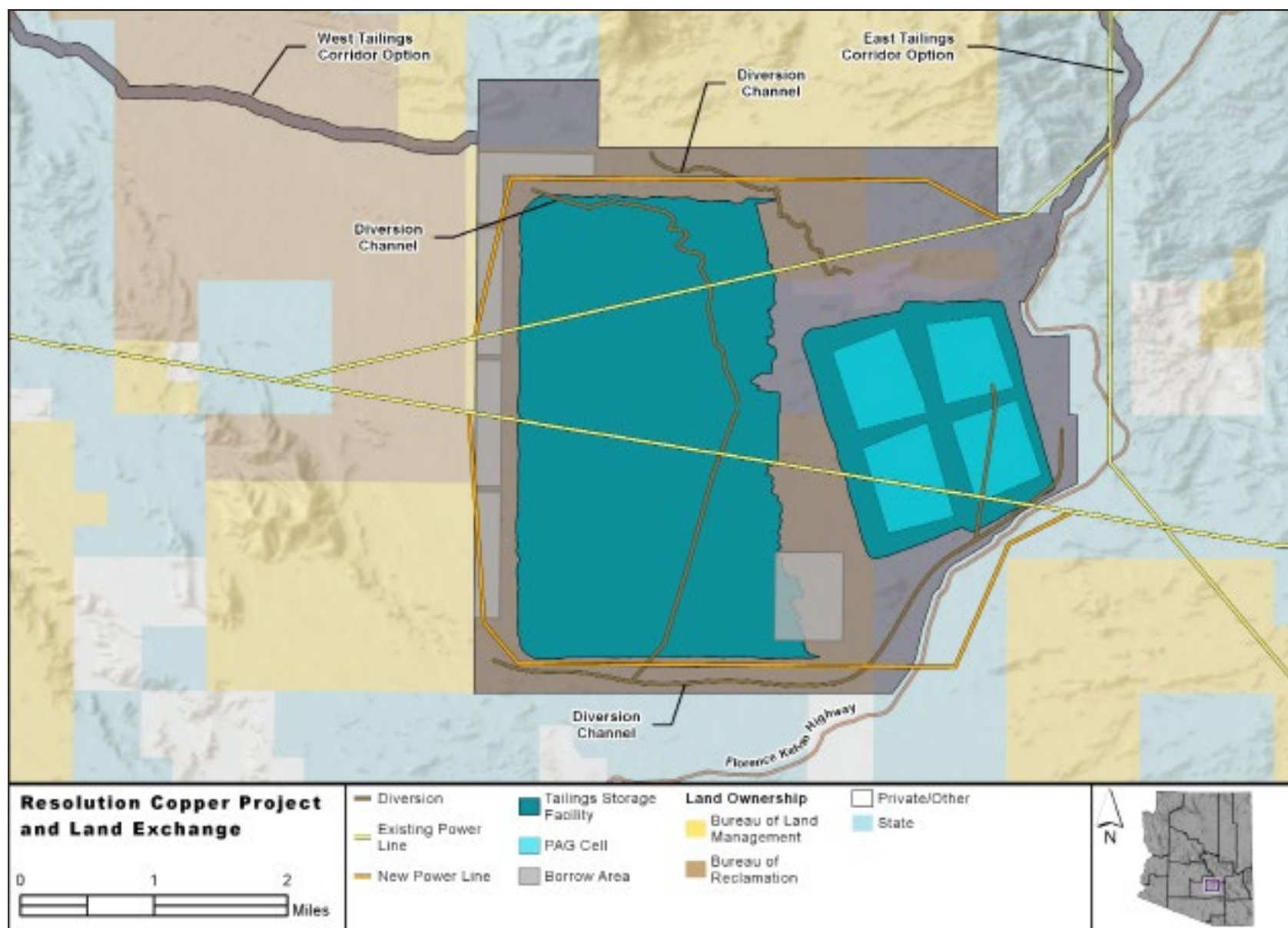


Figure 2.2.7-2. Alternative 5 – Peg Leg tailings storage facility

collection ponds. This collected water would then be pumped back to the recycled water ponds at each facility. A groundwater pumpback system would be operated downgradient of the tailings facility to recover seepage.

The uncontained seepage from the facility is expected to produce a groundwater mound. A well field would be installed downstream of the facility to further control seepage and groundwater would be pumped back to the recycled water pond.

Tailings Facility – Disposal Method

Tailings would be deposited by pipeline to their respective cells around each embankment. In this alternative, the PAG tailings would be deposited subaqueously. NPAG slurry would initially be deposited using traditional methods but would later transition to “thin-lift” (i.e., thin layer) deposition techniques to further increase evaporation and reduce seepage.

Tailings Facility – Auxiliary Facilities

Stormwater diversion channels and retention structures would be needed to manage stormwater runoff from the NPAG and PAG cells and to manage upstream (upslope) storm flows. Cutoff walls and diversion berms and channels would be constructed on the northern, eastern, and southern boundaries of the tailings facility to divert stormwater flows around the tailings impoundments.

Additional facilities that would support operations at the Peg Leg site would include electrical power lines and a substation; a cyclone separation plant; water pumping facilities for the PAG cells; collection ponds; a vehicle maintenance and fuel shop; an administration/maintenance building; an equipment storage building; and vehicle parking areas.

Existing powerlines would need to be rerouted around the tailings facility, including a 115-kV SRP powerline and a 12.5-kV San Carlos Irrigation Project powerline as shown in figure 2.2.7-2.

Tailings Facility – Closure and Reclamation

A difference in the management of this alternative with tailings stored in perpetuity on BLM-managed lands, would require the GPO to remain active along with any reclamation bonds for many decades. After final tailings deposition and formal closure of the Peg Leg tailings storage facility, the surfaces of both the NPAG and PAG facilities would be shaped as necessary to prevent standing water. Surface water diversion features, including channels, would be constructed to limit erosion and direct precipitation that falls within the facilities to lined collection ponds to evaporate. Upstream diversion features would continue to direct stormwater flows around and downstream of the two impoundments; these structures would permanently remain in place after all other closure and disassembly/removal work had concluded.

The NPAG facility would be covered with 1 to 2 feet of low-permeability, erosion-resistant soil (e.g., Gila conglomerate, or a sand, soil, and gravel mix) and revegetated. The PAG facility is separated into four separate cells to reduce the footprint of saturated tailings, thus reducing seepage and to promote early closure and reclamation. Each PAG cell would operate for approximately 10 years and would then be closed. The PAG facility would first be covered with a minimum of 10 feet of NPAG material, then topped with a similar 1- to 2-foot thickness of erosion-resistant soil and revegetated.

The seepage collection ponds would remain in place and passively evaporate seepage, and seepage extraction wells downstream would remain in place to control seepage as long as necessary. These seepage features are estimated to be in place between 100 to 150 years after closure. Once the collection ponds can be closed, the closure plan calls for encapsulating the accumulated sludge in geomembrane and backfilling with soil.

Other closure and reclamation measures, such as the removal of buildings, pipelines, electrical equipment and electrical lines, and the recontouring and revegetation of parking areas and other areas of ground disturbance, would be substantially identical to those described for Alternative 2.

Table 2.2.7-1 summarizes the components of the Peg Leg tailings storage facility.

Table 2.2.7-1. Summary of Alternative 5 – Peg Leg tailings storage facility

Tailings Storage Facility	Description
Location	South of the Gila River
Land ownership	ASLD, BLM, private
Distance from West Plant Site	15
Tailings type and disposal	Thickened slurry tailings placed subaqueously for PAG tailings from barge in one of four cells, NPAG placed hydraulically from perimeter in a thin-lift deposition once feasible At disposal—PAG tailings would be 50% solids content; thickened cyclone overflow (NPAG) would be 60% solids content; and thickened NPAG stream sent directly from the mill would be 60% solids content.
Tailings embankment	Cyclone sand centerline-type embankment at NPAG facility with a 3H:1V slope; earthfill and cyclone sand downstream-type embankment at PAG facility
Lining and other seepage controls	Foundation treatments and/or low-permeability liners and layers under the entire PAG cell, under the NPAG starter cell, and where needed under the rest of the NPAG facility, depending on foundation conditions Seepage from the tailings would be recovered in six seepage collection ponds downstream of the embankments. The seepage and stormwater collected at the collection ponds would be managed during operations for use in the process water system. Finger and blanket drains would underlie the embankment and part of the NPAG tailings. Seepage collection pumpback wells would be placed downstream of tailings storage facility.
Approximate size at fence line of tailings storage facility	10,782 acres
Approximate embankment height	310 feet NPAG; 200 feet PAG
Pipelines / conveyance	Thickened slurry pumped in two streams (PAG and NPAG) to the tailings storage facility and recycled water pipeline to return water to processing loop at West Plant Site West Option: 28 miles of corridor from West Plant Site to tailings storage facility East Option: 23 miles of corridor from West Plant Site to tailings storage facility
Auxiliary facilities	Booster pumps may be located at West Plant Site to improve pumping across topography. Diversions will divert water around the facility and back into downstream channels.
Other design considerations	Two transmission line corridors would need to be crossed and both transmission line corridors rerouted around the Peg Leg site. The Arizona National Scenic Trail would need to be crossed by the tailings pipeline corridors. No NFS roads are expected to be decommissioned or lost due to the tailings storage facility at Peg Leg, although BLM estimates 29 miles of inventoried routes would be directly affected.
Closure and reclamation	Reclamation of the tailings embankment face would not occur until construction of the tailings embankment face is complete, which would be at the end of the mining operations (approximately mine year 46). Seepage ponds would remain in use roughly 30 years after closure; groundwater pumpback system would remain in use roughly 20 years after closure.

2.2.8 Alternative 6 – Skunk Camp

Alternative 6 – Skunk Camp North Tailings Corridor Option would include approximately 15,872 acres of disturbance of which 3,265 acres is NFS, 7,923 acres is ASLD managed, and 4,684 acres is private land.

Alternative 6 – Skunk Camp South Tailings Corridor Option would include approximately 16,324 acres of disturbance of which 3,461 acres is NFS, 8,161 acres is ASLD managed, and 4,702 acres is private land.

The Skunk Camp alternative was developed to respond to the issues of public health and safety, groundwater quality, impacts on scenic resources and recreational opportunities and to limit the impacts on NFS surface resources. This alternative includes changes to the GPO for storing tailings, including the tailings facility location, tailings conveyance, and tailings storage embankment type. Public health and safety is addressed by locating the tailings facility in an area farther from specifically established towns and population centers. Groundwater quality is addressed by containing and controlling seepage from the facility. Additionally, the proposed Skunk Camp location is much less likely to adversely impact recreational users of public lands than the GPO location, and would be largely out of public view. Like Alternative 5, this alternative also rose in part from the desire to consolidate mining disturbance on the landscape; the Skunk Camp location is just east of the ASARCO Ray Mine. Other plan components of the GPO remain the same as described in Alternative 2 – Near West Proposed Action.

The Skunk Camp alternative tailings facility location is on a mixture of ASLD-administered and private land that would occupy the upper portion of Dripping Spring Valley, the northeastern slopes and foothills of the Dripping Spring Mountains, and the southwestern foothills of the Pinal Mountains, including a 4-mile reach of Dripping Spring Wash, a 3.5-mile reach of Stone Cabin Wash, and a 4.8-mile reach of Skunk Camp Wash. The proposed site lies approximately 2 miles due east of the existing ASARCO Ray Mine and approximately 13 miles north of the point where Dripping Spring Wash drains into the Gila River (figure 2.2.8-1). Selection of this alternative by the Forest Supervisor would not automatically approve this alternative, since the other areas are not

Federal land, obtaining access to use ASLD-administered trust land and private land is the responsibility of the applicant.

The Forest Service has identified Alternative 6 – Skunk Camp as the Lead Agency’s preferred alternative and seeks public feedback during the 90-day comment period for the DEIS regarding this choice.

2.2.8.1 Alternative 6 Mine Plan Components

Water Use

This alternative would need about 540,000 acre-feet of groundwater pumped from the Desert Wellfield through the life of the mine (see appendix H), or about 8 percent less water than under Alternative 2.

Tailings Facility – Tailings Type

Tailings types would be the same as described in Alternative 2 – Near West Proposed Action. The PAG tailings would be thickened at the West Plant Site. The thickened tailings would consist of approximately 84 percent NPAG and 16 percent PAG. Figure 2.2.8-2 shows the tailings storage facility for this alternative.

Tailings Facility – Tailings Conveyance

The two separate tailings streams (PAG and NPAG) would be piped as a thickened slurry from the West Plant Site to the Skunk Camp tailings storage facility, located approximately 14 miles (straight line) southeast of the West Plant Site. Like Alternative 5, two different route options from the West Plant Site are presently being studied. See figure 2.2.8-1 for both pipeline routes under consideration.

Tailings Facility – Embankment Type

As stated, the Skunk Camp tailings facility would comprise two physically separate starter facilities: PAG and NPAG (see figure 2.2.8-2).

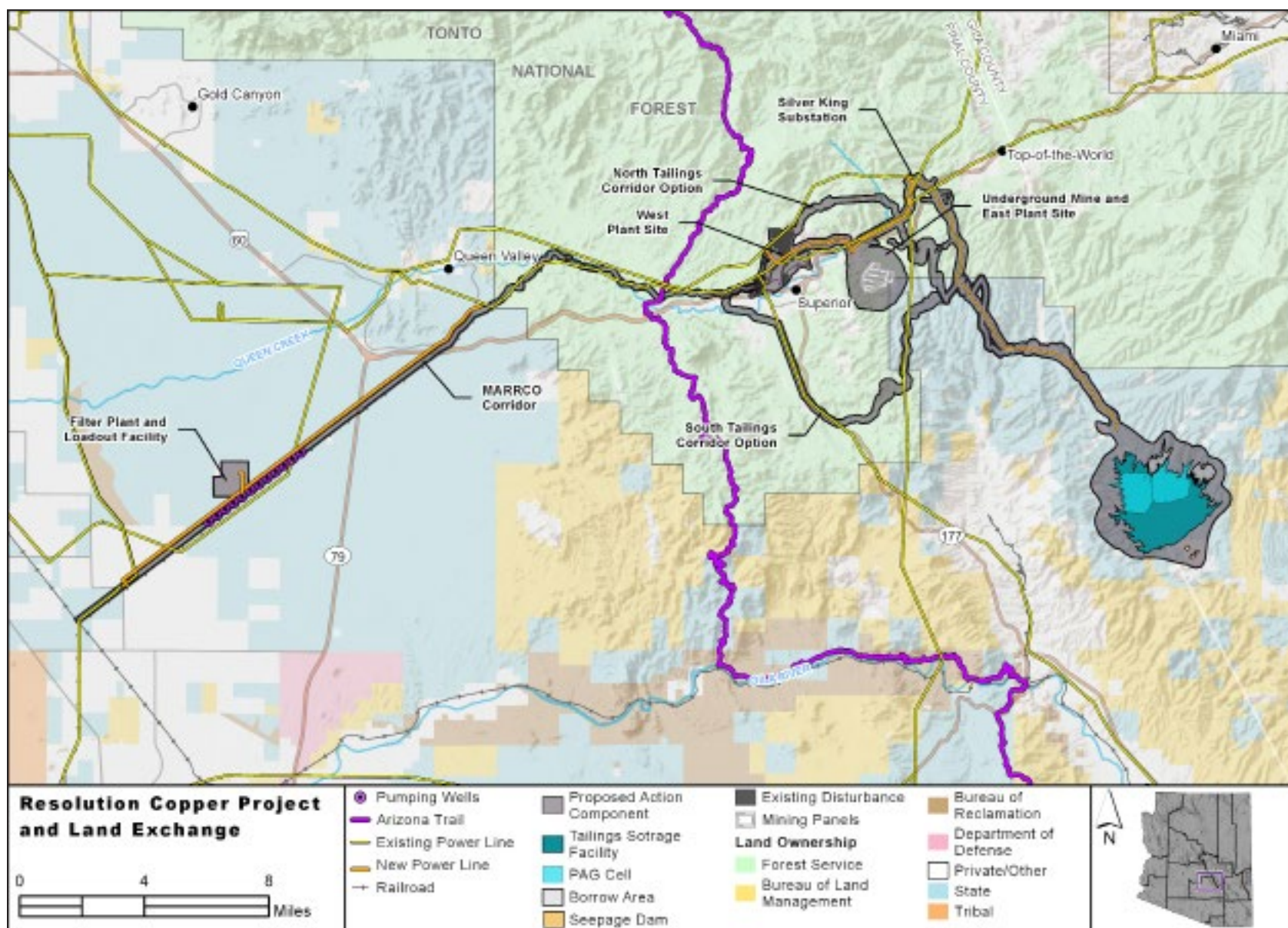


Figure 2.2.8-1. Alternative 6 – Skunk Camp overview

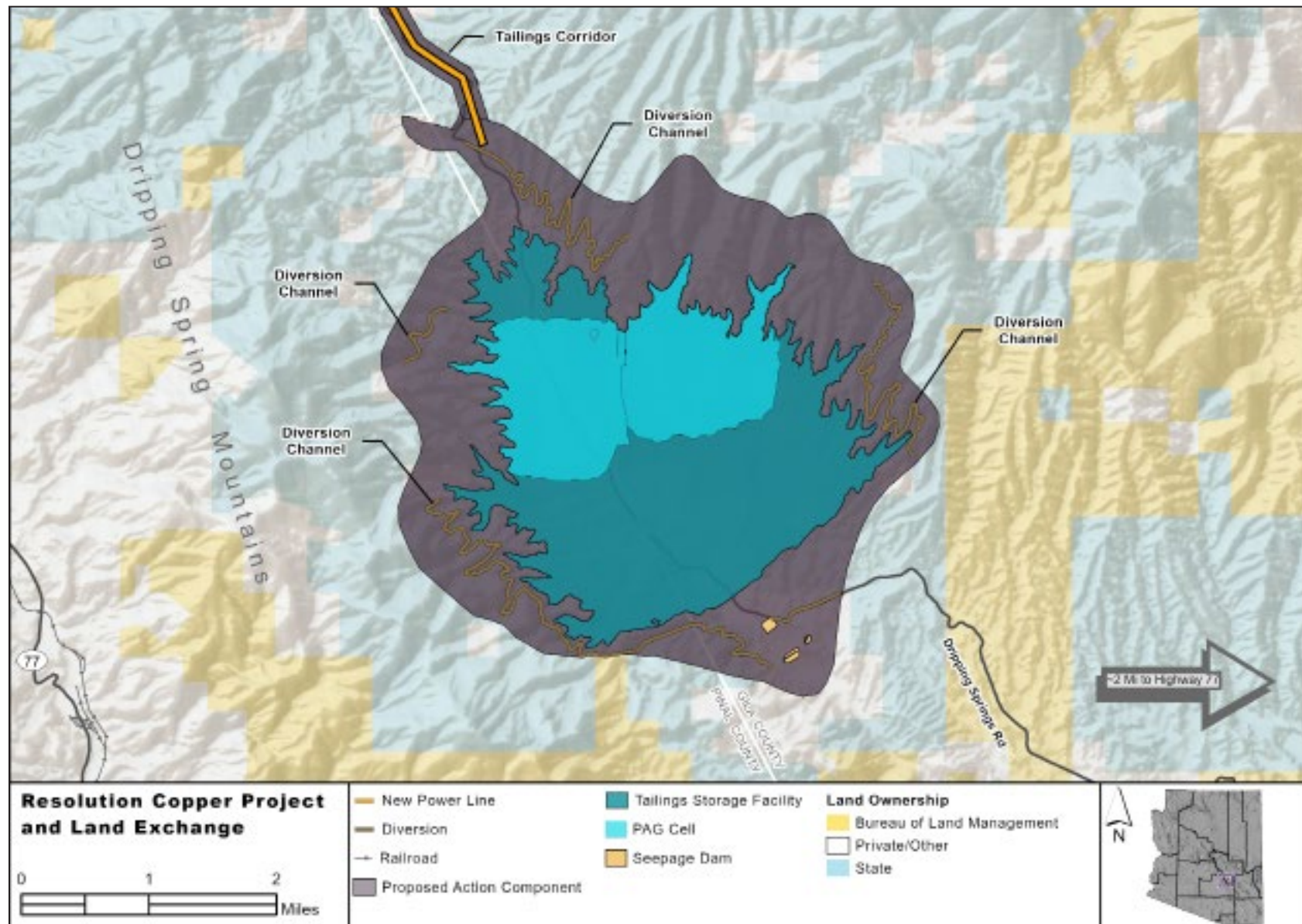


Figure 2.2.8-2. Alternative 6 – Skunk Camp tailings storage facility

Once delivered as a slurry to the Skunk Camp site, NPAG tailings would be cycloned to separate the coarser particles for use as embankment fill for part of the year, with the cyclone overflow (i.e., finer particles) being thickened at the tailings storage facility site before discharge into the impoundment. PAG tailings would be deposited into two separate cells, operated sequentially behind a separate cycloned sand embankment, to the north (upstream) end of the facility until they are encapsulated by the NPAG tailings.

The PAG and NPAG cells would be impounded by separate cross-valley starter embankments initially constructed of borrow material from within the ultimate tailings facility footprint. The impoundments would then periodically be raised in elevation during operations with compacted cycloned sand fill. The NPAG cell would use the centerline embankment construction approach, while the PAG cells would be constructed as downstream dams. The NPAG embankment would contain an underdrain system comprising sand and gravel blanket and finger drains (primarily along main drainages, with some extended beneath the NPAG beach) to maintain a low saturated surface in the tailings embankment and to intercept and direct seepage from the impoundment to the downstream seepage collection system ponds.

At full buildout, the embankment containing the NPAG tailings would be approximately 490 feet in height. As stated, the PAG cell embankment would be behind (upstream) and ultimately contained within the larger NPAG deposit.

Tailings Facility – Liner

To limit seepage under or around the Skunk Camp tailings storage facility, the PAG cell would incorporate an engineered low-permeability layer on the foundation and on the upstream face of the containment embankment. Engineered low-permeability layer containment could comprise one or more of the following: engineered low-permeability liner, compacted fine tailings, asphalt, slurry bentonite, cemented paste tailings, etc. To collect seepage downstream of the tailings storage facility, a foundation cut-off wall at the seepage collection pond would be constructed.

A single downvalley seepage collection pond would be the primary means for seepage and embankment construction and surface water collection during operations, with the collected water then pumped to a recycled water pond located within the operating PAG cell for use as process water at the cyclone house and/or at the West Plant Site, or for dust management at the tailings storage facility.

Tailings Facility – Disposal Method

Tailings would be deposited by pipeline to their respective cells around each embankment. In this alternative, the PAG tailings would be deposited subaqueously. NPAG slurry would initially be deposited using traditional methods.

Tailings Facility – Auxiliary Facilities

Five diversion dams, five diversion channels, and two non-contact water surface water pipelines would be constructed along the east and west sides of the tailings storage facility to intercept and route the upstream catchments around the facility. Collection ditches would be constructed along the embankment toe and at underdrain discharges to convey contact water to the seepage collection pond. Additional facilities at the Skunk Camp site would include the cyclone processing system (building to house the hydrocyclone(s), slurry dilution tanks, storage tanks, and associated equipment); an electrical substation and electrical distribution lines; a vehicle maintenance and fuel shop; equipment storage warehouse; administration and locker room facilities; and parking areas.

This is the only alternative that would require new transmission lines rather than tying into local lines nearby the facility. A new power line would be constructed from the existing Silver King substation north of U.S. 60 and Oak Flat that would follow a southeast alignment for 11.7 miles to the Skunk Camp location. Preliminary assessment of line voltage options show that either a 69-kV or 115-kV voltage level would be adequate to supply power to Skunk Camp. Further assessment by the electrical utility operating Silver King substation would be needed to

determine the adequate voltage and construction engineering, including access roads to service Skunk Camp.

Tailings Facility – Closure and Reclamation

Toward the end of operations, the tailings would be deposited or regraded to slope toward the north. At the end of operations, the remaining area of PAG tailings would be covered with a minimum 10-foot layer of NPAG tailings. The surfaces of both the NPAG and PAG facilities would be shaped to prevent standing water and divert runoff into channels leading to the downstream collection pond, and both NPAG and PAG areas would be covered by a 1- to 2-foot layer of low-permeability, erosion-resistant soil (e.g., Gila conglomerate or equivalent soil, sand, and gravel mix) and revegetated. The timing of reclamation is dependent on the surface being dry enough to allow equipment access for reclamation. A closure channel would be cut into the ridge between the tailings storage facility and the Mineral Creek drainage to convey the closed tailings storage facility runoff north.

Estimated seepage rates suggest active closure would be required up to 20 years after the end of operations. Up to 5 years after closure, the recycled water pond is still present and therefore all engineered seepage controls could remain operational. After 5 years, the recycled water pond is no longer present and seepage collection ponds would be expanded to maximize evaporation with active water management until the ponds could passively evaporate all incoming seepage (estimated at 20 years). The sludge containing concentrated metals and salts from evaporation would likely require cleanup and handling as a solid or hazardous waste.

Other closure and reclamation measures, such as the removal of buildings, pipelines, electrical equipment and electrical lines, and the recontouring and revegetation of parking areas and other areas of ground disturbance, would be substantially identical to those described for Alternative 2. Upstream (upslope) surface water diversion walls, channels, and other stormwater control elements would remain permanently in place to continue to direct surface flows around and

downstream of the tailings impoundments. Final reclamation plans would include the designs and long-term requirements for maintenance of these permanent facilities.

Table 2.2.8-1 summarizes the components of the Skunk Camp tailings storage facility.

Table 2.2.8-1. Summary of Alternative 6 – Skunk Camp tailings storage facility

Tailings Storage Facility	Description
Location	In Dripping Spring Wash approximately 13 miles north of confluence with the Gila River
Land ownership	ASLD, private
Distance from West Plant Site	15 miles
Tailings type and disposal	Thickened slurry tailings placed subaqueously for PAG tailings from barge in one of two cells, NPAG placed hydraulically from perimeter At disposal—PAG tailings would be 50% solids content; thickened cyclone overflow (NPAG) would be 60% solids content; and thickened NPAG stream sent directly from the mill would be 60% solids content.
Tailings embankment	Earthen starter dams raised with compacted cyclone sand. The NPAG facility would be a centerline construction approach with a 3H:1V slope and the PAG cells would be a downstream construction approach with a 2.5H:1V slope.
Lining and other seepage controls	Engineered, low-permeability layers would be installed on PAG cell foundation and the upstream slope of the embankment.
Approximate size at fence line of tailings storage facility	10,072 acres
Approximate embankment height	490 feet
Pipelines / conveyance	Thickened slurry pumped in two streams (PAG and NPAG) to the tailings storage facility and recycled water pipeline to return water to processing loop at West Plant Site North Option: 19.78 miles of corridor from West Plant Site to tailings storage facility South Option: 25.18 miles of corridor from West Plant Site to tailings storage facility
Auxiliary facilities	Surface water diversions would be large due to the steep surrounding terrain and need to surround the tailings facility on northern, eastern, and western sides with extensive stormwater diversion structures.
Other design considerations	No NFS roads are expected to be decommissioned or lost due to the tailings storage facility at Skunk Camp, although BLM has identified loss of access to mining activities and grazing facilities.
Closure and reclamation	Reclamation of the NPAG tailings embankment face would begin as soon as the slope reaches its final extent starting at approximately mine year 10–15. The top of the tailings storage facility would not be reclaimed until after mining is complete. Closure of the tailings recycled water pond is estimated to take up to 5 years after closure. Until that time, excess seepage in seepage ponds would be pumped back to the recycled water pond, and reclamation would take place on the embankment and tailings beaches. After the recycled water pond is closed, seepage ponds would be used to evaporate seepage, and the remaining reclamation of the tailings surface would occur.

2.2.9 Alternative GPO Components Common to All Action Alternatives

Minor modifications to two facilities proposed in the GPO have been considered in order to address specific resource impacts. These “alternative components,” described in the following subsections, may be applied to the proposed action or any of the action alternatives.

2.2.9.1 Relocation of Process Water Pond within West Plant Site

This alternative component would move the process water pond, as proposed in the GPO, off approximately 11.4 acres of NFS land immediately north of and adjacent to the West Plant Site and relocate the pond and associated facilities (e.g., fencing, stormwater control systems) fully within Resolution Copper private property boundaries on the western portion of the West Plant Site (figure 2.2.9-1).

As noted earlier, this potential amendment to the GPO was voluntarily brought to the attention of Tonto National Forest staff by representatives of Resolution Copper, who suggested this particular modification as a relatively low-cost change the company could make to reduce overall project impacts on NFS surface resources. It is anticipated that this alternative component to the GPO would be implemented under any project alternative and regardless of the site ultimately selected for location of the tailings storage facility and associated linear project features such as slurry pipelines and power lines.

2.2.9.2 Redesign and/or Improvement of Vehicle Access to and from the West Plant Site

Resolution Copper is also proposing an alternative routing of Silver King Mine Road (NFS Road 229), which would be used to transport mine personnel, equipment, supplies, and molybdenum and other mine products, to and/or from the West Plant Site (see figure 2.2.2-8).

This rerouting is anticipated to reduce typical use of NFS Road 229 by mine personnel from 2.3 miles, as described in the GPO, to just 0.4 mile. It is anticipated that this alternative component to the GPO would be implemented under any project alternative and regardless of the site ultimately selected for location of the tailings storage facility and associated linear project features such as slurry pipelines and power lines.

2.3 Mitigation Common to All Action Alternatives

Mitigation measures, as defined by the CEQ regulations (40 CFR 1508.20), include the following:

- Avoiding the impact altogether by not taking a certain action or parts of an action;
- Minimizing impacts 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 an impact over time, through preservation and maintenance operations during the life of the action; and
- Compensating for an impact by replacing or providing substitute resources or environments.

The Forest Service has developed mitigation measures and monitoring actions to be included as project design features in the proposed action and action alternatives. The effectiveness of the mitigation measures and monitoring actions has been evaluated as part of the projected impacts analyses for the proposed action and action alternatives. Refer to the impacts analyses in chapter 3 for further detail.

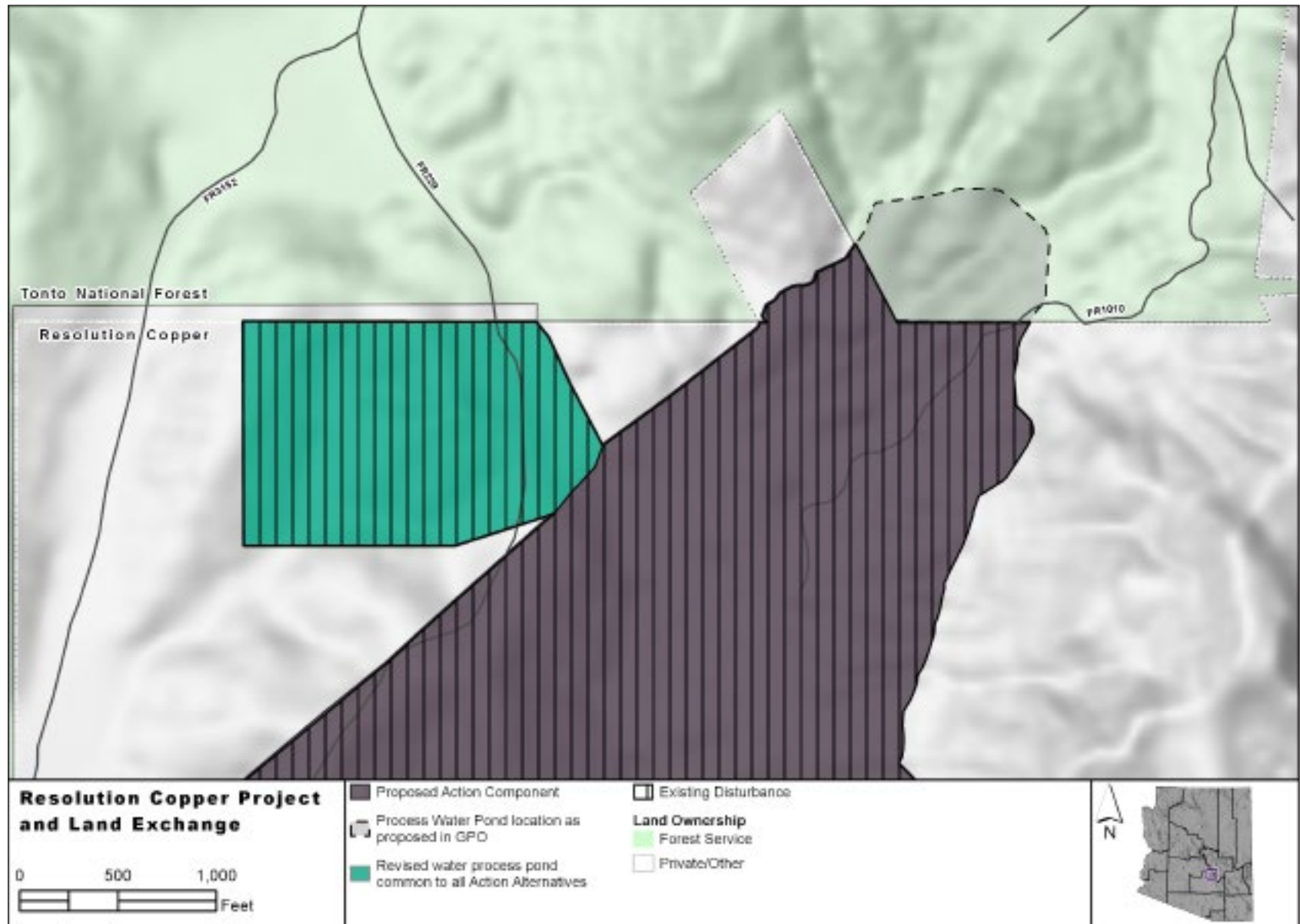


Figure 2.2.9-1. Relocation of process water pond within West Plant Site

2.3.1 Mitigation and Monitoring

The Forest Service has developed mitigation and monitoring actions that are evaluated in chapter 3 to be included in the proposed action and action alternatives. The framework for the project mitigation and monitoring plan is contained in appendix J of this DEIS. It is important to note that the full suite of mitigation measures and monitoring actions would not be known until many or most of the required permits have been issued, which often contain required measures intended to avoid or reduce environmental effects. It is fully expected that a more detailed and complete monitoring plan would be contained in the FEIS and ROD and ultimately included in the final GPO.

2.3.1.1 Authority

The CEQ (2011) states that agencies should not commit to mitigation measures absent the authority or expectation of resources to ensure that the mitigation is performed. The framework mitigation and monitoring plan is designed to clearly disclose which mitigation and monitoring items are within the authority of the Forest Service, or other regulatory and permitting agencies, such as the USACE, Arizona Department of Environmental Quality (ADEQ), and Arizona Department of Water Resources (ADWR).

Forest Service

The role of the Forest Service under its primary authorities in the Organic Administration Act, Locatable Regulations (36 CFR 228 Subpart A), and Multiple-Use Mining Act is to ensure that mining activities minimize adverse environmental effects on NFS surface resources.

Forest Service mitigation measures and monitoring are items that would help to minimize impacts on Forest Service surface resources; or are required by the project's U.S. Department of the Interior Fish and Wildlife Service (FWS) biological opinion, and the project's Programmatic Agreement (PA) with the Arizona State Historic Preservation Office (SHPO) and other signatories for compliance with

the National Historic Preservation Act. The Forest Service is responsible for determining whether the implementation of mitigation and the results of monitoring comply with the decision that would be documented in the ROD and in compliance with the final GPO.

The Forest Service has no authority, obligation, or expertise to determine or enforce compliance with other agencies' laws or regulations. The Forest Service seeks to coordinate with other agencies to approve a legally compliant final GPO; however, it is the operator's responsibility to ensure that its actions comply with applicable laws.

Other Regulatory and Permitting Agencies

Mitigation and monitoring items under this heading are within the authority of other regulatory permitting agencies, including the ADEQ, ADWR, ASLD, BLM, Pinal County Air Quality District, and USACE. Mitigation and monitoring measures under this authority include permit requirements and stipulations from legally binding permits and authorizations, such as the air quality permit, Aquifer Protection Permit, and groundwater withdrawal permit (see appendix H for a complete listing of permit requirements and stipulations). These other regulatory and permitting agencies would share monitoring results and any instances of non-compliance with the Forest Service. The Forest Service would use the information provided by the regulatory and permitting agencies to determine compliance with the decision that would be documented in the ROD and compliance with the final GPO.

Resolution Copper

Resolution Copper has agreed to implement additional mitigation and monitoring measures in the mitigation and monitoring plan that are outside the scope of the authorities listed here. As these were considered as required in the resource analyses, the final ROD would require these mitigations be enforced. These include contractual, financial, and other agreements over which the Forest Service and other regulatory agencies have no jurisdiction. The Forest Service and regulatory agencies have no authority, obligation, or expertise to determine or enforce

compliance of these measures. Since the Forest Service and regulatory permitting agencies cannot require implementation of the mitigation and monitoring measures in this authority, their implementation is not guaranteed until required by a signed final ROD and revised GPO with the mitigations included. The effectiveness of these mitigation measures is included in chapter 3 impact analyses.

2.3.1.2 Applicant-Committed Environmental Design Measures

Applicant-committed environmental design measures are features incorporated into the design of the project by Resolution Copper to reduce potential impacts on resources. These measures would be non-discretionary as they are included in the project design, and their effects are accounted for in the analysis of environmental consequences disclosed in each resource section of chapter 3.

2.3.1.3 Monitoring and Evaluation

Monitoring is fundamental for ensuring the implementation and effectiveness of mitigation commitments, meeting legal and permitting requirements, and identifying trends and possible means for improvement (Council on Environmental Quality 2011). CEQ regulations explicitly require that “a monitoring and enforcement program shall be adopted . . . where applicable for any mitigation” (40 CFR 1505.2(c)). In addition, any adaptive management approaches “must also describe the monitoring that would take place to inform the responsible official whether the action is having its intended effect” (36 CFR 220.5(e)). Detailed monitoring plans would be incorporated by reference into the agency’s decision document to ensure that they are legally binding. The following monitoring plans would identify the monitoring area, the monitoring systems, and future actions if thresholds are triggered:

- Subsidence management plan (appendix to GPO)

- Groundwater mitigation and monitoring plan
- Road use plan (appendix to GPO)
- Environmental emergency and response and contingency plan (appendix to GPO)
- Fire prevention and response plan (appendix to GPO)
- Preliminary spill prevention control and countermeasures plan (SPCC) (appendix to GPO)
- Explosives management plan (appendix to GPO)
- Acid rock drainage management plan (appendix to GPO)
- Hydrocarbon management plan (appendix to GPO)
- Environmental materials management plan (appendix to GPO)
- Preliminary stormwater pollution prevention plan (SWPPP) (appendix to GPO)
- Wildlife management plan (appendix to GPO)
- Noxious weed and invasive species plan (Resolution Copper 2019)
- Historic properties treatment plan for Oak Flat land exchange parcel (Deaver and O’Mack 2019)
- Historic properties treatment plan for GPO (in process)
- Tailings pipeline management plan (AMEC Foster Wheeler Americas Limited 2019)
- Concentrate pipeline management plan (M3 Engineering and Technology Corporation 2019b)

Monitoring and evaluation activities would be prescribed, conducted, and/or reviewed by Resolution Copper, the Forest Service, and other agencies with regulatory or permitting authority. Resolution Copper would fund monitoring as set forth in the ROD, approved final GPO, and the final mitigation and monitoring plan. Other monitoring activities

may be associated with the regulatory authority of other Federal and State agencies and would be funded by permit fees or the agencies themselves as part of their normal activities.

Evaluation and Reporting

Resolution Copper would submit an annual report to the Forest Service that contains a description of all activities conducted on NFS lands during the previous year and a summary of the amount of acreage disturbed, status of reclamation, spills or releases of chemicals or fuel, and results of all monitoring plans in a format approved by the Forest Service, including a complete data summary and any data trends, status of mining plan (tons of ore and waste mined and any changes to methods or equipment), and plans for the coming year. In addition to annual reporting, individual monitoring measures would also specify reporting requirements, which could include short-term emergency notification (for example, reporting spills within 72 hours) and interim reports (such as quarterly reports). The Forest Service would review reporting to ensure that mitigation commitments were implemented on NFS lands and the effectiveness of the mitigation. Significant changes would be required to be incorporated into the approved final GPO and reflected in financial assurance. Past, ongoing, or projected impacts on the environment may also require amendment of the approved final GPO, ROD, and/or financial assurance held for the project.

2.3.1.4 Financial Assurances

As part of the approval of a final GPO, the Forest Service would require Resolution Copper to post financial assurance, or reclamation bond, that would provide adequate funding to allow the Forest Service to complete reclamation and post-closure operation, maintenance activities, and necessary monitoring on NFS land for as long as required to return the site to a stable and acceptable condition. The amount of financial assurance would be determined by the Forest Service and would “address all Forest Service costs that would be incurred in taking over operations because of operator default” (U.S. Forest Service 2004). The financial assurance would be required in a readily available bond

instrument payable to the Forest Service. In order to ensure that the bond can be adjusted as needed to reflect actual costs and inflation, there would be provisions allowing for periodic adjustment on bonds in the final GPO prior to approval.

The reclamation bond amount is an estimate of both direct and indirect costs to reclaim the operation, based on contractors performing the work. This estimate is also to consider the time of operation in which reclamation costs would peak. This cost peak can be determined by looking subjectively at the mine schedule and timing of greatest areas and volumes of disturbance and materials or quantitatively calculating reclamation costs on an annual basis. As reclamation plans evolve from conceptual designs during permitting to as-built designs during construction, the bond estimates and requirements would be adjusted. Further, “Reclamation standards and bond estimates (with accompanying details) become legally binding when the operator changes the proposed Plan of Operation to include them, posts the required bond, and is notified by the authorized officer that the Plan of Operation is approved” (U.S. Forest Service 2004).

Other agencies also require separate financial assurance. The USACE requires financial assurance under Section 404 of the CWA where applicable. The ADEQ, ASLD, and Arizona State Mine Inspector also require bonds as part of their permitting authority. The BLM would require bonds if the project occurred on lands under their permitting authority. The APP requires bonding for closure and groundwater protection. Since the components of the final decision are unknown at this time, it is premature for the Forest Service to calculate bond.

Further discussion of financial assurance is included in section 1.5.5, and in certain sections of chapter 3, including section 3.3 (Soils and Vegetation), 3.7.2 (Groundwater and Surface Water Quality), and 3.10.1 (Tailings and Pipeline Safety).

2.4 Effects of the Land Exchange

As described in section 2.2.3.1, a completed land exchange is considered for all resource analyses in chapter 3.

Physically, the panel caving proposed to take place under Oak Flat is independent of the land exchange. The deposit would be mined with fundamentally the same techniques and require fundamentally the same infrastructure, and result in the same surface subsidence, regardless of whether the surface is under Forest Service jurisdiction or is private. The two primary differences are (1) the regulatory framework under which mining would occur “with” or “without” Federal oversight, and (2) without the land exchange, minerals underneath the withdrawal boundary could not be extracted. If a land exchange does not occur, Resolution Copper would mine and reclaim the mined land under Federal, State, and local permits and an approved GPO under 36 CFR 228 Subpart A. If the land exchange does occur and the Oak Flat area becomes private lands, Resolution Copper would be required to conduct its activities in accordance with all applicable Federal, State, and local permits but may not be subject to the requirement of obtaining an approved GPO under 36 CFR 228 Subpart A.

Mine operations are governed by several Federal, State, and local regulatory frameworks. Each of the regulatory frameworks is founded in statute and implemented through regulations and policies of the responsible agency. Agency regulations or rules provide guidance to the agency so it can implement the laws and provide guidance to mine operators so they can follow the laws. Each agency requires certain types of information (filing requirements) before it can process and issue permits under its regulations. Many of the filing requirements for permits from the various agencies are duplicative, even though each agency has its own regulatory authority and responsibilities. Performance standards specify the norm governing how operations would occur and describe the level of compliance expected by the agency.

Performance standards required by the Forest Service for mining on Federal land are contained in 36 CFR 228.8: “All operations shall be conducted so as, where feasible, to minimize adverse environmental impacts on National Forest surface resources.” These include specific requirements for air quality, water quality, solid waste, scenery values, fishery and wildlife habitat, roads, and reclamation.

State agencies have similar performance standards. For example, the goal of the State’s Aquifer Protection Permit program is to ensure no degradation of the state’s groundwater. ADEQ ensures this goal by implementing the performance standards outlined by the best available demonstrated control technology (Arizona Department of Environmental Quality 2004). Also, the goal of the state mined land reclamation rules is to ensure safe and environmentally sound reclamation of mined lands. The Office of the Arizona State Mine Inspector ensures this goal by requiring operators to meet operational and post-mine performance standards specified in the regulations at Arizona Revised Statutes (ARS) R11-2-601 *et seq.*

To ensure consistency, Federal, State, and local agencies in Arizona typically require that operators follow all other Federal, State, and local permit requirements and standards. The Forest Service specifies this explicitly for air quality (36 CFR 228.8(a)), water quality (36 CFR 228.8(b)), and solid waste (36 CFR 228.8(c)). Regulation also allows for certification or approval issued by State agencies or other Federal agencies to be accepted by the Forest Service as compliance with similar or parallel Forest Service regulations (36 CFR 228.8(h)).

While there is substantial overlap in many resources, there are also some resources that may lack any form of regulatory protection except under Federal jurisdiction. For instance, Forest Service regulations address scenic values (36 CFR 228.8(d)) and fisheries and wildlife habitat (36 CFR 228.8(e)), both of which are afforded little specific protection solely under other applicable Federal or State laws, the notable exception being species that are federally listed under the ESA.

A discussion of the differences in the regulatory framework if the land exchange occurs (mining occurs on private land) vs. if the land exchange does not occur (mining occurs under Forest Service jurisdiction) is included in appendix I.

2.5 Comparison of Alternatives

This section provides a summary of the effects of implementing each alternative. The information on the following pages is focused on

activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively between alternatives. See also Appendix E, Alternatives Impact Summary.

GEOLOGY, MINERALS, AND SUBSIDENCE — DEIS SECTION 3.2

Key factors to analyze the issue of geology, minerals, and subsidence	What are the results of impact analysis for the proposed action (Alternative 2)?	Are the analyzed impacts of these issues substantially different under Alternatives 3, 4, 5, or 6?
<ul style="list-style-type: none"> Assessment of the extent, amount, and timing of land subsidence, with estimates of uncertainty Assessment of potential public health risk from geological hazards, including seismic activity Assessment of the potential to impact caves or karst resources, and paleontological resources Assessment of impact on unpatented mining claims 	<p>Modeling indicates the subsidence area would first become evident at the surface at Oak Flat in mine year 6 or 7. At full mine development in year 40 or 41, the subsidence area is expected to be approximately 800–1,115 feet deep and approximately 1.8 miles in diameter. No damage is anticipated at Apache Leap, Devil's Canyon, or U.S. 60. Resolution Copper has stated they would cease mining additional subsurface panels if through ongoing monitoring it appears any of these areas would be impacted (see "Subsidence Impacts" in section 3.2.4.2).</p> <p>Potential risks to public safety from mine-induced seismic or other geological activity are low. Induced mine seismicity is possible, but unlikely to be of sufficient magnitude to cause structural damage (see "Geological Hazards" in section 3.2.4.2).</p> <p>With the exception of a small outcropping of Martin limestone that would be destroyed in the tailings facility footprint, no surface areas or geological units with known potential for caves, karsts, or paleontological resources are located within the predicted areas of disturbance (see "Paleontological Resources" and "Caves and Karst" in section 3.2.4.2).</p> <p>Access may be inhibited to non-Resolution Copper unpatented load or placer mining claims located under the tailings storage facility and pipeline (see "Unpatented Mining Claims" in section 3.2.4.2).</p>	<p>No. Subsidence is anticipated to only occur in the East Plant Site/Oak Flat area; these effects would be common to all action alternatives. Similarly, no geological or seismic activity of any kind is expected at any of the other proposed project facilities.</p> <p>All other alternatives also have non-Resolution Copper unpatented mining claims within either the tailings storage facility footprint or the tailings pipeline corridor.</p>

SOILS AND VEGETATION — DEIS SECTION 3.3

Key factors to analyze the issue of soils and vegetation	What are the results of impact analysis for the proposed action (Alternative 2)?	Are the analyzed impacts of these issues substantially different under Alternatives 3, 4, 5, or 6?
<ul style="list-style-type: none"> Acres of disturbance leading to lost soil productivity Assessment of the potential for revegetation of tailings and other mine facilities, based on revegetation efforts conducted in central and southern Arizona Evaluation of alteration of soil productivity and soil development Assessment of impacts on special status vegetation species Assessment of the potential to create conditions conducive for invasive species 	<p>All action alternatives, including Alternative 2, would result in impacts on endangered Arizona hedgehog cactus at the East Plant Site/subsidence area and possibly also at other project locations (see “Special Status Plant Species” in section 3.3.3.2 and “Construction/Operational Impacts” in section 3.3.4.2).</p> <p>Alternative 2 would remove or modify approximately 10,033 acres of vegetation and soils.</p> <p>Based on case studies in Arizona and New Mexico, a minimum of 8% of vegetation cover (including both native and non-native species) can consistently be established by year 10 within project disturbance areas (see “Expected Effectiveness of Reclamation Plans” in section 3.3.4.2).</p> <p>The revegetation response is expected to be influenced by the nature of the surface disturbance. Irrigation or active soil management could enhance revegetation success, thereby reducing erosional losses and net negative impacts on soil productivity. However, even with optimal soil management, impacts on soil health and productivity may last centuries to millennia; the ecosystem may not meet desired future conditions. Habitat may be suitable for generalist wildlife and plant species, but rare plants and wildlife with specific habitat requirements are unlikely to return (see “Potential to Achieve Desired Future Conditions” in section 3.3.4.2).</p> <p>The proposed project, under any action alternative, would increase the potential for noxious weed cover and possibly alter natural fire regimes. Reclamation of disturbed areas would decrease but not eliminate the likelihood of noxious weeds becoming established or spreading (see “Noxious Weeds” in section 3.3.4.2).</p>	<p>Yes. These discussions are applicable to all proposed and alternative tailings locations, but disturbance acreages would vary by alternative.</p> <p>Alternative 3: Same as Alternative 2</p> <p>Alternative 4 would remove or modify approximately 10,861 acres of vegetation and soils.</p> <p>Alternative 5 would remove or modify approximately 17,153 to 17,530 acres of vegetation and soils, depending on pipeline route.</p> <p>Both the east and west pipeline corridor options would also impact critical habitat. The west pipeline option would disturb around 103 acres of Acuña cactus critical habitat, and the east pipeline option would disturb about 12 acres of critical habitat.</p> <p>Alternative 6 would remove or modify approximately 16,166 to 16,557 acres of vegetation and soils.</p>

NOISE AND VIBRATION — DEIS SECTION 3.4

Key factors to analyze the issue of noise and vibration	What are the results of impact analysis for the proposed action (Alternative 2)?	Are the analyzed impacts of these issues substantially different under Alternatives 3, 4, 5, or 6?
<ul style="list-style-type: none"> Assessment of the ability of alternatives to meet rural landscape expectations Assessment of noise levels (A-weighted decibels [dBA]) and geographic area impacted from mine operations, blasting, and traffic, and qualitative assessment of effects of noise at nearby residences and sensitive receptors Assessment of effects of vibrations from blasting and mine operations at nearby residences and sensitive receptors 	<p>Noise impacts were modeled for 15 sensitive receptors representing residential, recreation, and conservation land uses. Under most conditions, predicted noise and vibrations during construction and operations, for both blasting and non-blasting activities, at sensitive receptors are below thresholds of concern; rural character would not change due to noise (see section 3.4.4.2).</p>	<p>Yes. For Alternatives 3, 4, and 5, noise impacts are the same, with noise and vibration levels at sensitive receptors below thresholds of concern under most conditions.</p> <p>For Alternative 6, noise levels along Dripping Springs Road exceed thresholds of concern. However, there would be no residual impacts after mitigation is implemented (i.e., new routing of access road), therefore rural character would not be altered due to increased noise.</p>

TRANSPORTATION AND ACCESS — DEIS SECTION 3.5

Key factors to analyze the issue of transportation and access	What are the results of impact analysis for the proposed action (Alternative 2)?	Are the analyzed impacts of these issues substantially different under Alternatives 3, 4, 5, or 6?
<ul style="list-style-type: none"> Assessment of change in type and pattern of traffic by road and vehicle type Assessment of the change in level of service (LOS) on potential highway routes and local roads Assessment of roads decommissioned by the mine and roads lost to motorized access 	<p>Sixty-four trips expected during the peak hour in peak construction and 46 trips expected during the peak hour during normal operations.</p> <p>Project-related traffic would contribute to decreased LOS at many intersections; unacceptable LOS (E/F) caused by project-related traffic occurs at Silver King Mine Road/U.S. 60 (construction and operations), Main Street/U.S. 60 (construction and operations), SR 177/U.S. 60 (construction), and Magma Mine Road/U.S. 60 (operations).</p> <p>A total of 8.0 miles of NFS roads would be lost due to the West Plant Site, East Plant Site, and filter plant and loadout facility. For the tailings facility, 21.7 miles of NFS roads would be lost and decommissioned.</p>	<p>Yes. Alternatives 3, 5, and 6 would have similar impacts as Alternative 2, but Alternative 4 would increase to 88 trips expected during the peak hour in peak construction and 58 trips expected during the peak hour during normal operations, due to placing the filter plant and loadout facility at the West Plant Site.</p> <p>LOS impacts from project-related traffic are similar to Alternative 2 for all other alternatives.</p> <p>At Alternative 4, a total of 17.7 miles of NFS roads would be lost to the tailings storage facility. Alternative 5 would not have loss to NFS roads but would result in the loss or decommissioning of 29 miles of BLM inventoried routes. Alternative 6 would be located on private lands and impact 5.7 miles of Dripping Springs Road.</p>

AIR QUALITY — DEIS SECTION 3.6

Key factors to analyze the issue of air quality	What are the results of impact analysis for the proposed action (Alternative 2)?	Are the analyzed impacts of these issues substantially different under Alternatives 3, 4, 5, or 6?
<ul style="list-style-type: none"> • Fugitive dust emissions • Stationary and mobile-source criteria air pollutant emissions and anticipated project conformance or non-conformance with National Ambient Air Quality Standards (NAAQS) • Conformance with the State Implementation Plan (SIP) in designated nonattainment and maintenance areas • Class I areas and air quality-related value impacts 	<p>Analysis finds that neither daily nor annual maximum impacts for fugitive dust (PM_{2.5} and PM₁₀) would exceed established air quality thresholds; no predicted results for criteria pollutants are anticipated to exceed the NAAQS at the ambient air boundary/fence line (see “Air Quality Impact Assessment” in section 3.6.4.2).</p> <p>The Forest Service determined that no conformity analysis is warranted. While the East Plant Site would be partially located in the Hayden PM₁₀ Nonattainment Area and the filter plant and loadout facility would be located in the West Pinal PM₁₀ Nonattainment Area, modeling results demonstrate that the impacts from the proposed action and alternatives would not exceed ambient air quality standards for these areas, and PM₁₀ emissions for stationary sources are well below the 100 tons/year threshold (see “Conformity” in section 3.6.3.2).</p> <p>Impacts are projected to be less than the PSD increments at all Class I areas but exceed 50% of the PM₁₀ and PM_{2.5} PSD increments at the Superstition Wilderness. Impacts on air quality-related values (deposition and visibility) would be within established thresholds for <i>de minimis</i> levels of acceptability (see “Impacts at Sensitive Areas” in section 3.6.4.2).</p>	<p>No. Emissions are largely similar between all alternatives, and no alternative is predicted to exceed NAAQS for criteria pollutants at the ambient air boundary/fence line.</p>

WATER RESOURCES: GROUNDWATER QUANTITY AND GROUNDWATER-DEPENDENT ECOSYSTEMS (GDES) — DEIS SECTION 3.7.1

Key factors to analyze the issue of groundwater quantity and groundwater-dependent ecosystems	What are the results of impact analysis for the proposed action (Alternative 2)?	Are the analyzed impacts of these issues substantially different under Alternatives 3, 4, 5, or 6?
<ul style="list-style-type: none"> Geographic extent in which water resources may be impacted and number of GDEs degraded or lost. Impact on public groundwater supplies Comparison of mine water needs Potential for subsidence to occur as a result of groundwater withdrawal. 	<p>Under no action, six GDEs (all springs) are anticipated to be impacted by groundwater drawdown from ongoing dewatering (see “Alternative 1 – No Action” in section 3.7.1.4).</p> <p>When block-caving occurs, groundwater impacts expand to overlying aquifers and two more GDEs (springs) are anticipated to be impacted. Alternative 2 also directly disturbs five GDEs (all springs), and reductions in stormwater runoff impact three more GDEs (Devil’s Canyon and two reaches of Queen Creek). There are surface water rights associated with many of these GDEs. A total of 16 GDEs would be impacted by Alternative 2. Loss of water would be mitigated but impacts on natural setting would remain (see Alternative 2, “Groundwater-Dependent Ecosystems Impacted,” in section 3.7.1.4).</p> <p>Groundwater supplies in Superior and Top-of-the-World could be impacted by groundwater drawdown but would be replaced through mitigation (see “Anticipated Impacts on Water Supply Wells” in section 3.7.1.4).</p> <p>Over the mine life, Alternative 2 would dewater about 87,000 acre-feet from the mine and would require about 590,000 acre-feet of makeup water pumped from the Desert Wellfield. The wellfield pumping would incrementally contribute to ground subsidence in the East Salt River valley, and cumulatively reduce overall groundwater availability in the area (see “Changes in Basin Water Balance – Mine Dewatering” and Alternative 2, “Changes in Desert Wellfield Pumping,” in section 3.7.1.4; and also see section 3.7.1.5).</p>	<p>Yes. There are differences between alternatives in the number of GDEs impacted and the amount of makeup water required.</p> <p>Alternative 3 would impact the same GDEs as Alternative 2 but would pump about 490,000 acre-feet from the Desert Wellfield over the mine life (see Alternative 3 in section 3.7.1.4).</p> <p>Alternative 4 would impact 14 GDEs (eight springs from groundwater drawdown, three springs from direct disturbance, and three stream reaches from reductions in stormwater runoff [Devil’s Canyon and two areas of Queen Creek]). Alternative 4 uses filtered tailings and would pump about 180,000 acre-feet from the Desert Wellfield over the mine life, much less than the other alternatives (see Alternative 4 in section 3.7.1.4).</p> <p>Alternative 5 would impact 14 GDEs (eight springs from groundwater drawdown, two springs from direct disturbance, and four stream segments from reductions in stormwater runoff [Devil’s Canyon, two areas of Queen Creek, and the Gila River]). Alternative 5 would pump about 540,000 acre-feet from the Desert Wellfield over the mine life (see Alternative 5 in section 3.7.1.4).</p> <p>Alternative 6 would impact the same GDEs and would pump about the same amount of water as Alternative 5 (see Alternative 6 in section 3.7.1.4).</p>

WATER RESOURCES: GROUNDWATER AND SURFACE WATER QUALITY — DEIS SECTION 3.7.2

Key factors to analyze the issue of groundwater and surface water quality	What are the results of impact analysis for the proposed action (Alternative 2)?	Are the analyzed impacts of these issues substantially different under Alternatives 3, 4, 5, or 6?
<ul style="list-style-type: none"> Anticipated groundwater and surface water quality changes, compared for context to Arizona water quality standards, in the block-cave zone and from tailings seepage Anticipated surface water quality impacts from stormwater runoff Assessment of seepage control techniques Potential for a lake to develop in the subsidence crater Reductions in assimilative capacity Potential impacts on impaired waters Assessment of the potential for processing chemicals, asbestos, or radioactive materials in tailings seepage 	<p>After closure, the reflooded block-cave zone is anticipated to have poor water quality (above Arizona water standards). No lake is anticipated to develop in the subsidence crater, and no other exposure pathways exist for this water (see “Potential for Subsidence Lake Development” in section 3.7.2.4).</p> <p>Stormwater runoff could have poor water quality but no stormwater contacting tailings or facilities is released during operations or post-closure until reclamation is successful and water meets appropriate standards (see “Potential Surface Water Quality Impacts from Stormwater Runoff” in section 3.7.2.4).</p> <p>Engineered seepage controls designed for Alternative 2 are modeled to capture 99% of seepage. No concentrations are above aquifer water quality standards; however, selenium concentrations in Queen Creek at Whitlow Ranch Dam are anticipated to be above surface water standards. There are substantial difficulties in adding additional seepage controls at this location; the risk for potential water quality problems is high (see Alternative 2, “Potential Water Quality Impacts from Tailings Storage Facility,” in section 3.7.2.4).</p> <p>Assimilative capacity for selenium in Queen Creek is used up by impact of tailings seepage. Queen Creek is impaired for copper, and copper load from tailings seepage inhibits watershed load reduction efforts (see “Potential Impacts on Impaired Waters” and “Predicted Reductions in Assimilative Capacity” in section 3.7.2.4).</p> <p>Analysis found little risk of processing chemicals, asbestos, or radioactive materials to persist in tailings or tailings seepage (see “Other Water Quality Concerns” in section 3.7.2.4).</p>	<p>Yes. All alternatives differ in engineered seepage controls, risk of water quality problems from tailings seepage, and impacts on downstream waters for assimilative capacity and impairment.</p> <p>Engineered seepage controls designed for Alternative 3 are modeled to capture 99.5% of seepage. This results in no concentrations above aquifer or surface water standards. Adding seepage controls at this location would be difficult, and risk for potential water quality problems high (see Alternative 3, “Potential Water Quality Impacts from Tailings Storage Facility,” in section 3.7.2.4).</p> <p>Engineered seepage controls designed for Alternative 4 are assumed (not modeled) to capture 90% of seepage. This results in no concentrations above aquifer water quality standards; however, selenium concentrations in Queen Creek at Whitlow Ranch Dam are anticipated to be above surface water standards. Some potential exists to add seepage controls at this location, so risk of potential water quality problems is less than Alternatives 2 and 3 (see Alternative 4, “Potential Water Quality Impacts from Tailings Storage Facility,” in section 3.7.2.4).</p> <p>Engineered seepage controls designed for Alternative 5 are modeled to capture 84% of seepage. This results in no concentrations above aquifer or surface water standards. Alternative 5 also has substantial flexibility for adding other layers of seepage controls during operations as needed (see Alternative 5, “Potential Water Quality Impacts from Tailings Storage Facility,” in section 3.7.2.4).</p> <p>Engineered seepage controls designed for Alternative 6 are modeled to capture 90% of seepage. This results in no concentrations above aquifer or surface water standards. Alternative 6 also has substantial flexibility for adding other layers of seepage controls during operations as needed (see Alternative 6, “Potential Water Quality Impacts from Tailings Storage Facility,” in section 3.7.2.4).</p>

WATER RESOURCES: SURFACE WATER QUANTITY — DEIS SECTION 3.7.3

Key factors to analyze the issue of surface water quantity	What are the results of impact analysis for the proposed action (Alternative 2)?	Are the analyzed impacts of these issues substantially different under Alternatives 3, 4, 5, or 6?
<ul style="list-style-type: none"> Assessment of the change in volume, frequency, and magnitude of runoff from the project area, as it affects Devil's Canyon, Queen Creek, and the Gila River Acres of 100-year floodplains impacted Acres of wetland impacted, based on National Wetlands Inventory Acres of potentially jurisdictional waters of the U.S. (Clean Water Act 404 permit) Potential changes in downstream geomorphology and sediment yield 	<p>There would be a reduction in average annual runoff due to the subsidence crater capturing precipitation, amounting to 3.5% at the mouth of Devil's Canyon, and 3.5% in Queen Creek at Whitlow Ranch Dam. The Alternative 2 tailings storage facility also captures precipitation, resulting in a combined loss in Queen Creek at Whitlow Ranch Dam of 6.5% (see Alternative 2, "Impacts on Surface Runoff and Streamflow," in section 3.7.3.4).</p> <p>Alternative 2 impacts 8.5 acres of floodplain (though Federal Emergency Management Agency [FEMA] coverage is incomplete), 98.6 acres of wetlands in the National Wetlands Inventory (94% of these are xeroriparian/ephemeral washes), and zero acres of impacts of jurisdictional waters (the USACE gave an approved delineation to Resolution Copper in 2015 that indicates waters upstream of Whitlow Ranch Dam are not considered jurisdictional; see Alternative 2 in section 3.7.3.4).</p> <p>Geomorphology and sediment impacts in downstream waters are unlikely to change for any alternative, due to nature of ephemeral washes and stormwater controls (see "Impacts on Sediment Yields and Geomorphology of Streams" in section 3.7.3.4).</p>	<p>Yes. Alternative 3 is identical to Alternative 2, but surface flow reductions, floodplains, wetlands, and waters of the U.S. differ for Alternatives 4 through 6.</p> <p>Alternative 4 results in an 8.9% combined loss of average annual runoff in Queen Creek at Whitlow Ranch Dam and 19.9% loss in Queen Creek at Boyce Thompson Arboretum. Alternative 4 impacts the same floodplains as Alternative 2, 90.5 acres of wetlands in the National Wetlands Inventory (95% of these are xeroriparian/ephemeral washes), and zero acres of impacts on jurisdictional waters (see Alternative 4 in section 3.7.3.4).</p> <p>Alternative 5 results in a 0.2% loss of average annual runoff in the Gila River at Donnelly Wash. Alternative 5 impacts up to 171 acres of floodplains (varies by pipeline route), up to 228.6 acres of wetlands in the National Wetlands Inventory (96% are xeroriparian/ephemeral washes), and 182.5 acres of potentially jurisdictional waters of the U.S. (Alternatives 5 and 6 are not in the Queen Creek drainage, unlike Alternative 2; see Alternative 5 in section 3.7.3.4).</p> <p>Alternative 6 results in a 0.5% loss of average annual runoff in the Gila River at Dripping Spring Wash and 0.3% in the Gila River at Donnelly Wash. Alternative 6 impacts 794 acres of mapped floodplain, up to 274 acres of wetlands in the National Wetlands Inventory (85% are xeroriparian/ephemeral washes), and 120 acres of potentially jurisdictional waters (see Alternative 6 in section 3.7.3.4).</p>

WILDLIFE AND SPECIAL STATUS WILDLIFE SPECIES — DEIS SECTION 3.8

Key factors to analyze the issue of wildlife	What are the results of impact analysis for the proposed action (Alternative 2)?	Are the analyzed impacts of these issues substantially different under Alternatives 3, 4, 5, or 6?
<ul style="list-style-type: none"> Assessment of effects on riparian habitat and species due to changes in flow Assessment of acres of suitable habitat disturbed for each special status species and by type of terrestrial and aquatic habitat lost, altered, or indirectly impacted Potential of mortality of animal species resulting from the increased volume of traffic related to mine operations Effects on wildlife behavior from noise, vibrations, and light Change in movement corridors and connectivity between wildlife habitats Impacts on aquatic habitats and surface water that support wildlife and plants 	<p>Alternative 2 would impact 16 groundwater-dependent ecosystems (GDEs). For the springs or stream segments impacted by groundwater drawdown or surface water flow reductions, mitigation would replace the water source and prevent widespread loss of riparian habitat. The remaining GDEs are lost to surface disturbance and would not be mitigated. Loss of xeroriparian habitat occurs for all alternatives.</p> <p>Habitat would be impacted to some extent for 50 special status wildlife species (see table 3.8.4.2 for details). Specific impacts could occur with western yellow-billed cuckoo (endangered) and southwestern willow flycatcher (endangered) from vegetation removal or project activities. Gila chub (endangered) has critical habitat along Mineral Creek but is not known to be present and habitat in Mineral Creek is not anticipated to be impacted (see “Impacts on Special Status Wildlife Species” in section 3.8.4.2).</p> <p>There is a high probability of mortality and/or injury of wildlife individuals from collisions with mine construction and employee vehicles as well as the potential mortality of burrowing animals in areas where grading would occur. Some individuals would be likely to move away from the sources of disturbance to adjacent or nearby habitats. Project-related noise, vibration, and light may also lead to increased stress on individuals and alteration of feeding, breeding, and other behaviors (see “General Construction Impacts” and “General Operations Impacts” in section 3.8.4.2).</p> <p>There would be loss and fragmentation of movement and dispersal habitats from the subsidence area and tailings storage facility. Ground-clearing and consequent fragmentation of habitat blocks for other mine-related facilities would also inhibit wildlife movement (see “Wildlife Connectivity” in section 3.8.4.2).</p> <p>There are 15 identified wildlife waters within 5 miles of the project footprint. Under Alternative 2, three would be lost beneath the tailings storage facility.</p>	<p>Yes. Alternative 3 is similar to Alternative 2.</p> <p>Alternative 4 would have more reduction in surface flow and greater impacts on Queen Creek. Alternatives 5 and 6 would have less impact on Queen Creek due to surface flow reductions. A total of 14 GDEs and 2 wildlife waters would be impacted under Alternatives 4, 5, and 6.</p> <p>Specific acres of habitat affected varies between alternatives (see table 3.8.4.2 for details).</p> <p>Alternative 6 (north and south tailings corridor options) would impact the greatest amount of acreage for Habitat Block 1 areas.</p>

RECREATION — DEIS SECTION 3.9

Key factors to analyze the issue of recreation	What are the results of impact analysis for the proposed action (Alternative 2)?	Are the analyzed impacts of these issues substantially different under Alternatives 3, 4, 5, or 6?
<ul style="list-style-type: none"> Changes in Recreation Opportunity Spectrum designations Assessment of acres of the Tonto National Forest that would be unavailable for recreational use, for various phases of mine life and reclamation Assessment of potential for noise to reach recreation areas (i.e., audio “footprint”) Assessment of impacts on solitude in designated wilderness and other backcountry areas Assessment of hunter-days lost (quantity based on number of permits available and number of days in season) Assessment of miles of Arizona National Scenic Trail, NFS trails, or other known trails requiring relocation, and qualitative assessment of user trail experience Assessment of increased pressure on other areas, including roads and trails/ trailheads, from displacement and relocation of recreational use as a result of mine facilities 	<p>Under Alternative 2, based on the Recreation Opportunity Spectrum (ROS) designation of user experiences, direct removal of 5,288 acres of the semi-primitive motorized setting, and 2,215 acres within the roaded natural setting (see table 3.9.4-1).</p> <p>All public access would be eliminated on 4,933 acres. Rock climbing opportunities at Euro Dog Valley, Oak Flat, and other portions of the mine area would be lost under all action alternatives but would be partially mitigated by new climbing area(s) set aside by Resolution Copper (see “Rock Climbing” in section 3.9.4.2).</p> <p>Under most conditions, with sensitive receptors representing recreation users, predicted noise during construction and operation are below thresholds of concern (see Alternative 2, “Recreation Opportunity Spectrum,” in section 3.9.4.3).</p> <p>Visitors to the Superstition Wilderness, Picketpost Mountain, and Apache Leap would have foreground and background views of the tailings facilities from trails and overlooks, and the recreation setting from certain site-specific views could change. Under Alternative 2, 0.07 mile of the tailings pipeline corridor would intersect the Arizona Trail (see Alternative 2, “Recreation Sites,” in section 3.9.4.3).</p> <p>The number of Arizona hunting permits that are issued in individual Game Management Units would not change as a result of the any of the action alternatives being implemented, though some individual's preferred hunting grounds may be lost (see “Hunting” in section 3.9.4.2).</p> <p>Under all action alternatives, it is likely that increased use would occur on other nearby lands that provide similar experiences, depending upon the recreational user type. A minor to moderate increase in user activity would be expected to occur in recreational use areas elsewhere, with uses largely similar to those displaced.</p>	<p>Yes.</p> <p>Alternative 3 is identical to Alternative 2.</p> <p>Alternative 4 would remove 5,548 acres of the semi-primitive motorized setting and 2,078 acres within the roaded natural setting. Alternative 4 would require 3.05 miles of the Arizona Trail to be closed and relocated to an area that would be safe for public use. Under Alternative 4, 26 NFS roads would be impacted for motorized recreation.</p> <p>Alternative 5 (east option) would remove 986 acres of the semi-primitive motorized setting, 1,209 acres of the semi-primitive non-motorized setting, and 1,977 acres of the roaded natural setting. Alternative 5 (west option) would remove 1,173 acres of the semi-primitive motorized setting, and 1,453 acres of the roaded natural setting. Under Alternative 5, 23 miles of BLM routes would be impacted for motorized recreation, and additional BLM and NFS roads would be crossed by the pipeline. Alternative 5 would intersect the Passage 16 segment of the Arizona Trail by 0.18 mile of the proposed tailings storage facility east pipeline. Visitors to the White Canyon Wilderness would have background views of the Alternative 5 east pipeline from some trails and overlooks.</p> <p>Alternative 6 (north option) would remove 1,665 acres of the semi-primitive motorized setting, and 1,740 acres of the roaded natural setting. Alternative 6 (south option) would remove 1,617 acres of the semi-primitive motorized setting, and 2,054 acres of roaded natural setting. Under Alternative 6, no BLM or NFS roads are within the footprint, although roads are crossed by the pipeline. The Alternative 6 south pipeline would be visible from trails and overlooks on Picketpost Mountain and the north pipeline from Superstition Wilderness.</p>

PUBLIC HEALTH AND SAFETY: TAILINGS AND PIPELINE SAFETY — DEIS SECTION 3.10.1

Key factors to analyze the issue of tailings and pipeline safety	What are the results of impact analysis for the proposed action (Alternative 2)?	Are the analyzed impacts of these issues substantially different under Alternatives 3, 4, 5, or 6?
<ul style="list-style-type: none"> Qualitative assessment of the risk of failure of tailings embankment or concentrate/tailings pipelines and potential impacts downstream in the event of a failure 	<p>Risk of failure of all alternatives is minimized by required adherence to National Dam Safety Program and APP standards, and applicant-committed environmental protection measures (see “Federal Requirements for Tailings Facility Design” in section 3.10.1.3).</p> <p>Failure of a slurry tailings facility has historically been demonstrated to have the potential to runout tailings dozens or even hundreds of miles downstream. Consequences of a catastrophic failure at the Alternative 2 tailings storage facility would include possible loss of life and limb, destruction of property, and displacement of large populations with a downstream population of over 600,000, including Queen Valley, within a few miles downstream. A catastrophic failure would disrupt the Arizona economy, would result in contamination of soils and water, and would jeopardize water supplies for over 700,000 people and key water infrastructure like the CAP canal (see 3.10.1.4, Alternative 2).</p> <p>Consequences of a concentrate or tailings pipeline failure would include soil and water contamination and destruction of vegetation in any water bodies crossed.</p> <p>The Alternative 2 embankment is less resilient than Alternatives 5 and 6 due to:</p> <ul style="list-style-type: none"> modified-centerline construction instead of centerline construction a long embankment (10 miles) a freestanding structure the potential to release PAG materials during a failure 	<p>Yes. While all built to the same standards, the alternatives differ in downstream environment and resilience of the design. Alternative 3 is similar to Alternative 2, but the design is more resilient because of the use of ultrathickened tailings (see Alternative 3 in section 3.10.1.4).</p> <p>Alternative 4 is fundamentally different from the other action alternatives. As a filtered tailings facility, if Alternative 4 were to fail, it would likely fail as an earth slump or landslide, impacting only several miles of xeroriparian wash and not jeopardizing life and limb, property, or water supplies (see Alternative 4 in section 3.10.1.4).</p> <p>Alternative 5 has smaller downstream populations (32,000), with no major population center for 20 miles. The Gila River Indian Community and substantial agricultural water supplies are downstream. Alternative 5 facility is more resilient than Alternatives 2 and 3 due to: centerline construction, a slightly shorter embankment (7 miles), and storage of PAG in separate cells that use downstream embankments (see Alternative 5 in section 3.10.1.4).</p> <p>Alternative 6 has the smallest downstream population (3,200) but with a population center just downstream. The Alternative 6 facility is more resilient than Alternatives 2, 3, or 5 due to: centerline construction, the shortest embankment (3 miles), cross-valley construction, and storage of PAG in separate cells that use downstream embankments (see Alternative 6 in section 3.10.1.4).</p>

PUBLIC HEALTH AND SAFETY: FUELS AND FIRE MANAGEMENT — DEIS SECTION 3.10.2

Key factors to analyze the issue of fuels and fire management	What are the results of impact analysis for the proposed action (Alternative 2)?	Are the analyzed impacts of these issues substantially different under Alternatives 3, 4, 5, or 6?
<ul style="list-style-type: none"> Potential for increased fire risk due to mine operations (i.e., inadvertent ignition) Potential for increased fuelwood loads in the Oak Flat area as a result of subsidence and dewatering Adequacy of Forest Service and municipal fire teams and equipment to respond to wildfires 	<p>Wildland fire is always a risk, particularly in areas where human activities and greater densities of standing and fallen vegetation intersect (areas, for example, such as Oak Flat). It is assumed that MSHA regulations, Resolution Copper's own internal policies, as well as Forest Service and Pinal County–announced fire risk alerts and restrictions during periods of drier conditions and higher winds, would serve to prevent most cases of inadvertent, human-caused ignition (see section 3.10.2.4).</p> <p>While some increase in dead and dying vegetation within the subsidence area may be expected, other plants may be expected to persist and still others to reestablish within the area, particularly once active subsidence ceases. The risk of human-caused ignitions in the subsidence area is effectively negligible because the area would be fenced off and no entry would be permitted. Die-off of riparian vegetation is not anticipated as a consequence of dewatering in the Oak Flat area generally, because agreed-upon mitigation measures would ensure replacement water in these areas.</p> <p>Wildland fire response in and adjacent to the project areas would be provided by local fire department personnel such as those from the Town of Superior. The Tonto National Forest, BLM, and Pinal County also provide support for initial wildland fire attack for areas within and adjacent to wildland–urban interface (WUI) areas, while the Arizona Department of Forestry and Fire Management is responsible for suppression of wildland fire on State Trust land and private property located outside incorporated communities. Historically, these assets and accompanying wildland fire control strategies have been considered adequate; it should be noted, however, that fire response resources tend to become limited during the height of the annual fire season due to commitments elsewhere in the state (see “Wildfire Response” in section 3.10.2.3).</p>	<p>Yes. While under any of the alternatives, the risk of inadvertent ignition and resulting wildland fire is considered quite low, Alternative 4 includes areas classified with shrub fuels (SH7) that burn with high intensity in the event of an ignition. Intense fire behavior was observed within the footprint of Alternative 4 during the Peachville Fire, which burned a portion of the proposed tailings area in 2005.</p> <p>In addition, the southern portion of the footprint for Alternative 4 is located within the WUI for the town of Superior, meaning this location could potentially expose life and property to wildfire impacts should an ignition occur. On the other hand, because of the close proximity to Superior, fire response to the area should be rapid with emergency services provided by both the Tonto National Forest and the Town of Superior (see section 3.10.2.4).</p>

PUBLIC HEALTH AND SAFETY: HAZARDOUS MATERIALS — DEIS SECTION 3.10.3

Key factors to analyze the issue of hazardous materials	What are the results of impact analysis for the proposed action (Alternative 2)?	Are the analyzed impacts of these issues substantially different under Alternatives 3, 4, 5, or 6?
<ul style="list-style-type: none"> Amount, type, location of storage, use, and disposal of hazardous materials and potential for release to the environment Transportation of hazardous materials to the project area and potential for release to the environment Fate and transport of different types of hazardous materials if they enter the environment 	<p>The Resolution Copper GPO and appendix G of the EIS provide information on the company's expected use of various chemicals and other hazardous materials in its mining and processing operations.</p> <p>MSHA and other regulations and standards govern the transport and storage of explosives and hazardous chemicals; risks of spills or releases are therefore considered possible, but unlikely.</p> <p>Potential releases of hazardous materials during transportation could occur, but the fate and transport of those hazardous materials depend entirely on where the release occurs and the quantity of the release. The company would be required by various local, State, and Federal regulations to maintain spill prevention, control, and emergency response plans.</p>	No. See section 3.10.3.4.

SCENIC RESOURCES — DEIS SECTION 3.11

Key factors to analyze the issue of scenic resources	What are the results of impact analysis for the proposed action (Alternative 2)?	Are the analyzed impacts of these issues substantially different under Alternatives 3, 4, 5, or 6?
<ul style="list-style-type: none"> Acres of Tonto National Forest that would no longer meet current forest plan Visual Quality Objective designations Anticipated changes in landscape character from key analysis viewpoints, for various phases of mine life and reclamation Miles of project area visibility along major thoroughfares in the area (i.e., U.S. 60, SR 79, and SR 177) Potential for increase in sky brightness resulting from the mine facility and mine-related vehicle lighting 	<p>Analysis finds that within the project footprint the following acreage totals have designations that would not allow for the proposed project activities: 393 acres of Retention, and 5,184 acres of Partial Retention (see table 3.11.4-2).</p> <p>The analysis of anticipated changes in landscape character from key analysis viewpoints for Alternative 2 is too extensive to summarize here and is presented in tables 3.11.4-1, 3.11.4-3, 3.11.4-4, and 3.11.4-5.</p> <p>Analysis shows that Alternative 2 facilities would be visible along 21.2 miles of U.S. 60 and 2.5 miles of SR 177 (see table 3.11.4-4).</p> <p>Lighting at the East Plant Site, West Plant Site, and tailings facility would be visible and noticeable at night from the town of Superior, U.S. 60, Boyce Thompson Arboretum, the Arizona Trail, and the surrounding national forest landscape (see Alternative 2, “Dark Skies,” in section 3.11.4.1).</p>	<p>Yes.</p> <p>Under Alternative 4, analysis finds that within the project footprint the following acreage totals have designations that would not allow for the proposed project activities: 371 acres of Retention, and 4,663 acres of Partial Retention (see table 3.11.4-2). Analysis of anticipated changes in landscape character for Alternative 4 is presented in tables 3.11.4-6 and 3.11.4-7. Alternative 4 facilities would be visible along 18.3 miles of U.S. 60 and 3.6 miles of SR 177 (see table 3.11.4-6).</p> <p>Under Alternative 5, analysis finds that within the project footprint the following acreage totals have designations that would not allow for the proposed project activities: 691 (east) or 530 (west) acres of Retention, and 1,905 (east) or 1,824 (west) acres of Partial Retention (see table 3.11.4-2). Analysis of anticipated changes in landscape character for Alternative 5 is presented in tables 3.11.4-8 and 3.11.4-9. Alternative 5 facilities would be visible along 1.5 miles of U.S. 60 and 1.5 miles of SR 177 (see table 3.11.4-8).</p> <p>Under Alternative 6, analysis finds that within the project footprint the following acreage totals have designations that would not allow for the proposed project activities: 676 (north) or 771 (south) acres of Retention, and 2,043 (north) or 2,225 (south) acres of Partial Retention (see table 3.11.4-2). Analysis of anticipated changes in landscape character for Alternative 6 is presented in table 3.11.4-10.</p> <p>Dark sky impacts are similar among alternatives.</p>

CULTURAL RESOURCES — DEIS SECTION 3.12

Key factors to analyze the issue of cultural resources	What are the results of impact analysis for the proposed action (Alternative 2)?	Are the analyzed impacts of these issues substantially different under Alternatives 3, 4, 5, or 6?
<ul style="list-style-type: none"> Assessment of the impacts on places of traditional and cultural significance to Native Americans, including natural resources Assessment of number of NRHP-eligible historic properties, sacred sites, and other landscape-scale properties to be buried, destroyed, or damaged Assessment of impacts on historic properties, including number of NRHP-eligible historic properties expected to be visually impacted 	<p>The NRHP-listed <i>Chi'chil Bildagoteel</i> Historic District TCP would be directly and permanently damaged.</p> <p>Under Alternatives 2 and 3, 101 NRHP-eligible sites and 31 sites of undetermined eligibility would be directly affected; another 29 sites would be indirectly affected (see "Direct Impacts" and "Indirect Impacts" in section 3.12.4.3).</p> <p>Additional historic properties and archaeological sites are located within 6 miles of the proposed project and could be impacted by their proximity to mining disturbance (see "Atmospheric Impacts" in section 3.12.4.3).</p>	<p>Under any action alternative, impacts of mine development at the associated project facilities would have equivalent adverse effects on cultural resources. Some surveys continue; all alternatives will be 100% pedestrian surveyed.</p> <p>For Alternative 4, 122 NRHP-eligible sites and 15 sites of undetermined eligibility would be directly affected; another 25 sites would be indirectly affected (see section 3.12.4.5).</p> <p>For Alternative 5 east option, 125 NRHP-eligible sites and 27 sites of undetermined eligibility would be directly affected; another 44 sites would be indirectly affected (see section 3.12.4.6).</p> <p>For Alternative 5 west option, 114 NRHP-eligible sites and 11 sites of undetermined eligibility would be directly affected; another 29 sites would be indirectly affected (see section 3.12.4.6).</p> <p>For Alternative 6 north option, 318 NRHP-eligible sites and 5 sites of undetermined eligibility would be directly affected depending on pipeline route; another 25 additional sites would be indirectly affected (see section 3.12.4.7).</p> <p>For Alternative 6 south option, 343 NRHP-eligible sites and 17 sites of undetermined eligibility would be directly affected depending on pipeline route; as another 41 additional sites would be indirectly affected (see section 3.12.4.7).</p>

SOCIOECONOMICS — DEIS SECTION 3.13

Key factors to analyze the issue of socioeconomics	What are the results of impact analysis for the proposed action (Alternative 2)?	Are the analyzed impacts of these issues substantially different under Alternatives 3, 4, 5, or 6?
<ul style="list-style-type: none"> Assessment of potential changes in employment, labor earnings, and area economic output as a result of the Resolution Copper Mine, including direct and indirect economic effects Assessment of changes to tax revenues; potential increased need for road maintenance and local emergency services; potential changes in tourism and recreation; potential effects on property values 	<p>On average, the mine is projected to directly employ 1,500 workers, pay about \$134 million per year in total employee compensation, and purchase about \$546 million per year in goods and services. Including direct and multiplier effects, the proposed mine is projected to increase average annual economic value added in Arizona by about \$1 billion (see “Impact on Employment, Earnings, and Value Added” under “Socioeconomic Impacts” in section 3.13.4.2).</p> <p>The proposed mine is projected to generate an average of between \$88 and \$113 million per year in state and local tax revenues and would also produce substantial revenues for the Federal Government, estimated at over \$200 million per year (see “State and Local Government Revenue Summary” under “Socioeconomic Impacts” in section 3.13.4.2).</p> <p>Construction and operations of the proposed mine could affect both the Town of Superior’s costs to maintain its network of streets and roads as well as those of Pinal County. A number of agreements between Resolution Copper and the Town of Superior would offset impacts on quality of life, education, and emergency services (see “Mine-Related Demands and Costs for Public Services” under “Socioeconomic Impacts” in section 3.13.4.2).</p> <p>Property values are expected to decline in close proximity to the tailings storage facilities and are estimated to average 4.1% under Alternative 2 (see “Potential Property Value Effects” under “Socioeconomic Impacts” in section 3.13.4.2).</p> <p>Loss of hunting revenue due to the tailings storage facility is expected to be greatest under Alternative 2 (see “Potential Effects on the Nature-Based Tourism Economy” under “Socioeconomic Impacts” in section 3.13.4.2).</p>	<p>Yes.</p> <p>Socioeconomic effects under any of the action alternatives are anticipated to be fundamentally the same as Alternative 2, except for property values and hunting revenue.</p> <p>Property values are expected to decline 10.6% under Alternative 4; approximately 6.3% under Alternative 5; and about 4.0% under Alternative 6 (see table 3.13.4-5).</p> <p>Loss of hunting revenue is similarly high under Alternative 4, and lowest under Alternative 5. Being private and State lands, hunting effects have yet to be determined for Alternative 6.</p>

TRIBAL VALUES AND CONCERNS — DEIS SECTION 3.14

Key factors to analyze the issue of tribal values and concerns	What are the results of impact analysis for the proposed action (Alternative 2)?	Are the analyzed impacts of these issues substantially different under Alternatives 3, 4, 5, or 6?
<ul style="list-style-type: none"> Assessment of how cumulative resource disturbance impacts tribal values and spiritual practices Assessment of number of sacred springs or other discrete sacred sites that would be impacted, and potential effects on Native Americans from the desecration of land, springs, burials, and sacred sites Estimated acres of traditional resource collection areas that would be impacted 	<p>Development of the Resolution Copper Mine would directly and permanently damage the NRHP-listed <i>Chi'chil Bildagoteel</i> Historic District TCP. Other large-scale mine development along with smaller transportation, utility, and private land development projects in the greater Superior region may also affect places and resources of value to Native Americans, including historical and ceremonial sites and culturally valued landforms and features.</p> <p>Dewatering or direct disturbance would impact between 14 and 16 groundwater dependent ecosystems, mostly sacred springs. While mitigation would replace water, impacts would remain to the natural setting of these places.</p> <p>Burials are likely to be impacted; the numbers and locations of burials would not be known until such sites are detected as a result of mine-related activities.</p> <p>Under this or any action alternative, one or more Emory oak groves at Oak Flat, used by tribal members for acorn collecting, would likely be lost. Other unspecified mineral- and/or plant-collecting locations would also likely be affected; historically, medicinal and other plants are frequently gathered near springs and seeps, so drawdown of water at these locations may also adversely affect plant availability.</p>	<p>Under any action alternative, impacts of mine development at the East Plant Site (Oak Flat), West Plant Site, MARRCO corridor, and at other ancillary facilities would have equivalent adverse effects on tribal values and concerns.</p> <p>Impacts on tribal values and concerns would be similar in context and intensity under Alternatives 4, 5, and 6; however, because the tailings storage facility under each of these alternatives would be in a different location, the specific impacts on potentially meaningful sites, resources, routes, and viewsheds would vary. See sections 3.11.4 (Scenic Resources), 3.12.4 (Cultural Resources), and 3.14.4 (Tribal Values and Concerns) for detailed impact analyses specific to each alternative.</p>

ENVIRONMENTAL JUSTICE — DEIS SECTION 3.15

Key factors to analyze the issue of environmental justice	What are the results of impact analysis for the proposed action (Alternative 2)?	Are the analyzed impacts of these issues substantially different under Alternatives 3, 4, 5, or 6?
<ul style="list-style-type: none"> Potential for disproportionate economic effects on identified environmental justice communities in the analysis area (see “Potential Effects on Environmental Justice Communities by Resource” in section 3.15.4.3) 	<p>Environmental justice communities identified in the analysis area include eight identified Native American communities, as well as</p> <ul style="list-style-type: none"> town of Hayden, town of Miami, city of Globe, town of Superior, and town of Winkelman. <p>Economic effects from the mine would be most apparent in the environmental justice community of the town of Superior due to its immediate proximity to Resolution Copper Project operations. While mine-induced beneficial economic activity would be expected to increase in the region generally, the expected influx of new workers may also lead to shortages of area housing and/or pressures on municipal infrastructure such as roads, schools, and medical facilities, and may be accompanied by price increases. Such changes would be most likely to adversely affect low-income and minority individuals in the town of Superior and other environmental justice communities in the region.</p> <p>Environmental effects in the immediate area such as increased traffic, noise, increased potential exposure to hazardous material spills or releases, as well as loss of certain recreational opportunities and changes to area scenic resources, are anticipated to occur, but would affect everyone equally and would therefore not be disproportionate.</p>	<p>No. Anticipated impacts on the environmental justice communities identified in the analysis area are not anticipated to vary by alternative, with the town of Superior having the most apparent effects.</p>

LIVESTOCK AND GRAZING — DEIS SECTION 3.16

Key factors to analyze the issue of livestock and grazing	What are the results of impact analysis for the proposed action (Alternative 2)?	Are the analyzed impacts of these issues substantially different under Alternatives 3, 4, 5, or 6?
<ul style="list-style-type: none"> Potential for changes to acreages of grazing allotments; potential for loss of grazing-related facilities (waters, stock tanks, roads, fences, etc.); and potential for changes to available animal unit months (AUMs) within individual grazing allotments (see section 3.16.4.2). 	<p>Under Alternative 2, affected grazing allotments would experience a reduction of 8,572 acres and 666 AUMs over six allotments and 25 grazing-related facilities would also be lost (see Alternative 2 in section 3.16.4.2).</p>	<p>Yes. Although acreage changes to grazing allotments would be identical under Alternatives 2 and 3, Alternatives 4, 5, and 6 would be different.</p> <p>Alternative 4: There would be a reduction in 9,399 acres and 737 AUMs over six allotments, and 24 grazing-related facilities would be lost (see Alternative 4 in section 3.16.4.2).</p> <p>Alternative 5: For the east pipeline corridor: There would be a reduction in 15,672 acres and 1,378 AUMs over 10 allotments, and 14 grazing-related facilities would be lost (see Alternative 5 in section 3.16.4.2).</p> <p>For the west pipeline corridor: There would be a reduction in 16,186 acres and 2,380 AUMs over 12 allotments, and 14 grazing-related facilities would be lost (see Alternative 5 in section 3.16.4.2).</p> <p>Alternative 6: For the north pipeline corridor: There would be a reduction of 14,747 acres and 2,674 AUMs over nine allotments, and 21 grazing-related facilities would be lost (see Alternative 6 in section 3.16.4.2).</p> <p>For the south pipeline corridor: There would be a reduction in 15,209 acres and 2,745 AUMs over nine allotments, and 21 grazing-related facilities would be lost (see Alternative 6 in section 3.16.4.2).</p>

This page intentionally left blank

Overview

Chapter 3 describes the natural and human environment that may be affected by the proposed action and its alternatives, and discloses the direct, indirect, and cumulative impacts that could occur because of the proposed action or alternatives.

Direct and indirect impacts are those caused by the project itself. Cumulative impacts take into account not just the direct and indirect impacts of the proposed action (or alternatives), but also the combined effects of other past, present, and reasonably foreseeable future actions. These actions may have individually minor effects but become significant when combined. In most cases past and present actions, including ongoing trends, are part of the description of the affected environment.

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 Introduction

Each of the following sections in chapter 3 focuses on a specific resource, describes the environment that may be affected by the proposed action and its alternatives, and describes the direct, indirect, and cumulative impacts that could occur for that resource.

“Geology, Minerals, and Subsidence” (section 3.2) describes known geological characteristics at each of the major facilities of the proposed mine—including alternative tailings storage locations—and how the development of the project may impact existing cave and karst features, paleontological resources, area seismicity and other geological hazards, and mining claims. It also outlines subsidence impacts that would result from Resolution Copper’s plans to extract the ore from below the deposit using a mining technique known as “block caving” or “panel caving” and describes how subsidence would affect Apache Leap.

“Soils and Vegetation” (section 3.3) explains how the proposed mine would disturb large areas of ground and potentially destroy native vegetation, including species given special status by the Forest Service, and encourage noxious or invasive weeds. This section also discusses reclamation plans and expected reclamation success.

“Noise and Vibration” (section 3.4) provides a detailed analysis of estimated impacts from noise

and vibration under the proposed mining plan and each of the alternatives, including blasting impacts.

“Transportation and Access” (section 3.5) discusses how the proposed Resolution Copper Mine would increase traffic on local roads and highways and likely alter local and regional traffic patterns and levels of service. NFS road closures, along with accelerated deterioration of local roadways as a result of increased use, are examined.

“Air Quality” (section 3.6) analyzes potential impacts from an increase in dust, wind-borne particulate, and transportation-related emissions as a result of construction, mining, and reclamation activities at the mine. It also assesses how those emissions affect distant sensitive areas like the Superstition Wilderness.

“Water Resources” analyzes how the Resolution Copper Project could affect water availability and quality in three key areas: groundwater quantity and groundwater-dependent ecosystems (section 3.7.1); groundwater and surface water quality (section 3.7.2); and surface water quantity (3.7.3). This includes analysis of the impacts of dewatering at the mine site, analysis of pumping from the Desert Wellfield for the mine water supply, and anticipated effects from tailings seepage.

“Wildlife and Special Status Wildlife Species” (section 3.8) describes how impacts on wildlife can occur from habitat loss and fragmentation as well as from artificial lighting, noise, vibration, traffic, loss of water sources, or changes in air or water quality.

“Recreation” (section 3.9) describes the anticipated changes to some of the area’s natural features

and recreational opportunities as a result of infrastructure development related to the project.

“Public Health and Safety” addresses three areas of interest: tailings and pipeline safety (section 3.10.1), fire risks (section 3.10.2), and the potential for releases or public exposure to hazardous materials (section 3.10.3).

“Scenic Resources” (section 3.11) addresses the existing conditions of scenic resources (including dark skies) in the area of the proposed action and alternatives, along with the potential changes to those conditions from construction and operation of the proposed project.

“Cultural Resources” (section 3.12) analyzes potential impacts on all known cultural resources within the project area.

“Socioeconomics” (section 3.13) examines the social and economic impacts on the quality of life for neighboring communities near the proposed mine.

“Tribal Values and Concerns” (section 3.14) discusses the high potential for the proposed mine to directly, adversely, and permanently affect numerous cultural artifacts, sacred seeps and springs, traditional ceremonial areas, resource gathering localities, burial locations, and other places and experiences of high spiritual and other value to tribal members.

“Environmental Justice” (section 3.15) examines issues related to the project that have the potential to harm vulnerable or disadvantaged communities.

“Livestock and Grazing” (section 3.16) describes the loss to public use of Federal and State lands—including livestock grazing—from implementation of the proposed action or alternatives.

The analyses contained in chapter 3 were developed from issues identified during the scoping process. The relevant issues are only briefly recapped in chapter 3. The reader is directed to chapter 1, appendix E, or the November 2017 report titled “Resolution Copper Project and Land Exchange Environmental Impact Statement: Final Summary of Issues Identified Through Scoping Process” (Issues Report) for full

details (SWCA Environmental Consultants 2017b). The geographic area included for analysis is unique to each resource and encompasses areas in which direct or indirect impacts would be expected to occur. The anticipated impacts on each resource are analyzed for all phases of the project (construction, operation, and post-closure); in some cases, the analysis may focus on the time period that would cause the maximum impact on that resource.

As with the issues, for brevity’s sake, several other discussions in the EIS are only summarized, with the full details found elsewhere. For “Analysis Methodology, Assumptions, and Uncertain and Unknown Information,” the intent is to provide enough information in the EIS for the reader to understand what tools were chosen for the analysis and any limitations of those tools. For “Relevant Laws, Regulations, Policies, and Plans,” the intent is to briefly list the most pertinent items for the reader. Most of this information is captured in a detailed memorandum for the project record; a guide to the additional information available in these memoranda is included in appendix K.

The “Affected Environment” section describes the existing conditions for the resource. Existing conditions include effects of past, present, and ongoing actions that are occurring or have occurred within the analysis area.

The “Environmental Consequences” section describes the impacts of the proposed action or alternatives on the environment. Impacts include both the direct effects and indirect effects of the proposed action or alternatives. Direct effects are caused by the action and occur at the same time and in the same place. Indirect effects are caused by the action and are later in time and/or farther removed in distance but are still reasonably foreseeable (40 CFR 1508.8). Where alternatives have similar (though not necessarily identical) impacts, all alternatives may be discussed together, to be followed if needed by a discussion of the impacts that differ substantially between the alternatives.

The “Environmental Consequences” section also describes the cumulative impacts of the proposed action or alternatives. CEQ regulations define a cumulative impact as one that “results from the incremental impact of the action when added to other past, present,

and reasonably foreseeable actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time” (40 CFR 1508.7).

Cumulative impacts are the combination of impacts from the proposed action or alternatives with other past, present, or reasonably foreseeable future actions. Past and present actions contribute to the existing condition of the affected environment in the project area and are included under the “Affected Environment” heading. The additional effects of the proposed action or alternatives are discussed under the “Environmental Consequences” heading. To assess cumulative impacts, those effects must then be considered in conjunction with the effects of “reasonably foreseeable” future actions, as long as they overlap in both space and time.

A “reasonably foreseeable” action is one that is likely to occur in the future and does not include those that are speculative. The Forest Service compiled a list of future actions to form the basis for the cumulative effects analysis and applied specific criteria to determine whether they were reasonably foreseeable or speculative (Rigg and Morey 2018). Only the effects of those actions determined to be reasonably foreseeable, and to overlap spatially and temporally with effects from the proposed action or alternatives, are included in the “Cumulative Effects” section of each resource (SWCA Environmental Consultants 2018a).

As described in chapter 2, the Forest Service is in the process of developing a comprehensive set of mitigation measures that, where practical and technically feasible to implement, would serve to avoid, minimize, rectify, reduce, or compensate for resource impacts identified during effects analyses conducted for this EIS. Concurrent with these mitigation measures, monitoring plans have been developed that would be used to gauge the effectiveness over time of each mitigation measure. If prior experience or analysis shows that a given mitigation measure is likely to reduce but is unlikely to eliminate an impact, an assessment was made to characterize the nature and scale of the anticipated residual impact. Thus, each chapter 3 resource section includes discussions of

applicable mitigation measures, monitoring plans, and unavoidable adverse impacts.

Overview

Perhaps the most dominant feature of the proposed Resolution Copper Mine is the great size and depth of the ore body; for this reason, Resolution Copper plans to extract the ore from below, using gravity, in a technique known as “block caving” or “panel caving.” However, removal of such a large volume of rock would result in an approximately 1.8-mile-wide and between 800- and 1,115-foot-deep subsidence crater at the Oak Flat Federal Parcel. Along with a discussion of subsidence impacts, this section of the EIS describes known geological characteristics at each of the major facilities of the proposed mine, including alternative tailings storage locations, and how the development of the project may impact existing cave and karst features, paleontological resources, mining claims, and geological hazards.

3.2 Geology, Minerals, and Subsidence

3.2.1 Introduction

This section presents an overview of the geology and mineral resources within the analysis area, analyzes the estimated extent, amount, and timing of potential land subsidence resulting from underground mining activities, and the potential impacts on cave and karst resources, paleontological resources, and mining claims.

Some aspects of the analysis are briefly summarized in this section. Additional details not included are captured in the project record (Newell and Garrett 2018a).

3.2.2 Analysis Methodology, Assumptions, and Uncertain and Unknown Information

3.2.2.1 Analysis Area

The analysis area for geology, minerals, and subsidence considers the potential direct effects of panel cave mining, the associated recovery of economic minerals, the footprint disturbance of all proposed facilities, and the exchange of Federal lands for private lands (“offered lands”). These areas are shown in figure 3.2.2-1.

Indirect effects are those caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable. Potential indirect

effects on geology and minerals could be related to the following:

- The area of groundwater dewatering, which could impact hydrogeological and geotechnical properties, as well as result in additional subsidence. Assessment of additional subsidence from groundwater dewatering is discussed in Section 3.7.1, Groundwater Quantity and Groundwater-Dependent Ecosystems.
- The reactivation of geological structures, such as joints and faults directly adjacent to the area of panel caving and subsidence, or in the region. These impacts are assessed in this section.
- Subsidence-related impacts on caves, karst resources, and mine shafts and adits in the analysis area. These impacts are assessed in this section.
- Changes to mineral availability as a result of the proposed land exchange, which in some cases may remove land parcels from mineral entry.

3.2.2.2 Surface Subsidence Review

Note that two different types of subsidence have been raised as concerns for the Resolution Copper Project. This section of the EIS addresses surface subsidence that occurs at the mine site due to the block-cave mining itself. Possible subsidence resulting from groundwater pumping for the mine water supply is addressed in section 3.7.1.

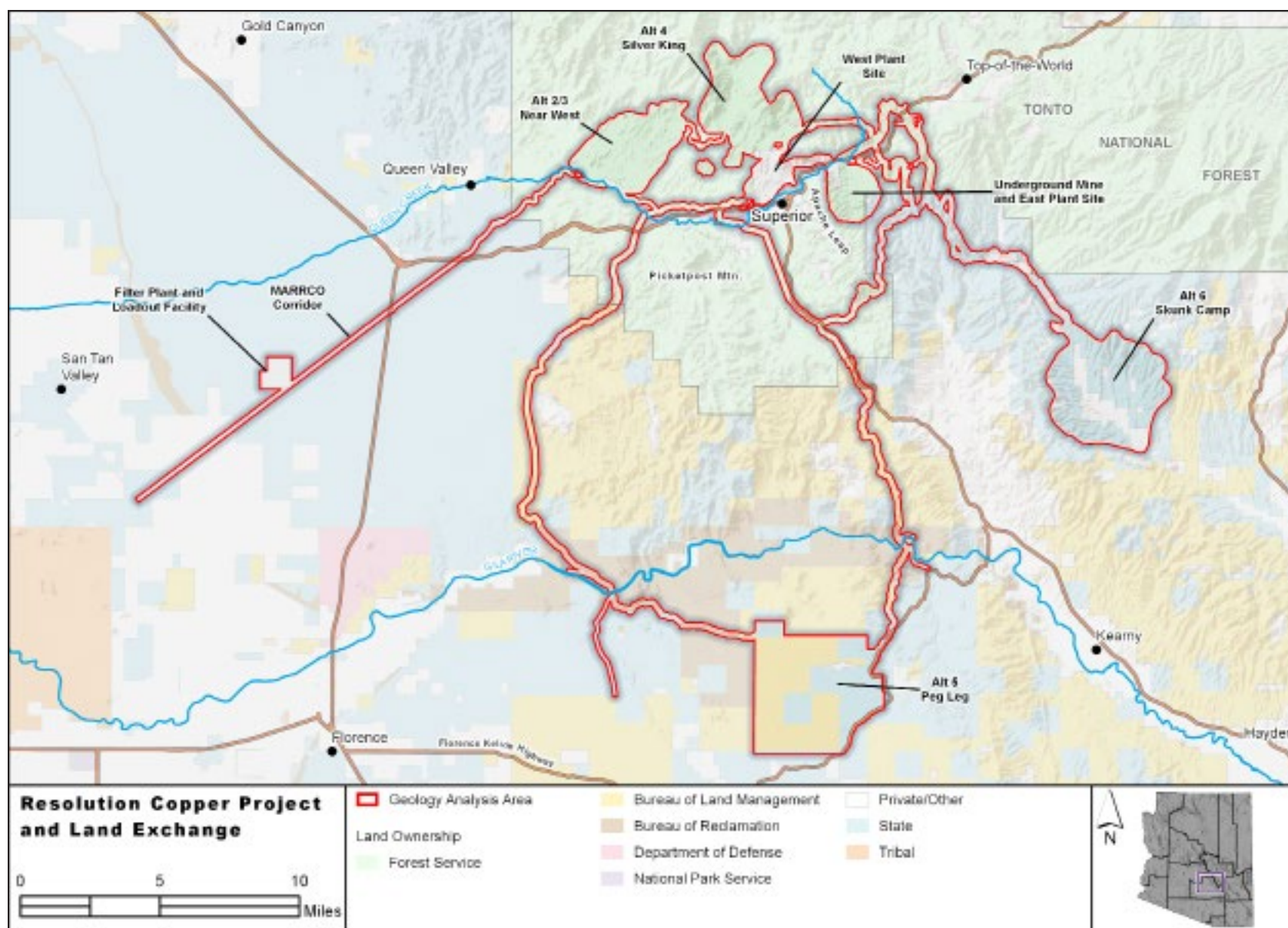


Figure 3.2.2-1. Geology, minerals, and subsidence analysis area

The understanding of regional and local geology relied on U.S. Geological Survey (USGS) maps, geological mapping data provided by Resolution Copper, and mineral resource information from Resolution Copper reports and published resource information. Subsidence effects were originally assessed in the GPO (Resolution Copper 2016d), but Resolution Copper conducted further modeling of the proposed caving operations, estimated the extent and depth of ground surface subsidence, and evaluated the potential impact on Apache Leap, Devil's Canyon, and the serviceability of U.S. 60 (Garza-Cruz and Pierce 2017, 2018).

The Tonto National Forest formed a Geology and Subsidence Workgroup to direct and evaluate this work. In 2017 and 2018, the Geology and Subsidence Workgroup submitted five formal data requests to Resolution Copper and participated in two site visits and seven technical meetings as part of the review. This review is documented in "Resolution Copper Project and Land Exchange Environmental Impact Statement: Geologic Data and Subsidence Modeling Evaluation Report" (BGC Engineering USA Inc. 2018a).

Resolution Copper developed an estimate of surface subsidence based on a three-dimensional numerical model of the proposed panel caving operation using an industry-standard model called FLAC3D (Garza-Cruz and Pierce 2017). The numerical model simulated caving and predicted ground surface subsidence, fracture limits, and cave angle (figure 3.2.2-2). The fracture limit consists of an area around the actual caved area in which the ground surface could be broken with open tension cracks and is the outer limit of any potential large-scale surface cracking (or fracturing). Cave angle is a key factor in estimating the extent of the surface subsidence. The model estimates a subsidence cave angle on the order of 70 to 78 degrees (angle varies with depth), with the cave fractures breaking through to the surface by year 6 of operations.

After reviewing Resolution Copper's geological data and subsidence modeling, the Geology and Subsidence Workgroup concluded the following:

- All aspects of geological data collection, including drilling, sample recovery, core logging, data management, and laboratory testing, met or exceeded industry standards.
- Resolution Copper's interpretations of geological structures, faults, rock properties, geotechnical data, and assumptions are reasonable.
- Geological data outside the mineralized zone, as well as for the Camp and Gant Faults, are not as well represented statistically as in the mineralized zone. To address this, conservative modeling assumptions were used and sensitivity analyses to account for sparse data in these areas.
- Resolution Copper's interpretations of subsidence are reasonable; therefore, the Geology and Subsidence Workgroup did not propose any alternative interpretations. However, there are numerous input variables and several layers of interpretation involved in modeling surface subsidence. There are several areas of uncertainty and some areas of sparse or low confidence data; actual surface subsidence could vary from the modeled results.

There is a great deal of interpretation required throughout the entire process, from data collection to testing and analysis, to model input and interpretations, and sensitivity runs. There are two approaches that consider the certainty of the geological and subsidence models. Both approaches were included in the Geology and Subsidence Workgroup review and are discussed in more detail in BGC Engineering (2018a).

- One approach to address uncertainty is empirical, meaning the model results are compared with what has been observed at other similar mines with similar geological settings. The modeled cave angle was compared observed cave angles from a database of more than 100 cave mining operations throughout the world, including both historical mines that have ceased to operate and those still producing (Woo et al. 2013); the historic database suggests a range from 72 to 84 degrees, which

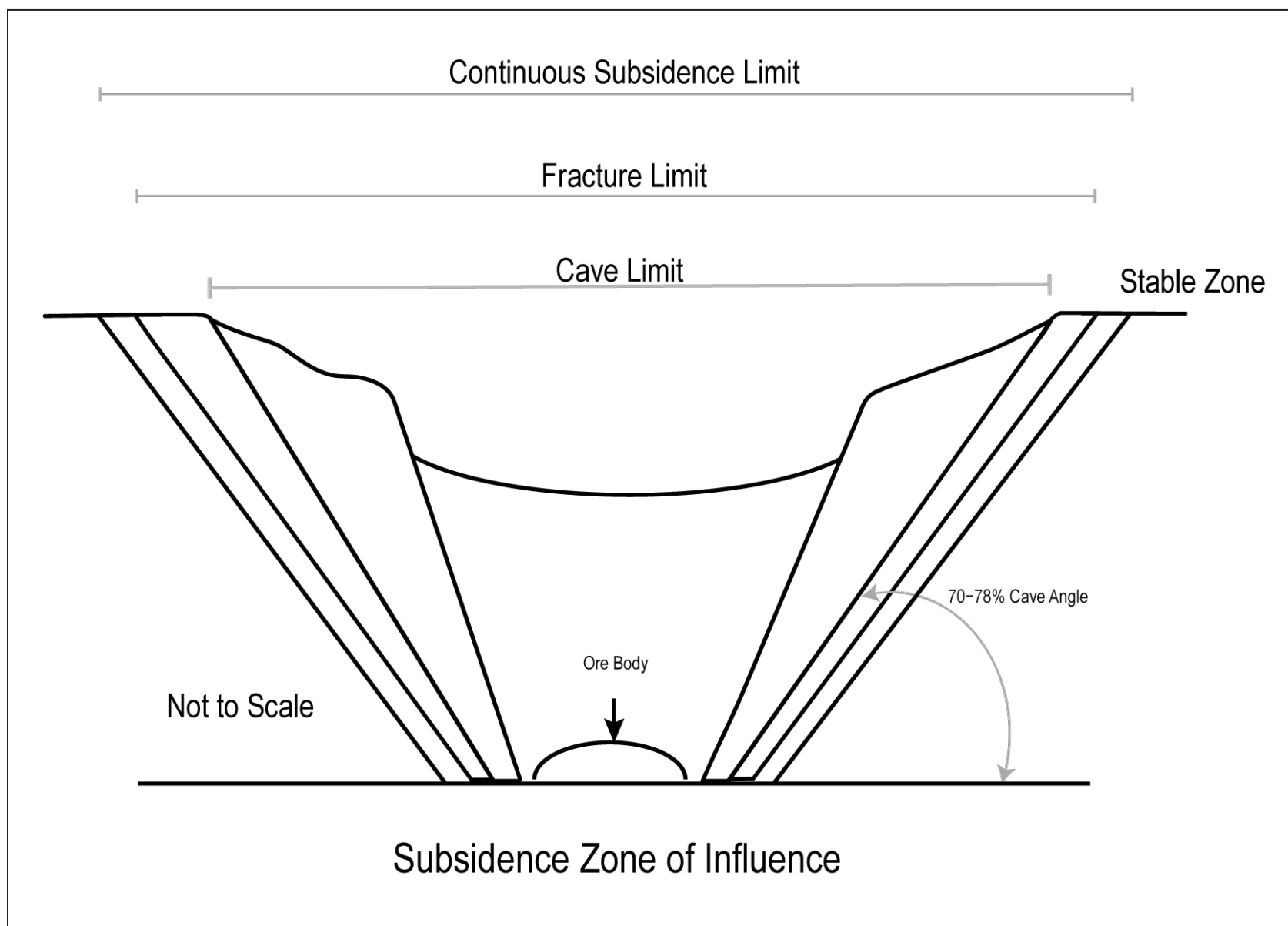


Figure 3.2.2-2. Conceptual cross section of the block-cave and subsidence zone

corresponds well with the modeled results (BGC Engineering USA Inc. 2018a). In a similar way, the conservativeness of the key rock units (Whitetail Conglomerate and Apache Leap Tuff units) was assessed by comparing results to actual measurements collected using underground instruments during the construction of Shaft #10.

- A second approach to address uncertainty is to vary the input parameters to reasonable upper and lower limits to see the resulting cave geometric response (i.e., sensitivity analyses).

3.2.2.3 Geological Hazards

Three types of geological hazards are evaluated: the potential for induced seismicity or reactivation of faults caused by the project; public access to the subsidence area; and the potential for rockfall or other changes to Apache Leap. The potential for induced seismicity is analyzed primarily using analog data observed at other mining sites. The potential for changes to Apache Leap is derived from the subsidence modeling results, and by assessing the changes in stresses and movement caused by the subsidence.

Many of the various rock units and tailings have potential to be acid generating when exposed to oxygen and moisture, resulting in the potential to create water quality problems. This issue is fully evaluated in section 3.7.2 and is not included here as a geological hazard.

3.2.2.4 Paleontological Resources

The probability of finding paleontological resources can be broadly predicted from the geological units present in the analysis area.

3.2.2.5 Caves and Karst Resources

Some cave resources are known to exist in the analysis area, derived from general knowledge of geology and recreation Forest Service specialists. Aside from these known resources, the probability of finding

Primary Legal Authorities Relevant to the Geology, Minerals, and Subsidence Analysis

- U.S. mining laws, implemented through regulation for administration of locatable minerals (36 CFR 228 Subpart A)
- Paleontological Resources Preservation Act (16 U.S.C. 470aaa through 470aaa-11), implemented through Paleontological Resources Preservation regulations (36 CFR Chapter 2, Part 291)
- Federal Cave Resources Protection Act of 1988 and its implementing regulations at 43 CFR Part 37

cave resources can be broadly predicted from the geological units present in the analysis area.

3.2.2.6 Unpatented Mining Claims

The known unpatented mining claims associated with the analysis area were taken from comprehensive claims databases administered by the BLM. The focus of this analysis is on claims that are not related to the Resolution Copper Project, but that could be impacted by the project.

3.2.3 Affected Environment

3.2.3.1 Relevant Laws, Regulations, Policies, and Plans

Metals and other mineral resources on NFS lands are managed in accordance with the Mining and Minerals Policy Act of 1970, which states that the Federal Government should “foster and encourage private enterprise in the development of economically sound and

stable industries, and in the orderly and economic development of domestic resources to help assure satisfaction of industrial, security, and environmental needs.” Administration of locatable mineral resources on NFS lands follows direction in Federal regulations (36 CFR 228 Subpart A); locatable minerals are those subject to claim and development under the General Mining Law of 1872, as amended.

The Multiple-Use Mining Act of 1955 reaffirms the right to conduct mining activities on public lands, including mine processing facilities and the placement of mining tailings and waste rock. Although a right to conduct mining activities exists, proposals must comply with applicable Federal and State environmental protection laws, and the Forest Service can require reasonable measures, within its authority, to minimize impacts on surface resources (see 30 U.S.C. 612 and 36 CFR 228.1). Mining claim location and demonstration of mineral discovery are not required for approval of locatable minerals operations subject to Forest Service regulations at 36 CFR 228 Subpart A.

One of the alternatives would involve construction of a tailings storage facility on BLM land instead of NFS land. BLM operates under different mining regulations (43 CFR 3809), but also has limited discretion for approving mining operations, provided the mine complies with applicable Federal and State environmental protection laws. As noted in chapter 2, BLM would require the submittal of a separate mining plan of operations to determine whether unnecessary or undue degradation would occur (43 CFR 3809.11(a)) and could require reasonable mitigation measures if determined necessary.

Alternative 6 does not involve any Federal land. Activities and resource impact occurring on these lands would not be regulated under either Forest Service or BLM regulations, though Resolution Copper would potentially employ some of the same environmental protection measures and mitigation.

3.2.3.2 Existing Conditions and Ongoing Trends

Regional Geology – East Salt River Valley, Superior Basin, and Oak Flat

The project is located within a geological region known as the Basin and Range province, near the boundary with another geological region known as the Arizona Transition Zone. The Basin and Range physiographic province is generally characterized by a series of mountain ranges separated by broad valleys filled with geologically young alluvium. The mountain ranges are typically bounded by faults that run northwest-southeast and north-south (Wong et al. 2013). At the northeastern edge of the Basin and Range province is the Arizona Transition Zone, a mountainous region that rises toward the highlands of the Colorado Plateau in northeastern Arizona. The Arizona Transition Zone is geologically complex, but generally consists of belts of linear rugged ridges, separated by relatively narrow valleys.

West of Whitlow Ranch Dam and Gonzales Pass the East Salt River valley begins—a 30- to 40-mile-wide alluvial valley that is typical of the Basin and Range. The Desert Wellfield is located in the East Salt River valley, where groundwater is readily accessible in the extensive, thick, alluvial aquifers. General elevation of this area is about 1,500 feet amsl.

The area roughly east of Whitlow Ranch Dam and east of Apache Leap is called the Superior Basin. This area is where the town of Superior, the West Plant Site, and the Alternative 2 tailings storage facility are located. The Superior Basin is about 10 miles wide, and generally flat, but unlike the East Salt River valley, young alluvium is limited to areas along washes and the main drainage of Queen Creek. Between drainages, low ridges formed of older geological units dominate the Superior Basin. The most distinctive landform immediately in the Superior Basin is

Picketpost Mountain, an isolated butte of Tertiary-aged rock²² with a peak at 4,378 feet. Queen Creek originates in the Oak Flat Plateau, cuts a deep canyon through the Apache Leap escarpment, and flows west through the town of Superior before continuing southwestward across the Superior Basin. The Superior Basin generally lies about 2,200 to 2,900 feet amsl.

East of Superior lies the rugged Oak Flat Plateau, with an elevation of roughly 4,000 to 4,600 feet amsl. Oak Flat is about 3 miles wide, with the eastern edge formed by Devil's Canyon. On the west, the prominent Apache Leap escarpment forms the division between Oak Flat and the Superior Basin. The East Plant Site is located on Oak Flat, and the Resolution ore deposit is located below Oak Flat.

Regional Geological Units

Previous researchers and Resolution Copper have mapped the geology of the analysis area. The most recent detailed geological map is a compilation of published USGS mapping and Resolution Copper geological mapping (Hart 2016). A number of other useful sources also exist, including the GPO (Resolution Copper 2016d; Spencer et al. 1996). A summary of the main geological units from oldest to youngest is presented in this section, and these are intended to be used in conjunction with the tables and figures reproduced in Newell and Garrett (2018a).

Regional geology of the Superior Basin and Oak Flat is shown in figure 3.2.3-1 and shown as a conceptual cross section in figure 3.2.3-2. The

abbreviations of the most common mapping units are included in the following text, which are commonly used on geological maps.

PRECAMBRIAN UNITS

The oldest rock units in the analysis area are more than 1 billion years old and include the Pinal Schist (pCpi); the Apache Group (pCy), which includes sedimentary and metamorphic units like shale, quartzite, limestone, and basalt; and the Troy Quartzite. Intrusions of granite, granodiorite, diorite, and diabase are found throughout these sedimentary units. These rocks underlie the entire analysis area but are only exposed in the western part of the Superior Basin.

PALEOZOIC SEDIMENTARY UNITS

Overlying the Precambrian units are sequences of Paleozoic-age (Pz) sedimentary formations. From oldest to youngest these include the Bolsa Quartzite, the Martin Formation, the Escabrosa Limestone, and the Naco Limestone. These units are well-exposed in the hills rising toward the Apache Leap escarpment.

CRETACEOUS-TERTIARY VOLCANIC UNITS

Numerous types of volcanic intrusions, including sills, dikes, and stocks of granite and diorite are located throughout the area. One well-known unit is the Silver King quartz diorite north of the town of Superior. A particularly thick sequence of Cretaceous-age volcanoclastic rock (Kvs) has been observed within the Resolution Graben (the Graben is

22. The use of technical geological terms has been intentionally limited in the EIS. However, the relative age of geological units can be important to understanding impacts, as some geologic time periods are commonly used to describe units. The following ages are the most commonly used, in order from youngest to oldest. The term "consolidated" means the unit is hard rock, whereas unconsolidated units are still loose, like soil or sand:

Quaternary – Refers to geologically young, largely unconsolidated units, that are less than 2.6 million years old.

Tertiary – Refers to geological units, largely consolidated, that are between 66 and 2.6 million years old.

Cretaceous – Refers to consolidated geological units that are about 145 to 66 million years old.

Paleozoic – Refers to consolidated geological units that are about 541 to 252 million years old.

Precambrian – Refers to the oldest geological units in the analysis area, older than 541 million years.

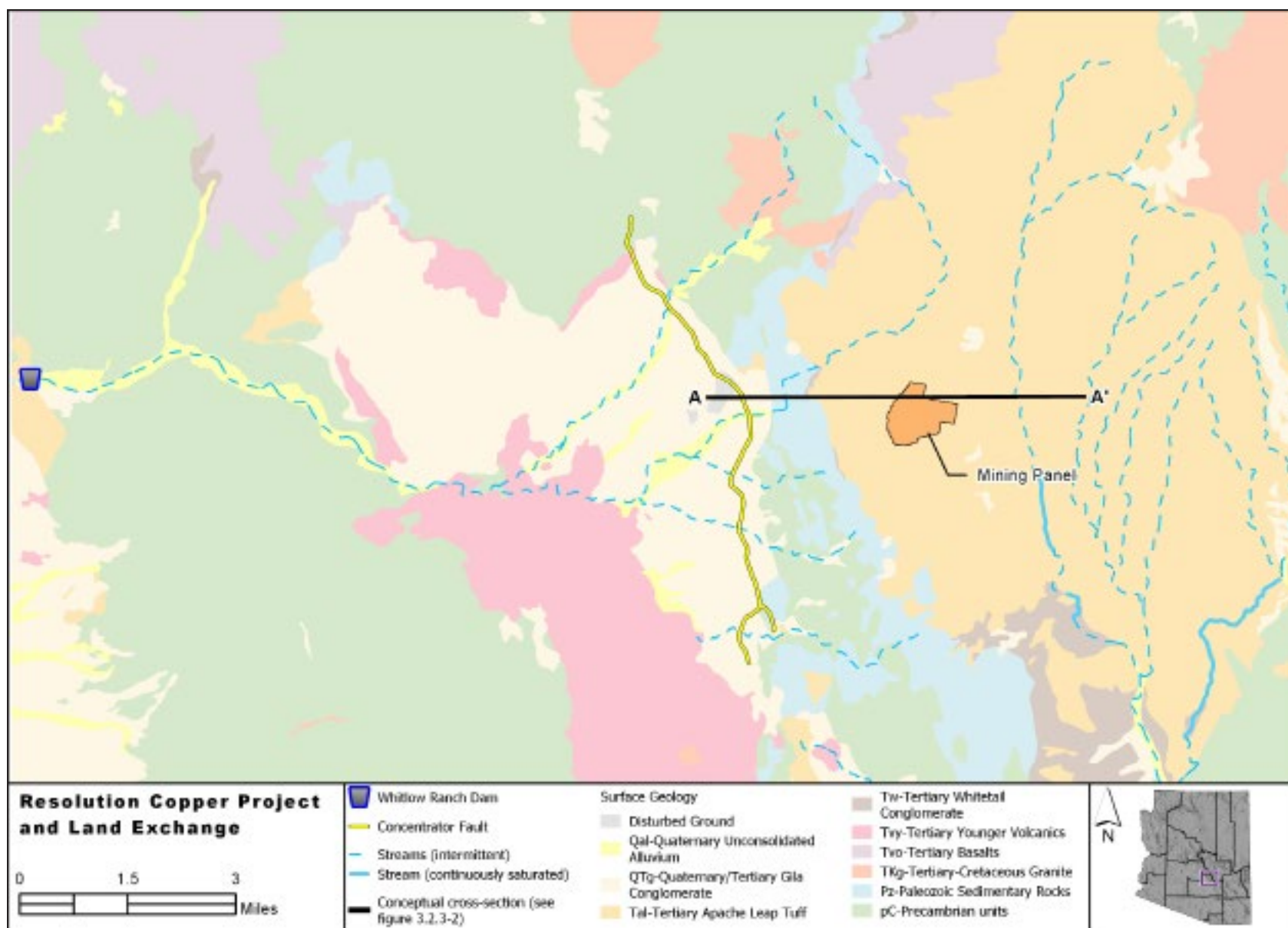


Figure 3.2.3-1. Generalized geological map of Superior Basin and Oak Flat

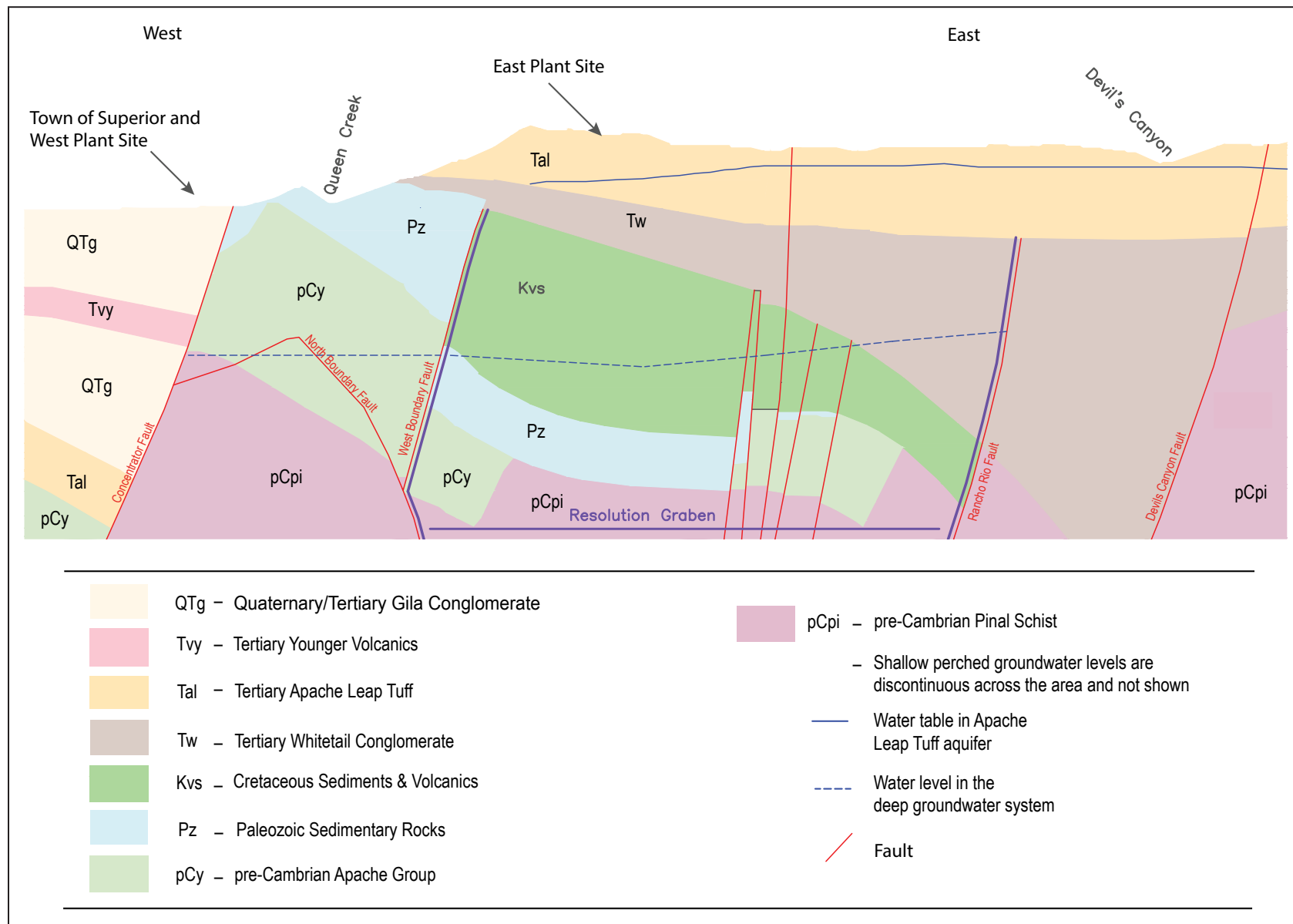


Figure 3.2.3-2. Generalized geological cross section

described in more detail later in this section), but these units are not known to outcrop anywhere in the analysis area (Kloppenborg 2017).

TERTIARY VOLCANOCLASTIC UNITS

Two units of key importance to both the analysis of subsidence and the analysis of impacts from groundwater drawdown are the Tertiary-aged Whitetail Conglomerate (Tw) and the Apache Leap Tuff (Tal). The older and deeper of these two geological units is the Whitetail Conglomerate, which consists of non-volcanic conglomerate and sandstone, as well as sedimentary breccia and mudstone. Overlying the Whitetail Conglomerate is the Apache Leap Tuff. The Apache Leap Tuff is a welded tuff of volcanic ash. It caps the Oak Flat plateau and forms the escarpment of Apache Leap. The Apache Leap Tuff also forms the most important aquifer unit in the area, supporting the perennial flow in springs and in Devil's Canyon. The Whitetail Conglomerate is important hydrologically because it largely isolates groundwater in the Apache Leap Tuff from dewatering taking place in the deep groundwater system (see section 3.7.1).

GILA CONGLOMERATE

The Gila Conglomerate (Qtg) is widespread throughout the Superior Basin and elsewhere in Arizona, including at the Skunk Camp location. The Gila Conglomerate consists of coarse gravel, cobbles, and boulders, many of which are derived from the Tertiary volcanics. The formation outcrops predominantly on the west side of the Concentrator Fault in the Superior Basin, is over 3,000 feet thick in places, and forms much of the surface geology near the Alternative 2 and Alternative 3 tailings storage facility. The Gila Conglomerate has portions that are unconsolidated or only weakly consolidated, as well as consolidated areas. The Gila Conglomerate is generally Tertiary aged but has also been mapped along with Quaternary deposits. For the purposes of the mapping presented in this section, it is presented as both Quaternary and Tertiary deposits.

QUATERNARY ALLUVIAL DEPOSITS

Quaternary deposits (Qal) consist of recent and near-recent stream deposits in basins, fans, terraces, floodplains, and channel deposits, as well as landslide and colluvial deposits. Particles range in size from clay, silt, and sand, to gravels, cobbles, and boulders. These deposits are generally unconsolidated but may be weakly to strongly cemented by calcite (i.e., caliche deposits). These deposits underlie most streams in the area, forming shallow, alluvial aquifers that store and transmit groundwater, and in places support riparian vegetation and perennial flow (see section 3.7.1).

Structural Geology and Faults

Many of the faults of importance to the structural geology in the analysis area are typical of Basin and Range faults. These are north- to northwest-trending normal faults with downward movement to the west, with movement dating from Tertiary or Quaternary time (Hehnke et al. 2012). The Superior Basin is bounded by the Concentrator Fault to the east and by the Elephant Butte Fault to the west. The Concentrator Fault is historically important as it displaces the Magma ore vein to an unknown depth and therefore defined the western limit of production in the Magma Mine. The Elephant Butte Fault is a major west-side-down normal fault that is located along the west side of Gonzales Pass and crosses Queen Creek east of Queen Valley near Whitlow Ranch Dam (Ferguson and Skotnicki 1996).

The Resolution ore deposit, lying about 4,500 to 7,000 feet below Oak Flat, is located in a structural feature called the "Resolution Graben." A graben is an area that is bounded on the sides by normal faults and is downthrust below those faults. The Resolution Graben is bounded by the West Boundary, North Boundary, South Boundary, Conley Springs, and Rancho Rio Faults. The Resolution Graben is hydrologically important because these faults tend to impede groundwater flow (WSP USA 2019). As such, much of the lowering of groundwater levels due to the dewatering that has taken place in the deep groundwater system since 2009 has been limited to the Resolution Graben (see section 3.7.1).

The analysis area has undergone multiple episodes of folding and faulting dating to the Precambrian. During the Tertiary period, two separate widespread orogenic (or mountain-building) events contributed to the structural geology of the analysis area, as well as the entire Southwest (the Late Sevier-Early Laramide Orogeny, and the Basin and Range extension) (Kloppenborg 2017). Regional extension, normal faulting, and tilting ended after Tertiary volcanism and during the deposition of Gila Conglomerate and Sandstone (Tcg) (Spencer and Richard 1995). The rotation, thickness, and offset of the geological units in the area (see figure 3.2.3-2) are the result of this series of large-scale structural movements.

Mineral Resources

GENERAL MINERAL OCCURRENCE

Mineral occurrences in the analysis area include a range of metallic, non-metallic, and industrial minerals. There is a more than 100-year history of silver and copper mining near the analysis area, and several operations continue to contribute to the region's economy. In addition to the nearby formerly producing Magma and Silver King mines, over 30 (active or inactive) mines are regionally located near what is known as the "Copper Triangle." These represent a variety of operations but primarily include copper, gypsum, and marble mining. The closest currently active major copper mines are the Ray Mine, approximately 9 miles south of the analysis area, the Pinto Valley Mine, approximately 14 miles northeast of the analysis area, and the Carlota Mine, also northeast of the analysis area. These mines are open-pit operations, but, like the Resolution ore deposit, they are large tonnage, low-grade copper porphyry deposits (Kloppenborg 2017).

RESOLUTION ORE DEPOSIT

The Resolution ore deposit is approximately 64 million years old and is a porphyry copper-molybdenum deposit. It lies approximately 4,500 to 7,000 feet below Oak Flat. As defined by the 1 percent copper shell, the deposit extends over an area of at least 1.2 miles in an east-northeast

direction, and 0.9 mile in a north-northwest direction. A detailed description of the deposit and associated mineralization is included in Hehnke et al. (2012).

Rock types with diabase, limestone, and local breccia host and control the strongest copper mineralization. Quartz-rich sedimentary rocks and Cretaceous-Tertiary intrusive rocks demonstrate the strongest molybdenum mineralization. The highest copper grades (greater than 3 percent) are located in the upper central portion of the deposit associated with a large hydrothermal breccia body and hosted primarily in breccia and diabase. The total mineral resource at the Resolution ore deposit is currently estimated (indicated and inferred) to be 1,970 million tons (1,787 million metric tonnes), with an average grade of 1.54 percent copper and 0.035 percent molybdenum (Rio Tinto 2018).

The location and geometry of the mineralization are structurally controlled by several generations of faulting that occurred before, during, and after mineralization. Chalcopyrite is the dominant copper mineral in the deposit, with lesser chalcocite and bornite. Molybdenum occurs primarily as molybdenite. The deposit is associated with hydrothermal alteration and includes a strong pyrite "halo" in the upper areas of the deposit, containing up to 14 percent pyrite. This mineralization has ramifications for water quality, as all of these are sulfide-bearing minerals and have the potential to interact with oxygen and cause water quality problems (acid rock drainage), as discussed in detail in section 3.7.2.

Tailings Storage Facility for Alternatives 2 and 3 – Near West

GENERAL GEOLOGY

The proposed tailings storage facility site for Alternatives 2 and 3, known as the Near West site, is located approximately 3 miles west of the town of Superior and 3 miles east of the community of Queen Valley, between Roblas Canyon on the west and Potts Canyon on the east. A number of geological units underlie the tailings storage facility footprint. Quaternary alluvial deposits are found along the washes, separated by a

series of parallel ridges formed of older rocks. The majority of the area is underlain by Gila Conglomerate, with older Pinal Schist under the southwestern portion of the proposed tailings embankment, and smaller areas of Apache Group, Paleozoic sedimentary rocks, Apache Leap Tuff, and other volcanics (Spencer and Richard 1995).

FOUNDATION CONSIDERATIONS

The Near West location is unique out of the alternative tailings locations in that Resolution Copper has completed geotechnical investigations at the site (Golder Associates Inc. 2017; Klohn Crippen Berger Ltd. 2017). Findings from site investigations (Klohn Crippen Berger Ltd. 2017) and other studies (Klohn Crippen Berger Ltd. 2018a, 2018b) at the Near West site include the following foundation considerations, which would need to be factored into the design:

- Some units exhibit weak foundation conditions. These include zones with weak clay layers, zones of potentially collapsible soils (including in the Gila Conglomerate), and weakness parallel to foliation (in the Pinal Schist). These conditions potentially could affect embankment stability.
- Dissolution features, such as voids and open joints, are present in the Mescal Limestone (part of the Apache Group), particularly near the contact between the limestone and an intruded diabase. Resolution Copper has noted open joints in numerous units, including the Gila Conglomerate, and a single high-angle fault with approximately 6 feet of normal displacement was also observed in the Gila Conglomerate. Heavy fracturing was observed in the Pinal Schist. These conditions potentially could affect embankment stability or seepage movement and capture.
- An abandoned mine, Bomboy Mine, is within the southwest corner of the tailings storage facility.

Tailings Storage Facility for Alternative 4 – Silver King

GENERAL GEOLOGY

The Alternative 4 – Silver King tailings storage facility site is approximately 2 miles from the West Plant Site and would occupy the lower end of Silver King Canyon, the lower portion of Whitford Canyon, and Peachville Wash. The Silver King site is approximately 5 miles northeast the Alternative 2 tailings site and shares similar foundation geology. The majority of the geology underlying the tailings facility footprint is Precambrian Pinal Schist, but numerous other geological units are present, including Apache Group units, Bolsa Quartzite, and Tertiary volcanic rocks. Unconsolidated Quaternary alluvial deposits are limited to ephemeral drainages.

Historical mining and exploration have taken place within or near the Silver King site, though the tailings storage facility footprint has been designed to avoid existing mining operations at the Silver King Mine itself (Klohn Crippen Berger Ltd. 2018c), which is 0.7 mile east of the site. The Silver King Mine workings are not expected to extend within the footprint of the tailings storage facility. Silverona Mine, Fortuna Mine, Black Eagle Mine, and “Unnamed Mine” are located near or in Peachville Wash. Also, the McGinnel Claim is at the intersection of the Main and Concentrator Faults, approximately 0.5 mile north of Silver King Wash, and within the footprint of the tailings facility.

FOUNDATION CONSIDERATIONS

No site-specific geotechnical investigations have been performed at the Silver King site. In general, many of the site characteristics at Silver King are anticipated to be similar to the Near West site, where geological units are the same. The following foundation considerations have been noted that would need to be factored into the design:

- One major difference noted by Klohn Crippen Berger (2018c) is the presence of potentially liquefiable (e.g., loose granular deposits that are saturated or will become saturated) soils in the Quaternary alluvium and in landslide deposits associated with

weak foliation in Pinal Schist. These conditions potentially could affect embankment stability.

- Abandoned mine workings within the tailings storage facility footprint could collapse beneath the tailings piles (Klohn Crippen Berger Ltd. 2018c), but none are known specifically to exist at this time.

Tailings Storage Facility for Alternative 5 – Peg Leg

GENERAL GEOLOGY

Most of the project facilities are located within the East Salt River valley (filter plant and loadout facility, Desert Wellfield), the Superior Basin (West Plant Site, tailings storage facilities under Alternatives 2, 3, and 4), and Oak Flat (East Plant Site). However, two of the alternative tailings storage facilities are located at some distance from the Superior Basin: Alternative 5 (Peg Leg) and Alternative 6 (Skunk Camp).

The Alternative 5 tailings storage facility (also known as the Peg Leg location), is located approximately 15 miles south of the West Plant Site and south of the Gila River, in a flat, northwest- to southeast-trending valley with Donnelly Wash (a tributary to the Gila River) as its main drainage (figure 3.2.3-3). This drainage lies at the eastern edge of the Basin and Range province and is typical of that geology. Alternative 5 is primarily underlain by a flat valley of Quaternary alluvial material, bounded by sedimentary and granitic rocks, although these hard rock areas do not rise to a great height and instead form a series of low hills at the margins of the valley.

The PAG tailings for Alternative 5 would be located to the east side of the facility and would be underlain by granitic rocks that include Precambrian Ruin Granite and Tertiary Tea Cup Granodiorite. The NPAG tailings would be located on alluvial deposits, including some travertine near the western boundary of the project site (Golder Associates Inc. 2018a).

FOUNDATION CONSIDERATIONS

Current foundation characterization for the Peg Leg site is based on surficial geology mapping, site reconnaissance, geophysical surveys (electrical resistivity, refraction seismic surveys, and gravity surveys), local well logs, and regional literature (Fleming, Kikuchi, et al. 2018; Golder Associates Inc. 2018a; hydroGEOPHYSICS Inc. 2017). The following foundation considerations have been noted that would need to be factored into the design:

- Fracture zones have been mapped on the bedrock surface near the Peg Leg tailings storage facility site, but there are no known active seismic features in the vicinity, and seismicity is expected to be similar to the Near West location.
- The Precambrian Ruin Granite and Tertiary Tea Cup Granodiorite are expected to have low permeability and high strength. However, well logs in the tailings storage facility area reviewed by Golder Associates (2018a) indicate that the granitic bedrock may be highly decomposed and weathered in areas, even to significant depths, which could indicate higher permeability and lower strength in these areas. These conditions potentially could affect embankment stability or seepage movement and capture.
- The presence of travertine may indicate shallow perched groundwater zones exist. These conditions potentially could affect embankment stability or seepage movement and capture.

Tailings Storage Facility for Alternative 6 – Skunk Camp

GENERAL GEOLOGY

Alternative 6 (also known as the Skunk Camp location) is located in a narrow northwest- to southeast-trending valley with Dripping Spring Wash (a tributary to the Gila River) as its main drainage. The Quaternary alluvium within the valley is bounded to the southwest by the Dripping

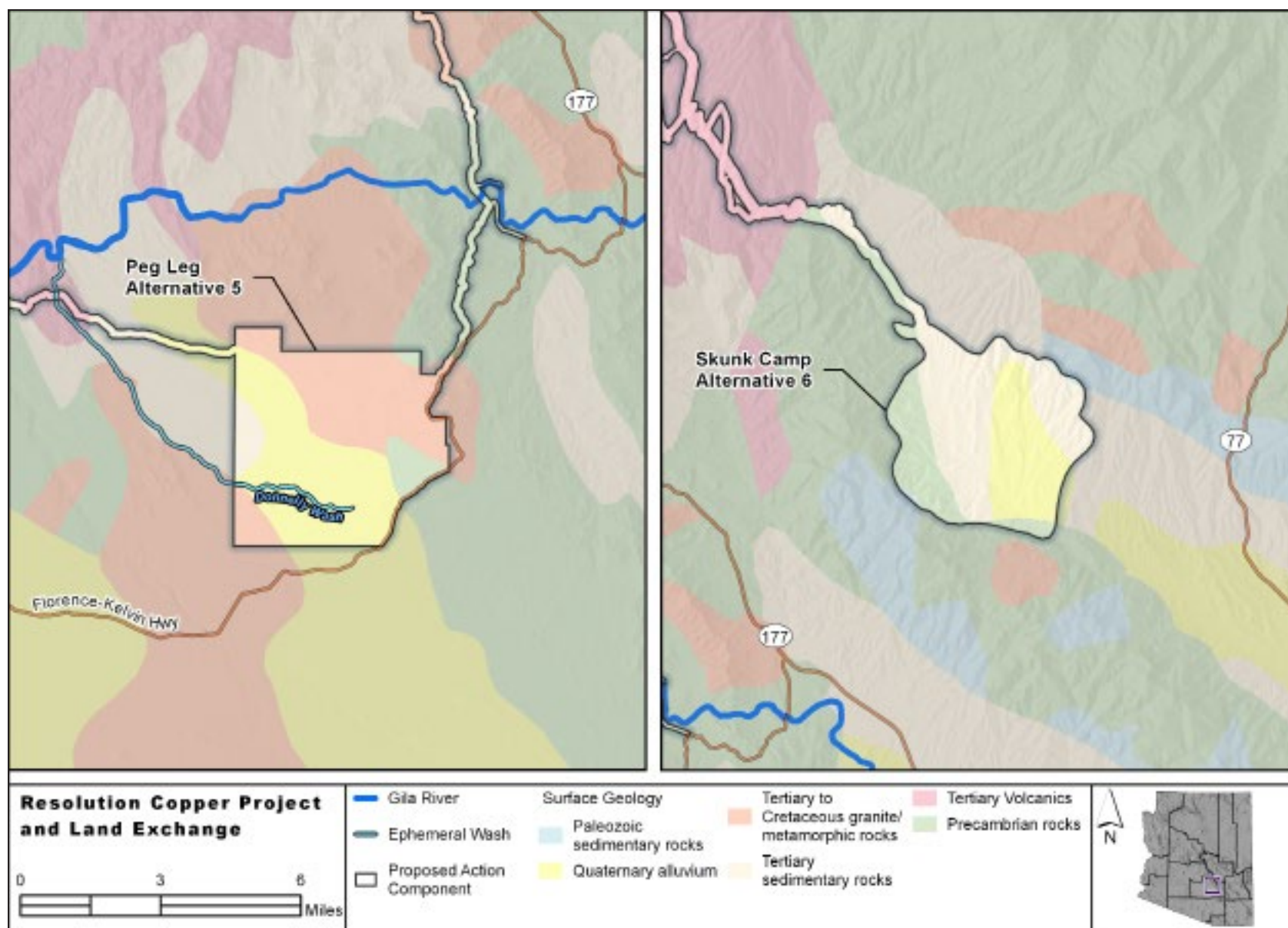


Figure 3.2.3-3. Generalized geological map of Peg Leg and Skunk Camp locations

Spring Mountains, and to the northeast by the Pinal and Mescal Mountains.

Underlying geological units are similar to Alternatives 2, 3, and 4, primarily Precambrian units such as Pinal Schist, overlain by Apache Group units, and Troy Quartzite (see figure 3.2.3-3). The valley itself is infilled with Gila Conglomerate, estimated to be over 1,500 feet thick in some locations. Quaternary alluvium partially covers the conglomerate and is present along the valley bottom and drainages. Occasional travertine deposits have been observed in valley walls.

FOUNDATION CONSIDERATIONS

Foundation characterization is based on recent site reconnaissance visits, limited well logs, regional geological maps, and assumptions based on similar sites given the similar geology (i.e., Near West) (Fleming, Shelley, et al. 2018; Klohn Crippen Berger Ltd. 2018e). The following foundation considerations have been noted that would need to be factored into the design:

- Potential strength reduction could result in areas due to saturation of the Gila Conglomerate. These conditions potentially could affect embankment stability.
- Gila Conglomerate varies across the site, and has been noted to be less cemented and coarser grained than at the Near West site, especially on the north end of the site; this unit may therefore exhibit higher permeability at the Skunk Camp site, compared with the Near West site, which could impact seepage within the basin. These conditions potentially could affect embankment stability or seepage movement and capture.

- Potential for groundwater flow paths—it is not known whether the faults on-site act as preferential flow paths or low-permeability boundaries for groundwater flows at this time.
- The presence of travertine may indicate shallow perched groundwater zones exist. These conditions potentially could affect embankment stability or seepage movement and capture.

Geological Hazards

SEISMICITY

Regional Seismicity

Historical natural seismicity is low within this general region. Within approximately 30 miles of the proposed mine site there have been three historical earthquakes with a magnitude greater than 3: a magnitude 4.2 in 1963; a magnitude 4.4 in 1969; and a magnitude 3.1 in 2010 (U.S. Geological Survey 2018c).

Lettis Consultants International completed site-specific hazard analyses for the proposed Near West tailings storage facility (Wong et al. 2017) and the mine site (Wong et al. 2018). A historical catalog was compiled including earthquakes within a 124-mile radius of the mine, and includes 26 events of moment magnitude 5 to 5.9, three events of magnitude 6 to 6.9, and three events of magnitude 7 and greater. However, one of the magnitude 7 events, dated 1830 in the record, is considered poorly documented and suspect (DuBois et al. 1982).

The largest earthquake in the record is a magnitude 7.4 earthquake that occurred in 1887 in northern Sonora, Mexico, approximately 200 miles southeast of the site (DuBois et al. 1982; Suter and Contreras 2002). Ground shaking was felt throughout Arizona and as far north as Albuquerque, New Mexico, and would also have been felt in the

analysis area. The maximum felt intensity was measured as between Modified Mercalli (MM) intensity XI and XII, and MM VI would have been observed at the mine site (DuBois et al. 1982).²³

The closest significant earthquake to the mine was a magnitude 5.0 event that occurred in 1922 near Miami, Arizona, approximately 13 miles east-northeast of the site (DuBois et al. 1982). The event was felt in the town of Miami, but no structural damage was reported (DuBois et al. 1982). Lettis Consultants International (Wong et al. 2018) surmised that the felt intensity likely would have been MM IV. This event was recorded on a seismograph over 80 miles away in Tucson; therefore, the location and size of the event are highly uncertain (Wong et al. 2008).

More recently, in 2014, there was a magnitude 5.3 event near the town of Duncan, Arizona, close to the Arizona–New Mexico border, and approximately 120 miles east-southeast of the mine site. This event was widely felt in Arizona and western New Mexico, with a reported intensity of MM V near the epicenter. Based on reported intensities surrounding the site, an intensity between MM II and III would have been observed at the mine (Wong et al. 2018). Following this event, there were over 40 likely aftershocks ranging from magnitude 2.0 to 4.0.

It should be noted that regional seismic hazard is a consideration handled explicitly during the design of tailings storage facilities, beyond the brief narrative provided here (see section 3.10.1).

Induced Seismicity

Seismic events due to human activity can and do occur, and are commonly referred to as “induced seismicity” (National Academy of Sciences 2013). There are two types of mine-induced seismicity (Gibowicz and Kijko 1994; Richardson and Jordan 2002). Type A events are smaller in magnitude (less than 1), related directly to mining activities (i.e., digging, blasting), and occur at or near the active mining face. Type B events have larger magnitudes and are the result of shear failure along a pre-existing structure (i.e., fault, joint bedding plane, or other zones of weakness). They may occur on structures not exposed at the active mine face, but which are affected by the perturbed stress field.

Induced seismicity has been recognized and observed in mines around the world, although not all mines exhibit seismicity (Gibowicz and Kijko 1994); over 100 years of worldwide observations of induced mine seismicity show that induced events of greater than magnitude 5 are rare, whereas events of magnitude 3 or less are more common. Since 2013, seismic activity has been observed in two mines in Arizona: in southeastern Arizona near Morenci (up to magnitude 3.1), over 120 miles east of the analysis area, and in northeastern Arizona, south of Shonto (up to magnitude 2.9) (U.S. Geological Survey 2018b), approximately 300 miles north of the analysis area. These minor magnitudes are within the range of seismicity currently observed in the region. However, these events consist of mine explosions, not earthquakes induced by mining. The closest occurrences of

23. The Modified Mercalli scale is a method of measuring the intensity of an earthquake at a given location, and is based on the real-world effects people would experience and observe. The intensities described above are generally described as follows:

- VI – Generally noted as being felt by all, and strong enough to frighten many; strong enough to move some heavy furniture; and slight damage like falling plaster.
- V – Generally noted as being moderate. It is felt by nearly everyone, and many are awakened. Some dishes and windows are broken, and unstable objects overturned. Pendulum clocks may stop.
- IV – Generally noted as being relatively light. It typically can be felt indoors by many but outdoors by only a few people; at night, some people are awakened; dishes, windows, and doors are disturbed, and walls make cracking sounds; and standing vehicles will rock noticeably.
- III – Weak. Many people do not recognize it as an earthquake, standing vehicles may rock slightly, and vibrations are similar to the passing of a truck.
- II – Weak. Felt only by a few persons.

mining-induced seismicity are in the coal mines of the Wasatch Plateau in eastern Utah and western Colorado (Wong 1993).

The nearest mapped Quaternary “active” surface fault relative to the mine is the Sugarloaf fault zone, located about 35 miles to the northwest (U.S. Geological Survey 2018a) of the mine, and 30 miles southeast of the proposed Near West tailings storage facility site (Wong et al. 2017). The Sugarloaf fault zone runs along the western margin of the Mazatzal Mountains (Pearthree et al. 1995). The fault likely experienced little Quaternary movement, as indicated by the minimal relief across the fault (Pearthree 1998); trenching to examine sediments shows that the fault disturbed deposits older than 12,000 years, but did not disturb younger deposits (Pearthree et al. 1995).

Faults are located within the footprints of several of the alternative tailings storage facilities. The Concentrator, Main, and Conley Springs Faults cross the Silver King site, but previous research indicates that these faults are healed (Cross and Blainer-Fleming 2012), and are not believed to be active within the last 2.6 million years (Wong et al. 2017). The Skunk Camp site includes two mapped faults, the Dripping Springs and Ransome Faults, neither of which are believed to have been active during the past 12,000 years (Wong et al. 2017).

As noted, numerous faults are also located near Oak Flat, bounding the Resolution Graben. These faults are key to how the subsidence area would develop and were incorporated into the subsidence modeling.

LANDSLIDES AND ROCKFALL

Landslides, in the form of general “earth slides,” have been mapped in several locations near the analysis area (Arizona Geological Survey 2018). These include (1) immediately north of U.S. 60, approximately 0.5 mile northeast of the town of Superior, (2) less than 1.0 mile southwest of the mine, and another approximately 2.0 miles south of the mine, and (3) immediately adjacent to and within the northwestern footprint area of the Silver King alternative tailings storage facility site.

Public concern has been raised about the stability of Apache Leap itself, in light of the subsidence that would occur on Oak Flat. The height

and steepness of the Apache Leap escarpment speaks to the strength of the Apache Leap Tuff and its overall stability. Observations related to Resolution Copper’s ongoing exploration work confirm the stability of the Apache Leap Tuff, including the strength of the rock observed as Shaft #10 was sunk (Tshisens 2018b).

The stability of Apache Leap is also demonstrated by actual monitoring of the Apache Leap escarpment using LiDAR techniques, which has taken place since 2011 and is still ongoing. This monitoring uses 11 measurement stations and has an accuracy to 0.2 feet. No significant movement has been observed since monitoring began; all movements are attributable to vegetation changes or to small rockfalls (Maptek Pty Ltd. 2011, 2012, 2014a, 2014b, 2015, 2016, 2017).

ABANDONED MINES

Abandoned mine workings or adits pose a safety hazard if they are not properly sealed from public access, and are also a concern with respect to stability of foundations for tailings embankments built in historical mining areas.

Historic-era mining features have been noted on several of the offered land parcels, most notably the Apache Leap South End Parcel on the west side of Oak Flat. Here there are multiple historical mining features and remnants of old mining-related roads located throughout the parcel, including small open cuts, shafts, tunnels, raises, crosscuts, and more extensive underground workings. The major underground mines in this area were principally known as the Grand Pacific and Belmont mines. Entrances to these mines are found on portions of the parcels and appear to date to the early 1900s. The Dripping Springs parcel has also been noted for historic mine activity.

The historic Bomboy Mine was identified in the vicinity of the embankment of the tailing site, in Roblas Canyon. This was an underground copper mine started in 1916, with last production noted in 1971.

Paleontological Resources

Paleontological resources are the fossilized remnants of life. The majority of rock types in the analysis area are igneous (volcanic and plutonic), volcanoclastics, metamorphic rocks, and coarse clastic sedimentary rocks, which are either environments that never had biological activity or were environments that were not conducive to the preservation of fossils or evidence of biological activity. The only formations with potential for paleontological resources are the sequence of Paleozoic sedimentary rocks, namely the Naco Limestone, the Escabrosa Limestone, and the Martin Limestone. These rocks outcrop in the Apache Leap escarpment below the Apache Leap Tuff and extend down to the western edge of the town of Superior.

The following are descriptions of the potential fossil-bearing formations and the fossils typically associated within those formations:

Naco Limestone. The Naco Limestone is roughly 300 million years old, and is a medium- to thin-bedded, gray, white, pale blue to pink limestone (Resolution Copper 2016d). Shallow-shelf marine fossils are common and locally abundant in Naco Limestone and they include foraminifera (especially fusulinids), brachiopods, mollusks (gastropods, clams and other bivalves, cephalopods), tabulate and rugose corals, sponges, bryozoans, echinoderms (crinoids), and rarely, vertebrates like shark teeth and fish bones (Reid 1966; Resolution Copper 2016d).

Escabrosa Limestone. The Escabrosa Limestone is roughly 350 million years old and is equivalent to the Redwall Limestone prevalent in the Grand Canyon. It is a thick-bedded, cliff-forming, resistant, white to dark gray limestone (Blainer-Fleming et al. 2013; Resolution Copper 2016d). This formation potentially contains mostly crinoids and rugose corals with some brachiopods and trilobites. However, it is sparsely fossiliferous and preservation of these fossils is generally poor because they are worn, fragmented, and nearly inseparable from the host limestone.

Martin Limestone. The Martin Limestone is roughly 400 million years old and contains dark to light gray limestone and shale (Pye 1959;

Resolution Copper 2016d). This formation can be fossiliferous and potentially contains brachiopods, crinoids, and corals (Blainer-Fleming et al. 2013).

Cave Resources and Karst Landforms

In addition to their preservation of fossils, limestone units also have the potential for cave formation by dissolution of the carbonate rock by groundwater. Of the three Paleozoic limestone formations discussed in the previous section, the Naco and the Escabrosa have the greatest potential for cave formation. According to Huddle and Dobrovolsky (1952), the Escabrosa Limestone formation contains karst features that are infilled with rubble breccia and Naco Limestone, indicating extensive karst topography in Central Arizona more than 300 million years ago. The Kartchner Caverns of the Whetstone Mountains of southern Arizona (near Benson), for example, are formed in the Escabrosa Limestone. There are no caves currently mapped in the Paleozoic limestone units within the analysis area and, due to the extensive intrusions and veins, cave formation is likely limited to small, discontinuous cavities.

While several karst features have been noted in Queen Creek Canyon upstream of Superior, only one existing cave has been identified in the area: Hawks Claw Cave is located near Alternative 2 tailings site.

Unpatented Mining Claims

Numerous unpatented mining claims—both lode and placer—are located within the footprint of the mine components. These are summarized in the GPO in appendix A and figure 3.2-1 (Resolution Copper 2016d) for Alternatives 2 and 3, and have been compiled separately for Alternatives 4, 5, and 6 (Garrett 2019a).

- No unpatented claims unrelated to Resolution Copper are located within the Oak Flat Federal Parcel, or on the East Plant Site.

- The West Plant Site is privately owned. No unpatented claims unrelated to Resolution Copper are located around the periphery of the West Plant Site.
- The MARRCO corridor right-of-way is already existing and in use. No unpatented claims unrelated to Resolution Copper are located within the MARRCO corridor.
- Unpatented claims unrelated to Resolution Copper are located within the various alternatives tailings storage facility footprints and/or the tailings pipeline corridor footprints. In Section 3.2.4, impacts on these claims are assessed specific to each alternative.

3.2.4 Environmental Consequences of Implementation of the Proposed Mine Plan and Alternatives

3.2.4.1 Alternative 1 – No Action Alternative

Under the no action alternative, the mine would not be constructed, block-caving would not occur, and there would be no impacts from subsidence, induced seismicity, increased potential for landslides or rockfall, impacts on caves, karst, or paleontological resources, or impacts on mining claims.

3.2.4.2 Impacts Common to All Action Alternatives

Effects of the Land Exchange

The land exchange would have effects on geology and mineral resources.

The Oak Flat Federal Parcel would leave Forest Service jurisdiction. The role of the Tonto National Forest under its primary authorities in the Organic Administration Act, Locatable Regulations (36 CFR 228 Subpart A), and Multiple-Use Mining Act is to ensure that mining activities minimize adverse environmental effects on NFS surface resources. The removal of the Oak Flat Federal Parcel from Forest

Service jurisdiction negates the ability of the Tonto National Forest to regulate effects on these resources from the proposed mine and block-caving. With respect to mineral development, no unpatented mining claims other than those associated with Resolution Copper are located on the Oak Flat Federal Parcel (see figure 1.3-2 in the GPO (Resolution Copper 2016d)).

The offered land parcels would enter either Forest Service or BLM jurisdiction. Section 3003 of the NDDA specifies that any land acquired by the United States is withdrawn from all forms of entry, appropriation, or disposal under the public land laws, location, entry, and patent under the mining laws, and disposition under the mineral leasing, mineral materials, and geothermal leasing laws.

Specific management of mineral resources on the offered lands would be determined by the agencies, but in general when the offered lands enter Federal jurisdiction, mineral exploration and development would not be allowed. Given these restrictions, no or little mine-related activity would be expected to occur on the offered lands.

Effects of Forest Plan Amendment

The Tonto National Forest Land and Resource Management Plan (1985b) provides guidance for management of lands and activities within the Tonto National Forest. It accomplishes this by establishing a mission, goals, objectives, and standards and guidelines. Missions, goals, and objectives are applicable on a forest-wide basis. Standards and guidelines are either applicable on a forest-wide basis or by specific management area.

A review of all components of the 1985 Forest Plan was conducted to identify the need for amendment due to the effects of the project, including both the land exchange and the proposed mine plan (Shin 2019). A number of standards and guidelines (18) were identified applicable to management of mineral, cave, or paleontological resources. None of these standards and guidelines were found to require amendment to the proposed project, either a forest-wide or management

area-specific basis. For additional details on specific rationale, see Shin (2019).

Summary of Applicant-Committed Environmental Protection Measures

A number of environmental protection measures are incorporated into the design of the project that would act to reduce potential impacts on geology and mineral resources or reduce potential impacts from subsidence and other geological hazards. These are non-discretionary measures, and their effects are accounted for in the analysis of environmental consequences.

In appendix E of the GPO (Resolution Copper 2016a), Resolution Copper has committed to various measures to reduce impacts from subsidence:

- Subsidence will be monitored to collect data to validate model calibration and refinements; to develop threshold and alarm levels for early warning and detection of subsidence impacts before surface impacts occur; to identify surface movements due to mining of the Resolution ore body; and to implement corrective actions and contingency plan.
 - Apache Leap, Queen Creek Canyon, and the surface area above the planned underground mine are currently monitored (prior to mining) using LiDAR, Interferometry Synthetic Aperture Radar (InSAR), and select rock spires using digital tilt meters.
 - During mining, the surface area above the ore deposit would be subdivided into a no-go zone, consistent with the limit of the subsidence fracture zone (where no person may enter) and a restricted public access zone consistent with the continuous subsidence limit (where Resolution Copper personnel are permitted for geotechnical monitoring and inspections). These zones would be reassessed during mining based on information collected from cave propagation monitoring.

Surface subsidence will be monitored through the use of available industry best practice and demonstrated technology including, extensometer, survey prisms, crack displacement monitors; Time Domain Reflectometer (TDR) cables; aerial photography; InSAR; microseismic monitoring system; and smart markers and cave trackers.

- Post-mining monitoring would continue for at least 15 years. Resolution Copper would continue to monitor the impact of surface subsidence on key infrastructures
 - Apache Leap, cliffs, and pillars
 - Queen Creek and Devil's Canyons
 - Highway U.S. 60
 - The surface subsidence area and Oak Flat Campground
- Resolution Copper will document and store all the results of surface subsidence inspection and monitoring. Results will be reported annually to the Forest Service for the Apache Leap Special Management Area. The reporting would include a summary of subsidence management actions undertaken to protect the Apache Leap SMA, a summary of observed and/or reported subsidence impacts, and a summary of cave performance and subsidence development based on monitoring.

Additional applicant-committed environmental protection measures by Resolution Copper are identified in the draft subsidence monitoring plan (Tshisens 2018a) and would reduce impacts from subsidence to Apache Leap, Queen Creek Canyon, or Devil's Canyon, staged depending on the level of effect observed:

- If monitoring indicates formation of new cracks or extension of existing cracks in the area, Harrison plots show slight damage based on monitoring data, small seismic events in the area, an average tilt up to 4 degrees, or measured subsidence angle is

between 72 and 78 degrees, measures implemented would be as follows:

- Resolution Copper would continue monitoring as per subsidence monitoring program; and
- Resolution Copper would update subsidence model predictions based on measured data or observations.
- If monitoring indicates extensive formation of new cracks or extension of existing cracks in the area; Harrison plots show moderate to severe damage based on monitoring data, major seismic events in the area, an average tilt of 5 degrees, or measured subsidence angle is less than 72 degrees; measures implemented would include the following:
 - Resolution Copper would increase monitoring frequency;
 - Resolution Copper would inform the Forest Service;
 - Resolution Copper would update subsidence model predictions based on measured data or observations; and
 - Resolution Copper would change draw strategy and mine plans.

Additional applicant-committed environmental protection measures by Resolution Copper would reduce impacts from subsidence to U.S. 60, mine roads and buildings, and Oak Flat Campground, staged depending on the level of effect observed (Tshisens 2018a):

- If monitoring shows formation of new cracks or extension of existing cracks in the area or on U.S. 60, Harrison plots show slight damage based on monitoring data, small seismic events in the area, an average angular distortion between 2×10^{-3} and 4×10^{-3} , or measured subsidence angle is between 72 and 78 degrees; measures would include the following:
 - Resolution Copper would continue monitoring as per subsidence monitoring program; and

- Resolution Copper would update the subsidence model predictions based on measured data or observations.

- If monitoring shows extensive formation of new cracks or extension of existing cracks in the area or on U.S. 60, Harrison plots show moderate to severe damage based on monitoring data, major seismic events in the area, an average angular distortion of more than 4×10^{-3} , or measured subsidence angle is less than 72 degrees; measures implemented would be as follows:
 - Resolution Copper would increase monitoring frequency;
 - Resolution Copper would inform relevant public authorities;
 - Resolution Copper would update subsidence model predictions based on measured data or observations; and
 - Resolution Copper would increase road maintenance programs and repairs.

To prevent exposure of the public to geological hazards, Resolution Copper would use fencing, berms, locking gates, signage, natural barriers/steep terrain (25 to 30 percent or greater), and site security measures to limit access roads and other locations near areas of heavy recreational use.

Subsidence Impacts

TIMING AND EXTENT OF SUBSIDENCE CRATER DEVELOPMENT, INCLUDING UNCERTAINTY

Resolution Copper proposes to use panel caving for underground mining at about 4,500 to 7,000 feet beneath the ground surface. The total mineralized rock to be removed is estimated to be about 1.4 billion tons of ore. Caving of this ore material is induced by undercutting the ore zone, which removes its ability to support the overlying rock material.

Fractures then spread throughout the area to be extracted, causing it to collapse and form a cave, which then propagates upward. This caving of the ore is predicted to be accompanied by surface subsidence. Subsidence occurs when the underground excavation caves and movement of material propagate all the way to the surface, and the land surface is subsequently deformed.

The depth of the land surface depression is a result of the properties of the collapsed rock material and the amount of rock removed below it. The geographic extent of surface disturbance is a function of the rock properties, local geological structure, regional geological stresses, and the amount of material removed through mining. The predicted surface subsidence is depicted in figure 3.2.4-1, at 6, 10, 15, 20, 30, and 41 years after the start of mining.

Figure 3.2.4-1 illustrates three areas: the crater limit, fracture limit, and continuous subsidence limit.

- The crater limit is the area of active caving, directly above the ore body. The surface in this area would be actively mobilized and moving during mining. This is defined in the subsidence model as areas with more than 6 to 7 feet of vertical displacement.
- The fracture limit is at the fringe of the crater limit and is the area where visible fracturing would be expected, including radial cracks and possible rotation and toppling of rocks. For the purposes of the EIS analysis, the fracture limit is generally considered to be the area where physical impacts from subsidence are likely to occur. This area is defined in the subsidence model as areas where the total measure of strain exceeds 0.5 percent.
- The continuous subsidence limit is characterized by extremely small rock deformations that can only be detected using high-resolution monitoring equipment. If deformations are significant enough, in some cases they can create small hairline cracks in the surface of concrete but would not be visible in the soil or on the ground. This area is also commonly referred to as the elastic

zone, because the deformations are usually below the threshold where rock fractures. This area is defined in the subsidence model by a combination of horizontal strain and angular distortion.

Figure 3.2.4-2 provides a detailed depiction of the anticipated subsidence at the end of the mine life; the fracture limit is estimated to extend to within approximately 1,115 feet (340 m) from Apache Leap, and to approximately 3,445 feet (1,050 m) from Devil's Canyon. The fracture limit area is roughly 1.8 miles in diameter.

The Geology and Subsidence Workgroup requested a number of sensitivity model runs as part of the evaluation of the subsidence model (BGC Engineering USA Inc. 2018a; Garza-Cruz and Pierce 2018). These model runs assess what would change if various input parameters or assumptions in the model were different, including rock mass strength, in-situ strength, fault strength, and bulked rock porosity. The size of the fracture limit under these different sensitivity runs does not differ substantially from the base case model, and while at least one sensitivity run brings it closer to the boundary of the Apache Leap SMA, it remains outside that boundary. Similarly, under all scenarios the first breakthrough of subsidence occurs in year 6 or 7 of mining, and subsidence ends very soon after ore extraction ends.

The primary difference in results among all the sensitivity model runs is the ultimate depth of the subsidence crater. Under the base case model, an ultimate depth of about 800 feet is anticipated. Under other sensitivity runs, the depth of the subsidence crater can vary between 800 and 1,115 feet.

POTENTIAL IMPACTS ON APACHE LEAP AND OTHER RESOURCES

While the fracture limit predicted by the subsidence model remains distant from Apache Leap, and Resolution Copper modelers concluded that there would be no anticipated damage to Apache Leap, there are still smaller modeled changes that are anticipated for Apache Leap. The

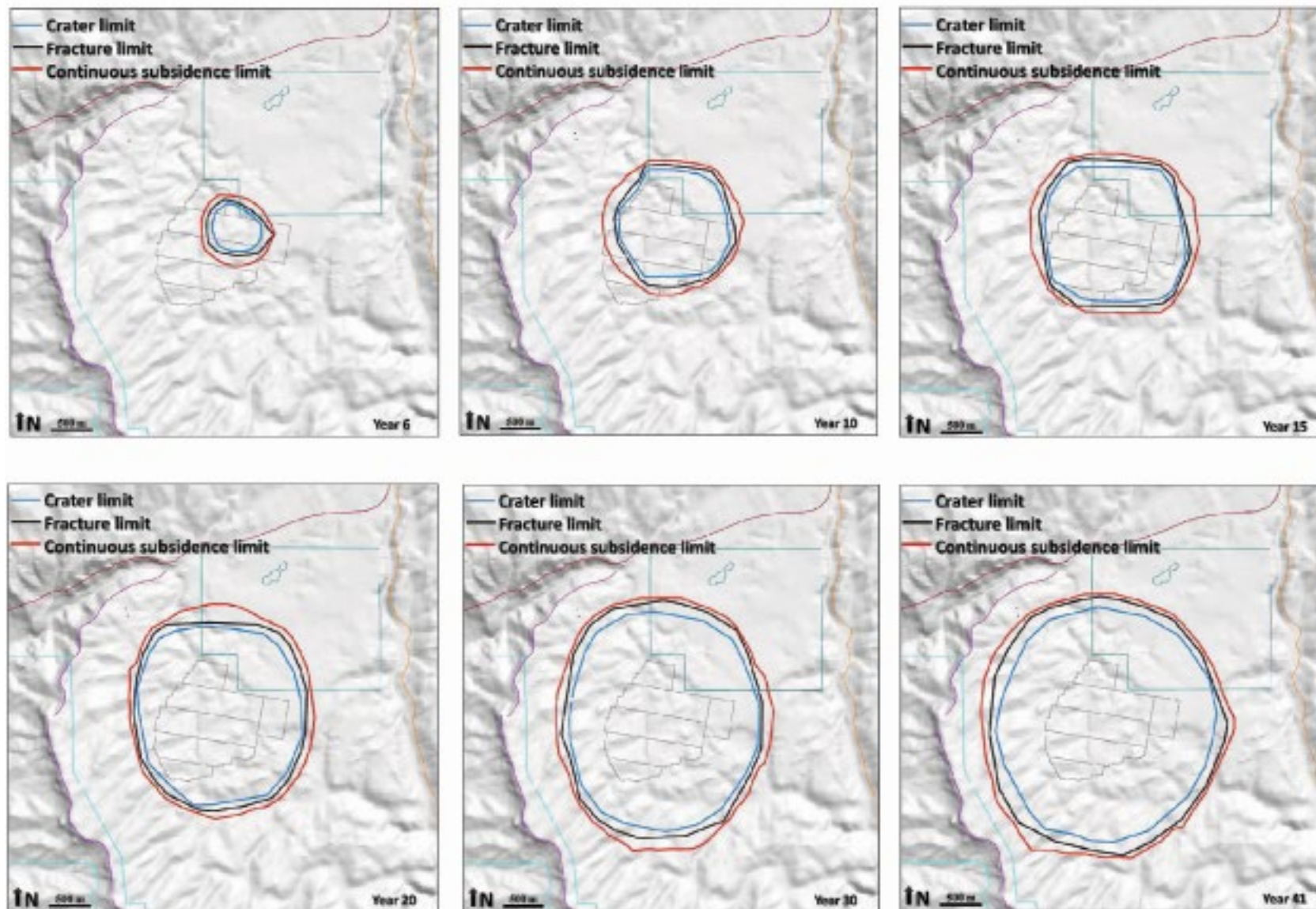


Figure 3.2.4-1. Evolution over time of the crater, fracture, and continuous subsidence limits predicted to exist (reproduced from Garza-Cruz and Pierce (2017))

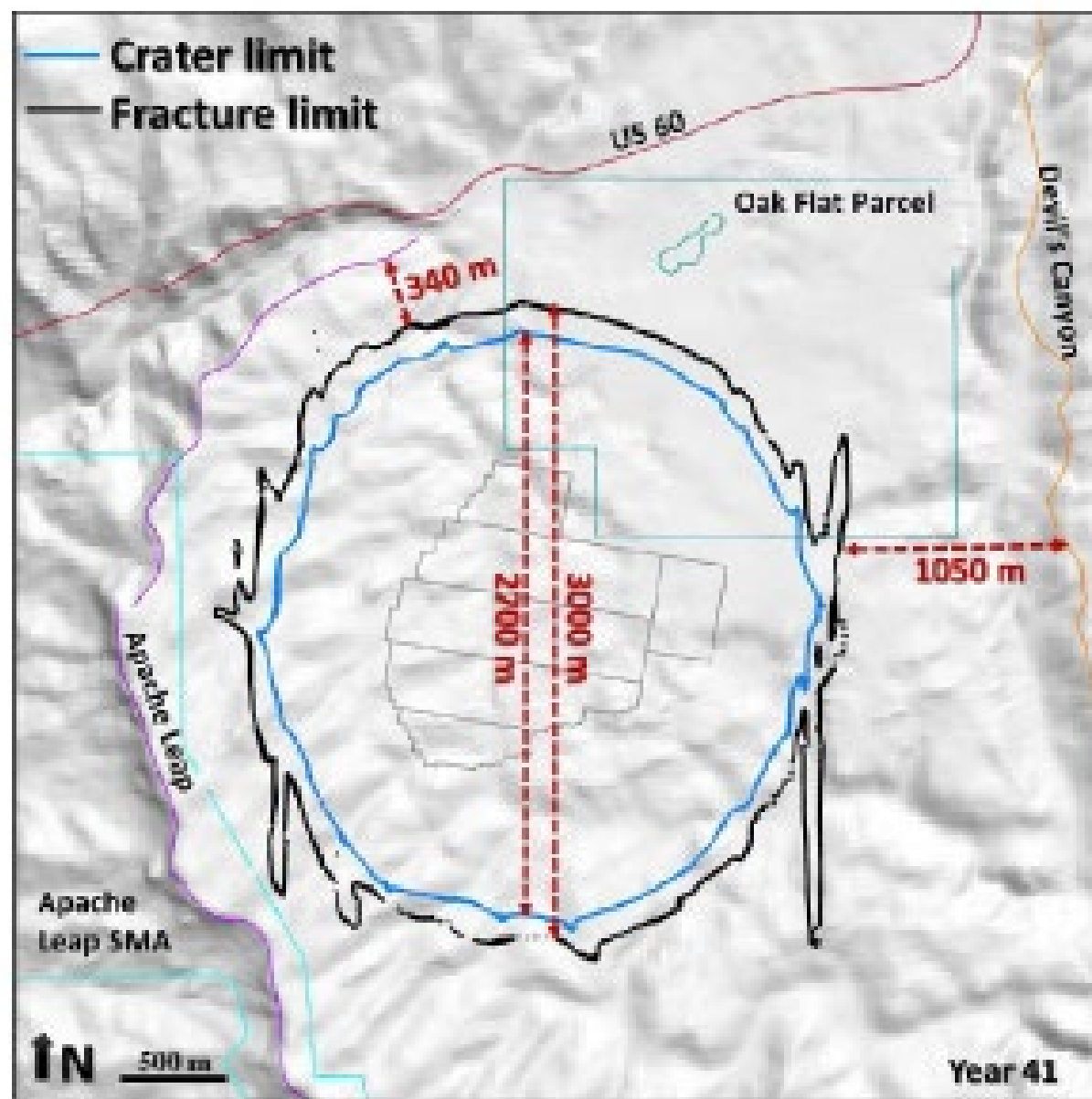


Figure 3.2.4-2. Final anticipated subsidence crater boundaries at end of mine life (reproduced from Garza-Cruz and Pierce (2017))

Geology and Subsidence Workgroup assessed predictions of horizontal displacement, vertical displacement, strain, and angular distortion.

- Roughly 1.5 feet (0.4 to 0.5 m) of horizontal and vertical displacement is anticipated at Apache Leap. Horizontal and vertical displacement by itself does not necessarily lead to damage.
- The angular distortion at Apache Leap is anticipated to be less than 1×10^{-3} meter/meter (BGC Engineering USA Inc. 2018a; Morey 2018b). The approximate threshold for damage is 3×10^{-3} , indicating that damage would not be expected at Apache Leap (BGC Engineering USA Inc. 2018a; Garza-Cruz and Pierce 2017).

The Geology and Subsidence Workgroup generally agreed with the conclusion that damage to Apache Leap would not be anticipated and found that many of the modeling choices were conservative (i.e., these choices would tend to overestimate the extent of subsidence, not underestimate it). However, after assessing a number of sensitivity analyses, some remaining uncertainties were recognized, including (BGC Engineering USA Inc. 2018a):

- The geographic extent of subsidence changes with the rock mass properties of the Apache Leap Tuff and Whitetail Conglomerate formations. When rock mass properties were reduced by 25 percent during a sensitivity run, the fracture limit extended closer to Apache Leap. However, even during this sensitivity run, angular distortion at Apache Leap did not exceed the 3×10^{-3} threshold for damage.
- The geographic extent of subsidence also changes with assumed fault strength. When fault strength was reduced during a sensitivity run, the fracture limit extended closer to Apache Leap. However, even during this sensitivity run, angular distortion at Apache Leap did not exceed the 3×10^{-3} threshold for damage.

Considering these uncertainties, the Geology and Subsidence Workgroup identified that the combination of horizontal displacement and vertical settlement could potentially cause angular distortion to locally exceed the damage threshold at Apache Leap and lead to localized rock block failure, but large-scale failures are not anticipated (BGC Engineering USA Inc. 2018a). A localized rock block failure refers to the gradual movement or sudden fall of one or more individual rock blocks due to progressive ground movement over time; these small rockfalls are a possibility but not anticipated to be substantially different from those observed in ongoing monitoring. Large-scale failure refers to progressive or sudden failure of a large mass of rock in response to ground movements over time; large failures, collapses, or major rockfalls are not anticipated and are considered to be unlikely.

In addition to Apache Leap, similar concerns were raised for Devil's Canyon and U.S. 60. These locations are located even farther than Apache Leap from the fracture limit. Damage is not anticipated at these locations, subject to the same uncertainties described in this section.

MINE INFRASTRUCTURE AND EFFECT OF SUBSIDENCE MONITORING

As noted, a number of applicant-committed environmental protection measures related to subsidence monitoring would occur. The intent of this monitoring is to understand the real-world progression of the block-caving and subsidence. Public comments have raised the concern that once block-caving begins, such monitoring would provide useful information but would ultimately not be effective at preventing impacts on Apache Leap or other areas if the subsidence modeling turns out to be incorrect.

While it is accurate that subsidence would progress unchecked once block-caving begins, there are several aspects of the mine plan that would make the subsidence monitoring effective at preventing damage to Apache Leap or U.S. 60.

The mine plan calls for the block-caving to occur in six discrete panels, described in detail in GPO section 3.2.9.1 (Resolution Copper 2016d).

The phasing of these panels is to mine from east to west, or in other words, starting farther from Apache Leap and working toward Apache Leap. In this manner, the results of subsidence monitoring from the initial panel caving would be available prior to any mining near Apache Leap. This would allow time for modifications to be made to the mine plan, if necessary, before damage occurred at Apache Leap.

In addition, the primary mine infrastructure at the East Plant Site is located closer to the subsidence fracture limit than Apache Leap. In the event that real-world subsidence is more extensive than anticipated by the subsidence modeling, the infrastructure needed to continue mining would be anticipated to be impacted prior to impacts occurring at Apache Leap. This would allow time for modifications to be made to the mine plan before damage occurred at Apache Leap.

Geological Hazards

INDUCED SEISMICITY

In general, the primary requirement for inducing seismicity is human activity that changes the state of stress in highly pre-stressed rocks (Gibowicz and Lasocki 2001); mining and subsidence at the project site could impact the existing state of stress. The potential for induced seismicity was assessed for the project (BGC Engineering USA Inc. 2018b).

It is not possible to make specific predictions about mine-induced seismicity at the proposed Resolution Copper Mine. However, the potential surface effects for induced earthquakes that might occur at the proposed mine could include ground shaking on a local scale, which could include the town of Superior. While mine-induced seismicity is possible, based on 100 years of worldwide observations, events greater than magnitude 5 are rare, and events of magnitude 3 or less are more common. This is observed in the most recent mine-related earthquakes in Arizona, which ranged from magnitude 2.9 to 3.1. For reference, damage to structures is rarely observed for earthquakes less than magnitude 5. Surface faulting is not expected because the magnitude of

possible induced seismic events falls far below the observed threshold (about magnitude 6.5) for surface faulting (Youngs et al. 2003).

Induced mine seismicity is possible, but unlikely to be of sufficient magnitude to cause structural damage.

SUBSIDENCE AREA ACCESS

With the exception of the southeast portion, the entirety of the subsidence area would be on Resolution Copper private land, after exchange of the Oak Flat Federal Parcel. Access to the subsidence area would be restricted on these lands using fencing, berms, signage, and natural barriers or steep terrain (25 to 30 percent or greater).

The southeast portion of the subsidence area would be on Arizona State Trust land; the future ownership or use of this land is not known. Regardless of ownership, it is anticipated that the entire subsidence area would be under the jurisdiction of both the Arizona State Mine Inspector, requiring adherence to the Arizona mining code, and MSHA, requiring adherence to national mining regulations. Both these entities take public safety into account when regulating and inspecting mines and would dictate access restrictions.

Paleontological Resources

No known paleontological resources, or surface geological units amenable to paleontological resources (Naco, Escabrosa, and Martin limestones), would be impacted by subsidence or other activities at the East Plant Site, West Plant Site, MARRCO corridor, or filter plant and loadout facility.

Caves and Karst Resources

No known cave/karst resources, or surface geological units amenable to cave/karst resources (Naco and Escabrosa limestones), would be impacted by subsidence or other activities at the East Plant Site, West Plant Site, MARRCO corridor, or filter plant and loadout facility. Several caves have been identified in the vicinity of these facilities

(Umbrella Cave, Superior High School Cave); these are considered in section 3.8 as suitable wildlife habitat but would not be impacted or disturbed by the project footprint.

Unpatented Mining Claims

No unpatented mining claims unassociated with Resolution Copper would be impacted by activities at the East Plant Site, West Plant Site, MARRCO corridor, or filter plant and loadout facility.

The development of the Resolution Copper Mine potentially could encourage additional exploration and staking of mining claims on Federal lands at the periphery of the mine. This type of activity has been observed to be spurred by the permitting or development of known ore bodies. This ultimately could drive additional ground disturbance for well pads and access roads; any such development would be subject to Forest Service analysis and permitting. Known exploration projects have been considered for cumulative effects.

3.2.4.3 Alternative 2 – Near West Proposed Action

Paleontological Resources

No known paleontological resources have been observed within the footprint of the Alternative 2 tailings storage facility. Naco and Escabrosa limestone have not been observed at the surface under the Alternative 2 tailings storage facility footprint. A small outcropping of Martin limestone is located on the west side of the tailings storage facility footprint. Although paleontological resources have not been observed here, this geological formation has the potential to host fossils, and this outcrop likely would be destroyed during tailings storage facility construction (Klohn Crippen Berger Ltd. 2018a).

Caves and Karst

No known cave/karst resources, or surface geological units amenable to cave/karst resources (Naco and Escabrosa limestones), would be

impacted by the footprint of the Alternative 2 tailings storage facility (Klohn Crippen Berger Ltd. 2018a).

Unpatented Mining Claims

A number of unpatented lode and placer claims are located within the footprint of the Alternative 2 tailings storage facility and tailings pipeline corridor footprint that are not associated with Resolution Copper (see figure 1.3-2 in the GPO). These include the Bomboy Placer claim and about 10 to 20 lode claims within the tailings storage facility footprint, along with 20 to 30 lode claims within the tailings pipeline corridor.

3.2.4.4 Alternative 3 – Near West – Ultrathickened

Impacts from Alternative 3 would be identical to those under Alternative 2 for caves, karst, paleontological resources, and mining claims.

3.2.4.5 Alternative 4 – Silver King

Paleontological Resources

No known paleontological resources, or surface geological units amenable to paleontological resources (Naco, Escabrosa, and Martin limestones), would be impacted by the footprint of the Alternative 4 tailings storage facility. All three of these units are in the vicinity but are not exposed at the surface within the tailings facility footprint (Klohn Crippen Berger Ltd. 2018c).

Caves and Karst

No known cave/karst resources, or surface geological units amenable to cave/karst resources (Naco and Escabrosa limestones), would be impacted by the footprint of the Alternative 4 tailings storage facility. Both of these units are in the vicinity but are not exposed at the surface within the tailings facility footprint (Klohn Crippen Berger Ltd. 2018c).

Unpatented Mining Claims

A number of unpatented lode claims are located within the footprint of the Alternative 4 tailings storage facility and tailings pipeline corridor footprint that are not associated with Resolution Copper. Roughly 70 to 80 unpatented claims, associated with three different owners, are within the tailings storage facility footprint.

3.2.4.6 Alternative 5 – Peg Leg

Paleontological Resources

No known paleontological resources, or surface geological units amenable to paleontological resources (Naco, Escabrosa, and Martin limestones), would be impacted by the footprint of the Alternative 5 tailings storage facility (Golder Associates Inc. 2018a).

Caves and Karst

No known cave/karst resources, or surface geological units amenable to cave/karst resources (Naco and Escabrosa limestones), would be impacted by the footprint of the Alternative 5 tailings storage facility (Golder Associates Inc. 2018a).

Unpatented Mining Claims

A number of unpatented lode claims are located within the footprint of the Alternative 5 tailings storage facility and tailings pipeline corridor footprint that are not associated with Resolution Copper. Roughly 80 to 90 unpatented claims, associated with two different owners, are located along the eastern tailings pipeline corridor, and roughly 40 to 50 unpatented claims, associated with five different owners, are located along the western tailings pipeline corridor.

3.2.4.7 Alternative 6 – Skunk Camp

Paleontological Resources

No known paleontological resources, or surface geological units amenable to paleontological resources (Naco, Escabrosa, and Martin limestones), would be impacted by the footprint of the Alternative 6 tailings storage facility (Klohn Crippen Berger Ltd. 2018d).

Caves and Karst

No known cave/karst resources, or surface geological units amenable to cave/karst resources (Naco and Escabrosa limestones), would be impacted by the footprint of the Alternative 6 tailings storage facility (Klohn Crippen Berger Ltd. 2018d).

Unpatented Mining Claims

While the Alternative 6 tailings storage facility is located on Arizona State Trust lands and private lands and therefore no Federal unpatented mining claims are present, a number of unpatented lode claims are located within the footprint of the Alternative 6 tailings pipeline corridor that are not associated with Resolution Copper. Roughly 120 to 130 unpatented claims, associated with three different owners, are located along the southern tailings pipeline corridor, and roughly 10 to 20 unpatented claims, associated with five different owners, are located along the northern tailings pipeline corridor.

3.2.4.8 Cumulative Effects

The Tonto National Forest identified the following reasonably foreseeable future actions as likely, in conjunction with development of the Resolution Copper Project, to contribute to cumulative impacts on geology, minerals, and subsidence. However, it should be noted that no other mining or other human activities in the cumulative impact assessment area were identified as likely to result in geological subsidence. The analysis presented here therefore focuses on effects on area geology and mineral resources. As noted in section 3.1, past and

present actions are assessed as part of the affected environment; this section analyzes the effects of any RFFAs, to be considered cumulatively along with the affected environment and Resolution Copper Project effects.

- *Pinto Valley Mine Expansion.* The Pinto Valley Mine is an existing open-pit copper and molybdenum mine located approximately 8 miles west of Miami, Arizona, in Gila County. Pinto Valley Mining Corporation is proposing to expand mining activities onto an estimated 1,011 acres of new disturbance (245 acres on Tonto National Forest land and 766 acres on private land owned by Pinto Valley Mining Corporation) and extend the life of the mine to 2039. The company estimates average annual copper production rates of between 125 and 160 million pounds to continue through the extended operational life of this mine.
- *Ripsey Wash Tailings Project.* ASARCO is planning to construct a new tailings storage facility to support its Ray Mine operations. The environmental effects of the project were analyzed in an EIS conducted by the USACE and approved in a ROD issued in December 2018. As approved, the proposed tailings storage facility project would occupy an estimated 2,574 acres and be situated in the Ripsey Wash watershed just south of the Gila River approximately 5 miles west-northwest of Kearny, Arizona, and would contain up to approximately 750 million tons of material (tailings and embankment material). ASARCO estimates a construction period of 3 years and approximately 50 years of expansion of the footprint of the tailings storage facility as slurry tailings are added to the facility, followed by a 7- to 10-year period for reclamation and final closure. The effects of this project on geology and minerals would include what is assumed to be irreversible loss to future use of any aggregate (i.e., sand, gravel, or decorative rock) or other mineral resource that would be permanently buried beneath the estimated 625-foot-high, nearly 2,600-acre facility.
- *Ray Land Exchange and Proposed Plan Amendment.* ASARCO is also seeking to complete a land exchange with the BLM by

which the mining company would gain title to approximately 10,976 acres of public lands and federally owned mineral estate located near ASARCO's Ray Mine in exchange for transferring to the BLM approximately 7,304 acres of private lands, primarily in northwestern Arizona. It is known that at some point ASARCO wishes to develop a copper mining operation in the "Copper Butte" area west of the Ray Mine; however, no specific details are currently available as to potential environmental effects resulting from this future mining operation. Also, while no data have been made publicly available regarding ASARCO's estimates of the overall size or estimated grade of the ore body at the Copper Butte location, the deposit is known to be relatively shallow and composed entirely or nearly entirely of oxide ore. ASARCO has stated that the ore would be mined via an open-pit operation.

- *Florence Copper In-Situ Mining Project.* This mining project, located on the northwestern outskirts of the town of Florence, is an underground copper leaching, recovery, and processing operation that is now in a production testing phase. The operational life of the mine is estimated at approximately 20 years. The mine owner, Florence Copper, estimates that the operation would produce an average of 55 million pounds of copper annually for the first 6 years and 85 million pounds annually for 14 years, equating to approximately 1.5 billion pounds of copper that would be permanently removed from this location.

With respect to these RFFAs, although no Resolution Copper Project effects from subsidence, geological hazards, paleontological resources, or cave/karst resources would overlap the effects from these mining projects, cumulatively, all would contribute to the overall regional effects of continued mineral extraction in the Copper Triangle. It is reasonable to assume that during the projected life of the Resolution Copper Mine (50–55 years), some mineral material extraction operations like the mines identified here may exhaust the supply of desired rock materials

in a given location and close, while other similar operations may start up elsewhere within the cumulative effects analysis area.

At any given time in this region of Arizona, it is extremely common for various mineral exploration projects, often involving the drilling of assay or test boreholes to evaluate the potential presence of an economically valuable mineral resource, to be ongoing. However, these types of activities are nearly always short term (typically lasting a few weeks to a few months) and generally have no effect or only the most negligible effect on the landscape and on area geological and mineral resources. It is reasonable to assume similar activities will continue into the foreseeable future.

3.2.4.9 Mitigation Effectiveness

The Forest Service is in the process of developing a robust mitigation plan to avoid, minimize, rectify, reduce, or compensate for resource impacts that have been identified during the process of preparing this EIS. Appendix J contains descriptions of mitigation concepts being considered and known to be effective, as of publication of the DEIS. Appendix J also contains descriptions of monitoring that would be needed to identify potential impacts and mitigation effectiveness. As noted in chapter 2 (section 2.3), the full suite of mitigation would be contained in the FEIS, required by the ROD, and ultimately included in the final GPO approved by the Forest Service. Public comment on the DEIS, and in particular appendix J, will inform the final suite of mitigations.

This section contains an assessment of the effectiveness of mitigation and monitoring measures found in appendix J that are applicable to geology, minerals, and subsidence.

Mitigation Measures Applicable to Geology, Minerals, and Subsidence

Subsidence monitoring plan (FS-222): Extensive subsidence monitoring has been proposed by Resolution Copper and is included in this document as an applicant-committed environmental protection

measure, as discussed earlier in this resource section under “Summary of Applicant-Committed Environmental Protection Measures.” The Forest Service generally has concluded that this monitoring would be effective at identifying potential effects of subsidence in time to inform a response to prevent damage.

However, as subsidence has the potential to affect Tonto National Forest surface resources, particularly within the Apache Leap SMA, the Forest Service will require that a final subsidence monitoring plan be completed and approved by the Forest Service prior to signing a decision. Given the unique and technical nature of subsidence modeling and monitoring, the Forest Service would engage with appropriate industry professionals (such as those involved in the Geology and Subsidence Workgroup) to review the subsidence monitoring plan, funded by Resolution Copper if deemed appropriate.

Mitigation Effectiveness and Impacts

The mitigation measure would focus on all aspects of the subsidence monitoring, including monitoring equipment, techniques, frequency, trigger levels, and remedial actions. As discussed earlier, the phasing of the panel caving is such that remedial actions can be taken if monitoring indicates subsidence impacts are more extensive than anticipated. The final subsidence monitoring plan is therefore anticipated to be effective at mitigating any damage to Apache Leap or other Tonto National Forest surface resources, once appropriate trigger levels and actions have been identified.

There would be no additional physical impacts associated with this mitigation.

Unavoidable Adverse Impacts

Unavoidable adverse impacts would occur through disturbance caused by the subsidence, to a small area of Martin limestone with potential paleontological resources (Alternatives 2 and 3), and to unpatented mining claims not associated with the Resolution Copper Project (all tailings facilities and/or pipeline corridors). Impacts on cave/karst

resources and to the public from geological hazards from access to the subsidence area, induced seismicity, or damage to Apache Leap are not considered likely to occur.

3.2.4.10 Other Required Disclosures

Short-Term Uses and Long-Term Productivity

Construction of the project would convert some undeveloped lands into an industrial mining operation, and construction of mine facilities would alter the area's topography. Impacts related to subsidence and the tailings storage facilities would permanently impact long-term productivity.

Irreversible and Irretrievable Commitment of Resources

Irreversible commitment of geological and mineral resources would occur with the excavation and relocation of approximately 1.4 billion tons of rock and with the recovery of approximately 40 billion pounds of copper, as well as the burying of any mineral resources below the alternative tailings facilities.

With respect to paleontological and cave/karst resources, a commitment of resources is considered to be irretrievable when project impacts limit the future use or productivity of a nonrenewable resource over a limited amount of time—for example, structures built on top of paleontologically sensitive geological units that might later be removed. A commitment of resources is considered to be irreversible when project impacts cause a nonrenewable resource to be permanently lost—for example, destruction of significant fossils and loss of associated scientific data.

An irreversible commitment of paleontological resources could occur at the Alternative 2 and 3 tailings storage facility location, where potentially fossil-bearing rocks associated with the Martin limestone could be destroyed in site preparation or buried permanently.

Overview

The proposed mine would disturb large areas of ground, not only from the mining and processing facilities, but also from the subsidence crater and tailings storage facility. Ground disturbance has the potential to destroy native vegetation, including species given special status by the Forest Service, and encourage noxious or invasive weeds. Ground disturbance also affects soils. Soils are a nonrenewable resource and can experience long-term impacts through compaction, accelerated erosion, and loss of productivity. After closure of the mine, reclamation can partially restore the function of these disturbed areas, but success depends on the stability of the tailings, on the closure design, and on how readily vegetation can be reestablished.

3.3 Soils and Vegetation

3.3.1 Introduction

This section discusses the effects of the project on soils, soil productivity, vegetation communities, noxious and invasive weeds, and special status plant species. Soils, which comprise mineral and organic material, provide the necessary structure, water, gases, and nutrients needed to support diverse microbial communities and growth and propagation of plants. Ground disturbance would potentially remove or destroy soil cover and vegetation, directly and indirectly impacting the quality, health, integrity, and stability of a soil, thereby degrading its productivity and capacity to sustain plant growth.

Soil and vegetation work together to form and support an ecosystem. The project would fundamentally change large areas of the landscape and remove these ecosystems for decades during the life of the mine. However, during reclamation and closure, these ecosystems can be recovered to a degree in some areas, particularly at the tailings storage facility. This section identifies what these ecosystems look like today, the management vision for how these ecosystems ideally would function in the long term (also known as the desired condition), and an assessment of whether the tailings landform can reach desired conditions over the long term, through reclamation and revegetation efforts.

3.3.2 Analysis Methodology, Assumptions, and Uncertain and Unknown Information

3.3.2.1 Analysis Area

This section includes a discussion of soils, revegetation, vegetation communities, special status plant species, and noxious weeds. The project area footprint (including all alternatives and facility components) is the analysis area for soils, soil productivity, and revegetation potential, as it encompasses all ground-disturbing activities. The analysis area for vegetation communities, noxious and invasive weeds, and special status plant species includes the project footprint with a 1-mile buffer, as well as areas along Queen Creek and Devil's Canyon, where changes to vegetation communities from groundwater drawdown and changes in surface water hydrology may occur. The soils analysis area is shown in figure 3.3.2-1, and the vegetation analysis area is shown in figure 3.3.2-2.

The area beyond the project footprint is informed by the water analyses for riparian areas (analyzed in section 3.7.1), reduction in surface runoff due to the project (analyzed in section 3.7.3); air quality analyses, particularly those focused on the generation and likely dispersion of fugitive dust (analyzed in section 3.6); lighting effects (analyzed in section 3.11), and the potential for noxious weed invasion (Foxcroft et al. 2010). According to the air quality analysis, ambient air quality standards would be achieved at the project footprint boundaries; for that reason, the 1-mile buffer is

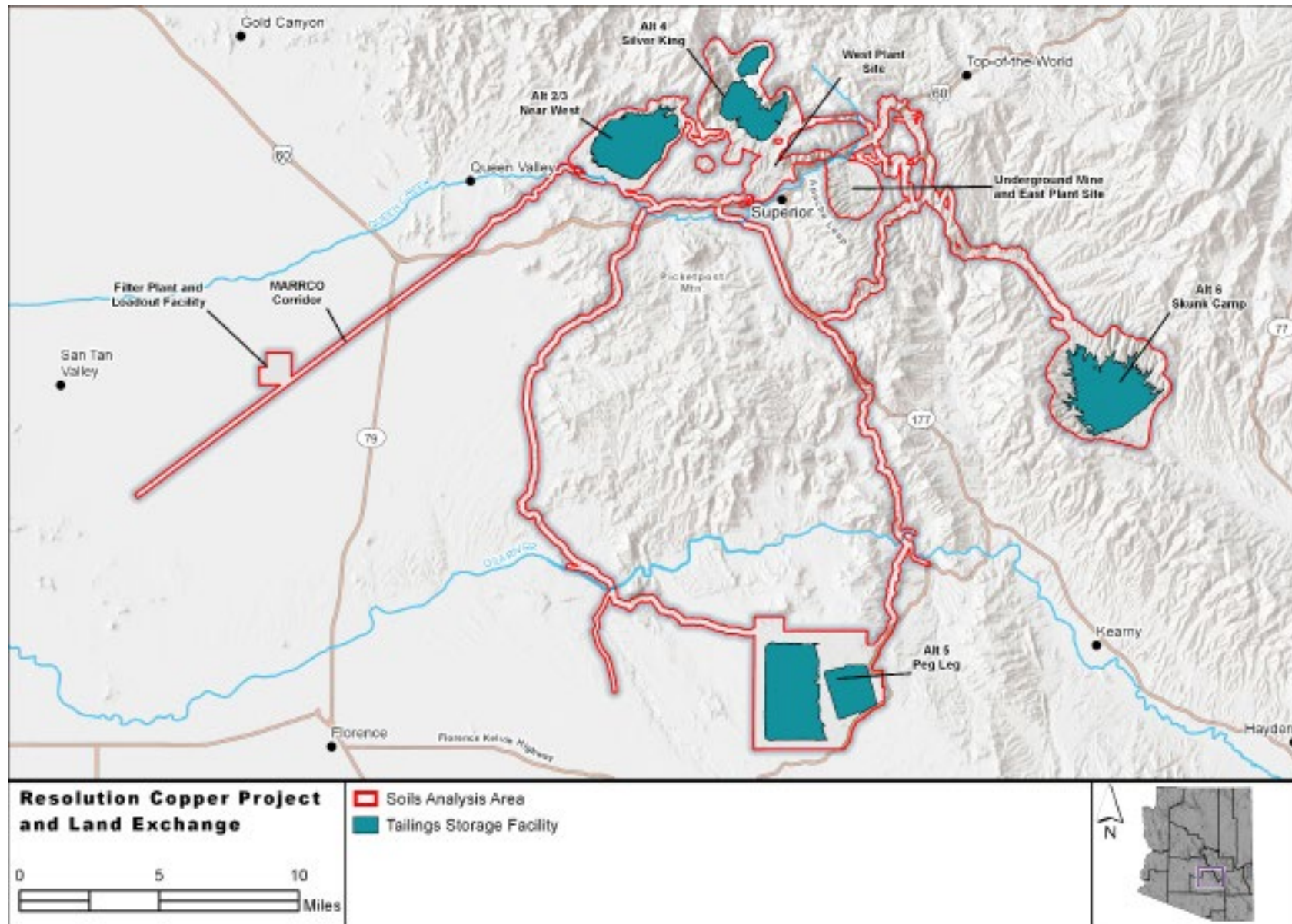


Figure 3.3.2-1. Soils analysis area

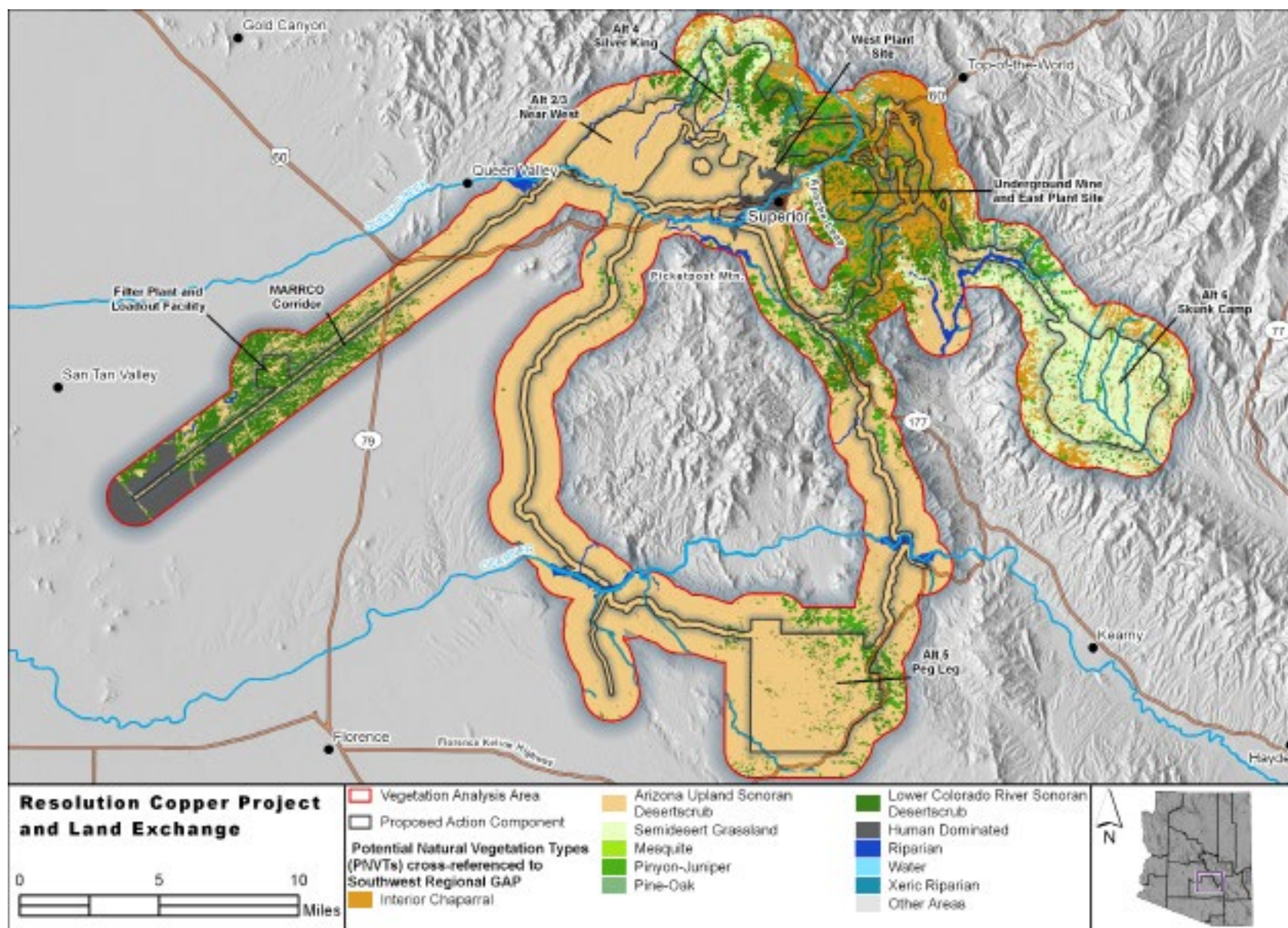


Figure 3.3.2-2. Vegetation analysis area

sufficient to address potential impacts from ambient air quality changes. Additional light associated with project construction and facilities is anticipated to increase night sky brightness by 1 to 9 percent (Dark Sky Partners LLC 2018). With the additional light increase of 1 to 9 percent over existing conditions, the 1-mile buffer would be sufficient to capture potential project-related impacts on plants from additional light.

The temporal parameters for this analysis involved the time frames for (1) construction: mine years 1 through 9; (2) operation: mine years 6 through 46; and (3) closure and reclamation: mine years 46 through 51–56. This analysis also extends to the time it takes to complete reclamation, because arid soils and vegetation communities in the analysis area can take very long periods (hundreds to thousands of years) to recover and reestablish; in some cases, complete recovery may not be possible.

3.3.2.2 Soils Analysis

The goal of the soils analysis is to identify the potential impacts on soil resources from all project activities and alternatives. In this analysis, soils are considered nonrenewable resources, as their formation in desert environments (particularly those characteristics that control biological community establishment) takes place over hundreds to thousands of years (Webb et al. 1988; Williams et al. 2013). Soil losses within the project footprint are, therefore, treated as permanent unless (1) soils are salvaged and reapplied during the construction and reclamation processes, (2) revegetation efforts successfully stabilize soils and reduce long-term erosion, and (3) soil productivity is returned to pre-mine conditions.

No single data set covers the entire project footprint; therefore, two data sources were combined for the soils analysis: (1) the U.S. Department of Agriculture (USDA) National Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) database (2017); and (2) the Forest Service General Terrestrial Ecosystem Survey (GTES) (U.S. Forest Service 2018e), applied where SSURGO data were unavailable. Where available, SSURGO data (Natural Resources Conservation Service 2017) provided information regarding general soil morphological

characteristics, soil depth, soil productivity, soil fertility, and soil wind and water erosion potential (Natural Resources Conservation Service 2018b). For this analysis, soil productivity is defined as “capacity of soil, in its normal environment, to support plant growth” (Minnesota Forest Resources Council 1999). GTES data provide some information on erosion susceptibility in other areas (U.S. Forest Service 2018e). In areas lacking SSURGO data, information regarding the nature and thickness of alluvial deposits and soil cover was taken from the “Near West Tailings Storage Facility Geotechnical Site Characterization Report” (corresponding directly to Alternatives 2 and 3) and extrapolated to other alternatives (Klohn Crippen Berger Ltd. 2017). Data and interpretations could be reasonably extrapolated across alternatives, as all sites occur within similar ecosystems of central Arizona. Site-specific interpretations of soil map units and erosion potential are limited by the resolution and accuracy of GIS data, which varied by data source and survey effort. Details of the soils analysis approach are available in Newell (2018g).

3.3.2.3 Revegetation Analysis

The goal of the revegetation analysis is to provide a site-specific assessment of current conditions and guidance for future revegetation efforts throughout the life of the project. Revegetation success depends on several controlling environmental variables (precipitation or water availability, climate, soil or revegetation substrate, reclamation techniques, etc.); therefore, no individual study includes enough information to project rates of revegetation success. For this analysis, a meta-analysis drew data from many sources to model revegetation rates. The analysis does not reflect outcomes for individual project components but instead relies on conceptual reclamation plans and provides a range of possible revegetation outcomes that could be expected at a given time after reclamation has commenced. The first step in the meta-analysis was to gather relevant case studies from published scientific literature, technical reports, and semi-quantitative field observations. Two attributes were compiled from each study: (1) the number of years since reclamation commenced, and (2) the minimum and maximum observed percent vegetation cover at the given time.

The results from each study were combined into a single plot for visual interpretation. Details of the data sources and the analysis approach are provided in Bengtson (2019b).

The assessment of revegetation relies in part on the reclamation plans that have been prepared by Resolution Copper, both as part of the GPO (section 6.0) and during alternatives development for the different tailings storage facilities. These reclamation plans largely describe the expected timing, type, and location of reclamation activities and provide the reclamation goals to be achieved. These conceptual reclamation plans are briefly summarized in this section.

A further level of reclamation detail would be developed in the final reclamation plans approved by the Forest Service and used to guide bonding estimates. As an example, the GPO identifies only that reseeding would occur and proposes a likely seed mix. Details in the final reclamation plan would identify surface preparation (ripping or tilling), site amendments (straw or fertilizers), a final seed mix, whether, where, and how any direct planting would be done, the need for supplemental watering, and performance standards that would need to be met through monitoring of revegetation progress.

3.3.2.4 Vegetation Communities, Noxious Weeds, and Special Status Plant Species Analysis

This analysis identifies the potential impacts on vegetation, vegetation communities, and special status plant species from all activities associated with each project alternative, including closure and reclamation (see table E-1 in appendix E for details associated with each alternative). The analysis also evaluates the increased likelihood of introduction and/or spread of noxious weed species in the analysis area.

The factors for analysis identified during the NEPA scoping process, survey, and records data provided as part of this project, as well as a scientific examination using current literature on species and how environmental changes (human or natural) affect species and their habitat, constitute the foundation of this analysis.

The uncertainties and unknown information, as well as assumptions, of this analysis include (1) limitations in the use of geographic information system (GIS) data (e.g., mapping data may have inaccuracies and resulting calculations could be an overestimation or underestimation) or data come from different sources for different portions of the analysis area; however, the analysis area contains similar overall environments and data sources have been reasonably extrapolated to cover the entire analysis area; (2) lack of current scientific data on how certain environmental changes affect species (e.g., there are only a few studies available regarding dust effects on plants); and (3) reliance on other, previous resource analyses as informational sources for the conclusions reached in this current analysis may inadvertently reiterate the assumptions, uncertainties, or unknown information inherent in these prior studies.

The analysis of reclamation success relies in part on the desired conditions for the lands, which are the expectations for how the landscape should appear and function over the long term. For the purposes of this analysis, desired conditions were informed by internal work by the Tonto National Forest on the ongoing revision to the forest plan, which has not yet been completed or released. The desired conditions used in this section are meant to allow an assessment of reclamation success but should not be construed as management direction from the Tonto National Forest.

3.3.3 Affected Environment

3.3.3.1 Relevant Laws, Regulations, Policies, and Plans

A summary of the principal legal authorities pertinent primarily to reclamation is shown in the accompanying text box. A complete listing and brief description of the laws, regulations, reference documents, and agency guidance used in this soils and vegetation effects analysis may be reviewed in Newell (2018g).

Primary Legal Authorities Relevant to the Soils and Vegetation Effects Analysis

- Forest Service locatable mineral regulations (36 CFR 228 Subpart A), specifically:
 - Minimizing adverse environmental impacts on NFS surface resources (36 CFR 228.8)
 - Requirements for reclamation (36 CFR 228.8(g))
- Forest Service Manual 2500, Chapter 2550 – Soil Management
- Arizona Native Plant Law (ARS 3-904)
- Federal Noxious Weed Act of 1974
- Arizona Mined Land Reclamation Program
- State of Arizona Noxious Weed Statute
- Taylor Grazing Act (43 U.S.C. 315-315(o))
- Federal Land Policy and Management Act of 1976 (43 U.S.C. 1701–1782)

3.3.3.2 Existing Conditions and Ongoing Trends

Soil Occurrence and Characteristics

The project area footprint, including all components and alternatives, is characterized by Basin and Range geomorphology (Peterson 1981), with soils formed in alluvium, eolian deposits, colluvium, and thin residuum (overlying bedrock outcrops). In general, the deepest soils are formed within expansive alluvial fan piedmonts or alluvial deposits within the bottoms of canyons. Shallower soils form as thin alluvial or colluvial deposits along ridges and hillslopes (overlying shallow bedrock), or as shallow soils overlying calcium carbonate-cemented horizons (petrocalcic horizons) that form root-restrictive layers.

There are 42 soil units mapped in the analysis area (including the combination of map units from SSURGO and GTES datasets), with the majority of these individual map units being minor and constituting less than 1.0 percent of the area of each alternative. These map units are delineated in figure 3.3.3-1. The predominant soil units mapped for each action alternative are detailed in table 3.3.3-2, which includes descriptions of each predominant map unit's morphological characteristics, soil depths, soil productivity (either annual biomass production or dominant vegetation community), and soil fertility. Areas covered by SSURGO (Natural Resources Conservation Service 2017) data contain the most detailed soil descriptions, whereas data from other sources were used to extrapolate soils-related data to areas covered by GTES data (U.S. Forest Service 2018e). Data provided later in table 3.3.3-2 include only predominant soil map unit information; details of acreages of all individual map units are provided in Newell (2018g). Soil mapping is at an insufficient scale to delineate the location of each soil unit with respect to a specific disturbance feature for each alternative.

Soils across all project alternatives display characteristics that are unique to arid and semi-arid environments, which influence ecological function and response to disturbance. For example, soil resources such as water and nutrients display extreme variation through space and time, as pulses in precipitation drive pulses in biological and chemical cycles and processes (Abella 2017). Arid and semi-arid soils display distinct surface features such as desert pavements and biotic soils that provide critical

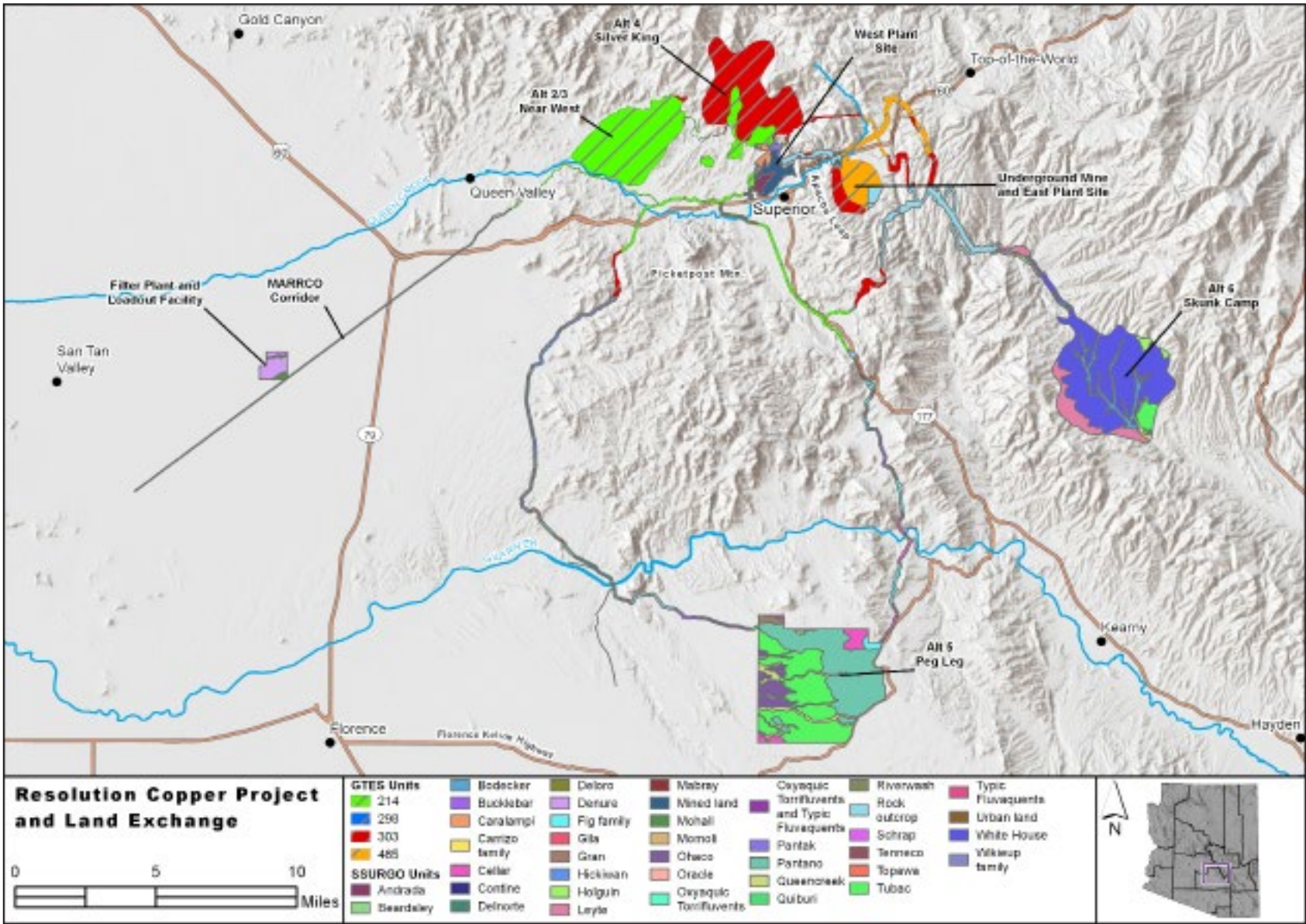


Figure 3.3.3-1. Soil map units as delineated from SSURGO (Natural Resources Conservation Service 2017) GTES (U.S. Forest Service 2018e) datasets

soil cover (in areas where vegetation is sparse) and play an active role in the capture of dust and formation of dust-rich vesicular horizons, which strongly influence the distribution and storage of water (Williams 2011; Williams et al. 2013). Desert pavements form a single layer of surface rock fragments that resemble smooth pavement surfaces (Wood et al. 2005), whereas biotic soils formed by cyanobacteria, mosses, lichens, bacteria, algae, and fungi that grow around soil mineral particles create a living soil cover (Eldridge and Greene 1994; Williams et al. 2012).

Fertile islands are also ubiquitous surface features in these soils, where nutrients, organic material, macro- and microbiological activity, and water availability are elevated in surface soils beneath the canopies of perennial vegetation as compared with the soils of surrounding plant interspaces (Schlesinger et al. 1996). Surface soils further contain soil seedbank, which in most deserts is limited to the upper 2 inches of soil (Scoles-Sciulla and DeFalco 2009). Surface topography and soil cover drive the distribution of water and infiltration across arid soil surfaces in arid environments. Soil water runs off smooth surfaces with low infiltration only to be captured along rougher surfaces with greater infiltration potential and stored where soil water-holding capacity is high (Wood et al. 2005). Similarly, slope drives the redistribution of water, with drainages capturing and storing the majority of water run-off, leading to different community composition in those areas than adjacent upland areas (Schwinning et al. 2010).

Note that where specific soil data are shown to be lacking, several mitigations are required that would provide for collection of this information (see section 3.3.4.9).

Soils Suitability for Reclamation

According to the GPO (Resolution Copper 2016d), soils within much of the project footprint (particularly those within Alternatives 2 and 3) are primarily bedrock-controlled, and only a thin veneer of soils could be salvaged for previous reclamation and revegetation efforts (Resolution Copper 2016d). The GPO states that, where possible, soil would be salvaged for reuse during reclamation. The geotechnical study for the Near West tailings storage facility (Klohn Crippen Berger Ltd. 2017)

has identified thick alluvial deposits in drainages within the footprint and borrow areas of the proposed facility (alluvial deposits 6 to 35 feet thick); however, the alluvium has been allocated for construction of drains and filters. These bedrock-controlled soils (alluvium and colluvium up to 5 feet in thickness (Klohn Crippen Berger Ltd. 2017)) and thicker alluvial soils in drainages are typically capable of supporting vegetation communities ranging from Arizona Upland Sonoran Desertscrub and to Interior Chaparral Semi-desert Grassland (table 3.3.3-3).

Alternative 5 has both shallow, bedrock-controlled soils (up to 20 inches deep) and deeper soils formed along alluvial fan terraces (more than 60 inches deep). These soils have low organic matter (approximately 1 percent) and near neutral to slightly alkaline pH conditions that support annual rangeland productivity ranging from 350 to 600 lb biomass/acre/year (Natural Resources Conservation Service 2017).

Alternative 6 has both bedrock-controlled soils (alluvium and colluvium up to 5 feet in thickness (Klohn Crippen Berger Ltd. 2017) and deeper soils formed in alluvial fans (more than 60 inches deep) (Natural Resources Conservation Service 2017). These soils have low organic matter (approximately 1 percent) and slightly acidic to slightly alkaline pH conditions that support annual rangeland productivity ranging from 600 to 800 lb biomass/acre/year (Natural Resources Conservation Service 2017).

While some volume of soils would be salvaged (as practicable) for project reclamation, most of the capping material for the proposed tailings storage facility would be derived from other sources. The closure cover study completed for the Near West tailings storage facility (Klohn Crippen Berger Ltd. 2016) identified Gila Conglomerate as the preferred closure material for reclamation within the Near West tailings storage facility, which is present in sufficient quantities to be the primary capping material (for this facility's alternative). Gila Conglomerate was selected for the following reasons (Klohn Crippen Berger Ltd. 2016):

1. availability of material and ease of extraction,
2. favorable chemical and physical properties, and
3. its potential to support plant growth.

The characteristics of this material as a closure material and plant growth medium are described in more detail in Bengtson (2019a). In general, Gila Conglomerate is a neutral to slightly alkaline material (pH 7 to 8.2), is not potentially acid generating, and has a high net neutralization potential (Klohn Crippen Berger Ltd. 2016). Gila Conglomerate has both high saturated hydraulic conductivity and low water-holding capacity. Organic matter ranges from 1.6 to 3.2 percent (Klohn Crippen Berger Ltd. 2016). Total Nitrogen ranges from less than 0.02 to 0.028 percent, and organic carbon ranges from 1.6 to 3.2 percent²⁴ (Klohn Crippen Berger Ltd. 2016). Gila Conglomerate bedrock and soils formed from Gila Conglomerate parent material have been shown to support native and warm- and cool-season perennial grasses, annual forbs, and perennial forbs, some shrubs, and trees (Lawson 2012; Lawson 2011; Milczarek et al. 2011; Romig et al. 2006; Vinson et al. 1999). Revegetation studies on Gila Conglomerate-derived soils have shown vegetation cover may range from 2.8 to 26 percent, less than 1 year after reclamation treatments were applied (Lawson 2012; Lawson 2011). For surfaces capped by crushed Gila Conglomerate bedrock, another study showed vegetation cover varied from 11 to 71 percent 1 year after treatment, and by year 12, vegetation cover ranged from 23 to 77 percent (Milczarek et al. 2011). These studies further indicate that soil amendments, such as organic amendments and mulch treatments, may help increase the success of revegetation when crushed Gila Conglomerate bedrock is the plant growth medium, by increasing soil water-holding capacity and soil fertility and decreasing erosion susceptibility (Klohn Crippen Berger Ltd. 2016; Lawson 2011; Milczarek et al. 2011; Vinson et al. 1999).

24. Gila Conglomerate samples analyzed for organic matter included: (1) 30 surface samples from Near West site (organic matter ranging from 1.6 to 3.2 percent), which could have been impacted by soil formation (i.e., organic additions from soil biological activity); and (2) 25 samples from the Superior Mine stockpile (organic matter content was 1.7 percent), which were blasted, crushed, and screened (the influence of soil biological processes on organic matter contents is unknown).

Note that while the materials described here have been demonstrated in other situations to be theoretically suitable for reclamation, at least to a degree, several mitigations are required that would provide for collection of additional information to inform final reclamation plans, including the overall suitability of these materials (see section 3.3.4.9).

Estimates of Salvage Volumes

The GPO identified different geological units that would be salvaged during site preparation as being favorable for different uses for final cover (see table 4.6-1 in Resolution Copper (2016d)):

- Alluvial material. Primarily used for drains and filters for seepage control.
- Apache Leap Tuff. Primarily used for drains and filters, and for armoring of tailings embankment and seepage control embankments.
- Gila Conglomerate. Used for starter dams, drains and filters, and closure cover.
- Pinal Schist. Primarily used for armoring of tailings embankment, seepage control embankment, and diversion channels.

With respect to the final reclamation cover, the GPO originally estimated that over 8,000 acre-feet (13 million cubic yards) of Gila Conglomerate material would be available for cover during reclamation for the proposed action (Alternative 2), based on salvage from two borrow areas of about 350 acres, roughly to a depth of about 20 feet. With the development of different tailings alternatives, the specific borrow areas have changed. The borrow areas and estimated amounts of closure cover material are summarized in table 3.3.3-1.

Table 3.3.3-1. Estimated locations and amounts of available reclamation cover material

	Alternatives 2 and 3	Alternative 4	Alternative 5	Alternative 6
Proposed borrow area acreage	209 acres (one location)	247 acres (one location)	721 acres (five locations)	390 acres (two locations)
Primary geology of borrow area	Gila Conglomerate	Gila Conglomerate	Alluvium and Gila Conglomerate; some granite	Gila Conglomerate
Estimated volume of cover material available*	4,180 acre-feet (6.7 million cubic yards)	4,940 acre-feet (8 million cubic yards)	14,400 acre-feet (23.2 million cubic yards)	7,800 acre-feet (12.5 million cubic yards)
Approximate depth of cover from borrow areas for tailings storage facility†	1.3 feet	2.2 feet	2.7 feet	1.8 feet

* Assumes excavation to depth of 20 feet

† Based on planar acreage of tailings storage facility. Accounting for slopes (at 3H:1V) would require minimal additional material (less than a 5% increase)

The conceptual reclamation plans for the tailings storage facilities call for a minimum of 1.5 feet of cover, and the borrow areas proposed are roughly sufficient to provide this material for the tailings storage facility. Additional cover material would be obtained from salvage of surface soils within the footprint of the facility.

Previous investigations have looked at the possibility of the closure cover being a mix of materials, such as Gila Conglomerate and NPAG tailings (Klohn Crippen Berger Ltd. 2016). Geochemical characterization tests have been conducted on these materials and identified that there may be some potential for elevated metals in stormwater runoff. See section 3.7.2 for details of the geochemical tests

conducted for NPAG tailings, and tests on Gila Conglomerate have been described in several other reports (Klohn Crippen Berger Ltd. 2016, 2017).

Note that several mitigations are required that would provide for detailed estimates of soil available for salvage, salvaged soil storage techniques, potential preparation techniques (like excavation and crushing for Gila Conglomerate), conducting of appropriate tests to identify any potential water quality concerns for the selected cover material, and preparation of detailed reclamation plans that specify the cover materials to be used (see section 3.3.4.9). The predominant soil units mapped for each action alternative are detailed in table 3.3.3-2, which includes descriptions of each predominant map unit's morphological characteristics, soil depths, soil productivity (either annual biomass production or dominant vegetation community), and soil fertility.

Vegetation Occurrence and Characteristics

VEGETATION COMMUNITIES

Eleven vegetation communities and land cover types occur within the analysis area. These communities and land cover types along with the acres of each are given in table 3.3.3-3 and are shown in figure 3.3.3-2. The vegetation community GIS data used for this analysis comprised a specialized dataset developed by the Arizona Game and Fish Department (AGFD) that is a crosswalk between the larger scale (Brown 1994; Brown et al. 2007) and Southwest Regional Gap Analysis Project (SWReGAP) vegetation communities data and, more specifically, a modified SWReGAP layer that was used in the AGFD's statewide modeling process (Morey 2018a).

A brief description of each of the vegetation communities in the analysis area is provided here, with more technical description included in Newell (2018g). Within each alternative footprint, a variety of combinations of different vegetation communities are present. Note that where specific vegetation data are shown to be lacking, several mitigations are required that would provide for collection of this information (see section 3.3.4.9).

Table 3.3.3-2. Predominant soils by alternative

Alternative	Total Acres	Map Unit Symbol (data source)	Map Unit Name	Map Unit Description and Soil Composition	Productivity [†] (pounds of biomass per acre or dominant vegetation community)	Fertility [‡]	Acreage within Map Unit	Percentage of Alternative
Alternative 2 – Near West Proposed Action	10,033	214 (GTES)	CEMI2, LATR	<p>Klohn Crippen Berger Ltd. (2017) identified the majority of soils and soil parent material within the Near West project footprint to be formed in Undifferentiated Quaternary Deposits (Qs).[*] These surfaces are covered in slope wash and colluvium, and recent alluvium in narrow drainages low-relief areas underlain by bedrock (up to 5 feet in thickness). The material comprises gravel (10%–50%), silt and clay (28%–45%), and sand (10%–50%). Material is generally thinner along ridges and thicker along concave backslopes and toe-slopes.</p> <p>Active channels and drainages contain localized deposits of Recent Alluvium (Qal) and Old Alluvium (Qoa). Qal deposits are located adjacent to active channels reaches thicknesses of 6 to 35 feet (within the Near West footprint) and comprises uncemented, loose to dense sand (25%–80%) and gravel (10%–55%), silt and clay (2%–40%), and trace boulders (up to 24-inch diameter). Qoa deposits are located along the margins of active channels and include partially cemented to well-cemented gravel (40%–60%), sand (25%–40%), silt and clay (18%–30%), with some cobbles and boulders (up to 24-inch diameter). Carbonate cementation varies by deposit age.</p> <p>Old Lacustrine (Qoa-Lu) units occur in limited areas as 1- to 4-foot-thick deposits overlying Gila sandstone, and include gravel <10%, clay and silt (37%–78%), and sand (20%–28%).</p>	Arizona Upland Sonoran Desertscrub	No information available	5,274	54
		485 (GTES)	QUTU2	The majority of areas are covered by Qs deposits (along ridges and hillslopes) with some of Qal and Qoa deposits (adjacent to active channels). [*] See unit descriptions above.	Interior Chaparral	No information available	1,457	15

continued

Table 3.3.3-2. Predominant soils by alternative (cont'd)

Alternative	Total Acres	Map Unit Symbol (data source)	Map Unit Name	Map Unit Description and Soil Composition	Productivity [†] (pounds of biomass per acre or dominant vegetation community)	Fertility [‡]	Acreage within Map Unit	Percentage of Alternative
Alternative 3 – Near West – Ultrathickened	10,033	214 (GTES)	CEMI2, LATR	Similar to Alternative 2 Near West Proposed Action (see above)	Arizona Upland Sonoran Desertscrub	No information available	5,274	54
		485 (GTES)	QUTU2	Similar to Alternative 2 Near West Proposed Action (see above)	Interior Chaparral	No information available	1,457	15
Alternative 4 – Silver King	10,861	214 (GTES)	CEMI2, LATR	No direct observations from Kohn Crippen Berger Ltd. (2017) were available to inform interpretations regarding soils or quaternary deposit thickness.* Based on extrapolation (from aerial imagery and geological mapping), most canyon bottoms are likely to contain Qal and Qoa deposits (adjacent to active channels) with some Qs deposits along ridges and hillslopes. See unit descriptions above, in this table.	Arizona Upland Sonoran Desertscrub	No information available	1,259	12
		303 (GTES)	FOSP2, QUTU2, GRANITE OUTCROP	No direct observations from Kohn Crippen Berger Ltd. (2017) were available to inform interpretations regarding soils or quaternary deposit thickness.* Based on extrapolation (from aerial imagery and geological mapping), most areas are covered by Qs deposits (along ridges and hillslopes) with some Qal and Qoa deposits (adjacent to active channels). See unit descriptions above, in this table.	Mix of Semi-desert Grassland and Lower Colorado River Sonoran Desertscrub	No information available	5,345	50
		485 (GTES)	QUTU2	No direct observations from Kohn Crippen Berger Ltd. (2017) were available to inform interpretations regarding soils or quaternary deposit thickness.* Based on extrapolation (from aerial imagery and geological mapping), most areas are covered by Qs deposits (along ridges and hillslopes) with some discrete Qal and Qoa deposits (adjacent to active channels). See unit descriptions above, in this table.	Interior Chaparral	No information available	1,457	14

continued

Table 3.3.3-2. Predominant soils by alternative (cont'd)

Alternative	Total Acres	Map Unit Symbol (data source)	Map Unit Name	Map Unit Description and Soil Composition	Productivity [†] (pounds of biomass per acre or dominant vegetation community)	Fertility [‡]	Acreage within Map Unit	Percentage of Alternative
Alternative 5 – Peg Leg East Option	17,153	74 (SSURGO)	Pantano-Anklam-Rock outcrop complex, 3 to 20 percent slopes	<p>The Pantano soil series are well-drained soils formed on steep alluvial and colluvial slopes and have a loamy matrix with ≥ 35% rock fragments. Soils are shallow, overlying fractured bedrock at 20-inch depths.</p> <p>The Anklam soil series are well-drained soils formed on moderate to steep alluvial slopes and have a loamy matrix with ≥ 35% rock fragments. Soils are shallow, overlying fractured bedrock at 10- to 20-inch depths.</p> <p>Granite or other bedrock outcrops cover 20% of the soil surface.</p>	<p>Pantano: 350 lb/acre</p> <p>Anklam: 500 lb/acre</p> <p>Bedrock: negligible</p>	<p>Organic Matter: 0.5%–1%</p> <p>pH: 6.1–8.4</p>	4,243	25
		98 (SSURGO)	Tubac-Rillino complex, 3 to 25 percent slopes	<p>The Tubac soil series are well-drained soils formed along alluvial fan terraces and basin floors with 0%–8% slopes. Soil textures are fine clay to sandy clay loam with 2% rock fragments, with diagnostic argillic horizons from 11–44 inches. Soils reach depths of 44–60+ inches.</p> <p>The Rillino soil series are well-drained soils formed along alluvial fan terraces with 1%–50% slopes. Soil textures range from sandy loam to loam with 15%–35% rock fragments. Soils reach depths of 60+ inches, with calcic (calcium carbonate-rich) soils at a depth of 5–20 inches.</p>	<p>Tubac: 600 lb/ac</p> <p>Rillino: 400 lb/ac</p>	<p>Organic Matter: 1%</p>	4,210	25

continued

Table 3.3.3-2. Predominant soils by alternative (cont'd)

Alternative	Total Acres	Map Unit Symbol (data source)	Map Unit Name	Map Unit Description and Soil Composition	Productivity [†] (pounds of biomass per acre or dominant vegetation community)	Fertility [‡]	Acreage within Map Unit	Percentage of Alternative
Alternative 5 – Peg Leg West Option	17,530	74 (SSURGO)	Pantano-Anklam-Rock outcrop complex, 3 to 20 percent slopes	Same as Alternative 5 Peg Leg East Option (above)	Pantano: 350 lb/acre Anklam: 500 lb/acre Bedrock: negligible	Organic Matter: 0.5%–1% pH: 6.1–8.4	4,381	25
		98 (SSURGO)	Tubac-Rillino complex, 3 to 25 percent slopes	Same as Alternative 5 Peg Leg East Option (above)	Tubac: 600 lb/acre Rillino: 400 lb/acre	Organic Matter: 1% pH: 6.6–8.4	4,226	25
Alternative 6 – Skunk Camp North Option	16,116	485 (GTES)	QUTU2	No direct observations from (Klohn Crippen Berger Ltd. 2017) were available to inform interpretations regarding soils or quaternary deposit thickness.* Based on extrapolation (from aerial imagery and geological mapping), most areas are covered by Qs deposits (along ridges and hillslopes) with some discrete Qal and Qoa deposits (adjacent to active channels). See unit descriptions above, in this table.	Interior Chaparral	No information available	1,856	12
		104 (SSURGO)	White House-Stronghold complex, 5 to 60 percent slopes	The White House soil series are well-drained soils formed in alluvial fans, with 0%–60% slopes. Soil textures range from sandy clay to clay with less than 35% rock fragments. Soils reach depths of 60+ inches, with argillic horizons from 3–39 inches. The Stronghold soil series are well-drained soils formed in alluvial fan remnants, with 1%–60% slopes. Soil textures range from loamy sand to loam with less than 35% rock fragments. Soils reach depths of 60+ inches, with a calcic (calcium carbonate-rich) horizon from 1–60 inches.	White House: 800 lb/acre Stronghold: 600 lb/acre	Organic Matter: >1% pH: 5.6–8.4	6,429	41

continued

Table 3.3.3-2. Predominant soils by alternative (cont'd)

Alternative	Total Acres	Map Unit Symbol (data source)	Map Unit Name	Map Unit Description and Soil Composition	Productivity [†] (pounds of biomass per acre or dominant vegetation community)	Fertility [‡]	Acreage within Map Unit	Percentage of Alternative
Alternative 6 – Skunk Camp South Option	16,557	485 (GTES)	QUTU2	Same as Alternative 6 Skunk Camp North Option (above)	Interior Chaparral	No information available	1,739	11
		104 (SSURGO)	White House-Stronghold complex, 5 to 60 percent slopes	Same as Alternative 6 Skunk Camp North Option (above)	White House: 800 lb/acre Stronghold: 600 lb/acre	Organic Matter: >1% pH: 5.6–8.4	6,429	40

* Soil composition data within Tonto National Forest lands are derived from the Near West Tailings Storage Facility Geotechnical Site Characterization Report (Klohn Crippen Berger Ltd. 2017). Data were specific to the Near West tailings storage facility but have been extrapolated (as appropriate) to other alternatives.

† Productivity data are reported as pounds of biomass per acre per year, as derived from SSURGO datasets where data are available (Natural Resources Conservation Service 2017). No productivity data are available for areas mapped by GTES data; dominant vegetation communities (as reported in table 3.3.3-3) are used as a proxy for productivity.

‡ Limited soil fertility data are available from SSURGO datasets (Natural Resources Conservation Service 2017). No soil fertility data are available for areas mapped by GTES data (U.S. Forest Service 2018e).

Desert Ecosystems (includes Arizona Upland Sonoran Desertscrub and Lower Colorado River Sonoran Desertscrub)

This vegetation community generally dominates in broad valleys, lower bajadas, plains and low hills of lower elevations. Trees are sparse and the understory is bare ground or sparse grass and shrubs, typically whitethorn, creosote, and bursage. Cacti are also present, such as saguaro, prickly pear, and cholla. Common trees are palo verde, catclaw acacia, mesquite, and ironwood. On slopes, plants are often distributed in patches around rock outcrops where suitable soil exists.

Semi-Desert Grasslands

Typically occurring roughly 3,000 to 5,000 feet in elevation, this vegetation community is dominated by diverse perennial grasses, which

vary depending on region. Shrubs also occupy these grasslands, with predominant shrubs, including mesquite, snakeweed, creosote, and catclaw acacia.

Interior Chaparral

Typically occurring roughly 3,000 to 7,000 feet in elevation, this vegetation community consists of chaparral on side slopes that transition into pinyon-juniper woodlands. Chaparral is a term describing an ecosystem dominated by desert shrubs, grasses, and scrub oak. Interior chaparral has an open canopy and open space either bare or covered with grasses and forbs.

Table 3.3.3-3. Vegetation communities and land cover types in the analysis area

Vegetation Community or Landform Type	Alternatives 2 and 3 (acres)	Alternative 4 (acres)	Alternative 5 West Pipeline Option (acres)	Alternative 5 East Pipeline Option (acres)	Alternative 6 South Pipeline Option (acres)	Alternative 6 North Pipeline Option (acres)
Human dominated	5,511	5,511	5,620	5,547	5,123	5,511
Interior Chaparral	10,138	12,385	10,137	10,410	17,790	20,061
Lower Colorado River Sonoran Desertscrub	17,075	20,934	19,521	21,627	19,396	20,498
Mesquite	5	5	6	5	15	15
Open-Pit Mine	3	3	3	3	3	3
Pine-Oak	185	362	185	185	439	500
Pinyon-Juniper	760	1,109	1,166	1,640	1,604	1,362
Riparian	1,336	1,316	1,771	1,854	1,542	1,472
Rock	102	103	102	102	108	117
Semidesert Grassland	1,855	6,384	1,465	2,021	18,831	25,459
Arizona Upland Sonoran Desertscrub	45,110	37,250	96,987	83,365	39,982	36,886
Water	29	29	29	29	15	29
Xeric Riparian	851	1021	1,611	1,526	2,065	2,618
Total Acres	82,960	86,412	138,603	128,314	106,913	114,531

Note: Acreages in this table are rounded to the nearest whole number

Pinyon-Juniper Woodland

Typically occurring roughly 4,500 to 7,000 feet in elevation, these woodlands occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges, and are characterized by being an open forest dominated by low, bushy, evergreen junipers and pinyon pines. Annual and perennial grasses, forbs, and shrubs typically abound beneath the woodland overstories.

Ponderosa Pine-Evergreen Oak

Typically occurring roughly 5,000 to 7,500 feet in elevation, these woodlands occur on mountains and plateaus generally south of

the Mogollon Rim. Ponderosa pine intermingled with oak species predominate, mingled with patchy shrublands or grasslands.

Xeric Riparian

Xeric riparian or xeroriparian vegetation typically occurs along washes or arroyos that receive concentrated runoff during storms. Although often dry, the intermittent flows in these washes greatly affect the vegetation by providing additional periodic soil moisture. Channels are often clear of vegetation, but shrubs and small trees are located along the banks, such as acacia, mesquite, palo verde, and desert broom. Xeroriparian vegetation can vary from sparse to thick, depending on the amount of moisture received.

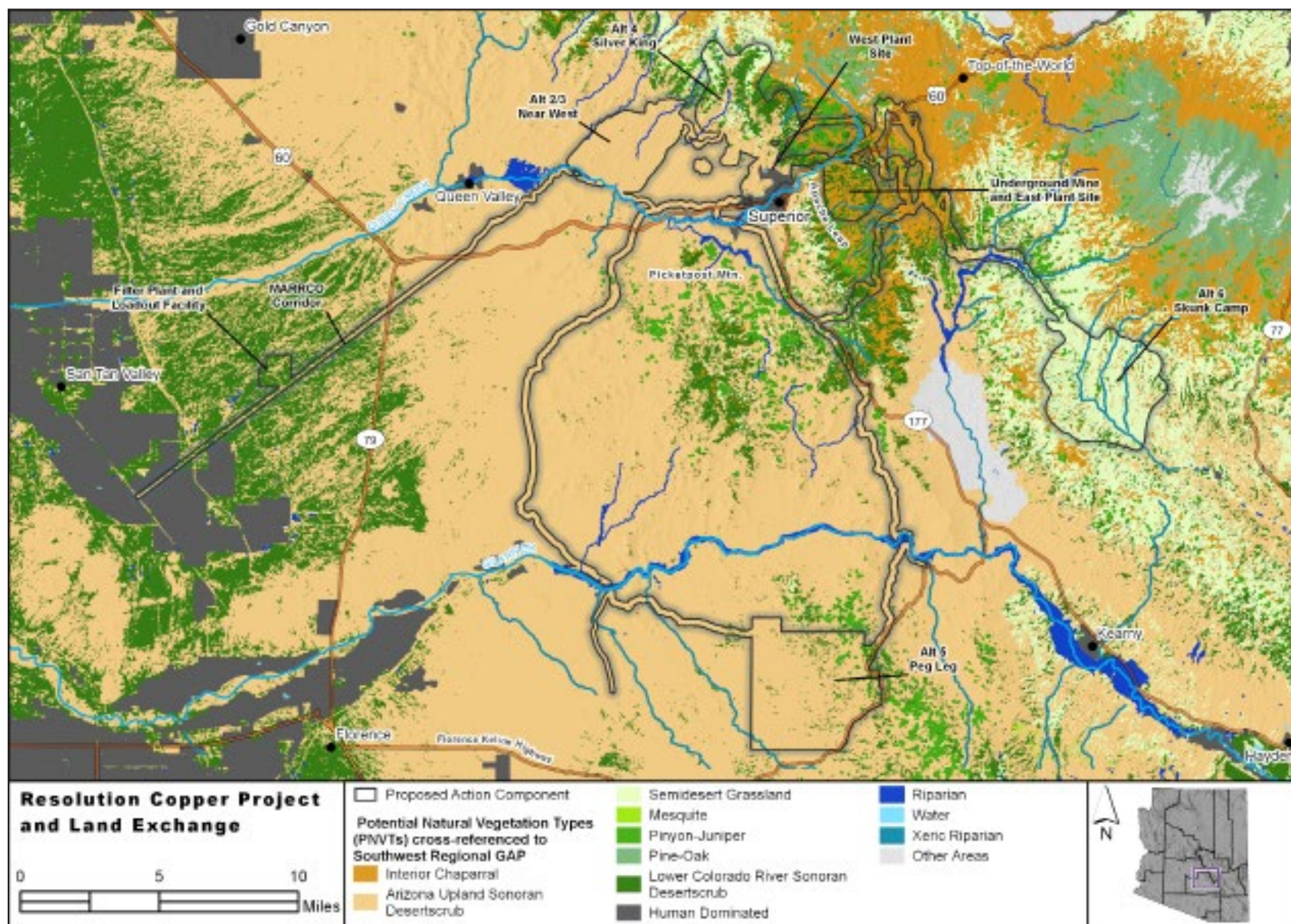


Figure 3.3.3-2. Vegetation communities and land cover types

Riparian

Riparian corridors are located along medium to large perennial streams in canyons and desert valleys, supported by the presence of persistent groundwater. Dominant trees can include willow, cottonwood, mesquite, ash, walnut, and sycamore. Understory is usually present, including herbaceous vegetation, grasses, and wetland species along streambanks. Note that a full discussion of all areas determined to be dependent on groundwater is included in section 3.7.1, including potential impacts caused by mine dewatering.

SPECIAL STATUS PLANT SPECIES

Special status plant species addressed include species listed under the Endangered Species Act (ESA) for Gila and Pinal Counties, Tonto National Forest Sensitive Plant Species, as well as BLM Sensitive Plant species for the BLM Tucson Field Office. See Newell (2018g) for a complete list of all species addressed and their potential for occurrence.

Special status plant species with the potential to occur in the analysis area are broken out by action alternative in table 3.3.3-4, including information on their habitat components and geographic ranges. Figure 3.3.3-3 depicts the designated critical habitat for ESA-listed plant species in and near the analysis area. The only special status plant species critical habitat present is for acuña cactus, which occurs in the project area for Alternative 5 for both the east and west pipeline options.

Baseline data of species-specific surveys for special status plants species included sample surveys of portions of some of the alternatives for four species: Arizona hedgehog cactus (*Echinocereus triglochidiatus* var. *arizonicus*), mapleleaf false snapdragon (*Mabrya [Maurandya] acerifolia*), Hohokam agave (*Agave murpheyi*), and Parish's Indian mallow (*Abutilon parishii*). For Arizona hedgehog cactus, survey data from WestLand Resources Inc., Tonto National Forest, and SWCA Environmental Consultants were used for this analysis. These surveys encompassed approximately 4,738 acres and covered most of the East Plant Site and subsidence area, as well as portions of the transmission corridor from Silver King to Oak Flat, Alternative 6 (both the south and

north pipeline options), and Alternative 6 north and south transmission corridor. Approximately 98 individual Arizona hedgehog cacti were located during these surveys. For mapleleaf false snapdragon, 336 acres of suitable habitat was surveyed, and none were detected. For Hohokam agave, 239 acres of suitable habitat was surveyed, and none were detected. For Parish's Indian mallow, 949 acres of suitable habitat was surveyed and approximately 90 plants were observed on and around the bluffs in the area just west of Perlite Spring in the northeastern portion of the proposed tailings facility of Alternatives 2 and 3. Some of the observed plants were outside the random sample survey area as well. Additionally, approximately 40 Parish's Indian mallow plants were also detected during survey in the area south of Roblas Canyon in the northwestern portion of the proposed tailings facility of Alternatives 2 and 3 (WestLand Resources Inc. 2017a).

Note that where specific data on the presence of special status plant species are shown to be lacking, several mitigations are required that would provide for collection of this information (see section 3.3.4.9).

ARIZONA NATIVE PLANT LAW SPECIES

Numerous native plant species are protected from destruction under the Arizona Native Plant Law (Title 3 Arizona Administrative Code Chapter 3); the law also encourages salvage of these species. The Arizona Department of Agriculture enforces the Arizona Native Plant Law (Arizona Department of Agriculture 2019). Within the four given categories—Highly Safeguarded, Salvage Restricted, Salvaged Assessed, and Harvest Restricted—most are common species except for within the Highly Safeguarded category, which includes rare species. Thus, most species designated as Highly Safeguarded are also ESA endangered or threatened species or sensitive species under other land management agency policies. Therefore, those species that are identified in this analysis as protected under the Arizona Native Plant Law are addressed under more stringent regulations; a separate analysis for Arizona Native Plant Law species is not considered necessary for any of the action alternatives.

Table 3.3.3-4. Special status plant species with the potential to occur in the analysis area

Common Name						
(Scientific Name)	Status	Habitat	Alternatives 2 and 3	Alternative 4	Alternative 5	Alternative 6
Acuña cactus (<i>Echinomastus erectocentrus</i> var. <i>acunensis</i>)	ESA: E with critical habitat. Found in Maricopa, Pinal, and Pima Counties	Occurs in valleys and on small knolls and gravel ridges of up to 30 percent slope in the Palo Verde-Saguaro Association of the Arizona Upland subdivision of the Sonoran Desertscrub. Elevation between 1,198 and 3,773 feet amsl (U.S. Fish and Wildlife Service 2016a).	Unlikely to occur.	Unlikely to occur.	Possible to occur where small knolls and gravel ridges of up to 30 percent slope are present near the tailings facility and along pipeline corridor routes. Critical habitat for the species is located along the west pipeline option and fencing area, adjacent to the tailings facility, and along the fence line for the east pipeline option.	Unlikely to occur.
Arizona hedgehog cactus (<i>Echinocereus triglochidiatus</i> var. <i>arizonicus</i>)	ESA: E No critical habitat. Found in Maricopa, Pinal, and Gila Counties.	Found on dacite or granite bedrock, open slopes, in narrow cracks, between boulders, and in the understory of shrubs in the ecotone between Madrean Evergreen Woodland and Interior Chaparral. Elevation between 3,300 and 5,700 feet amsl (Tonto National Forest 2000).	Known to occur, where soils of igneous origin (primarily Shultze granite and dacite) are present on the East Plant Site and subsidence area.	Known to occur at the East Plant Site and in subsidence area. Possible to occur in tailings facility area.	Known to occur at the East Plant Site and in subsidence area.	Known to occur at the East Plant Site and in subsidence area. Possible to occur along pipeline route alternatives and in tailings facility location.
Chiricahua Mountain alumroot (<i>Heuchera glomerulata</i>)	Tonto National Forest: S	Found on north-facing shaded rocky slopes, near seeps, springs, and riparian areas, often in humus soil. Elevation between 4,000 and 9,000 feet amsl (Tonto National Forest 2000).	Unlikely to occur.	Possible to occur in tailings facility area.	Unlikely to occur.	Possible to occur.
Mapleleaf false snapdragon (<i>Mabrya [Maurandya] acerifolia</i>)	Tonto National Forest: S	Occurs on rock overhangs and in bare rock/talus/scree, cliff, and desert habitats. Elevation around 2,000 feet amsl (Tonto National Forest 2000).	Possible to occur at tailings facility and borrow sites.	Unlikely to occur.	Unlikely to occur.	Possible to occur.

continued

Table 3.3.3-4. Special status plant species with the potential to occur in the analysis area (cont'd)

Common Name						
(Scientific Name)	Status	Habitat	Alternatives 2 and 3	Alternative 4	Alternative 5	Alternative 6
Parish's Indian mallow (<i>Abutilon parishii</i>)	Tonto National Forest: S BLM: S	Occurs in mesic situations in full sun within higher elevation Sonoran desertscrub, desert grassland, and Sonoran deciduous riparian forest. Elevation between 3,000 and 4,800 feet amsl (Tonto National Forest 2000).	Known to occur at tailings facility. Possible to occur at the West Plant Site, borrow sites, and in the MARRCO corridor.	Possible to occur at the West Plant Site, borrow sites, tailings facility area, and in the MARRCO corridor.	Possible to occur at the West Plant Site, borrow sites, and in the MARRCO corridor.	Possible to occur at the West Plant Site, borrow sites, and in the MARRCO corridor.
Pringle's fleabane (<i>Erigeron pringlei</i>)	Tonto National Forest:	Ledges of cliffs and rock crevices in canyons, near springs and in shaded canyons. Elevation between 3,500 and 7,000 feet amsl (Tonto National Forest 2000).	Possible to occur where soils of igneous and metamorphic granites are present.	Unlikely to occur.	Unlikely to occur.	Possible to occur.

Note: The analysis area for each alternative includes all project components (i.e., West Plant Site, East Plant Site, tailings storage facility, etc.).

Status Definitions

Tonto National Forest:

S = Sensitive. Species identified by a Regional Forester for which population viability is a concern, as evidenced by a significant current or predicted downward trends in population number or density or significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

Endangered Species Act (ESA):

E = Endangered. Endangered species are those in imminent jeopardy of extinction. The ESA specifically prohibits the take of a species listed as endangered. Take is defined by the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to engage in any such conduct.

Bureau of Land Management (BLM):

S = Sensitive. Species that could easily become endangered or extinct in the state.

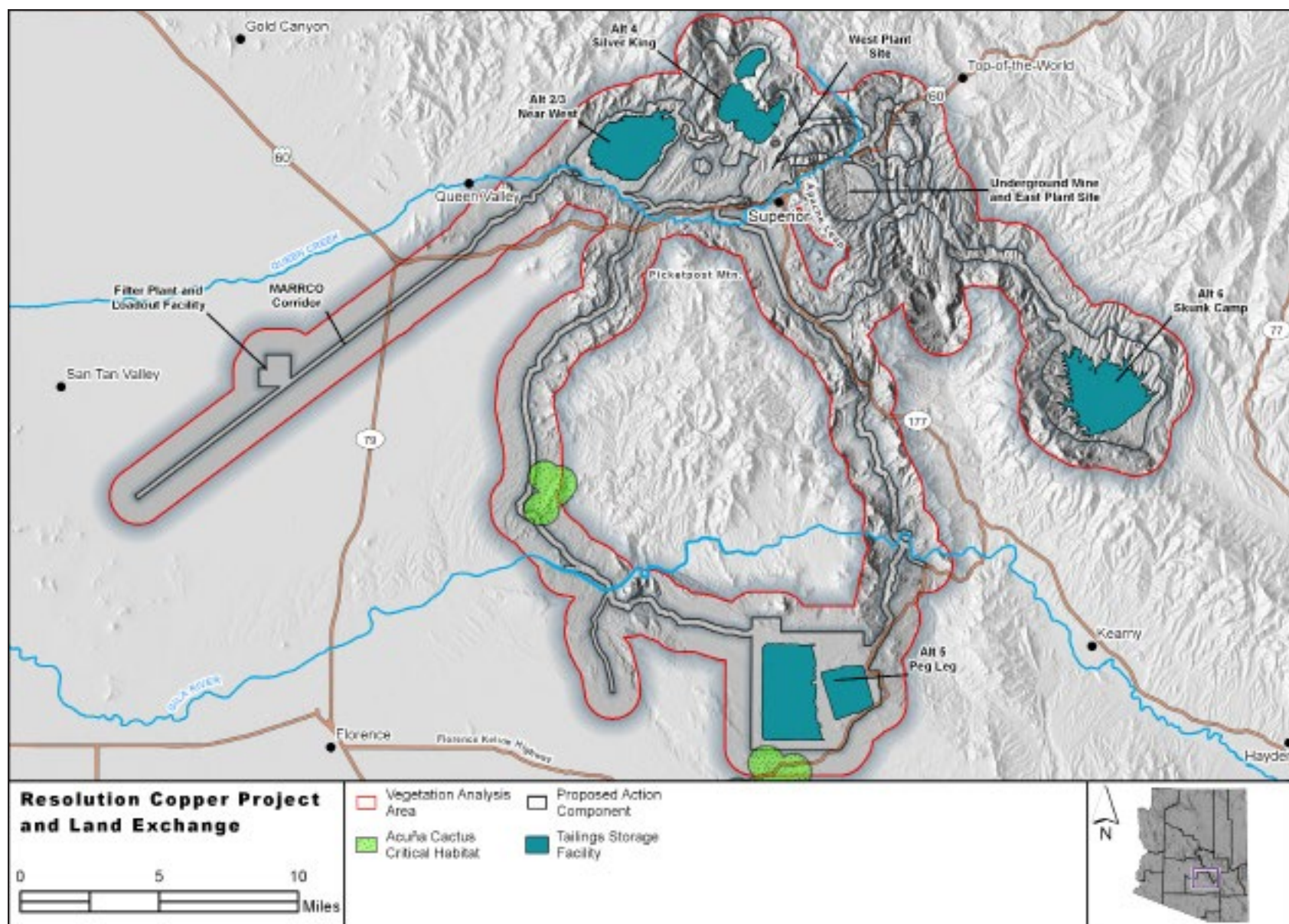


Figure 3.3.3-3. Designated and proposed critical habitat for ESA-listed plant species

NOXIOUS AND INVASIVE WEEDS (INCLUDING FEDERAL, STATE, AND TONTO NATIONAL FOREST LISTS)

Eighty-nine Federal, Tonto National Forest, and Arizona Department of Agriculture noxious and invasive weed species were evaluated for this analysis. There was overlap between the different species lists, and species numbers do not double-count species. See Newell (2018g) for a table of species and their status listings. Of those listed noxious and invasive weed species, Alternatives 2 and 3 have 33 species known to occur or possible to occur within the analysis area; Alternative 4 has 38 species known to occur or possible to occur within the analysis area; Alternative 5 has 26 species known to occur or possible to occur within the analysis area; and Alternative 6 has 31 species possible to occur within the analysis area.

Existing Disturbance within Mine Area and Selected Lands

A variety of land use disturbances have affected the condition of vegetation and soils within and near the project area footprint. Historical and ongoing mining and mineral exploration, land development, grazing, recreation, and fires have left a legacy of disturbances to the landscape (table 3.3.3-5). Total acreage of each disturbance type within the project footprint varied by alternative. Most alternatives had approximately 1,300 to 1,400 acres of previous disturbance, with the exception of Alternative 4, which had 2,719 acres of previous disturbance (which included 1,528 acres of fire disturbance). More information regarding the nature and extent of disturbance is provided in Newell (2018g).

Existing Vegetation and Soil Trends

Relatively little long-term monitoring and evaluation of soil and vegetation health exists for the analysis area. Most of the monitoring available has been undertaken for assessment for rangeland health and livestock grazing suitability (see section 3.16 for discussion of livestock grazing).

Table 3.3.3-5. Existing disturbance acreage by alternative (calculated within the project footprint)

Alternative	Facilities Disturbance (acreage)	Road Disturbance* (acreage)	Fire Disturbance (acreage)	Total Disturbance (acreage)
Alternative 2 – Near West Proposed Action	1,086	122	61	1,270
Alternative 3 – Near West – Ultrathickened	1,086	122	61	1,270
Alternative 4 – Silver King	1,084	107	1,528	2,719
Alternative 5 – Peg Leg West Option	1,100	98	77	1,274
Alternative 5 – Peg Leg East Option	1,100	88	62	1,250
Alternative 6 – Skunk Camp North Option	1,086	131	192	1,409
Alternative 6 – Skunk Camp South Option	1,100	151	134	1,385

* Single-track recreational trails excluded from area calculations.

Long-term monitoring of soil and vegetation conditions was conducted on the Millsite grazing allotment, managed by the Forest Service, which includes the area of the Alternative 2 and 3 tailings storage facility. Range monitoring has been conducted in this area from 1956 through 2003. The most recent trends between 1991 and 2003 indicate that the overall state of vegetation is in very poor to poor condition, with largely downward trends. Soils are similar, rated mostly poor condition, but with a stable trend (U.S. Forest Service 2010d). These trends in vegetation and soil conditions are likely the result of historic-era grazing and other disturbances (U.S. Forest Service 2010d).

Some additional rangeland health assessments have been conducted for the Teacup Allotment, managed by the BLM, which includes the area of the Alternative 5 tailings storage facility. In 2013, it was observed that overall the soil on the allotment was stable, and the allotment exhibited biotic integrity and was in a productive and sustainable condition (Bureau of Land Management 2017a).

3.3.4 Environmental Consequences of Implementation of the Proposed Mine Plan and Alternatives

3.3.4.1 Alternative 1 – No Action Alternative

Under the no action alternative, the proposed project would not be constructed and potential impacts on soils, vegetation communities, special status plant species, and noxious weeds would not occur. Impacts on soil and vegetation resources from existing disturbances (e.g., recreation, livestock grazing, mining and development, wildfires) would continue.

3.3.4.2 Impacts Common to All Action Alternatives

The proposed project would include three phases: construction, operations, and closure/reclamation. All phases have the potential to affect (1) soil resources, (2) revegetation potential, (3) vegetation communities, (4) special status plant species, and (5) noxious weeds, as detailed in the following text.

Effects of the Land Exchange

The selected Oak Flat Federal Parcel would leave Forest Service jurisdiction. The role of the Tonto National Forest under its primary authorities in the Organic Administration Act, Locatable Regulations (36 CFR 228 Subpart A), and Multiple-Use Mining Act is to ensure that mining activities minimize adverse environmental effects on National

Forest System surface resources; this includes effects on the soil and vegetation that occur on the Oak Flat Federal Parcel. The removal of the Oak Flat Federal Parcel from Forest Service jurisdiction negates the ability of the Tonto National Forest to regulate effects on these resources, or manage them to achieve desired conditions, including for control of noxious and invasive weeds.

The offered parcels would come under Federal jurisdiction. Specific management of the soil and vegetation resources of those parcels would be determined by the agencies to meet desired conditions or support appropriate land uses. In general, these parcels contain a variety of ecosystems similar to those found in the analysis area, including riparian, xeroriparian, semi-desert grassland, and desert ecosystems, that would come under Federal jurisdiction.

Effects of Forest Plan Amendment

The Tonto National Forest Land and Resource Management Plan (1985b) provides guidance for management of lands and activities within the Tonto National Forest. It accomplishes this by establishing a mission, goals, objectives, and standards and guidelines. Missions, goals, and objectives are applicable on a forest-wide basis. Standards and guidelines are either applicable on a forest-wide basis or by specific management area.

A review of all components of the 1985 Forest Plan was conducted to identify the need for amendment due to the effects of the project, including both the land exchange and the proposed mine plan (Shin 2019). A number of standards and guidelines (15 for soil, 33 for vegetation) were identified applicable to management of ecosystems and vegetation communities. None of these standards and guidelines were found to require amendment to the proposed project, either on a forest-wide or management area-specific basis. For additional details on specific rationale, see Shin (2019).

Summary of Applicant-Committed Environmental Protection Measures

A number of environmental protection measures are incorporated into the design of the project that would act to reduce potential impacts on soils and vegetation. These are non-discretionary measures, as they are currently part of the GPO, and their effects are accounted for in the analysis of environmental consequences.

From the GPO (Resolution Copper 2016d), Section 4.5, “Water Resources,” Resolution Copper has outlined a variety of measures to reduce impacts on soils:

- Road embankment slopes will be graded and stabilized with vegetation or rock as practicable to prevent erosion;
- During construction and operations, diversions will be constructed around the affected areas to minimize erosion. A number of best management practices, including check dams, dispersion terraces, and filter fences, also will be used during construction and operations; and
- Off-road vehicle travel across Tonto National Forest will generally be avoided.

Resolution Copper has also developed a noxious weed plan (Resolution Copper 2019) to reduce impacts on vegetation:

- Newly reclaimed areas on Tonto National Forest will be monitored for weeds and invasive plants for the first 5 years after reclamation. Infestations of invasive species would be treated as soon as they are identified, or as soon as weather conditions are appropriate for treatment.
- Additionally, in the “Baseline EA Decision Notice,” Resolution Copper stipulated that on NFS lands, seed mixes used in reclamation will be certified free of seeds listed on the Forest

Service’s noxious weed list and contain only species native to the project area. Seed mixes will be developed from a native species seed list approved by the Forest Service.

Desired Future Conditions

Desired future conditions were informed by internal work by the Tonto National Forest on the revised forest plan. These desired conditions are based on Ecological Response Units (ERUs), which are mapped ecosystem types that represent the range of conditions that occur under natural disturbance regimes. The desired future conditions of ERUs that occur in the analysis area are described here by ERU. The distribution and condition of these ERUs are strongly tied to the health of soils, climate, topography, and other environmental factors.

DESERT ECOSYSTEMS

The Desert Ecosystems ERU in the analysis area includes the Lower Colorado River Sonoran Desertscrub and Arizona Upland Sonoran Desertscrub, the desired future conditions of which include the following:

- Vegetation community composition and structure should include the following: 10 to 25 percent perennial grass and cacti cover, presence of saguaro (*Carnegiea gigantea*) and mesquite (*Prosopis* sp.) that provide habitat for cavity nesting birds, and limited infestation of non-native grasses (ideally less than 1 percent cover) to mitigate for fine-fuel potential to increase fire susceptibility.
- Fires should be infrequent and localized with return intervals greater than 100 years.
- Suitable habitat for federally listed and rare or special status animal and plant species is preserved.

SEMI-DESERT GRASSLANDS

The Semi-Desert Grasslands ERU is limited to the semi-desert grasslands vegetation community, the desired future conditions of which include the following:

- Vegetation community composition and structure should include the following: a variety of cool- and warm-season understory plants, less than 10 percent tree and shrub canopy cover, and limited cover by non-native species.
- Native herbaceous vegetation cover provides fine fuels to support stand-replacement fires; however, non-native annual vegetation cover should be limited to mitigate the spread, intensity, and severity of uncharacteristic fire.
- Habitat is preserved to support wildlife.

INTERIOR CHAPARRAL

The desired future conditions for the Interior Chaparral ERU and vegetation community include the following:

- Vegetation community composition and structure should include the following: dense thickets of closed shrub canopy cover (40 percent cover on dry sites to 80 percent cover on wet sites) dominated by shrub live oak (*Quercus turbinella*), thick shrub litter, annual regeneration of native grasses and forbs (in most years), and low cover by non-native annual species.
- Stand-replacing fires should occur at 35- to 100-year fire return intervals to support diverse community ages at the landscape scale; native fire-adapted species resprout vigorously after fire to prevent excessive erosion; and non-native annual vegetation cover is kept to a minimum to avoid uncharacteristic fire.
- Habitat is preserved to support wildlife.

PINYON-JUNIPER WOODLAND

The desired future conditions for the Pinyon-Juniper Woodland ERU and vegetation community include the following:

- Vegetation community composition should include the following: even-aged patches (tens to hundreds of acres) of pinyon and juniper trees forming multi-aged woodlands (including trees greater than 300 years old), closed canopy cover by trees to shade ground surfaces, structural diversity from old trees, snags, woody debris, and sparse ground cover (5 to 15 percent) of shrubs, perennial grasses, and forbs.
- Shrubs and herbaceous ground cover is sparse, supporting low-intensity ground fires.
- Habitat is preserved to support wildlife.

PONDEROSA PINE-EVERGREEN OAK

The Ponderosa Pine-Evergreen Woodland ERU includes the pine-oak vegetation community, the desired future conditions of which include the following:

- Vegetation community composition should include the following: open forest stands with diverse tree ages, sizes, and densities (at the landscape scale), some old-growth tree stands, shrub and herbaceous basal cover ranging from 5 to 15 percent.
- The landscape is a functioning ecosystem that contains all its components, processes, cycles, and conditions that result from natural disturbances (e.g., insects, diseases, fire, and wind) and as supported through human disturbance. The composition, structure, and function of vegetative conditions are resilient to the frequency, extent, and severity of disturbances and climate variability.
- Habitat is preserved to support wildlife.

XERIC RIPARIAN

The desired future conditions for Xeric Riparian ERUs include the following:

- Vegetation community composition should include xeric riparian/riparian scrubland and upland species, upland desert scrub species intergrading within riparian scrubland (reaching higher densities at drier sites), dominant shrubs reaching heights up to 10 feet, and species such as arrow-weed, burro bush (*Ambrosia* sp.), and desert broom (*Baccharis sarothroides*) dominating sandy soils on secondary floodplains.
- Soil and other environmental conditions support a diversity of healthy, deciduous desert trees and scrub vegetation.
- Habitat is preserved to support wildlife.

RIPARIAN

The desired future conditions for Riparian ERUs include the following:

- Vegetation community composition would vary based on hydrologic conditions and may include the following: facultative- and obligate-wetland species; cottonwood-willow habitats; common distributions of hackberry (*Celtis reticulata*) and mesquite, velvet ash (*Fraxinus velutina*) and Arizona sycamore (*Platanus wrightii*) at mid- to high elevations; blue paloverde (*Parkinsonia florida*) and catclaw acacia (*Senegalia greggii*), and ironwood (*Olneya tesota*) at warmer low-elevation sites; well-established mesquite stands are located in abandoned channels or terraces, connecting riparian vegetation and the uplands to support wildlife movement; and understories with open to closed conditions, including woody species and herbaceous vegetation cover that support bank stability. Healthy riparian vegetation communities show few signs of stress, wilting, or disease; high reproductive output; and minimal soil compaction/degradation.

- Flood timing, magnitude, and frequency maintain conditions for vernal flood-adapted species, such as Gooding's willow (*Salix gooddingii*) and cottonwood (*Populus* spp.)-willow (*Salix* spp.).
- Wildfire frequency and intensity with the adjacent uplands (riparian corridor) is low, thereby reducing flooding or erosional risk to riparian areas.
- Habitat is preserved to support wildlife.

Reclamation Plans and Effectiveness

CONCEPTUAL RECLAMATION PLANS

General Reclamation Goals and Strategies

Reclamation plans are required under several regulatory programs, including by the Forest Service as part of a final mining plan of operations, by ADEQ as part of the Aquifer Protection Permit program, and by the Arizona State Mine Inspector. The primary goals of reclamation are to stabilize areas of surface disturbance, prepare areas for post-mining land use, and ensure long-term protection of the surrounding land, water, and air. Reclamation and closure standards are established by these programs that must be met by the company, and financial assurance or bonding is required to ensure the capability exists to conduct and complete reclamation activities.

The following discussion is based on the conceptual reclamation plans that have been prepared to date by Resolution Copper and are included in the GPO. Note that a mitigation measure is required that would provide for preparation of detailed reclamation plans, specific to the preferred alternative and supported by site-specific data collection, that would provide more extensive information than that produced to date (see section 3.3.4.9).

Key tenets guiding the Resolution Copper reclamation plans are implementing reclamation as soon as practicable (including concurrent reclamation while the mine is still operational, where feasible), return disturbed areas to near-natural conditions, salvage soil resources (where

practicable) for later use in reclamation, and monitor to ensure that reclamation is successful and reclamation and closure standards are met.

The general reclamation steps identified by Resolution Copper in the GPO (see section 6 in Resolution Copper (2016d)) are as follows:

- Decommission facilities (remove equipment, chemicals, furnishings)
- Demolish or dismantle structures and buildings, including pipelines, storage tanks, and power lines. This includes removing foundations up to 3 feet below grade. Some facilities like pipelines, wells, or power lines may be transferred to third parties for continued use where beneficial.
- Recontour and regrade disturbed areas, including roads not needed for future uses. Many stormwater controls (diversion ditches, seepage collection ponds) need to stay in place permanently or for decades after closure of the mine to control water quality (analyzed in detail in section 3.7.2).
- Replace growth media, using salvaged soils or borrow soils (largely Gila Conglomerate)
- Seeding or planting
- Monitoring and maintenance

Tailings Reclamation Plans

The largest area of disturbance from the proposed project is from the tailings storage facility, and virtually all of the area taken up by the tailings can be reclaimed. Specific details for closure of the tailings storage facilities differ by alternative (Golder Associates Inc. 2018a; Klohn Crippen Berger Ltd. 2018a, 2018b, 2018c, 2018d, 2018e). In general, closure of the tailings storage facilities takes place in several phases:

- Final deposition of the tailings is managed so that the PAG tailings are ultimately covered with NPAG tailings to prevent contact with oxygen (not applicable to Alternative 4).
- At the same time, the recycled water pond is allowed to gradually shrink through evaporation or water use (not applicable to Alternative 4).
- Engineered seepage controls remain in place as long as monitoring indicates they are needed to protect downstream water quality. Seepage collection ponds would remain in place to collect seepage and stormwater. Until water quality is acceptable for release to the environment (this is typically determined by ADEQ through the APP program), the collected water is either pumped back to the recycled water pond while it exists, or the ponds are engineered to allow the water to evaporate once the recycled water pond is gone. Note that specific release criteria would be developed in detailed reclamation plans, which are a required mitigation by the Forest Service (see section 3.3.4.9).
- When surfaces are no longer going to be disturbed, growth media are placed on the surface and any treatments or additives are used. Generally, about 1.5 feet of growth media are planned for, but would vary across the surface, depending on needs. Rock armoring would be used in places where erosion is a concern on slopes or along stormwater conveyance channels. Seeding or planting would then take place on the growth media. Note that specific closure materials, depths, and preparations would be developed in detailed reclamation plans, which are a required mitigation by the Forest Service (see section 3.3.4.9).

Fully successful reclamation would either meet the desired conditions for the landscape or be sufficient to support the chosen post-mine land uses. A fully reclaimed tailings storage facility should be a stable landform (low risk of large slumps or collapses), have a stable surface either vegetated or armored (low risk of erosion from water or wind), have no long-term water quality concerns from runoff or seepage, and

be sustainable without active management. Long-term sustainability requires a balanced interaction of growth media, water, and vegetation. The growth media act to store moisture, which supports the vegetation, but are vulnerable and have to be protected from erosion during storm events. Vegetation helps anchor the growth media and slow runoff, allowing it to infiltrate into the soil. Post-closure monitoring and comparison to clear success criteria is the means to ensure the balance of growth media, water, and vegetation is functioning properly.

Expected Timing of Reclamation Activities

Decommissioning and demolishing structures and regrading/recontouring all take place during the 5-year closure period described in the GPO. For tailings, the closure periods are longer because they depend on management of the recycled water pond:

- Alternative 2. The slopes and tailings beaches are reclaimed in the first 5 years. It is estimated to take 25 years for the recycled water pond to be drawn down and reclaimed (Klohn Crippen Berger Ltd. 2018a). Active water management would continue as long as necessary. Note that specific release criteria would be developed in detailed reclamation plans, which are a required mitigation by the Forest Service (see section 3.3.4.9).
- Alternative 3. The slopes and tailings beaches, as well as the recycled water pond, are reclaimed in the first 9 years (Klohn Crippen Berger Ltd. 2018b). Active water management would continue as long as necessary.
- Alternative 4. The slopes and tailings piles are reclaimed in the first 5 years (Klohn Crippen Berger Ltd. 2018c). Active water management would continue as long as necessary.
- Alternative 5. The slopes and tailings piles are reclaimed in the first 5 years. An estimated 30 years is needed for water quality

management, but would continue as long as necessary (Golder Associates Inc. 2018a).

- Alternative 6. Similar to Alternative 2, the slopes and tailings beaches are reclaimed in the first 5 years. It is estimated to take 25 years for the recycled water pond to be drawn down and reclaimed (Klohn Crippen Berger Ltd. 2018d). Active water management would continue as long as necessary.

EXPECTED EFFECTIVENESS OF RECLAMATION PLANS

As noted, the reclamation plans prepared to date by Resolution Copper and included in the GPO are conceptual in nature. The following discussion is based on the anticipated effectiveness of the conceptual plans. Note that a mitigation measure is required that would provide for preparation of detailed reclamation plans, specific to the Preferred Alternative and supported by site-specific data collection, that would provide more extensive information than that produced to date (see section 3.3.4.9), and would support detailed estimates of reclamation effectiveness to support post-closure financial assurance estimates.

A meta-analysis was completed to constrain the level of vegetation cover (and potential variability) that could be expected at a given time point after reclamation and revegetation efforts have commenced (see analysis details and source data in Bengtson (2019b)). The analysis included case studies from Arizona and New Mexico primarily from mining or mineral exploration activities, which reflect similar characteristics in vegetation communities, climate, soils, and disturbance types to the proposed project.²⁵

Results of the meta-analysis are shown in figure 3.3.4-1. Each vertical bar in the figure represents the range in vegetation cover observed from a single year in a given case study. (Some case studies provided multiple years of data.) The combined results of all analyzed case

25. The meta-analysis is meant to capture the general potential for revegetation efforts to be successful but is not specific to the Resolution Copper Project. Limitations to consider in interpreting outcomes of the meta-analysis include the following: (1) variability in revegetation outcomes, (2) semi-quantitative nature of analysis, (3) sensitivity of outcomes to the degree of initial disturbance, and (4) lack of specificity of outcomes to any project components.

studies illustrate the range in observed vegetation cover (percentage of vegetation cover) that have been recorded previously. The analysis demonstrates the following relationships (from Arizona and New Mexico case studies), which would also be expected for Resolution Copper revegetation efforts:

- Vegetation cover (by native and non-native species) of 8 percent or greater is consistently established by mine year 10.
- Vegetation can be as low as 0 percent, as observed in year 1 for one case study or a high as 100 percent in mine year 4.5 in another case study, with significant variation among and within the years after reclamation.
- From the case studies illustrated in figure 3.3.4-1, vegetation cover may plateau around mine year 12; however, analysis of additional case studies is needed to confirm this trend.

Overall, these findings indicate that, irrespective of the revegetation and reclamation methods applied, a minimum of 8 percent of vegetation cover (including both native and non-native species) can consistently be established within project disturbance areas. While this level of vegetation growth would provide some soil cover and erosion control functions, it does not necessarily reflect the desired future conditions set forth by the Forest Service. The revegetation response is expected to be influenced by the nature of the surface disturbance, while irrigation or active soil management interventions could enhance revegetation success thereby reducing erosional losses and net negative impacts on soil productivity. More specific outcomes are discussed under “Closure and Reclamation Impacts” later in this section.

Construction/Operational Impacts

SOILS

Project ground-disturbing activities would potentially compact soils, accelerate erosion and soil loss, contaminate soils, and reduce soil productivity. The longevity of these impacts on soil productivity and

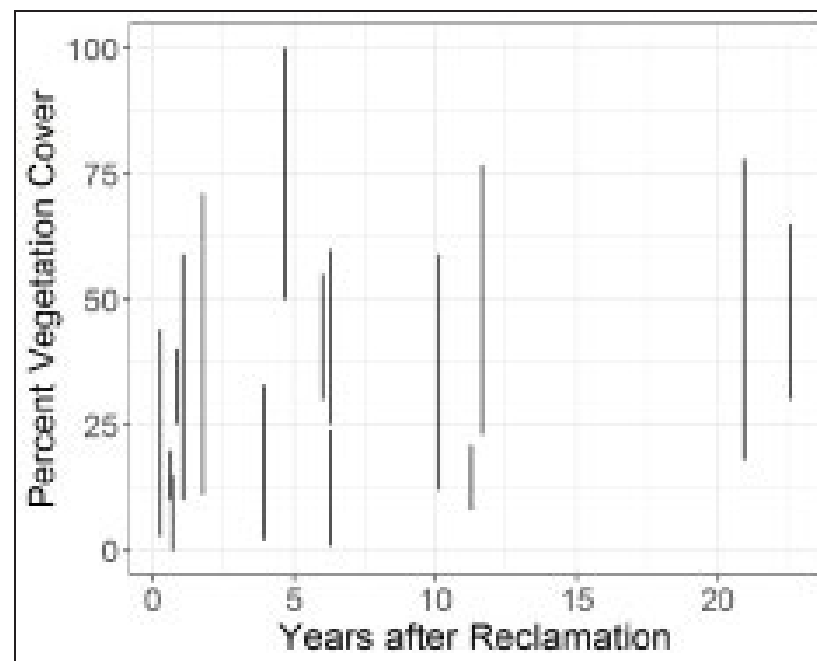


Figure 3.3.4-1. Meta-analysis summary. Each vertical bar represents the range in vegetation cover (percentage) observed from a single year (shown in years after reclamation) from a given case study. Data shown include only case studies from Arizona and New Mexico (see Bengtson (2019b)).

revegetation potential would depend on the nature of the disturbance and vary by project component and alternative. Most potential impacts on soil resources are common to all action alternatives; however, the level of impact is dependent on the nature of disturbance. For this analysis, the levels of impact, soil productivity responses, and revegetation success potential are summarized as six disturbance response groups, which are detailed in tables 3.3.4-1 and 3.3.4-2. Possible impacts include the following:

- Soils exposed by grading, excavation, subsidence, and vegetation clearing would be subject to accelerated wind and water erosion—all disturbances that decrease soil productivity. Erosion may also cause sediment losses and delivery to downstream washes and streams (see Section 3.7.2, Groundwater and Surface Water Quality).
- Topsoil mixing, compaction, removal, or redistribution may cause changes or losses to soil structure, seedbank, fertility, microbial communities, biotic soils, and water availability, which can negatively affect vegetation communities and further challenge revegetation efforts and success. Likewise, soil productivity and function would be lost for any soils that are not salvaged.
- Temporary loss of habitat while vegetation and soils recover from disturbance.
- Permanent soil productivity losses would occur where soils are covered, removed, or no longer available (i.e., covered by permanent structures or not reclaimed) to support vegetation or wildlife habitat. Tailings, waste-rock materials, exposed subsurface soils, or capping media used in reclamation may further challenge vegetation reestablishment.
- Waste materials may be a source of soil contamination (if not properly contained). Ground-disturbing activities could re-expose contaminated subsurface soils.

Soil salvage is one possible mitigation to erosional soil loss and productivity losses. While there are some advantages to storing soils, long-term soil stockpiling causes a number of biological and chemical changes requiring amelioration before soils are reapplied during reclamation (Strohmayer 1999). Specifically, long-term storage causes increases in soil bulk density, decreases in a soil's water holding capacity, changes to soil chemistry and nutrient cycling (e.g., development of anaerobic conditions, accumulation of ammonium, loss of organic carbon), losses of microbial community viability, and native soil seedbank losses (reviewed in (Strohmayer 1999)). In most arid ecosystems, the soil seedbank is limited to the upper 2 inches of soil (Scoles-Sciulla and DeFalco 2009); therefore, the process of salvaging even the upper 6 to 8 inches of soil can severely dilute seed concentrations (Abella et al. 2013). Moreover, seedbank viability has been shown to diminish by 68 percent over 2 years of stockpiling (Golos and Dixon 2014) and lose all germination potential within 5 years of storage (Scoles-Sciulla and DeFalco 2009).

A detailed analysis acreages of impacts on individual soil types is available in Newell (2018g).

VEGETATION COMMUNITIES, SPECIAL STATUS PLANT SPECIES, NOXIOUS WEEDS

Construction

All action alternatives would involve the removal of vegetation during construction activities, resulting in the direct loss of plant communities. Construction of tailings facilities for all alternatives would continue throughout most of mine life as areas would not be disturbed until necessary. The primary impacts on vegetation communities during construction of the action alternatives would be associated with

- removal and/or crushing of natural, native species;
- increased potential for noxious and invasive weed establishment and spread;
- decreased plant productivity from fugitive dust;

Table 3.3.4-1. Disturbance response groups

Disturbance Response Group	Disturbance Type and Description	Level and Type of Impact on Long-term Soil Productivity	Relative Revegetation Potential
No Disturbance	No disruption of soils or vegetation; e.g., areas within a facility remaining undisturbed	No impacts	Revegetation efforts are unneeded
Drive and Crush	Minimal disturbance from minor grading or vegetation mowing; surface soils and some vegetation remain intact; e.g., transmission line right-of-way	Minor impacts on soil productivity from compaction; some increased potential for erosion if vegetation is removed or soils are disrupted	High potential: Soil nutrients, cover, organic matter, microbiota, and seedbank remain intact, supporting revegetation success
Excavation with Soil Salvage	Soils are removed, salvaged, and replaced within disturbed surfaces; e.g., portions of the tailings storage facility	Moderate impacts on soil productivity due to topsoil redistribution; increased erosion potential, if revegetation is unsuccessful or delayed; potential for soil contamination in tailings or waste storage areas	Moderate potential: If salvaged soils are reapplied immediately, they will maintain some nutrients, organic matter, microbiota, and seedbank to enhance revegetation success
Excavation without Soil Salvage	Soils are removed or covered permanently, no soil salvage occurs, inert capping material used as plant growth medium; e.g., portions of the tailings storage facility	Major impacts on soil productivity due to loss of topsoils; increased erosion potential, if revegetation is unsuccessful or delayed; potential for soil contamination in tailings or waste storage areas	Low to moderate potential: Soil capping material lacks nutrients, organic matter, microbiota, and seedbank, limiting potential revegetation success
Subsidence Area	Soils and vegetation are redistributed as subsidence proceeds	Minor to moderate impacts on soil productivity, erosion potential, and existing vegetation depending on subsidence rates	Variable potential: No active revegetation planned; natural regeneration may occur as soil resources are redistributed
Structural Loss	Soils covered by a permanent structure	Soil productivity effectively lost in perpetuity; erosion losses are minimal under covered surfaces	Revegetation would not occur

Table 3.3.4-2. Disturbance, reclamation, and revegetation outcomes by facility and tailings alternative

Facility or Alternative	Facilities or Disturbance Remaining Post-decommissioning; Other Reclamation Considerations*	Primary (P) and Secondary (S) Disturbance Response Groups	Total Facility Disturbance (acres) and Impacts on Productivity†	High Water Erosion Potential (acres)‡	High Wind Erosion Potential (acres) §
East Plant Site facility (all action alternatives)	Headframes and hoists for groundwater monitoring; paved or graveled roads necessary for monitoring; subsidence area; <i>contact water basins would be closed</i>	P: Subsidence Area S: Excavation without soil salvage; Structural loss; No disturbance	1,856	206	0
West Plant Site facility (all action alternatives)	Roads necessary to support the reclamation and closure; stormwater diversion infrastructure; <i>process water ponds and contact water basins would be closed</i>	P: Excavation with and without soil salvage S: Structural loss; No disturbance	940‡	153§	0
Filter plant and loadout facility and MARRCO corridor (all action alternatives)	Other MARRCO corridor or bridge infrastructure may remain (depending on other intended uses); <i>all tanks and ponds would be closed</i>	P: Excavation with and without soil salvage; Drive and crush S: Structural loss; No disturbance	1,248	939	0
Power transmission facilities (common to all action alternatives)	Power transmission facilities (e.g., electrical substations, transmission lines, power centers) to remain if post-mining use is identified	P: Drive and crush; Excavation with and without soil salvage S: Structural loss; No disturbance	670¶	274	0
Near West Proposed Action tailings storage facility (Alternative 2)	Roads and berms necessary to support the reclamation and closure; <i>concurrent reclamation of outer slopes; gradual reduction and closure of seepage ponds; 1.5-foot-thick rock armor (growth medium) shell on tailings</i>	P: Excavation with and without soil salvage S: Structural loss; No disturbance	5,084 (10,033)	4	0
Near West – Ultrathickened tailings storage facility (Alternative 3)	Roads and berms necessary to support the reclamation and closure; <i>concurrent reclamation of cyclone sand embankment slopes PAG ponds evaporated over time; NPAG and PAG tailings slopes and surfaces covered in in erosion-resistant capping material (growth medium)</i>	P: Excavation with and without soil salvage S: Structural loss; No disturbance	5,086 (10,033)	4	0
Silver King (Alternative 4)	Upstream stormwater diversion features (cutoff walls and channels); roads and berms necessary to support the reclamation and closure; <i>concurrent reclamation of sloped face of stacks; store and release cover design; tailings covered in in erosion-resistant capping material (growth medium)</i>	P: Excavation with and without soil salvage S: Structural loss; No disturbance	5,779 (10,861)	2	0

continued

Table 3.3.4-2. Disturbance, reclamation, and revegetation outcomes by facility and tailings alternative (cont'd)

Facility or Alternative	Facilities or Disturbance Remaining Post-decommissioning; Other Reclamation Considerations*	Primary (P) and Secondary (S) Disturbance Response Groups	Total Facility Disturbance (acres) and Impacts on Productivity†	High Water Erosion Potential (acres)‡	High Wind Erosion Potential (acres) §
Peg Leg (Alternative 5)	Stormwater diversion channels, dropchutes, cutoff walls; roads and berms necessary to support the reclamation and closure; <i>reclamation begins at end of mine operations; PAG covered in 10 feet of NPAG material; all tailings covered in 1 to 2 feet of erosion-resistant capping material (growth medium)</i>	P: Excavation with and without soil salvage S: Structural loss; No disturbance	East pipeline option: 12,232 (17,153) West pipeline option: 12,574 (17,530)	East pipeline option: 204 West pipeline option: 562	East pipeline option: 3 West pipeline option: 47
Skunk Camp (Alternative 6)	Upstream stormwater diversion features (diversion walls, channels, and other stormwater control elements); roads and berms necessary to support the reclamation and closure; <i>reclamation begins at end of mine operations; PAG covered in 10 feet of NPAG material; all tailings covered in 1 to 2 feet of erosion-resistant capping material (growth medium)</i>	P: Excavation with and without soil salvage S: Structural loss; No disturbance	North pipeline option: 9,830 (16,116) South pipeline option: 10,269 (16,557)	North pipeline option: 7,768 South pipeline option: 8,117	North pipeline option: 735 South pipeline option: 735

* All disturbed surfaces not covered by a permanent structure would be reclaimed and revegetated; reclamation and decommissioning plans are detailed in chapter 2.

† The acreage shown in parentheses represents the total disturbed acreage for the entire project, which includes areas such as the East Plant Site and subsidence area. The acreage not in parentheses represents the disturbed acreage that is likely to be revegetated—the tailings storage facility and pipeline corridors—and represents an area that may recover productivity in the future.

‡ Wind and water erosion potential are provided as the total acreage for an entire facility or alternative. Details on how erosion susceptibility was determined are provided in Newell (2018g).

§ No wind erosion data are available where SSURGO data are unavailable.

- plant community fragmentation; and
- changes in plant growth and seasonal phenology from artificial lighting.

Vegetation Communities

Vegetation removal could have a variety of effects on vegetation communities ranging from changes in community structure and composition within the project footprint to alteration of soils. This could result in further loss of soil and vegetation, as well as increased sediment input to water resources. This impact would occur in localized areas of disturbance.

Soil disturbance may lead to the increased potential for the introduction and colonization of disturbed areas by noxious and invasive plant species, which may lead to changes in vegetation communities, including a possible shift over time to more wildfire-adapted vegetation that favors noxious or invasive exotic species over native species. This potential impact would be greatest in vegetation communities that are not adapted to fire, such as Arizona Upland and Lower Colorado River subdivisions of Sonoran Desertscrub. In more fire-adapted communities, such as Interior Chaparral and Semidesert Grasslands, these impacts could still occur, but the intensity of the impacts would decrease as native vegetation in these communities may respond positively to fire.

Fugitive dust from construction activities has the potential to affect photosynthetic rates and decrease plant productivity. Dust can have both physical and chemical impacts (Farmer 1993; Goodquarry 2011; Havaux 1992; Sharifi et al. 1997; Thompson et al. 1984; Walker and Everett 1987). Physical impacts of windborne fugitive dust on plants could include blockage and damage to stomata, shading, and abrasion of leaf surface or cuticle. Dust can increase leaf temperature; inhibit pollen germination; reduce photosynthetic activity, respiration, transpiration, and fruit set; decrease productivity; alter community structure; and contribute to cumulative impacts (e.g., drought stress on already stressed species or allow the penetration of phytotoxic gaseous pollutants, such

as sulfur dioxide, nitrogen dioxide, and ozone). Some studies, however, indicate that plant species living in high light conditions are flexible to adapting to lower light conditions (e.g., desert plants) (Alves et al. 2002; Barber and Andersson 1992; Werner et al. 2002) and that some plant species show improved growth with increased dust deposition (i.e., limestone) (Brandt and Rhoades 1972). The overall impact on vegetation from fugitive dust would be localized near sources of dust and would be highest near areas of ground disturbance during construction activities and would decrease with the completion of construction activities.

The construction of project facilities would fragment vegetation communities and create edge areas. Edge areas have different microclimatic conditions and structure and may be characterized by compacted soils and increased runoff that can lead to changes in species composition and vegetation structure.

Artificial lighting associated with the construction phase of the proposed project is less defined but is assumed to be less intense than associated with the operations phase and to vary in location and intensity through the 1- to 9-year time period. Specific impacts would be similar to those described in the Operational Impacts section; impacts on species groups are also provided in subsequent sections.

Special Status Plant Species

The primary direct and indirect impacts on special status plant species during construction of the proposed project would be similar to those described in this section for vegetation communities and would be associated with

- removal and/or crushing of special status plant species from construction of project facilities,
- increased potential for noxious and invasive weed establishment and spread,
- decreased plant productivity from fugitive dust,
- plant community fragmentation,

- changes in plant growth and seasonal phenology from artificial lighting, and
- inability to reestablish pre-mining populations.

Vegetation removal and ground disturbance may affect special status plant species through decreased productivity from fugitive dust and the potential for changes to habitat from a decline in productive soils and from the increased potential for noxious and invasive weed establishment and spread.

All action alternatives would impact Arizona hedgehog cactus (*Echinocereus triglochidiatus* var. *arizonicus*) through direct loss of individual plants where they occur as well as habitat changes from subsidence at the East Plant Site and Oak Flat site as well as other ground-disturbing activities. The likelihood of reestablishment is unknown.

Noxious Weeds

The primary direct and indirect impacts associated with noxious weeds during construction of the proposed project would be associated with

- increased potential for introduction and spread of noxious and invasive weeds,
- changes to habitat from noxious and invasive weed establishment and spread, and
- direct and indirect impacts on and competition with native vegetation and special status plant species.

The proposed project, under any action alternative, would increase the potential for noxious weed cover, and produce vegetation assemblages that could alter natural fire regimes. Noxious weeds are often fire adapted and so perpetuate increased fire risk once established or following a fire. However, these impacts would be minimized on Tonto National Forest-administered lands with the implementation of the “Resolution Copper Project Noxious Weed and Invasive Species

Management Plan on National Forest System Lands” (Resolution Copper 2019).

This impact would be highly likely to occur in areas disturbed by construction activities and is possible in adjacent habitats.

Operations

Vegetation Communities

Operation of the proposed mine and associated facilities would result in impacts on vegetation communities. The primary impacts of operations would be associated with

- subsidence,
- potential reduction in surface water flows and groundwater availability to riparian vegetation,
- increased potential for noxious and invasive weed establishment and spread,
- decreased plant productivity from fugitive dust, and
- changes in plant growth and seasonal phenology from artificial lighting.

During the operations phase of the proposed mine there would be impacts on vegetation communities from subsidence. Subsidence of the ground surface is anticipated to occur beginning approximately 6 years after initiation of mining activities. It is anticipated to continue until approximately 40 years after initiation of mining activities.

Within the cave zone, the development of a subsidence area would change the slope, aspect, surface water flow direction and rate; surface elevation; and would impact the seed bank on approximately 1,329 acres. This would likely modify the vegetation communities within portions of the cave limit. Within the fracture limit (1,579 acres), the potential impacts would be similar to the cave limit; however, the intensity would be decreased as this area would have reduced surface

impacts. The zone of continuous subsidence (1,686 acres) would have limited potential for localized impacts on vegetation communities as it would have minimal surface impacts.

In areas near the mine site, water usage would reduce water in the regional aquifer and would reduce surface water and groundwater levels downstream of the mine in Devil's Canyon and Queen Creek. Surface water amounts would be reduced, and timing/persistence of surface water would decrease. These potential decreases in groundwater and surface water would occur over a long period of time but could cause changes in riparian vegetation extent or health, and the reduction in stream flow could impact aquatic plant species, which need standing or flowing water or moist soils. As a result, the amount or volume of water within perennial pools or moisture in soils could decrease, which could result in indirect impacts on riparian vegetation and sensitive plant species through long-term habitat alteration, causing changes in the health of individual plants or populations, or even death and long-term elimination of certain plant species at these locations. Potential impacts from all action alternatives on vegetation communities in the analysis area could result from decreased surface water flow and groundwater drawdown, which could convert vegetation communities to those that are better adapted to drier conditions and result in long-term changes in the health of and reductions in the extent of riparian vegetation. Impacts on these groundwater-dependent ecosystems are analyzed in detail in section 3.7.1.

No impacts on vegetation communities are anticipated from water quality impacts at any of the tailings locations during operations as any stormwater that comes in contact with the tailings piles would be contained in the tailings facilities or in seepage ponds downstream. Water quality impacts associated with seepage that potentially could reach surface waters is analyzed in detail in section 3.7.2; specific impacts on vegetation communities are not anticipated from the potential increases in metals in surface water described in that section.

Potential impacts on vegetation communities from increased noxious and invasive weed establishment and spread would be similar in nature

to those described earlier in this section for the construction phase; however, as ground-disturbing activities would be reduced during the operations phase, the magnitude of potential impacts would be greatly reduced.

Potential impacts on vegetation communities from fugitive dust would be similar in nature to those described earlier in this section for construction; however, the magnitude of impacts would be reduced as dust-producing activities would be less during the operations phase.

Artificial lighting associated with the operations phase of the proposed project would increase overall brightness in the night sky by 1 to 9 percent; therefore, impacts on plant species may occur. However, these impacts are not well understood or researched in current literature since much of the literature focuses on non-light-emitting diode (LED) lights. One thing that is known about LED lights and plants is that LED lights are best for growing plants indoors (Mitchell and Sutte 2015). Additionally, the potential impacts, if realized, would be associated within the direct vicinity of the main operations areas, i.e., where the most lights are concentrated to increase overall night-sky brightness. The potential impacts from light would lessen with distance from the light source. The main impact on plant species of lighting associated with the operations phase of the proposed project is through the plants' photoreceptors, and since plants are not mobile, they cannot move away from stimuli like this. The addition of artificial light at night could impact seed germination, stem elongation, leaf expansion, induce flowering, flower development, fruit development, and leaf senescence, i.e., loss of a cell's power of division and growth (Briggs 2006). In addition, artificial night lighting may lead to changes in plant growth and seasonal phenology as well as the interaction between some species and pollinators (Bennie et al. 2016). This may lead to decreased fitness of some plant species and could lead to changes in plant community structure over time near areas with artificial lighting. These impacts would be greatest near light sources and would decrease with distance from the sources.

Special Status Plant Species

Under all action alternatives, special status plant species, including Arizona hedgehog cactus, may be impacted during operations through subsidence; increased potential for noxious and invasive weed establishment and spread; fugitive dust; and changes in plant growth and seasonal phenology from artificial lighting.

Within the subsidence area, individual Arizona hedgehog cactus may be destroyed during subsidence events in the cave limit and to a lesser extent within the fracture limit. Within the cave limit and to a lesser extent the fracture limit, the changes to existing habitat could create and/or remove habitat suitable for Arizona hedgehog cactus and other species status plant species.

Potential impacts on special status plant species from noxious and invasive weed establishment and spread, fugitive dust, and artificial lighting would be similar in nature to those described earlier in this section for vegetation communities; however, the magnitude of impacts would be greater for special status plant species as they generally have more specific habitat requirements, smaller ranges, and smaller population size.

Noxious Weeds

Potential impacts from noxious weeds during operations would be similar in nature to those previously described for the construction phase; however, as there would be less ground disturbance during operations, the magnitude of impacts would be reduced. However, these impacts would be minimized on Tonto National Forest-administered lands with the implementation of the “Resolution Copper Project Noxious Weed and Invasive Species Management Plan on National Forest System Lands” (Resolution Copper 2019).

Closure and Reclamation Impacts

Closure and reclamation of the proposed mine and associated facilities would result in short- and long-term impacts on vegetation and soil resources. During this phase, facilities would be decommissioned, sites

would be regraded (as needed) and reclaimed, soil or capping material would be applied along tailings and other surfaces (as needed), erosion control measures would be implemented, and disturbed areas would be revegetated. The goal of this phase would be to reestablish vegetation on all disturbed areas, to reduce soil erosion potential, and, over time, create stable, functioning ecosystems. Specific details regarding the potential to reestablish stable, functioning ecosystems as they relate to the desired future conditions identified by the Forest Service (described earlier) are discussed in the following sections. Note that the physical stability and safety of the tailings facility are described in section 3.10.1.

POTENTIAL TO ACHIEVE DESIRED FUTURE CONDITIONS

Projecting the outcomes of reclamation and the potential to achieve desired future conditions can be challenging for any project because several factors, including precipitation, temperature, topography, existing native and non-native seedbank, type and magnitude of disturbance, and reclamation methods (e.g., planting/seeding methods, weed management, soil salvage or capping media), all interact to influence success of revegetation efforts (see Bengtson (2019b)). While the meta-analysis does provide some constraint on revegetation trends that could be expected on a mining facility (see “Expected Effectiveness of Reclamation Plans” earlier in this section and Bengtson (2019b)), this analysis only addresses potential vegetation cover, and not the function of the ecosystem as a whole, including all of its biotic and abiotic components. A conservative strategy to estimate the time required to reach desired future conditions is to constrain natural rates of recovery from disturbance (in the absence of revegetation or other management interventions), because natural recovery estimates reflect the potential outcomes if reclamation efforts fail to accelerate vegetation reestablishment.

In a comprehensive investigation of natural recovery from 47 studies in the Mojave and Sonoran Deserts, Abella (2010) estimated that perennial plant cover requires 76 years to recover, and complete recovery of pre-disturbance species compositions would require, on average,

215 years. Another literature review from the Mojave and Sonoran Deserts estimated that biomass recovery may require 50 to 300 years, and complete recovery of the functioning ecosystem could require up to 3,000 years (Lovich and Bainbridge 1999). These two studies include results from many types of disturbance with differing levels of disturbance magnitude (Abella 2010; Lovich and Bainbridge 1999) with varying environmental conditions that can impact recovery rates (e.g., soil type, landform, and physical attributes of the site); see Lathrop and Archbold (1980). Despite the disparate estimates in natural recovery rates, there are two notable observations that have implications for projecting trends toward desired future conditions.

First, recovery generally follows natural succession, which is the “sequential, directional changes in species composition of a vegetation assemblage” (Webb et al. 1988). While short-lived, early-succession communities may recover in a matter of a few years to decades (Abella 2010; Lathrop and Archbold 1980; Prose et al. 1987), recovery for some long-lived, late-succession plant communities could require thousands of years, following the sequence of soil development (Lovich and Bainbridge 1999; Webb et al. 2003; Webb et al. 1988).

Second, the type and magnitude of disturbance strongly influences the nature and rates of ecosystem recovery (Abella 2010; Webb et al. 1987). For example, recovery of ground-clearing disturbances requires more time than other non-ground-clearing disturbances, because ground clearing can severely compact soils or remove surface resources (e.g., seedbank, microbial communities, fertile islands, nutrients, biotic soils, desert pavements, etc.) (Abella 2010). Likewise, the type and intensity of ground disturbance can influence recovery (Abella 2010; Lovich and Bainbridge 1999). For example, excavation disturbance generally requires approximately 100 years to recover pre-disturbance levels of biomass, and less-intense disturbance that only disrupts surface soils may require only around 20 years for biomass recovery (Lathrop and Archbold 1980). Ground disturbance impacts may be species specific, as soil compaction, topsoil removal, and changes to ephemeral drainages seems to hinder recovery of longer lived species or those sensitive to soil compaction (Prose et al. 1987). The shape of the disturbance footprint may also play a role, as some research suggests that recovery of linear

disturbances (i.e., roads, pipeline corridors, transmission line corridors), is accelerated by the availability of seeds and propagules from adjacent undisturbed areas, whereas wider or larger disturbance areas lack nearby propagule sources (Abella 2010).

The findings of these natural recovery studies, the outcomes of the meta-analysis (Bengtson 2019b), and species-specific resource studies have been used to constrain the potential for reclamation efforts to achieve desired future conditions. Trends toward desired future conditions largely vary based on the level and nature of disturbance across all project components (see table 3.3.4-1). In general, fast-growing and early-successional plant species and those tolerant of a variety of conditions would be the first to reestablish after reclamation, recovering over years to decades. In contrast, some slower growing, late-successional species may also reestablish but may require centuries or even millennia to reach pre-disturbance levels of ecosystem function. In areas where ground disturbance is relatively low, and soil resources (e.g., nutrients, organic matter, microbial communities) and vegetation propagules (e.g., seedbank or root systems to resprout) remain relatively intact, it would be expected that vegetation communities could rebound to similar pre-disturbance conditions in a matter of decades to centuries. In contrast, the tailings storage facility, which would be covered in non-soil capping material (such as Gila Conglomerate) would provide, at best, some habitat structure for generalist wildlife species. It is expected that biodiversity and ecosystem function of the tailing storage facility may never reach the original, pre-disturbance conditions even after centuries of recovery. The following sections detail the estimated potential, as well as some time constraint, for individual vegetation communities to reach their respective desired future conditions and potential impacts on soil resources, special status plant species, and noxious weeds.

Soils

Healthy soils are the basis for a stable, functioning ecosystem—providing a plant growth medium, habitat for burrowing animals, water and nutrients to support plant communities, and harboring seeds and

plant propagules. During the closure and reclamation project phase, the reestablishment of vegetation and improvements to soil conditions (through soil management or application of amendments) would offset impacts from construction, operations, and maintenance.

Even with optimal soil management intervention, the legacy of impacts on soil health and productivity may last centuries to millennia, impacting the ability of the ecosystem to meet its desired future conditions. For example, natural recovery from compaction (associated with heavy equipment traffic) is estimated to require 92 to 124 years (Webb 2002). Similarly, biotic soils and desert pavements, which trap fine-grained dust to form vesicular soil horizons, naturally prevent erosion, influence the distribution of soil nutrients, and control soil water dynamics, develop over hundreds to thousands of years (Anderson et al. 2002; Felde et al. 2014; Haff and Werner 1996; Williams 2011; Williams et al. 2012; Williams et al. 2013). The following impacts on soils would be expected during and in the years following closure and reclamation:

- Losses of topsoil resources (e.g., fine-grained soil particles, soil fertility, compaction, natural soil structure, water-holding capacity, biotic soils) during construction, operations, and maintenance may be considered permanent, as these resources accumulate over hundreds to thousands of years of soil formation. It is expected that erosion control and revegetation efforts during closure and reclamation would stop the continued loss of these resources.
- Some soil function may be enhanced through application of soil amendments (e.g., mulch, organic matter application) by increasing soil fertility, erosion resistance, and soil water-holding capacity, which would improve soil productivity.
- Over time, as soil formation proceeds (over hundreds to thousands of years), soil health and function would improve as dust accretes to increase natural soil fertility and water-holding capacity, soil structure redevelops and improves soil hydrologic function, organic matter and nutrients accumulate, bioturbation mixes soil resources, plants and microorganisms continue to

colonize soils, biotic soils and desert pavements reform, and carbon and nitrogen are fixed within the soil.

- The productivity of the soil and its ability to support healthy and resilient vegetation communities (which meet an ecosystem's desired future conditions) would increase as soil formation proceeds over centuries and millennia.

These changes to soil function and productivity through time are considered in the following sections that detail the potential to achieve desired future conditions. The time frames for the recovery of soil function would largely depend on the initial level of disturbance (see table 3.3.4-1), with those soils that have had the least-impacted disturbance type (and have the greatest soil resources remaining) recovering the fastest.

Desert Ecosystems

Under optimal conditions, and with sufficient revegetation efforts and resource inputs (e.g., soil amendments and watering), fast-growing perennial shrubs, forbs, grasses, cacti, and mesquite trees would rebound within a few years to a few decades. Saguaro are slow-growing, and larger (older) individuals have low transplant survival rates (Elliot 2003). Managing the fine fuels associated with non-native grasses to maintain fire intervals greater than 100 years may not be possible, even in undisturbed and low-disturbance areas. Overall, the habitat may be suitable for generalist wildlife and plant species, but rare plants and wildlife with specific habitat requirements would be unlikely to return.

Semi-desert grasslands

Under optimal conditions, and with sufficient revegetation efforts and resource inputs (e.g., soil amendments and watering), many native grasses would return within a few years to a few decades. Tree and shrub canopy cover can be limited with management intervention. Managing non-native vegetation cover to limit the intensity of uncharacteristic fires may not be possible on the landscape scale. Because many important

grass species would recover in the short-term, much of the habitat function of these ecosystems would be likely to return.

Interior Chaparral

Under optimal conditions, and with sufficient revegetation efforts and resource inputs (e.g., soil amendments and watering), recovery of shrubs (particularly shrub live oak, see (Tirmenstein 1999)), shrub litter, and regeneration of grasses and forbs should be achievable over decades to centuries on most disturbance types other than the tailings storage facility. While management of non-native species may not be achievable, support of stand-replacing fires at 35- to 100-year intervals that promote resprouting of fire-adapted species may be achievable with management interventions. Much of the habitat function should return to these habitats after decades to centuries for generalist species but may not return for sensitive species with specific habitat requirements.

Pinyon-Juniper Woodland

Under optimal conditions, reestablishment of multi-aged woodlands with complex structure and sparse ground cover of shrubs, perennial grasses, and forbs would be achievable with management intervention and resource inputs for most disturbance types, with the exception of the tailings storage facility. However, very old trees would take centuries to reestablish. Support of low-intensity ground fires should be possible with management intervention. Habitat structure would return for most generalist wildlife species but would likely require decades to centuries.

Ponderosa Pine-Evergreen Oak

Given optimal conditions, revegetation efforts, management interventions, and resource inputs, reestablishment of old-growth tree stands with sparse shrub and herbaceous groundcover should be achievable on most disturbance types with the exception of the tailings storage facility. Recreating a functional ecosystem that is resilient to a variety of human and natural disturbances may be challenging to achieve, even with intense management interventions. Habitat structure

would return for most generalist wildlife species but would likely require decades to centuries.

Xeroriparian

With maintenance or recovery of the optimal hydrologic conditions, and with some management interventions, the reestablishment of most xeroriparian communities would return for all disturbance types with the exception of the tailings storage facilities. However, these communities may recover around the tailings facilities, under the appropriate conditions. Habitat structure would return for most generalist wildlife species but would likely require decades to centuries.

Riparian

Riparian community composition is expected to vary based on soil and hydrologic conditions, however, in general site-appropriate communities are expected to reestablish (given suitable management intervention and revegetation efforts) on all disturbance types with the exception of the tailings storage facilities. However, these communities may reestablish adjacent to the tailings storage facility. Habitat structure would return for most generalist wildlife species but would likely require decades to centuries.

Special Status Plant Species

Impacts on special status plant species during closure/reclamation would be similar to those described for vegetation communities. However, as special status plant species generally have specific habitat requirements, it is unlikely that reclaimed areas would retain or develop those habitat requirements over more than a small portion of the areas previously disturbed.

Noxious Weeds

Reclamation of disturbed areas would decrease but not eliminate the likelihood of noxious weeds becoming established or spreading in

and adjacent to the project area. In areas where reclamation activities would occur, there would likely be reduced soil stability and an initial increase in the potential for noxious and invasive weed establishment and spread due to ground disturbance and decreased competition for space, light, and water. Efforts to reclaim these areas would lessen the potential for weed establishment and spread in the long term; however, it is anticipated that reclaimed areas would have a higher density of these non-native species than were present before ground-disturbing activities, even at completion of reclamation activities.

3.3.4.3 Alternative 2 – Near West Proposed Action

Potential impacts on soils, vegetation communities, and special status plant species, as well as impacts from noxious weeds, would be as described earlier under “Impacts Common to All Action Alternatives” and “Potential to Achieve Desired Future Conditions.” Alternative 2 would remove or modify approximately 10,033 acres of vegetation and impact 10,033 total acres of soils (see table 3.3.4-2). Of the disturbed area, 5,084 acres would potentially be revegetated and would recover productivity to some extent, as described under “Impacts Common to All Action Alternatives.” The acres of potential impacts on vegetation communities and special status plant species habitat by alternative are given in tables 3.3.4-3 and 3.3.4-4.

Financial Assurance for Closure and Post-Closure Activities

Alternative 2 potentially involves long time periods of post-closure maintenance and monitoring related to revegetation and reclamation of the tailings storage facility. This raises the concern for the possibility of Resolution Copper going bankrupt or otherwise abandoning the property after operations have ceased. If this were to happen, the responsibility for these long-term activities would fall to the Forest Service. The Forest Service would need to have financial assurance in place to ensure adequate funds to undertake these activities for long periods of time—for decades or even longer.

The authority and mechanisms for ensuring long-term funding is discussed in section 1.5.5. The types of activities that would likely need to be funded could include the following:

- Monitoring of the success of revegetation
- Implementing remedial actions if revegetation success criteria are not met
- Monitoring of the post-closure landform for excessive erosion or instability, and performance of any armoring
- Maintenance and monitoring of post-closure stormwater control features
- Monitoring the water quality of stormwater runoff associated with the closure cover, to determine ability to release stormwater back to the downstream watershed

Additional financial assurance requirements for long-term maintenance and monitoring are part of the Arizona APP program and include the following:

The applicant or permittee shall demonstrate financial responsibility to cover the estimated costs to close the facility and, if necessary, to conduct postclosure monitoring and maintenance by providing to the director for approval a financial assurance mechanism or combination of mechanisms as prescribed in rules adopted by the director or in 40 Code of Federal Regulations section 264.143 (f)(1) and (10) as of January 1, 2014. (Arizona Revised Statutes 49-243; also see Arizona Administrative Code R18-9-A203 for specific regulations and methods allowed for financial assurance)

Table 3.3.4-3. Acres of vegetation communities to be disturbed within each action alternative footprint

Vegetation Community or Landform Type	Alternative 2 (acres)	Alternative 3 (acres)	Alternative 4 (acres)	Alternative 5 West Pipeline Option (acres)	Alternative 5 East Pipeline Option (acres)	Alternative 6 South Pipeline Option (acres)	Alternative 6 North Pipeline Option (acres)
Total Acres	10,033	10,033	10,861	17,530	17,153	16,557	16,116
Human dominated	410	410	410	423	423	423	410
Interior Chaparral	1,251	1,251	1,379	1,251	1,257	2,564	2,654
Lower Colorado River Sonoran Desertscrub	1,619	1,619	3,592	2,399	2,451	2,572	2,535
Pine-Oak	2	0	3	2	2	18	48
Pinyon-Juniper	44	0	83	118	133	92	116
Riparian	28	28	44	35	35	92	90
Semidesert Grassland	137	135	1,417	143	149	7,041	7,045
Arizona Upland Sonoran Desertscrub	6,393	6,393	3,706	12,976	12,494	2,866	2,438
Water	14	15	15	15	15	15	15
Xeroriparian	135	135	184	171	195	813	766

Note: Acreages in this table are rounded to the nearest whole number.

The Arizona State Mine Inspector also has authority to require a mine reclamation plan and financial assurance for mine closure (Arizona Administrative Code Title 11, Chapter 2). The regulations for these focus primarily on surface disturbance and revegetation.

3.3.4.4 Alternative 3 – Near West – Ultrathickened

Potential impacts on soils, vegetation communities, special status plant species, and noxious weeds would be the same in magnitude and nature as those described for Alternative 2 as they have the same footprint, and differences in the tailings facility construction and operation would not increase or decrease potential impacts between the two alternatives.

Financial assurance for closure and post-closure activities would be the same as described for Alternative 2.

3.3.4.5 Alternative 4 – Silver King

Potential impacts on soils, vegetation communities, special status plant species, and from noxious weeds would be as described under “Impacts Common to All Action Alternatives” and “Potential to Achieve Desired Future Conditions.” Alternative 4 would remove or modify approximately 10,861 acres of vegetation and impact 10,861 total acres of soils (see table 3.3.4-2). Of the disturbed area, 5,779 acres would potentially be revegetated and would recover productivity to some extent, as described under “Impacts Common to All Action Alternatives” and “Potential to Achieve Desired Future Conditions.” The acres of potential impacts on vegetation communities and special status plant species habitat by alternative are given in tables 3.3.4-3 and 3.3.4-4.

Financial assurance for closure and post-closure activities would be the same as described for Alternative 2.

Table 3.3.4-4. Acres of modeled habitat for special status plant species potentially occurring within each action alternative footprint

Common Name (Scientific Name)	Status	Alternatives 2 and 3 (acres)	Alternative 4 (acres)	Alternative 5 West Pipeline Option (acres)	Alternative 5 East Pipeline Option (acres)	Alternative 6 South Pipeline Option (acres)	Alternative 6 North Pipeline Option (acres)
		Percentage of Modeled Habitat in Analysis Area		Percentage of Modeled Habitat in Analysis Area	Percentage of Modeled Habitat in Analysis Area	Percentage of Modeled Habitat in Analysis Area	Percentage of Modeled Habitat in Analysis Area
		Percentage of Modeled Habitat in 5-mile Buffer Area	Percentage of Modeled Habitat in 5-mile Buffer Area	Percentage of Modeled Habitat in 5-mile Buffer Area	Percentage of Modeled Habitat in 5-mile Buffer Area	Percentage of Modeled Habitat in 5-mile Buffer Area	Percentage of Modeled Habitat in 5-mile Buffer Area
Acuña cactus (<i>Echinomastus erectocentrus</i> var. <i>acunensis</i>)	ESA: E with critical habitat. Found in Maricopa, Pinal, and Pima Counties	N/A 0% 0%	N/A 0% 0%	14,531 82% 5%	14,130 65% 5%	N/A 0% 0%	N/A 0% 0%
Arizona hedgehog cactus (<i>Echinocereus triglochidiatus</i> var. <i>arizonicus</i>)	ESA: E No critical habitat. Found in Maricopa, Pinal, and Gila Counties	2,2594 13% 4%	2,857 17% 4%	2,594 21% 5%	52,617 20% 5%	2,698 17% 7%	5,597 18% 7%
Chiricahua Mountain alumroot (<i>Heuchera glomerulata</i>)	Tonto National Forest: S	0 0% 0%	94 19% 1%	0 0% 0%	0 0% 0%	133 22% 1%	110 19% 1%

continued

Table 3.3.4-4. Acres of modeled habitat for special status plant species potentially occurring within each action alternative footprint (cont'd)

Common Name (Scientific Name)	Status	Alternatives 2 and 3 (acres)		Alternative 5 West Pipeline Option (acres)	Alternative 5 East Pipeline Option (acres)	Alternative 6 South Pipeline Option (acres)	Alternative 6 North Pipeline Option (acres)
		Percentage of Modeled Habitat in Analysis Area	Alternative 4 (acres) Percentage of Modeled Habitat in Analysis Area	Percentage of Modeled Habitat in Analysis Area	Percentage of Modeled Habitat in Analysis Area	Percentage of Modeled Habitat in Analysis Area	Percentage of Modeled Habitat in Analysis Area
		Percentage of Modeled Habitat in 5-mile Buffer Area	Percentage of Modeled Habitat in 5-mile Buffer Area	Percentage of Modeled Habitat in 5-mile Buffer Area	Percentage of Modeled Habitat in 5-mile Buffer Area	Percentage of Modeled Habitat in 5-mile Buffer Area	Percentage of Modeled Habitat in 5-mile Buffer Area
Mapleleaf false snapdragon (<i>Mabrya [Maurandya] acerifolia</i>)	Tonto National Forest: S	0 0% 0%	0 0% 0%	737 3% 1%	319 3% 1%	0 0% 0%	0 0% 0%
Parish's Indian mallow (<i>Abutilon parishii</i>)	Tonto National Forest: S BLM: S	1,463 23% 4%	4,999 99% 17%	4,874 39% 18%	5,011 29% 8%	3,395 23% 7%	3,245 33% 8%
Pringle's fleabane (<i>Erigeron pringlei</i>)	Tonto National Forest: S	1,305 20% 4%	1,439 16% 3%	1,305 20% 4%	1,310 19% 4%	2,676 16% 5%	2,770 18% 5%

Notes: Modeled habitat includes areas outside of the current range of some species and is used here as a conservative estimate of impacts. It was necessary to use modelled habitat since the only baseline survey and suitable habitat data available were only for four species within Alternatives 2 and 3. Acreages in this table are rounded to the nearest whole number.

Status Definitions

Tonto National Forest:

S = Sensitive. Species identified by a Regional Forester for which population viability is a concern, as evidenced by a significant current or predicted downward trends in population number or density or significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

Endangered Species Act (ESA):

E = Endangered. Endangered species are those in imminent jeopardy of extinction. The ESA specifically prohibits the take of a species listed as endangered. Take is defined by the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to engage in any such conduct.

Bureau of Land Management (BLM):

S = Sensitive. Species that could easily become endangered or extinct in the state.

3.3.4.6 Alternative 5 – Peg Leg

Potential impacts on soils, vegetation communities, special status plant species, and from noxious weeds would be as described under “Impacts Common to All Action Alternatives.” Alternative 5 would remove or modify approximately 17,153 acres of vegetation with the east pipeline route option and 17,530 acres with the west pipeline route option. The disturbance would impact 17,153 acres of soils in the east pipeline route option and 17,530 acres of soils for the west pipeline route option (see table 3.3.4-2). Of the disturbed area, just over 12,000 acres would potentially be revegetated and would recover productivity to some extent, as described under “Impacts Common to All Action Alternatives” and “Potential to Achieve Desired Future Conditions.” The acres of potential impacts on vegetation communities and special status plant species habitat by alternative are given in tables 3.3.4-3 and 3.3.4-4. Within Alternative 5, both the east and west pipeline options would impact critical habitat. The west pipeline option would disturb around 103 acres of acuña cactus critical habitat, and the east pipeline option would disturb about 12 acres of critical habitat.

The regulatory framework under the State of Arizona to require financial assurance for long-term closure activities is the same as described for Alternative 2. However, for the tailings facility, financial assurance requirements would be required by BLM, not the Forest Service. Like the Forest Service, BLM also has regulatory authority to require financial assurance for closure activities, contained in their surface management regulations (43 CFR Subpart 3809). BLM considers that the financial assurance must cover the estimated cost as if BLM were hiring a third-party contractor to perform reclamation of an operation after the mine has been abandoned. The financial assurance must include construction and maintenance costs for any treatment facilities necessary to meet Federal and State environmental standards.

3.3.4.7 Alternative 6 – Skunk Camp

Potential impacts on soils, vegetation communities, special status plant species, and from noxious weeds would be as described under “Impacts Common to All Action Alternatives” and “Potential to Achieve Desired

Future Conditions.” Alternative 6 would remove approximately 16,557 acres of vegetation for the south pipeline route option and 16,116 acres for the north pipeline route option. The disturbance would impact 16,116 acres of soils in the north pipeline route and 16,557 acres of soils for the south pipeline route (see table 3.3.4-2). Of the disturbed area about 10,000 acres would potentially be revegetated and would recover productivity to some extent, as described under “Impacts Common to All Action Alternatives.” The acres of potential impacts on vegetation communities and special status plant species habitat by alternative are given in tables 3.3.4-3 and 3.3.4-4.

The regulatory framework under the State of Arizona to require financial assurance for long-term closure activities is the same as described for Alternative 2. However, Alternative 6 differs from the other alternatives because the tailings facility would not be located on lands managed by the Forest Service (as in Alternatives 2, 3, and 4) or BLM (Alternative 5). For Alternative 6, the Federal financial assurance mechanisms would not be applicable.

3.3.4.8 Cumulative Effects

The assessment area for cumulative impacts on soils and vegetation in conjunction with the Resolution Copper Project is broadly defined as the “Copper Triangle” region of south-central Arizona (generally understood as encompassing lands from the Globe-Miami area southwest to the town of Superior and southeast to the towns of Hayden and Winkelman), as well as adjacent watersheds.

In assessing cumulative effects on soils and vegetation, it should be understood that all forms of surface disturbance have the potential to remove or damage vegetation and increase soil erosion in the immediate vicinity of the disturbance and possibly beyond. Loss of vegetation leads to potential habitat losses that may last hundreds or thousands of years, as natural recovery proceeds. Intensified or accelerated erosion may occur through the effects of wind, or water, or both, causing permanent losses of soils and soil resources. Vegetation destruction, habitat loss, and increased erosion may occur whether the surface disturbance is intentional, such as that resulting from a construction project, or

incidental, such as that arising from OHV use or other recreational activity in previously undisturbed areas.

The Tonto National Forest identified the following list of reasonably foreseeable future actions as likely to occur in conjunction with development of the Resolution Copper Mine and as having potential to contribute to incremental changes to soils and vegetation. As noted in section 3.1, past and present actions are assessed as part of the affected environment; this section analyzes the effects of any RFFAs, to be considered cumulatively along with the affected environment and Resolution Copper Project effects.

- Pinto Valley Mine Expansion.* The Pinto Valley Mine is an existing open-pit copper and molybdenum mine located approximately 8 miles west of Miami, Arizona, in Gila County. Pinto Valley Mining Corporation is proposing to expand mining activities onto an estimated 1,011 acres of new disturbance (245 acres on Tonto National Forest land and 766 acres on private land owned by Pinto Valley Mining Corporation) and extend the life of the mine to 2039. EIS impact analysis is pending. However, it is assumed that the proposed action as described in the recently amended mining plan of operations would result in the direct short-term (less than 5 years) or long-term (20–30 years) loss of soils and vegetation through surface disturbance of up to 1,011 acres. Some areas could later be reclaimed and revegetated, but there would also be the permanent, irreversible loss of other areas that would, for example, be buried beneath expanded tailings impoundments or waste-rock stockpiles or would be permanently lost to expansion of the pit area. In addition, given what is known of the historical environmental effects of similar mining operations elsewhere, the potential exists for adverse effects on both soils and riparian vegetation communities downgradient of the mine due to contamination or decreased water availability. A more accurate assessment of the potential for downstream seepage or other contamination would not be known until the environmental effects analysis of the proposed mine expansion is complete and mitigation measures
- and other environmental controls are agreed upon between the Tonto National Forest, Pinto Valley Mining Corporation, and other Federal and State regulatory agencies.
- Ripsey Wash Tailings Project.* Mining company ASARCO is planning to construct a new tailings storage facility to support its Ray Mine operations to replace the existing Elder Gulch tailings storage facility near Hayden, which is now nearing its maximum capacity. The environmental effects of the project were analyzed in an EIS conducted by the USACE and approved in a ROD issued in December 2018. As approved, the proposed tailings storage facility project would occupy an estimated 2,574 acres and be situated in the Ripsey Wash watershed just south of the Gila River approximately 5 miles west-northwest of Kearny, Arizona, and would contain up to approximately 750 million tons of material (tailings and embankment material). Development of the new facility would result in the permanent loss (i.e., burial) of existing soils and vegetation within the tailings storage facility boundary. Other existing surface soils and vegetation would, for approximately the next 50 years, be overlain by tailings storage facility maintenance roads, slurry and water pipeline corridors, and other supporting tailings facility infrastructure. Following facility closure, however, the majority of these linear facilities would be removed and the underlying soils and vegetation reclaimed. Cumulative effects with the Resolution Copper Project would be most pronounced for Alternative 5 – Peg Leg, which would result in large areas of impact on soil and vegetation in the same general vicinity and watershed.
- Superior to Silver King 115-kV Relocation Project.* At the request of Resolution Copper, SRP intends to relocate an approximately 1-mile segment of the existing Superior-Silver King 115-kV transmission line, located on Resolution Copper-owned private property, approximately 0.25 mile to the northwest to accommodate future Resolution Copper Mine-related facilities. This relocation of the transmission line would directly affect relatively small areas of previously

undisturbed soil and vegetation to allow for installation of footings for transmission line poles and possibly of other areas for maintenance access. These activities could increase the potential for introduction and establishment of noxious weeds and invasive species along this portion of the transmission line corridor.

- *Silver Bar Mining Regional Landfill and Cottonwood Canyon Road.* A private firm, Mineral Mountain LLC, is proposing to develop a landfill on land the company owns approximately 6 miles southeast of Florence Junction and 4 miles due east of SR 79. This private land lies entirely within an area of BLM-administered lands and cannot be accessed without crossing Cottonwood Canyon Road, located on BLM lands. The company received Master Facility Plan Approval for the proposed landfill from ADEQ in 2009 and a BLM right-of-way grant in 2017. The firm's proposed construction on Cottonwood Canyon Road and on the landfill property could increase the potential for introduction and/or spread of noxious weeds and invasive plants. Approximately 4 acres of creosotebush-bursage vegetation and 11 acres of Arizona Upland Desertscrub would be removed to expand Cottonwood Canyon Road. Development of the landfill would result in the clearing of 350 acres of vegetation on private lands.
- *APS Herbicide Use within Authorized Power Line Rights-of-Way on NFS lands.* Arizona Public Service Company (APS) has proposed to include Forest Service-approved herbicides as a method of vegetation management, in addition to existing vegetation treatment methods, on existing APS transmission rights-of-way within the Tonto National Forest. An environmental assessment (EA) with a Finding of No Significant Impact (FONSI) was published in December 2018. The EA determined that environmental resource impacts would be minimal, and the use of herbicides would be useful in preventing and/or reducing fuel buildup that would otherwise result from rapid, dense regrowth and sprouting of undesired vegetation. No residual effects on underlying soils are anticipated as a result of use of these herbicides.
- *ADOT Vegetation Treatment.* Like the APS vegetation control program, Arizona Department of Transportation (ADOT) plans to conduct annual treatments using EPA-approved herbicides to contain, control, or eradicate noxious, invasive, and native plant species that pose safety hazards or threaten native plant communities on road easements and NFS lands up to 200 feet beyond road easement on the Tonto National Forest. No residual effects on underlying soils are anticipated as a result of use of these herbicides.
- *Ray Land Exchange and Proposed Plan Amendment.* ASARCO is also seeking to complete a land exchange with the BLM by which the mining company would gain title to approximately 10,976 acres of public lands and federally owned mineral estate located near ASARCO's Ray Mine in exchange for transferring to the BLM approximately 7,304 acres of private lands, primarily in northwestern Arizona. It is known that at some point ASARCO wishes to develop a copper mining operation in the "Copper Butte" area west of the Ray Mine; however, no details are currently available for specific mine development plans or how these may directly or indirectly affect existing soils and vegetative communities in the Copper Butte area.
- *AGFD Wildlife Water Catchment Improvement Projects.* These individual catchment projects are part of a larger, longer term cooperative effort between the Tonto National Forest and Arizona Game and Fish Department to improve wildlife habitat throughout the Tonto National Forest, and specifically to benefit mule deer populations (although access to water provided by the catchments would also benefit elk, javelina, Gambel's quail, and other species). Each catchment array (including water storage tanks, a large "apron" to gather and direct precipitation to the storage tanks, drinking trough, and fencing) would disturb no more than 0.5 acre, causing minimal cumulative disturbance of soils and vegetation.

- *Tonto National Forest Travel Management Plan.* The Tonto National Forest is currently in the process of developing a Supplemental EIS to address certain court-identified deficiencies in its 2016 Final Travel Management Rule EIS. This document and its implementing decisions are expected within the next 2 years. This document will have substantial impacts on current recreational uses of Tonto National Forest lands and transportation routes, which in turn would have some impact on disturbance of soils and vegetation for new road construction or decommissioning of other roads.

Nearly all forms of human development activity involve some amount of short- or long-term surface disturbance of existing soils and vegetation. These activities may include agriculture, mining, roadbuilding, utility construction, private residential and commercial land development, rangeland improvements, and many other actions beyond the specific projects described here. Many of these types of earth-disturbing activities are certain to occur in this area of south-central Arizona during the foreseeable future life of the Resolution Copper Mine (50–55 years), including developments that have yet to be imagined or planned. In some instances, the disturbed soils and vegetation are eventually returned to approximately pre-disturbance conditions, but in most cases they are not.

3.3.4.9 Mitigation Effectiveness

The Forest Service is in the process of developing a robust mitigation plan to avoid, minimize, rectify, reduce, or compensate for resource impacts that have been identified during the process of preparing this EIS. Appendix J contains descriptions of mitigation concepts being considered and known to be effective, as of publication of the DEIS. Appendix J also contains descriptions of monitoring that would be needed to identify potential impacts and mitigation effectiveness. As noted in chapter 2 (section 2.3), the full suite of mitigation would be contained in the FEIS, required by the ROD, and ultimately included in the final GPO approved by the Forest Service. Public comment

on the EIS, and in particular appendix J, will inform the final suite of mitigations.

This section contains an assessment of the effectiveness of design features from the GPO and mitigation and monitoring measures found in appendix J that are applicable to soils and vegetation.

Mitigation Measures Applicable to Soils and Vegetation

Salvage of select vegetation and trees within the tailings storage facility footprint (RC-208): To the extent practicable, Resolution Copper will salvage select vegetation and select suitable trees within the tailings storage facility footprint. This measure would be applicable to all alternative tailings storage facility locations and would be noted in the final ROD or final mining plan of operations as a requirement by the Forest Service.

Conduct soil surveys within the area to be disturbed by the preferred alternative tailings storage facility (FS-223): While adequate soil and vegetation information exists to conduct an assessment for the purposes of disclosing impacts under NEPA and comparing between alternatives, the level of information may not be sufficient to support detailed final reclamation plans and a final mining plan of operations. To support these documents, soil surveys need to be conducted within the disturbance footprint of the preferred alternative tailings storage facility. The specific purpose of the surveys would be to identify general soil characteristics, estimate the amount of soil or unconsolidated material that would be available for salvage to support reclamation activities, and inform the ability of salvaged material to support reclamation efforts. The appropriate level of detail for the soil survey would be determined in conjunction with the Tonto National Forest. The Forest Service is requiring that these surveys be conducted between the DEIS and FEIS. This exercise will inform the requirements to be specified in the ROD and ultimately incorporated into a final mining plan of operations.

Conduct appropriate testing of soil materials within the preferred alternative tailings storage facility (FS-224): Similarly, in order to

support detailed final reclamation plans and a final mining plan of operations, appropriate testing would be conducted on soil samples collected from within the Preferred Alternative footprint. These tests could include such parameters as soil organic carbon, moisture capacity, nutrients, pH/acidity/alkalinity. Tests would also include those appropriate to estimate post-closure water quality of stormwater runoff interacting with the salvaged soil. The appropriate suite of tests to be conducted would be determined in conjunction with the Tonto National Forest. The Forest Service is requiring that these tests be conducted between the DEIS and FEIS. This exercise will inform the requirements to be specified in the ROD and ultimately incorporated into a final plan of operations.

Conduct vegetation surveys within the preferred alternative disturbance footprint (FS-225): Also, in order to support detailed final reclamation plans and a final mining plan of operations, vegetation surveys need to be conducted within the disturbance footprint of the preferred alternative tailings storage facility. These surveys would identify general vegetation present, density, abundance of native/non-native species, and any special status plant species for which site characteristics are appropriate for occurrence. The appropriate level of detail for these surveys would be determined in conjunction with the Tonto National Forest. The Forest Service is requiring that these surveys be conducted between the DEIS and FEIS. This exercise will inform the requirements to be specified in the ROD and ultimately incorporated into a final plan of operations.

Preparation of detailed reclamation plans for the preferred alternative (FS-226): Information derived from the soil surveys, vegetation surveys, and soil testing would be used to develop detailed reclamation plans for the preferred alternative. These reclamation plans would be more specific than those included in the GPO, and would include such details as maps of the post-closure landform depicting the type of final closure cover for each area (depth of material, type of material, anticipated source of material and preparation methods like crushing or sorting, and need for/presence of armoring); anticipated reclamation techniques such as surface preparation, seeding, planting, watering (if any), soil amendments; soil salvage storage locations and

storage management techniques; maps of the post-closure landform or the landform over time, depicting phasing of revegetation or reclamation activities; monitoring details including proposed success criteria and the potential use of comparison reference plots. The detailed reclamation plans would also include more specific information on post-closure stormwater controls, the anticipated longevity of engineered control systems, and criteria for when stormwater would be deemed appropriate for release back to the downstream drainages. The appropriate level of detail for the final reclamation plans would be determined in conjunction with the Tonto National Forest. The Forest Service is requiring that these plans be prepared between the DEIS and FEIS. This exercise will inform the requirements to be specified in the ROD and ultimately incorporated into a final mining plan of operations.

Mitigation Effectiveness and Impacts

The salvage of vegetation would not result in any additional ground disturbance and would be effective at offsetting some loss of vegetation through salvage and replanting. Not all salvaged vegetation would likely survive transplantation, and many decades might be required before areas are available for replanting. The amount of vegetation salvaged would be a small portion of that lost.

Soil surveys, soil testing, vegetation surveys, and preparation of detailed reclamation plans would not result in any additional ground disturbance and would be effective at developing information and techniques that would allow revegetation activities to be as successful as possible. These would also inform monitoring requirements that would ensure that revegetation activities are performing over time as predicted.

Unavoidable Adverse Effects

The mitigation described would only minimally offset project impacts. The unavoidable adverse effects remain as described earlier in this section, including the complete loss during operations of soil productivity, vegetation, and functioning ecosystems within the area of disturbance, and eventual recovery after reclamation (though not

likely to the level of desired conditions or potentially over extremely long time frames). Impacts on special status plant species, where they occur, and the spread of noxious and invasive weeds (though reduced by applicant-committed environmental protection measures) would also be unavoidable adverse effects.

3.3.4.10 Other Required Disclosures

Short-Term Uses and Long-Term Productivity

Productivity loss for soils would be limited to the disturbed areas affected by land clearing, grading, and construction; subsidence; and areas permanently occupied by tailings. It is not expected that the tailings would ever be removed, or that the subsidence crater would be filled, and effects on soils and some land uses would be permanent.

Reclamation efforts are anticipated to reestablish vegetation in all areas other than the subsidence crater.

Test plots at the West Plant Site have demonstrated that it is possible to successfully revegetate under certain conditions and research has demonstrated successful revegetation on Gila Conglomerate in the same geographic area; however, it is not known whether the areas would return to current conditions or the length of time that would be needed to successfully reclaim the site. However, the goal of reclamation is to create a self-sustainable ecosystem that would promote site stability and repair hydrologic function, and while pre-project habitat conditions are not likely to be achieved, it is likely that some level of wildlife habitat would eventually be reestablished in most areas, reestablishing some level of long-term productivity.

Irreversible and Irretrievable Commitment of Resources

Soils are a finite resource, and any loss of soils resulting from their removal for tailings storage and from erosion and delivery to downstream channels is irreversible. The loss of soil productivity is effectively irreversible because a stable new plant community would take an extremely long time to redevelop on the surface of the

tailings and waste-rock facilities (decades or centuries). The area of the subsidence crater and tailings storage facility would constitute an irreversible loss of soil that would be lost in perpetuity.

Irretrievable effects on soils and vegetation would take place at disturbed areas where reclamation is successfully accomplished or only temporary in nature, particularly along rights-of-way. Soils and vegetation in these areas would eventually return to full functionality, possibly within years or decades.

Overview

Any large-scale earthmoving operation, such as mining, will inevitably result in increased machinery-generated noise and vibration above previous ambient levels for a given location. The proposed Resolution Copper Mine differs from many mining operations in that most sounds and vibrations from blasting and ore removal would occur far underground and not be perceptible at the surface. There would, however, be increases in noise and vibration throughout the construction and operational phases of the mine from facility-building activity, haul truck traffic, and employee vehicles moving to and from the mine. The text section below provides a detailed analysis of estimated impacts from noise and vibration under the GPO-proposed mine plan and each of the alternatives.

3.4 Noise and Vibration

3.4.1 Introduction

Development, operation, and reclamation of the mine could result in an increase in noise and vibrations in the immediate vicinity of mine facilities. Activities that could increase noise and vibrations include blasting, underground conveyance of ore, processing operations, operations at the filter plant and loadout facility, and operations at the tailings facilities. Increases in traffic associated with worker commuting, material delivery, and mine product shipment could also contribute to an overall increase in noise on area roads and highways.

Noise and vibration (both blasting and non-blasting related) associated with mining activities would vary spatially and temporally throughout the life of the project, depending on the phase.

This section describes noise and vibrations from blasting and non-blasting activities, during both construction and operation, for each alternative. Additional details not included may be found in the project record (Newell 2018d). Note that noise and vibration impacts on wildlife are addressed in section 3.8.

3.4.2 Analysis Methodology, Assumptions, and Uncertain and Unknown Information

3.4.2.1 Analysis Area

The spatial analysis area consists of the area in which predicted noise and vibration caused by the

project attenuate to background levels. The analysis generally evaluated land uses within 2 miles of each mine component, which encompasses the area in which predicted noise would be noticeable. The noise and vibration analysis area is shown in figure 3.4.2-1.

3.4.2.2 Noise Analysis Methodology

The following sections describe the analysis methodology, assumptions, and uncertainties involved in modeling noise and vibration, respectively.

Sensitive Receptors

The noise analysis focuses on noise levels at areas where there are existing or future land uses that are particularly sensitive to noise, known as “noise sensitive areas.” These are as follows:

- Areas potentially affected by noise from the West Plant Site or traffic: Residences in Superior and residences along U.S. 60 and Main Street
- Areas potentially affected by noise from the East Plant Site: Oak Flat Campground and Apache Leap Special Management Area
- Areas potentially affected by noise from the filter plant and loadout facility: Westernstar Road, Lind Road, Felix Road, and Attaway Road
- Areas potentially affected by noise from the Alternative 2 and 3 tailings storage facility: Hewitt Station, residences in Queen Valley,

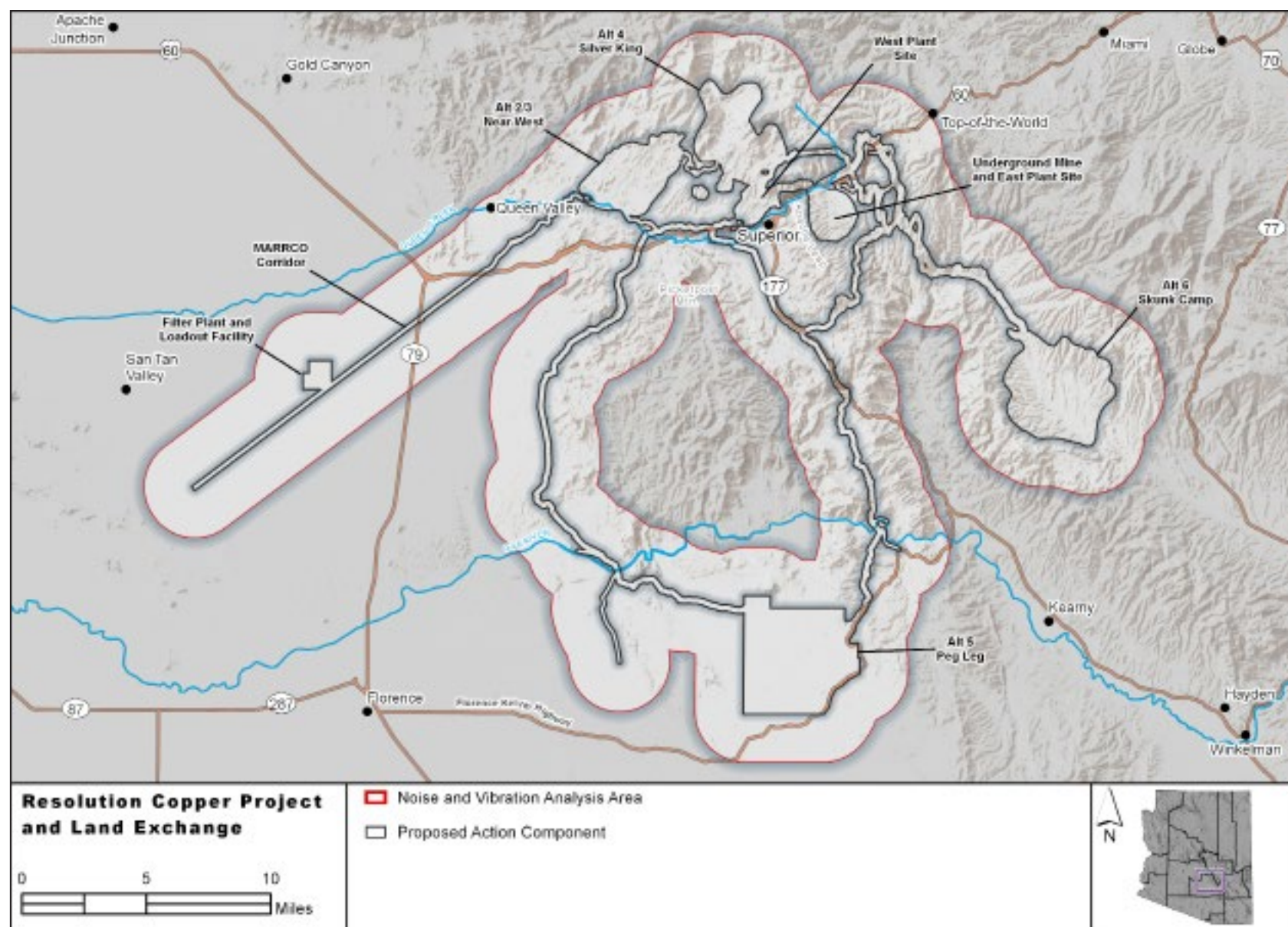


Figure 3.4.2-1. Noise and vibration analysis area

Boyce Thompson Arboretum, and Arizona Trail (northwest of Superior)

- Areas potentially affected by noise from the Alternative 4 tailings storage facility: Arizona Trail (northwest of Superior)
- Areas potentially affected by noise from the Alternative 5 tailings storage facility: Arizona Trail (near Zellweger Wash)
- Areas potentially affected by noise from the Alternative 6 tailings storage facility: Dripping Springs Road and Arizona Trail (near Kelvin)

Within each of these general areas, a specific location was selected for modeling of predicted noise impacts from the project, referred to as a “sensitive receptor.” The specific location of each sensitive receptor was placed where predicted noise levels were expected to be highest for that area; these receptors are described further in section 3.4.3.

Background Noise Measurements

In order to conduct noise modeling, an understanding of background noise levels is required. Background noise levels were measured at five locations, corresponding to the noise sensitive areas described under “Sensitive Receptors.” Note that background noise levels were not collected specifically for the Alternative 6 tailings storage facility but were assumed to be similar to the Alternative 5 tailings storage facility based on the general area and land use.

Background noise levels are monitored for several days or weeks in order to account for variation between day and night, and weekends and weekdays. The background noise data are then reviewed to identify any anomalies, such as fireworks, thunder, rainfall, high wind, or very close activity (like a nearby off-road vehicle). While these types of noises do occur in the analysis area, they happen infrequently or may affect the monitoring equipment more than they would a human listener. The goal of background noise measurements is to obtain a “typical” background level, while acknowledging that occasional louder noises would also occur.

- East Plant Site. Monitored June 7 through 20, 2016.
- West Plant Site. Monitored June 7 through 10, and June 22 through July 5, 2016.
- Alternative 2 and 3 tailings storage facility. Monitored June 7 through 16, and June 20 through July 5, 2016 (summer conditions), and monitored November 15 through 23, and November 28 through December 6, 2017 (winter conditions).
- Filter plant and loadout facility. Monitored June 7 through 16, and June 20 through July 5, 2016.
- Alternative 4 tailings storage facility. Monitored November 14 through 18, 2017, and January 5 through 15, 2018.
- Alternative 5 tailings storage facility (also used for Alternative 6 tailings storage facility). Monitored November 14 through December 27, 2017.

In order to check whether the background noise levels measured in the field were reasonable, they were checked against the expected noise levels based on similar types of land uses, and also checked against several previous studies conducted for the West Plant Site in 2015. These comparisons, which are described in section 3.4.4, are important because they confirm that the background noise measurements are a reasonably accurate estimate of current baseline conditions and because they also verify that background noise from these six monitoring locations can reasonably be used for all 16 sensitive receptors for which project noise levels are predicted.

Construction Phase – Blasting Noise Modeling

Construction activities include the construction of the underground tunnel to convey ore from the underground production area to the West Plant Site. The tunnel construction would use underground drilling and explosives, generating airblast noise (or more technically, peak air overpressure, which is a measure of the pressure wave generated by the blast).

The predictive model for airblast noise is based on information from the U.S. Bureau of Mines (Siskind et al. 1980) and surface mining regulations (30 CFR 816.67). The model predicts the amount of explosive that can be used, given the distance (as measured at a slant through the ground) between an underground source and a sensitive receptor, and given a desired limit on airblast noise.

Construction Phase – Non-Blasting Noise Modeling

Construction activities occur both underground and aboveground. Construction-phase noise modeling focuses on the aboveground construction of the West Plant Site, the filter plant and loadout facility, and the East Plant Site. Each of these has a focused construction period with increased noise levels that would last from 12 to 18 months.

Underground construction of tunnels and infrastructure would continue throughout the operations phase of the project, as would construction of the tailings storage facility. These construction noise impacts are therefore incorporated into the operational modeling.

To model construction noise, different types of equipment were identified that would be used at each site (i.e., dozers, graders, pickup trucks). Typical noise levels from these types of equipment have been documented by the U.S. Environmental Protection Agency (EPA) (Bolt et al. 1971) and Federal Highway Administration (Knauer et al. 2006). The assumption is made that all equipment is running simultaneously at the middle of each construction site, and the spread of sound waves is modeled, without accounting for any shielding effects from topography or structures. Specific construction assumptions include the following:

- West Plant Site. Construction activities occur over an 18-month period, and include improving the main site entrance at Lone Tree Road, improving Silver King Mine Road, and constructing a number of buildings (administration, warehouse, contractor laydown yard, concentrator site, and new substation).
- East Plant Site. Construction activities occur near Shafts 9 and 10 over a 12-month period, and include expansion of the shaft

pad and construction of surface infrastructure that supports the underground operations. Shaft construction is analyzed as part of the blasting noise analysis.

- Filter plant and loadout facility. Construction activities occur over an 18-month period, and include construction of the filter plant, and improvements along the MARRCO corridor (rail line, pipelines, wells, pipeline booster station sites, and access points), and improvements along Skyline Drive.

Operations Phase – Non-Blasting Noise Modeling

Noise modeling for the operational phase identifies the quantity and type of equipment in use, the expected sound level from the equipment, and what percentage of the time it would be used. The noise modeling also takes into account noise from project road and rail traffic. In order to avoid underestimating impacts, all equipment is modeled as if it were operating simultaneously and under weather conditions favorable to sound propagation.

The modeling takes into account the combined effect of multiple noise sources, and factors that tend to attenuate sound like reflection from surfaces, screening by topography or obstacles, and terrain effects like elevation.

The noise modeling produces the following results. The metrics listed— $Leq(h)$ and Ldn —are common noise metrics, and detailed explanations are included in Newell (2018d):

- The hourly equivalent sound level, $Leq(h)$, at the location of each sensitive receptor
- The 24-hour day-night average sound level, Ldn , at the location of each sensitive receptor
- Noise contours showing how sound from the project propagates over the surrounding area. Noise contours graphically display how the combined project noise would be distributed over the surrounding area; they are similar to topography elevation

maps. Equal noise levels are represented by continuous lines around a source.

The results shown in this section include the noise predicted from the project, the anticipated future noise range (background noise added to predicted project noise), and the incremental increase in noise over background levels.

3.4.2.3 Vibration Analysis Methodology

Construction Phase – Blasting Vibration Modeling

The construction of the underground tunnel would also generate ground-borne vibrations. The predictive model for blasting vibrations is based on information from the U.S. Bureau of Mines (Nicholls et al. 1971; Siskind et al. 1980) and surface mining regulations (30 CFR 816.67). The predictive model for blast vibrations predicts the amount of explosive that can be used, given the distance between an underground source and a sensitive receptor, and given a desired limit on vibrations.

Background vibration measurements were taken at the same locations as the background noise measurements, at approximately the same time. To provide context, the analysis compares the predicted vibrations to measured background vibrations, and also assesses real-world vibration measurements that were collected during blasting at the East Plant Site in 2018.

Construction and Operations Phase – Non-Blasting Vibration Modeling

Non-blasting vibration occurs from train movement, construction activities, stationary equipment, and other mobile equipment. Ground-borne vibrations were predicted using the type of equipment generally causing the greatest vibrations (an earthmoving truck), using estimates from the Federal Transit Administration (Quagliata et al. 2018).

3.4.3 Affected Environment

3.4.3.1 Relevant Laws, Metrics, Regulations, Policies, and Plans

No single regulatory agency or threshold is applicable to non-blasting noise generated by activities at the project sites. A full discussion of noise thresholds of significance appropriate for mining activities can be found elsewhere (Newell 2018d).

Primary Legal Authorities Relevant to the Noise Effects Analysis

- U.S. Department of Housing and Urban Development standards
- Pinal County Excessive Noise Ordinance
- Federal Highway Administration and Arizona Department of Transportation (ADOT) standards
- Office of Surface Mining Reclamation and Enforcement
- Federal Transit Administration
- Occupational Safety and Health Administration
- Mine Safety and Health Administration

3.4.3.2 Selected Thresholds

A variety of thresholds are used to put the predicted noise and vibration modeling results in context. These thresholds are being used for the purposes of the NEPA analysis. Note that these thresholds are likely not applicable to the project in a legal or regulatory sense, and in many cases have very specific applications or specific limitations that are not included explicitly in this analysis.

Blasting Noise Thresholds (Peak Air Overpressure)

The selected threshold for airblast level is at or below 120 unweighted decibels (dBL), which is based on results presented in U.S. Bureau of Mines RI 8485 (Siskind et al. 1980) and represents a reasonable maximum threshold to avoid impacts on structures and humans.

Non-Blasting Noise Thresholds

Thresholds of interest for non-blasting noise include the following:

- For the Ldn metric, the selected threshold is 65 A-weighted decibels (dBA). This is based on the U.S. Department of Housing and Urban Development's Acceptability Standards.
- For the Leq(h) metric, the selected threshold is 55 dBA. This is based on the Pinal County Excessive Noise Ordinance for residential areas during nighttime hours.
- For the Leq(h) metric, an additional selected threshold is 66 dBA. This is based on the ADOT Noise Abatement Criteria for external noise at residential areas (activity class "B").
- An additional threshold applied to all metrics is the incremental increase in noise over background, with a threshold of 15 dBA. This is based on the ADOT substantial noise increase criteria.

Blasting Vibration Thresholds

The selected threshold for ground-borne vibrations is 0.1884 inches per second, peak particle velocity (PPV in/sec.), which is below the human tolerable threshold of 0.5 PPV in/sec., and represents a worst-case threshold. The selected value is also considered reasonable because blasting activities at the mine site are proposed at significant depths, primarily resulting in low-frequency components. However, once blasting commences and vibration monitoring is conducted, if blasting is found to mostly generate frequencies above 3 hertz (i.e., corresponding to high frequency), the selected threshold could increase to 0.5 PPV in/sec.

Non-Blasting-Vibration Thresholds

The selected threshold is at or below 0.04 PPV in/sec. (80 vibration decibels [VdB]), which is based upon results presented in Federal Transit Administration 2018 guidelines (Quagliata et al. 2018).

3.4.3.3 Existing Conditions and Ongoing Trends

The information presented in the following subsections are presented in more detail in the report titled "Sound and Vibration Analysis Report" (Tetra Tech Inc. 2019) and the memorandum titled "Blasting Monitoring Review Memorandum" (Rodrigues 2018).

Land Use and Sensitive Receptor Identification

Land uses within 2 miles of each mine component (i.e., West Plant Site, East Plant Site, filter plant and loadout facility, MARRCO corridor, tailings storage facility alternatives) were grouped and categorized into three main land uses: (1) residential, (2) commercial, and (3) recreation/conservation. Sensitive receptors were then identified and are shown on figure 3.4.3-1.

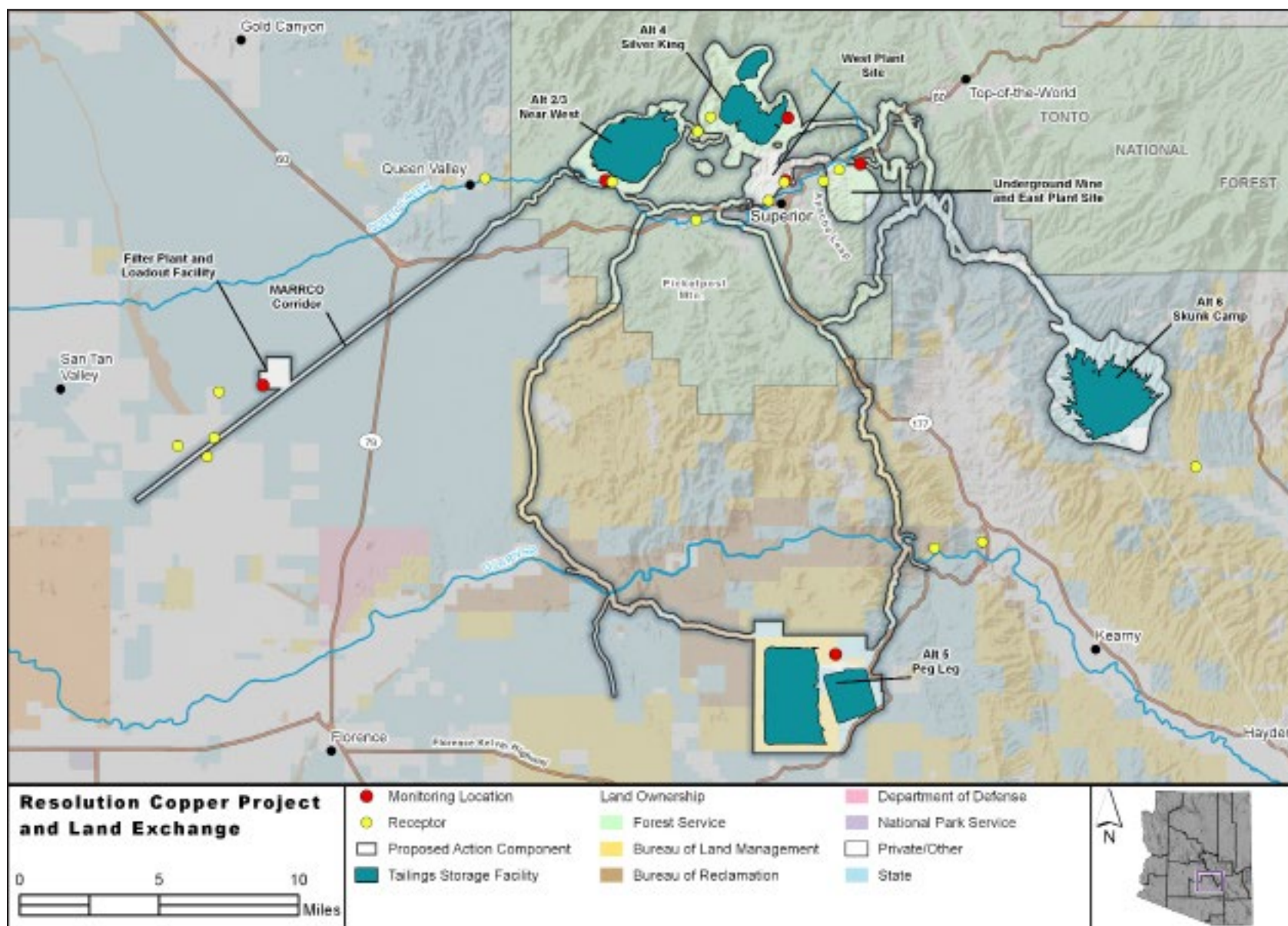


Figure 3.4.3-1. Land use, sensitive areas/receptors identification, and measurement locations

Background Measurement Locations and Descriptions

Background noise and vibration measurements were conducted during two periods, representing the acoustical environment during the spring/summer months (i.e., fewer residents and less outdoor recreation) and fall/winter months (i.e., more residents and more outdoor recreation). The following briefly describes the measurement locations:

- East Plant Site measurement: placed near the edge of the East Plant Site, approximately 650 feet from the existing Shaft 10 and 0.8 mile from the Oak Flat Campground and U.S. 60 route. Nearby land uses include recreation/conservation uses and two sensitive receptors (Oak Flat Campground and the Apache Leap Special Management Area). Noise anomalies removed from the data set included rainfall, thunder, and operation of the existing East Plant Site. These were removed because the East Plant Site noise expected to occur during operations is part of the predicted modeling, not part of the background.
- West Plant Site measurement: placed near the West Plant Site facility property line and adjacent to the town of Superior (incorporated county land), where the nearest residential property line is approximately 260 feet to the south. Land uses within a 2-mile radius include residential, commercial, and recreation/conservation use. Nearby land use represented at this location is residential and includes one sensitive receptor (residences in the town of Superior). Noise anomalies removed from the data set included rainfall, thunder, fireworks, and operation of the existing West Plant Site. These were removed because the West Plant Site noise expected to occur during operations is part of the predicted modeling, not part of the background.
- Near West tailings storage facility measurement: placed on private land, a residential property at 32898 Hewitt Station Road, within the Tonto National Forest, approximately 1,000 feet from the edge of the proposed Near West tailings storage facility. To avoid data contamination from residential activities, the monitoring location was 550 feet from the residence. Nearby land uses include residential and recreation/conservation uses and four sensitive receptors (Hewitt Station, the section of the Arizona Trail near the Near West tailings storage facility, residences in Queen Valley, and Boyce Thompson Arboretum). Noise anomalies removed from the data set included rainfall, thunder, and limited activities of all-terrain vehicles (ATVs) during the summer months and excessive wind, noise from the ranch, rainfall, and ATVs during the winter months.
- Filter plant and loadout facility measurement: placed at the proposed facility location, where the nearest residential property line is approximately 1.6 miles to the west along Skyline Drive. Nearby land uses include residential near Westernstar Road, Lind Road, Felix Road, and Attaway Road. Noise anomalies removed from the data set included rainfall and thunder. Because this location is isolated from any significant noise source, there were no identified primary noise sources.
- Silver King tailings storage facility measurement: placed at the proposed facility location. Nearby land uses include residential and recreation/conservation uses and one sensitive receptor (a section of the Arizona Trail located 2 miles to the west). Noise anomalies removed from the data set included excessive wind and light rainfall. Because this location is isolated from any significant noise source, there were no identified primary noise sources.
- Peg Leg tailings storage facility measurement: placed at the proposed facility location. Nearby land uses include recreation/conservation uses and one sensitive receptor (a section of the Arizona Trail located 2.4 miles to the east). Noise anomalies removed from the data set included excessive wind. Although this location was near a substation, the monitor placement was far enough from the substation to avoid data contamination. Because this location is isolated from any significant noise source, there were no identified primary noise sources. This location also serves as the source of background noise for

Alternative 6, given the similar rural setting. Future background noise measurements may be collected at Alternative 6 if substantial differences are identified in background noise levels.

Interpretation of Background “Ambient” Noise Measurements

Noise levels within the analysis area showed relatively low levels and exhibited typical diurnal patterns. The predominant source in the measured adjusted noise levels (i.e., after removal of identified anomalies) at each of the measurement locations were (1) for the East Plant Site: wildlife and vehicle traffic from Magma Mine Road and U.S. 60, (2) for the West Plant Site: wildlife and community sources from the town of Superior, (3) for the Near West tailings storage facility: operations from nearby ranches, light vehicle traffic on local roadways, and wildlife, (4) for the filter plant and loadout facility: wildlife and aircraft overflights, (5) for the Silver King tailings storage facility: wildlife and light traffic from campers, and (6) for the Peg Leg tailings storage facility: wildlife and aircraft overflights.

In general, the measured adjusted noise levels were within the expected ranges for the given land use, except for the East Plant Site measurement location, where measured levels were approximately 5 to 10 decibels (dB) higher than expected ranges. However, the higher measured data (i.e., 5–10 dB) is reasonable because the expected range assumes an isolated location and does not consider any influence from the nearby U.S. 60 route. Table 3.4.3-1 summarizes the project sites and associated sensitive receptors, land uses, and expected and measured noise level ranges.

Interpretation of West Plant Site Previous Study Noise Measurements

ARCADIS Inc. conducted two noise studies along the West Plant Site property line adjacent to the town of Superior. The first study, “West

Plant Noise Monitoring Study” (ARCADIS U.S. Inc. 2015b), included three measurement locations and collected noise data from May 7 through 15, 2015. Of the three locations, one was placed similar to the West Plant Site measurement location discussed earlier in this section and shown on figure 3.4.3-1. The study found that noise levels at this location ranged from 39 to 65 dBA, Leq(h); however, 65 dBA was noted as an anomaly where noise levels typically ranged between 40 to 50 dBA Leq(h).

The second study, titled “Lower Smelter Pond Noise Monitoring Report Superior, Arizona” (ARCADIS U.S. Inc. 2015a), included four measurement locations and collected noise data from August 18 to September 17, 2015. Three measurement locations were along the West Plant Site southern property line and one was within the residential area near the lower smelter pond. The study found that noise levels at these locations were as high as 75 to 80 dBA, Leq(h) during sludge removal activities, but noise levels typically ranged from 31 to 50 dBA Leq(h).

Noise levels from ARCADIS Inc. studies further confirm that the background noise levels at the West Plant site (39–47 dBA daytime, 33–47 dBA nighttime) are reasonably accurate and representative of adjacent residences in the town of Superior.

Interpretation of Project Area Background “Ambient” Vibration Measurements

The vibration levels at the measurement location were at levels that could be perceived by humans (table 3.4.3-2), but considerably below the U.S. Bureau of Mines RI 8507 threshold of 0.5 PPV in/sec., which is tolerable by 95 percent of humans for an event occurring in a 1-second duration. Based on the maximum values, vibration levels recorded were highest at the West Plant Site—0.07 PPV in/sec. (85 VdB)—which exceeds the Federal Transit Administration’s threshold for residential annoyance of 0.04 PPV in/sec. (80 VdB). Average values for vibration levels did not exceed any thresholds of interest.

Table 3.4.3-1. Background measured noise levels and expected ranges for sensitive receptors based on land use

Project Site	Sensitive Receptors	Land Use Type	Data Source	Sound Level (dBA)		
				Ldn	Daytime Leq(h)	Nighttime Leq(h)
West Plant Site	Noise Measurement Location		Measured	43–53	39–47	33–47
	Residences in Superior	Residential and Commercial	Expected	48–54	48–54	38–44
	Residences between U.S. 60 and Main Street	Residential and Commercial	Expected	48–54	48–54	38–44
East Plant Site	Noise Measurement Location		Measured	52–54	45–50	45–48
	Oak Flat Campground	Recreation/Conservation	Expected	41–44	41–45	31–33
	Apache Leap Special Management Area	Residential/Recreation/Conservation	Expected	41–54	41–54	31–44
Near West tailings storage facility	Noise Measurement Location		Measured	40–46	36–43	32–39
	Hewitt Station	Residential	Expected	35–45	35–45	31–33
	Queen Valley	Residential	Expected	36–42	36–42	26–32
	Boyce Thompson Arboretum	Recreation/Conservation	Expected	41–44	41–45	31–33
	Arizona Trail (northwest of Superior)	Recreation/Conservation	Expected	33–35	32–37	25–30
Filter plant and loadout facility	Noise Measurement Location		Measured	38–48	38–45	27–41
	Westernstar Road	Residential	Expected	36–45	35–45	28–35
	Lind Road	Residential	Expected	36–45	35–45	28–35
	Felix Road	Residential	Expected	36–45	35–45	28–35
	Attaway Road	Residential	Expected	36–45	35–45	28–35
Silver King tailings storage facility	Noise Measurement Location		Measured	35–46	31–41	27–39
	Arizona Trail (northwest of Superior)	Recreation/Conservation	Expected	33–35	32–37	25–30
Peg Leg tailings storage facility (measured) and Skunk Camp tailings storage facility (assumed)	Noise Measurement Location		Measured	34–52	30–51	26–46
	Arizona Trail (near Zellweger Wash)	Recreation/Conservation	Expected	33–35	32–37	25–30

Note: Noise measurements were collected as described below:

West Plant Site: June 7–10, 2016, and June 22–July 5, 2016

East Plant Site: June 7–20, 2016

Near West tailings storage facility: June 7–16, 2016, June 20–July 5, 2016, November 15–23, 2017, and November 28–December 6, 2017

Filter plant and loadout facility: June 7–16, 2016, and June 20–July 5, 2016

Silver King tailings storage facility: November 14–18, 2017, and January 5–15, 2018

Peg Leg tailings storage facility: November 14–December 27, 2017

Table 3.4.3-2. Background vibration measurement summary

Project Site	Measurement Period	Average PPV, in/sec.	Maximum PPV, in/sec.	Maximum VdB
West Plant Site	June 7–July 5, 2016	0.0034		
East Plant Site	June 7–July 5, 2016	0.0031	0.013	70
Near West tailings storage facility	June 7–July 5, 2016	0.0035	0.0164	72
Filter plant and loadout facility	June 7–July 5, 2016	0.0077	0.0186	73
Silver King tailings storage facility	November 15–December 12, 2017	0.0033	0.0048	62
Peg Leg tailings storage facility	November 15–December 12, 2017	0.0057	0.0175	73

Notes:

VdB = calculated vibration decibel using a vibration reference of 10–6 in/sec. and a crest factor of 4 (i.e., representing a difference of 12 VdB).

Shaded cells indicate an exceedance of a selected threshold by background measurements.

Interpretation of East Plant Site Additional Noise and Vibration Measurements

In January 2018, blasting activities commenced at the East Plant Site 4,000 level (i.e., 4,000 feet below surface) and occurred periodically between January 30 and March 19, 2018. Blasting time histories indicate that 29 blasting activities took place during this period, during both daytime and nighttime hours. Noise and vibration data from blasting events were continuously monitored and recorded. Each event incorporated an average loading of 225 pounds of explosives distributed in a patterned hole system consisting of approximately 50 to 60 holes. The blasting monitoring data show that vibration levels from blasting activities were not distinguishable from background ground-vibration levels.

Table 3.4.3-3. East Plant Site noise data comparison (with blasting and no-blasting activities)

Noise Level Ranges for Each Measurement Period								
Ldn, dBA	Daytime Leq(h), dBA				Nighttime Leq(h), dBA			
	Leq	L10	L90	Lmax	Leq	L10	L90	Lmax
Measurement Period (June 7–20, 2016)								
51.9–54.2	45.2–49.7	47.5–52.2	43.7–46.8	52.1–60.3	45.3–47.7	47.6–50.1	44.3–46.4	49.9–57.9
Measurement Period (January 30–March 19, 2018)								
48.5–58.5	44.1–55.4	48.7–62.3	41.6–53.3	52.5–65.9	41.5–51.2	46.3–56.6	40.3–49.8	48.6–62.8

Notes:

Ldn = Day-night average noise level, a 24-hour average with annoyance penalty of 10 dBA for nighttime noise levels.

Daytime Leq(h) = Equivalent sound level for period between 7:00 a.m. and 10:00 p.m.

Nighttime Leq(h) = Equivalent sound level for period between 10:00 p.m. and 7:00 a.m.

L10 = sound level was exceeded 10 percent of the time (overall monitoring period).

L90 = sound level was exceeded 90 percent of the time (overall monitoring period).

Lmax = Maximum sound level recorded during the measurement period.

To determine whether the blasting events influenced background noise levels, the noise data set from January/March 2018 (which included blasting events) was compared with the noise data set from June 2016 (which did not include any blasting events and was used to establish the background acoustic environment). Table 3.4.3-3 presents a summary of noise monitoring data collected during the 2016 and 2018 periods.

The two data sets are comparable overall for most metrics. The 2018 noise data exhibited a wider range, with the minimum values generally lower than the 2016 background measurements, and the maximum values generally higher than the 2016 background measurements. The L10 (noise level exceeded 10 percent of the time) and Lmax (maximum sound level) metrics are both widely used to describe noise from intermittent or individual events, though very short individual events (like blasting) are unlikely to show up in the L10 values. The 2018 daytime L10 and Lmax metrics had a wide range but were overall higher

than the 2016 background noise measurements, suggesting blasting noise may have been detected. However, a direct comparison of noise levels (collected every second) immediately before, during, and after each blasting event does not show any clear effects (Tetra Tech Inc. 2019).

3.4.4 Environmental Consequences of Implementation of the Proposed Mine Plan and Alternatives

Direct impacts from noise and vibration during construction and operational phases have been modeled for the project (AMEC Foster Wheeler Environment and Infrastructure 2017; Rodrigues 2018; Tetra Tech Inc. 2019).

3.4.4.1 Alternative 1 – No Action

As detected in the 2016 background noise measurements, certain noise-producing activities are currently taking place on Resolution Copper private property at the West Plant Site and East Plant Site. Under the no action alternative, these activities would continue. Noise and vibration levels do not rise above any selected thresholds under background conditions

3.4.4.2 Impacts Common to All Action Alternatives

Effects of Land Exchange

The selected Oak Flat Federal Parcel would leave Forest Service jurisdiction. The role of the Tonto National Forest under its primary authorities in the Organic Administration Act, Locatable Regulations (36 CFR 228 Subpart A), and Multiple-Use Mining Act is to ensure that mining activities minimize adverse environmental effects on National Forest System surface resources; this includes effects on the natural setting from noise that could occur on the Oak Flat Federal Parcel. The Oak Flat Federal Parcel would become private at the completion of

the NEPA process, and the Forest Service would not have the ability to require mitigation for effects from noise on the lands; however, no adverse noise effects were identified to occur from the East Plant Site operations.

The offered parcels would come under Federal jurisdiction. Specific management of the natural setting of those parcels would be determined by the agencies to meet desired conditions or support appropriate land uses and would include noise considerations.

Effects of Forest Plan Amendment

The Tonto National Forest Land and Resource Management Plan (1985b) provides guidance for management of lands and activities within the Tonto National Forest. It accomplishes this by establishing a mission, goals, objectives, and standards and guidelines. Missions, goals, and objectives are applicable on a forest-wide basis. Standards and guidelines are either applicable on a forest-wide basis or by specific management area.

A review of all components of the 1985 forest plan was conducted to identify the need for amendment due to the effects of the project, including both the land exchange and the proposed mine plan (Shin 2019). No standards and guidelines were identified applicable to noise or vibration. For additional details on specific rationale, see Shin (2019).

Summary of Applicant-Committed Environmental Protection Measures

A number of environmental protection measures are incorporated into the design of the project that would act to reduce potential impacts on noise and vibration. These are non-discretionary measures and their effects are accounted for in the analysis of environmental consequences.

The GPO (2016d) outlined applicant-committed environmental protection measures by Resolution Copper in the “Environmental Protection Elements” section.

- Mining activities, primary crushing and conveying, will take place underground, and exhaust fans will be equipped with silencers for noise reduction. Milling will take place within a fully enclosed building.

3.4.4.3 Alternatives 2 and 3 – Near West – Modified Proposed Action

Construction Phase – Blasting Noise and Vibration Impacts

In order to analyze ground-borne vibrations associated with construction of the underground tunnel, 10 structures in the town of Superior were selected as representative samples based on the shortest slant distance to the tunnel. Sections of the tunnel would also run along the Apache Leap SMA sensitive receptor, where the shortest slant distance is approximately 1,536 feet (near the westerly side) and 3,506 feet (near the easterly side) (figure 3.4.4-1).

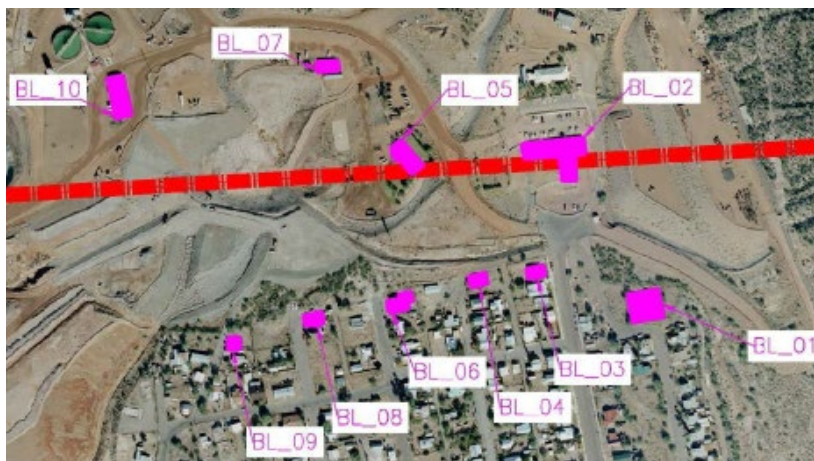


Figure 3.4.4-1. Locations of buildings analyzed for selected vibration threshold near West Plant Site and underground tunnel

Table 3.4.4-1. Calculated explosive loading at sensitive receptor samples based on selected vibration threshold

Sensitive Receptor	Slant Distance (feet)	Allowable Explosive Load per Delay (kg TNTe)
BL_1	1,235	24
BL_2 (located on West Plant Site facility property)	864	12
BL_3	1,114	19
BL_4	1,061	18
BL_5 (located on West Plant Site facility property)	758	9
BL_6	1,101	19
BL_7 (located on West Plant Site facility property)	1,023	16
BL_8	1,135	20
BL_9	1,210	23
BL_10 (located on West Plant Site facility property)	775	9
Apache Leap SMA	1,535	37

Note: Calculated allowable explosive load per delay is based on 0.1884 PPV in/sec. vibration threshold.

The explosive load per delay presented in table 3.4.4-1 are calculated based on the selected vibration threshold, sensitive receptor locations, tunnel alignment, and profile data. At the nearest sensitive receptor (BL_5), located on the West Plant Site facility property, the blast loading should be kept below 9 kilograms TNT equivalent (kg TNTe) per delay. Impacts on the Apache Leap SMA could also be limited by keeping the blast loading below 37 kg TNTe/delay.

Airblast impacts could be more notable near the vent raise and portal openings; analysis for these areas is shown in table 3.4.4-2. The vent raise location is approximately 1,600 feet and the portal opening is approximately 2,792 feet from the closest sensitive receptor (identified

Table 3.4.4-2. Calculated explosive loading at sensitive receptor samples based on airblast selected threshold

Source Location	Sensitive Receptor	Slant Distance (feet)	Allowable Explosive Load per Delay (kg TNTe)	Estimated Results	
				Airblast Level, dBL	PPV in/ sec.
Vent raise	BL_10	1,600	35	118	0.170
	Apache Leap SMA	5,981	380	114	0.157
Portal opening	BL_10	2,792	120	118	0.186

as BL_10). The vent raise location is also approximately 5,981 feet from the westerly side of the Apache Leap SMA boundary. Blasting loading should be kept below 35 kg TNTe at the vent raise and 120 kg TNTe at the portal opening.

The exact blasting plan for the tunnel would depend on conditions encountered during construction and has not yet been developed; explosive loads kept under these limits are not anticipated to result in adverse impacts from vibration.

Construction Phase – Non-Blasting Noise Impacts

Table 3.4.4-4, later in this section, shows noise level estimates from the construction of the operational facilities would range from 89 dBA at 50 feet to 63 dBA at 1,000 feet. Construction activities would occur for 10 hours during daytime weekday shifts. The most appropriate noise threshold for daytime activities is the Leq(h) of 66 dBA, based on ADOT residential criteria. Past 1,000 feet, noise levels do not exceed this threshold. The overall levels should be lower, because (as discussed in section 3.4.2) these estimates exclude attenuation factors and trend toward quieter construction equipment since the source data were developed. Beyond 1,000 feet, construction noise is not anticipated to result in adverse impacts.

Operations Phase – Non-Blasting Noise Impacts

Table 3.4.4-5, later in this section, shows that noise impacts in Leq(h) metric are not expected to occur based on the predicted minimum and average noise level ranges, whether looking at overall combined noise levels (project noise plus background noise), or the incremental noise increase over background levels.

If the maximum of each range is used, incremental increases are at or above the selected threshold of 15 dBA at following sensitive receptors:

- Residential receptors near U.S. 60 and Main Street.
- Recreational users within Apache Leap SMA.
- Recreational users of nearby section of the Arizona Trail.

Residential receptors near U.S. 60 and Main Street would also experience future levels (project noise plus background noise) above 55 dBA (Pinal County nighttime noise threshold limit), but below 66 dBA (ADOT's modified Noise Abatement Criteria "B" for residential uses). Because residential receptors near U.S. 60 and Main Street are within incorporated lands in the town of Superior, ADOT's modified Noise Abatement Criteria would be more applicable.

Table 3.4.4-6, later in this section, shows that predicted future noise levels in Ldn metric would comply with the selected threshold of 65 Ldn. Nearby sections of the Arizona Trail would experience increases in noise above the incremental threshold of 15 dBA, but only under maximum conditions. The maximum condition assumes all equipment operating simultaneously during the quietest period; this would be an infrequent and unlikely occurrence. Figures 3.4.4-2 and 3.4.4-3 show the predicted noise contours propagation over the surrounding area of the mine site associated with the Alternatives 2 and 3.

Table 3.4.4-3. Predicted non-blasting vibration impacts during operations, Alternatives 2 and 3

Feet from Source	Calculated Non-Blasting Vibration Levels	
	PPV in/sec.	VdB
25	0.0890	87
50	0.0315	78
75	0.0171	73
100	0.0111	69
125	0.0080	66
150	0.0061	64
175	0.0048	62
200	0.0039	60
225	0.0033	58
250	0.0028	57
275	0.0024	56
300	0.0021	55

Shaded cells indicate an exceedance of selected threshold of 0.04 PPV in/sec (80 VdB).

OPERATIONS PHASE – NON-BLASTING VIBRATION IMPACTS

Table 3.4.4-3 shows that ground-borne vibration PPV in/sec. are not expected to exceed the selected threshold of 0.04 PPV in/sec. (80 VdB) at 50 feet or more from the source. The calculated vibration levels in 25-foot increments from the source show 0.0315 PPV in/sec. (78 VdB) at 50 feet, which is less than the selected threshold.

Beyond 50 feet, vibration during operations is not anticipated to result in adverse impacts.

3.4.4.4 Alternative 4 – Silver King

Alternative 4 would have identical impacts on Alternatives 2 and 3 for construction blasting noise, construction blasting vibration, construction non-blasting noise, and operations non-blasting vibration. Only operational noise impacts would differ and are described here.

Similar to Alternatives 2 and 3, table 3.4.4-7 shows that noise impacts in Leq(h) metric are not expected to occur based on the predicted minimum and average noise level (whether looking at overall combined noise levels [project noise plus background noise], or the incremental noise increase over background levels). If the maximum of each range is used, incremental increases are at or above the selected threshold of 15 dBA at the following receptors:

- Residential receptors near U.S. 60 and Main Street.
- Recreational users within Apache Leap SMA.

The maximum condition assumes all equipment operating simultaneously during the quietest period; this would be an infrequent and unlikely occurrence.

Residential receptors near U.S. 60 and Main Street would also experience future levels above 55 dBA, but below 66 dBA, based on maximum values. Table 3.4.4-8 shows that predicted future noise levels in Ldn metric would comply with all the selected thresholds. Figure 3.4.4-4 shows the predicted noise contours for Alternative 4.

Table 3.4.4-4. Estimated noise levels from construction activities

Sound Source	Quantity			Utilization Factor		dBA Leq(h)*			
	West Plant Site	East Plant Site	Filter Plant and Loadout Facility	%	50	100	250	500	1,000
Dozer	6	5	1	40	81	75	67	61	55
Grader	3	3	1	40	81	75	67	61	55
Compactor	2	2	1	20	73	67	59	53	47
Scraper	3	3	1	40	81	75	67	61	55
Water truck	2	1	1	40	80	74	66	60	54
Fuel/lube truck	1	1	1	40	80	74	66	60	54
Excavator	2	2	1	40	81	75	67	61	55
Loader	1	1	0	40	86	70	62	56	50
Haul truck	1	1	0	40	80	74	66	60	54
Pickup truck	3	3	0	40	51	45	37	31	25
Combined Noise Levels					89	83	75	69	63

Source: Tetra Tech (2018)

Note: Shaded cells indicate an exceedance of selected threshold of 66 dBA

* Calculations assume only one sound source is in operation

Table 3.4.4-5. Predicted noise impacts during operations, Alternatives 2 and 3, Leq(h) metric

Project Site	Sensitive Receptors	Future Levels, dBA						
		Project Predicted Levels	Project plus Background Levels			Increase Over Background Levels		
			Min	Avg	Max	Min	Avg	Max
West Plant Site	Noise Measurement Location*	47	47	49	50	3	5	14
	Residences in Superior	47	47	49	50	3	5	14
	Residences U.S. 60 and Main Street†	53	53	55	57	3	4	15
East Plant Site	Noise Measurement Location*	61	61	61	61	11	12	16
	Oak Flat Campground‡	43	43	49	51	1	1	12
	Apache Leap SMA‡	46	46	50	51	1	2	15
Near West tailings storage facility	Noise Measurement Location*	43	43	45	46	3	4	11
	Hewitt Station	44	44	46	47	4	5	12
	Residences in Queen Valley‡	<10	26	40	43	<1	<1	<1
	Boyce Thompson Arboretum	24	33	41	43	<1	<1	1
	Arizona Trail (northwest of Superior)‡	51	51	51	52	9	11	26
Filter plant and loadout facility/ MARRCO corridor	Noise Measurement Location*	47	47	48	49	4	6	20
	Westernstar Road	<10	27	42	45	<1	<1	<1
	Lind Road	32	33	43	45	<1	<1	6
	Felix Road	26	30	42	45	<1	<1	3
	Attaway Road	13	27	42	45	<1	<1	<1

Note: Shaded cells indicate an exceedance at a sensitive receptor of selected threshold of 55 dBA for project plus background levels, and 15 dBA for increase over background levels.

Min = Minimum, Avg = Average, Max = Maximum

* Prediction location is not a sensitive receptor and included for comparison to the existing measured noise levels (see table 3.4.3-1).

† Lower and upper levels are based on the expected sound levels due to the vicinity of the highway (see table 3.4.3-1).

‡ The expected lower level was applied to be conservative (see table 3.4.3-1).

Table 3.4.4-6. Predicted noise impacts during operations, Alternatives 2 and 3, Ldn metric

Project Site	Sensitive Receptors	Future Levels, dBA						
		Project Predicted Levels	Project plus Background Levels			Increase Over Background Levels		
			Min	Avg	Max	Min	Avg	Max
West Plant Site	Noise Measurement Location*	54	54	56	57	4	5	11
	Residences in Superior	54	54	56	57	4	5	11
	Residences U.S. 60 and Main Street†	59	59	60	60	6	7	11
East Plant Site	Noise Measurement Location*	67	67	67	67	13	16	26
	Oak Flat Campground‡	50	51	54	55	1	2	10
	Apache Leap SMA‡	52	55	56	56	2	2	4
Near West tailings storage facility	Noise Measurement Location*	48	49	50	50	4	5	9
	Hewitt Station	50	50	51	51	5	6	10
	Residences in Queen Valley‡	<10	36	44	46	<1	<1	<1
	Boyce Thompson Arboretum	31	41	45	46	<1	<1	1
	Arizona Trail (northwest of Superior)‡	58	58	58	58	12	15	25
Filter plant and loadout facility/ MARRCO corridor	Noise Measurement Location*	53	53	54	54	6	8	15
	Westernstar Road	<10	38	46	48	<1	<1	<1
	Lind Road	30	39	46	48	<1	<1	1
	Felix Road	24	38	46	48	<1	<1	<1
	Attaway Road	11	38	46	48	<1	<1	<1

Note: Shaded cells indicate an exceedance at a sensitive receptor of selected threshold of 65 dBA for project plus background levels, and 15 dBA for increase over background levels.

Min = Minimum, Avg = Average, Max = Maximum

* Prediction location is not a sensitive receptor and included for comparison to the existing measured noise levels (see table 3.4.3-1).

† Lower and upper levels are based on the expected sound levels due to the vicinity of the highway (see table 3.4.3-1).

‡ The expected lower level was applied to be conservative (see table 3.4.3-1).

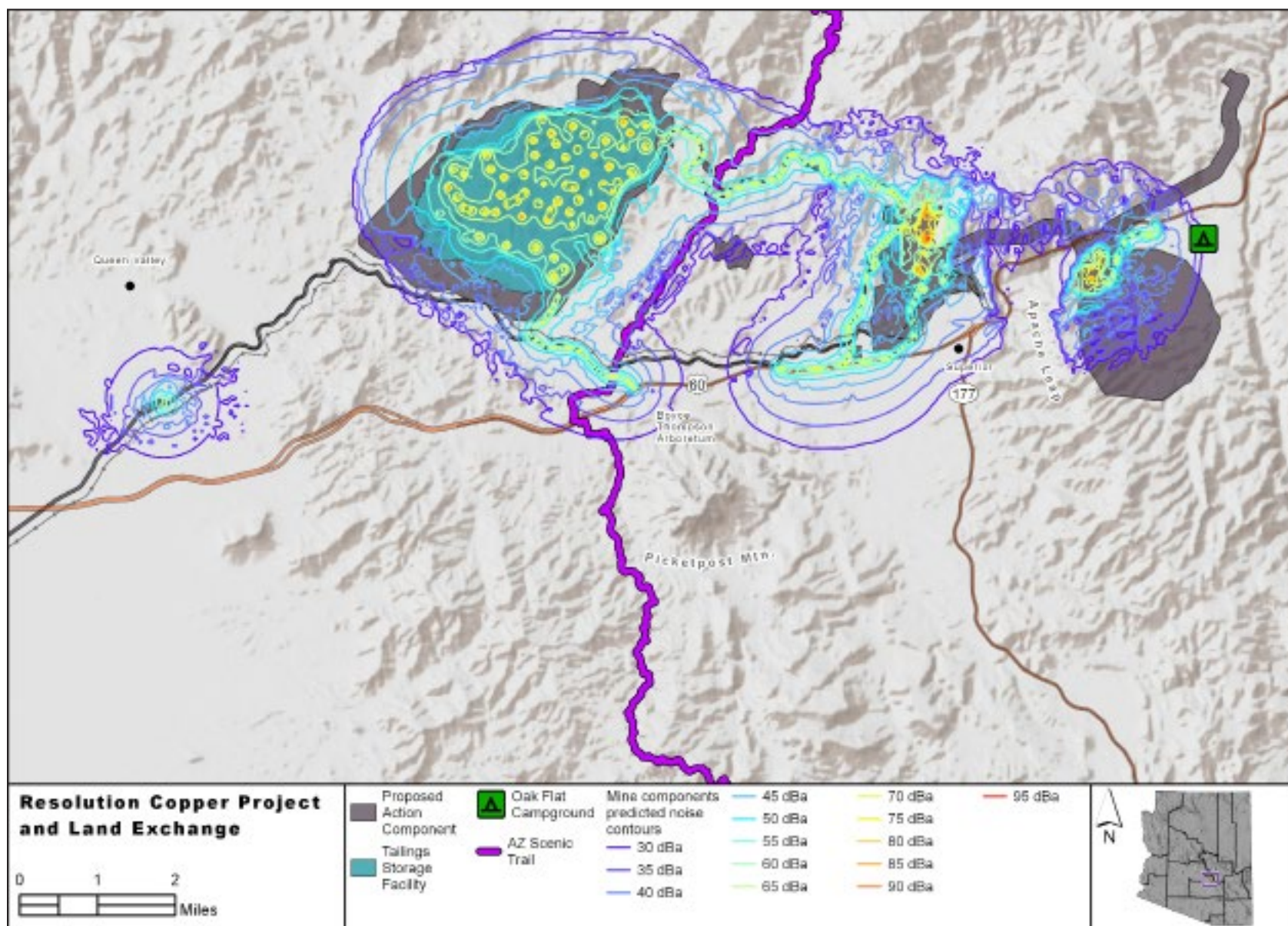


Figure 3.4.4-2. Predicted noise contours associated with Alternatives 2 and 3 (1 of 2)

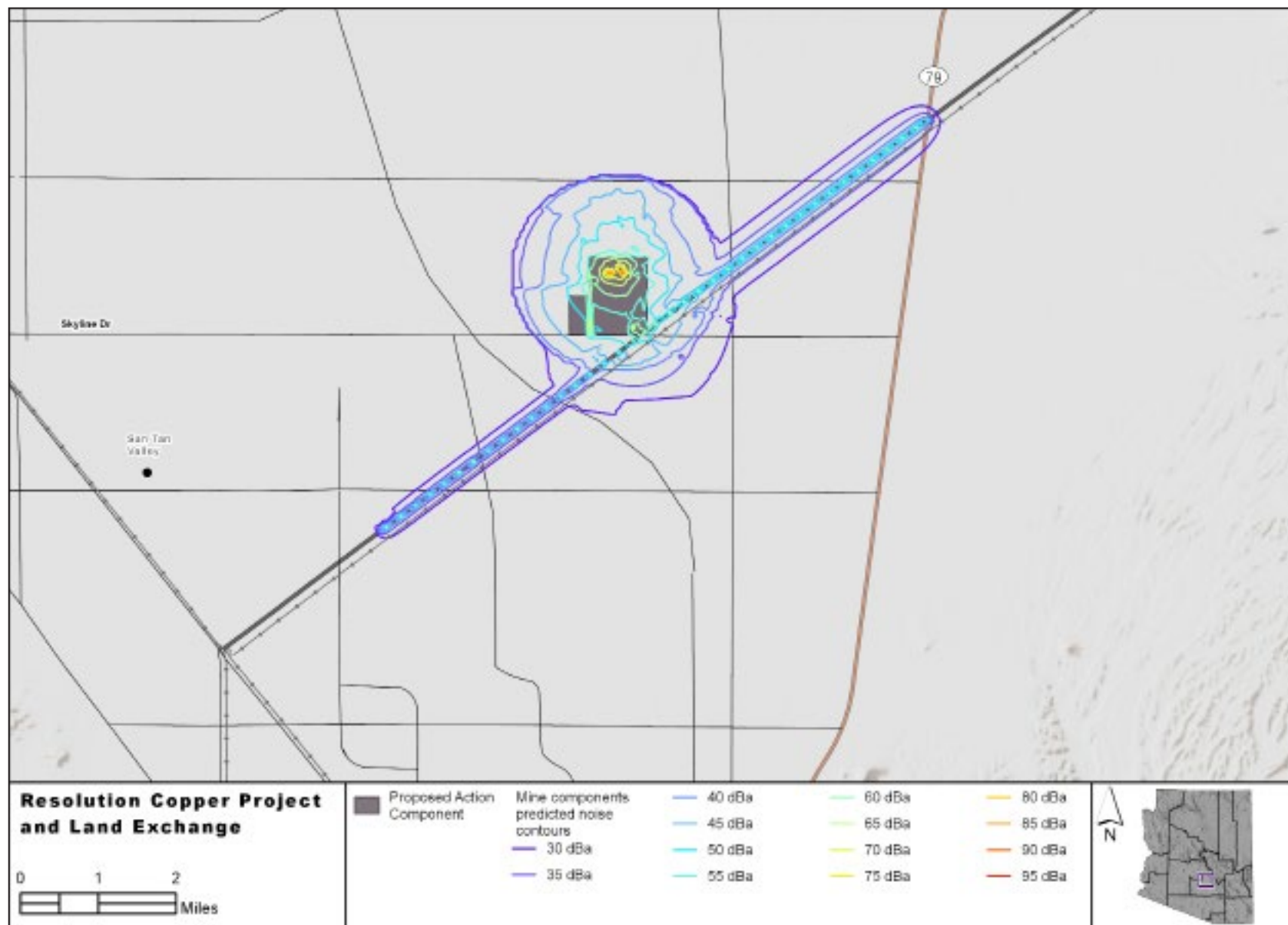


Figure 3.4.4-3. Predicted noise contours associated with Alternatives 2 and 3 (2 of 2)

Table 3.4.4-7. Predicted noise impacts during operations, Alternative 4, Leq(h) metric

Project Site	Sensitive Receptors	Future Levels, dBA						
		Project Predicted Levels	Project plus Background Levels			Increase Over Background Levels		
			Min	Avg	Max	Min	Avg	Max
West Plant Site	Noise Measurement Location*	47	47	49	50	3	5	14
	Residences in Superior	47	47	49	50	3	5	14
	Residences U.S. 60 and Main Street†	53	53	55	57	3	4	15
East Plant Site	Noise Measurement Location*	61	61	61	61	11	12	16
	Oak Flat Campground	43	43	49	51	1	1	12
	Apache Leap SMA	46	46	50	51	1	2	15
Filter Plant and Loadout Facility/ MARRCO corridor	Noise Measurement Location*	20	28	42	45	<1	<1	1
	Westernstar Road	<10	27	42	45	<1	<1	<1
	Lind Road	32	33	43	45	<1	<1	6
	Felix Road	26	30	42	45	<1	<1	3
	Attaway Road	21	28	42	45	<1	<1	1
Silver King tailings storage facility	Noise Measurement Location*	52	52	52	52	11	14	25
	Arizona Trail (northwest of Superior)	43	43	44	45	4	6	16

Notes: Shaded cells indicate an exceedance at a sensitive receptor of selected threshold of 55 dBA for project plus background levels, and 15 dBA for increase over background levels.

Min = Minimum, Avg = Average, Max = Maximum

* Prediction location is not a sensitive receptor and is included for comparison with the existing measured noise levels (see table 3.4.3-1).

† Lower and upper levels are based on the expected sound levels due to the vicinity of the highway (see table 3.4.3-1).

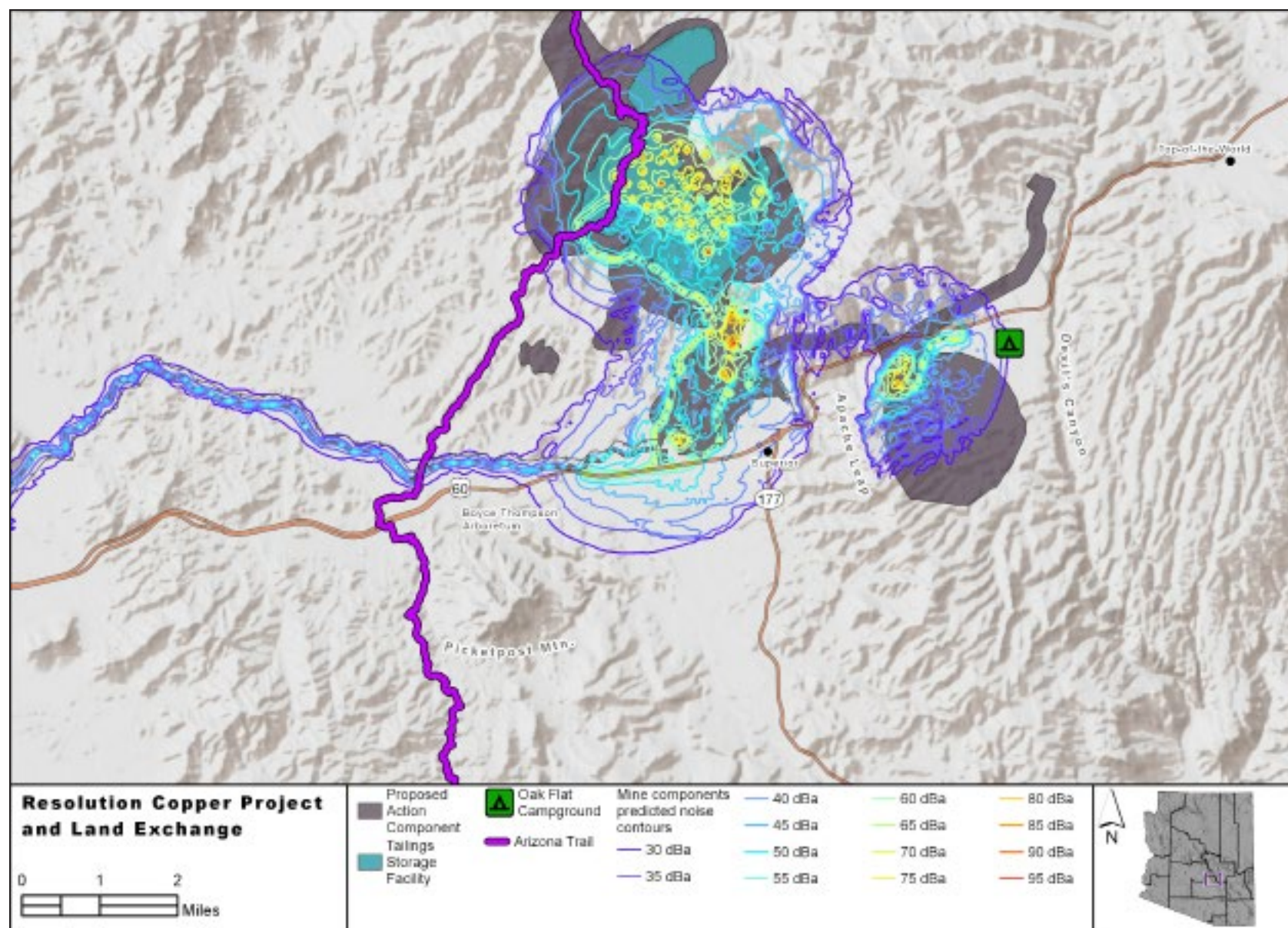


Figure 3.4.4-4. Predicted noise contours associated with operations, Alternative 4

3.4.4.5 Alternative 5 – Peg Leg

Alternative 5 would have identical impacts on Alternatives 2 and 3 for: construction blasting noise, construction blasting vibration, construction non-blasting noise, and operations non-blasting vibration. Only operational noise impacts would differ and are described here.

Similar to Alternatives 2 and 3, table 3.4.4-9 shows that noise impacts in Leq(h) metric are not expected to occur based on the predicted minimum and average noise level (whether looking at overall combined noise levels [project noise plus background noise], or the incremental noise increase over background levels). If the maximum of each range is used, incremental increases are at or above the selected threshold of 15 dBA at the following receptors:

- Residential receptors near U.S. 60 and Main Street.
- Recreational users within Apache Leap SMA.

The maximum condition assumes all equipment operating simultaneously during the quietest period; this would be an infrequent and unlikely occurrence.

Residential receptors near U.S. 60 and Main Street would also experience future levels above 55 dBA, but below 66 dBA, based on maximum values. Table 3.4.4-10 shows that predicted future noise levels in Ldn metric would comply with all the selected thresholds. Figure 3.4.4-5 shows the predicted noise contours for Alternative 5.

3.4.4.6 Alternative 6 – Skunk Camp

Alternative 6 would have identical impacts on Alternatives 2 and 3 for construction blasting noise, construction blasting vibration, construction non-blasting noise, and operations non-blasting vibration. Only operational noise impacts would differ and are described here.

Table 3.4.4-11 shows that noise impacts in Leq(h) metric are not expected to occur based on the predicted minimum and average noise level, except along Dripping Springs Road. There, the expected sound

levels exceed the Leq(h) selected threshold of 55 dBA but are below the selected threshold of 66 dBA. If the maximum of each range is used, incremental increases are at or above the selected threshold of 15 dBA at the following receptors:

- Residential receptors near U.S. 60 and Main Street.
- Recreational users within Apache Leap SMA.
- Residential/recreational users along Dripping Springs Road.

The maximum condition assumes all equipment operating simultaneously during the quietest period; this would be an infrequent and unlikely occurrence.

Residential receptors near U.S. 60 and Main Street would also experience future levels above 55 dBA, but below 66 dBA, based on maximum values. For the Ldn metric, noise levels along Dripping Springs Road are also above the selected threshold of 65 dBA, as shown in table 3.4.4-12. Figure 3.4.4-6 shows the predicted noise contours for Alternative 6.

3.4.4.7 Cumulative Effects

The Tonto National Forest has identified the following list of reasonably foreseeable future actions as likely to occur in conjunction with development of the Resolution Copper Mine. The projects described here are expected, or have potential, to contribute to incremental changes in the existing noise and vibration conditions near the Resolution Copper Mine. As noted in section 3.1, past and present actions are assessed as part of the affected environment; this section analyzes the effects of any RFFAs, to be considered cumulatively along with the affected environment and Resolution Copper Project effects.

- *Pinto Valley Mine Expansion.* The Pinto Valley Mine is an existing open-pit copper and molybdenum mine located approximately 8 miles west of Miami, Arizona, in Gila County. Pinto Valley Mining Corporation is proposing to expand mining

Table 3.4.4-8. Predicted noise impacts during operations, Alternative 4, Ldn metric

Project Site	Sensitive Receptors	Future Levels, dBA						
		Project Predicted Levels	Project plus Background Levels			Increase Over Background Levels		
			Min	Avg	Max	Min	Avg	Max
West Plant Site	Noise Measurement Location*	54	54	56	57	4	5	11
	Residences in Superior	54	54	56	57	4	5	11
	Residences U.S. 60 and Main Street†	59	59	60	60	6	7	11
East Plant Site	Noise Measurement Location*	67	67	67	67	13	16	26
	Oak Flat Campground	50	51	54	55	1	2	10
	Apache Leap SMA	52	55	56	56	2	2	4
Filter plant and loadout facility/ MARRCO corridor	Noise Measurement Location*	18	38	46	48	<1	<1	<1
	Westernstar Road	<10	38	46	48	<1	<1	<1
	Lind Road	30	39	46	48	<1	<1	1
	Felix Road	24	38	46	48	<1	<1	<1
	Attaway Road	19	38	46	48	<1	<1	<1
Silver King tailings storage facility	Noise Measurement Location*	57	57	57	57	11	14	22
	Arizona Trail (northwest of Superior)	49	49	50	51	5	6	14

Notes: Shaded cells indicate an exceedance at a sensitive receptor of selected threshold of 65 dBA for project plus background levels, and 15 dBA for increase over background levels.

Min = Minimum, Avg = Average, Max = Maximum

* Prediction location is not a sensitive receptor and is included for comparison with the existing measured noise levels (see table 3.4.3-1).

† Lower and upper levels are based on the expected sound levels due to the vicinity of the highway (see table 3.4.3-1).

Table 3.4.4-9. Predicted noise impacts during operations, Alternative 5, Leq(h) metric

Project Site	Sensitive Receptors	Future Levels, dBA						
		Project Predicted Levels	Project plus Background Levels			Increase Over Background Levels		
			Min	Avg	Max	Min	Avg	Max
West Plant Site	Noise Measurement Location*	47	47	49	50	3	5	14
	Residences in Superior	47	47	49	50	3	5	14
	Residences U.S. 60 and Main Street†	53	53	55	57	3	4	15
East Plant Site	Noise Measurement Location*	61	61	61	61	11	12	16
	Oak Flat Campground‡	43	43	49	51	1	1	12
	Apache Leap SMA‡	46	46	50	51	1	2	15
Filter plant and loadout facility/ MARRCO corridor	Noise Measurement Location*	47	47	48	49	4	6	20
	Westernstar Road	<10	27	42	45	<1	<1	<1
	Lind Road	32	33	43	45	<1	<1	6
	Felix Road	26	30	42	45	<1	<1	3
	Attaway Road	13	27	42	45	<1	<1	<1
Peg Leg tailings storage facility	Noise Measurement Location*	56	56	57	57	6	9	30
	Arizona Trail (near Zellweger Wash)	34	35	48	51	<1	<1	9

Notes: Shaded cells indicate an exceedance at a sensitive receptor of selected threshold of 55 dBA for project plus background levels, and 15 dBA for increase over background levels.

Min = Minimum, Avg = Average, Max = Maximum

* Prediction location is not a sensitive receptor and is included for comparison with the existing measured noise levels (see table 3.4.3-1).

† Lower and upper levels are based on the expected sound levels due to the vicinity of the highway (see table 3.4.3-1).

‡ The expected lower level was applied to be conservative (see table 3.4.3-1).

Table 3.4.4-10. Predicted noise impacts during operations, Alternative 5, Ldn metric

Project Site	Sensitive Receptors	Future Levels, dBA						
		Project Predicted Levels	Project plus Background Levels			Increase Over Background Levels		
			Min	Avg	Max	Min	Avg	Max
West Plant Site	Noise Measurement Location*	54	54	56	57	4	5	11
	Residences in Superior	54	54	56	57	4	5	11
	Residences U.S. 60 and Main Street†	59	59	60	60	6	7	11
East Plant Site	Noise Measurement Location*	67	67	67	67	13	16	26
	Oak Flat Campground‡	50	51	54	55	1	2	10
	Apache Leap SMA‡	52	55	56	56	2	2	4
Filter plant and loadout facility/ MARRCO corridor	Noise Measurement Location*	53	53	54	54	6	8	15
	Westernstar Road	<10	38	46	48	<1	<1	<1
	Lind Road	30	39	46	48	<1	<1	1
	Felix Road	24	38	46	48	<1	<1	<1
	Attaway Road	11	38	46	48	<1	<1	<1
Peg Leg tailings storage facility	Noise Measurement Location*	62	62	62	62	10	13	28
	Arizona Trail (near Zellweger Wash)	40	41	50	52	<1	1	7

Notes: Shaded cells indicate an exceedance at a sensitive receptor of selected threshold of 65 dBA for project plus background levels, and 15 dBA for increase over background levels.

Min = Minimum, Avg = Average, Max = Maximum

* Prediction location is not a sensitive receptor and is included for comparison with the existing measured noise levels (see table 3.4.3-1).

† Lower and upper levels are based on the expected sound levels due to the vicinity of the highway (see table 3.4.3-1).

‡ The expected lower level was applied to be conservative (see table 3.4.3-1).

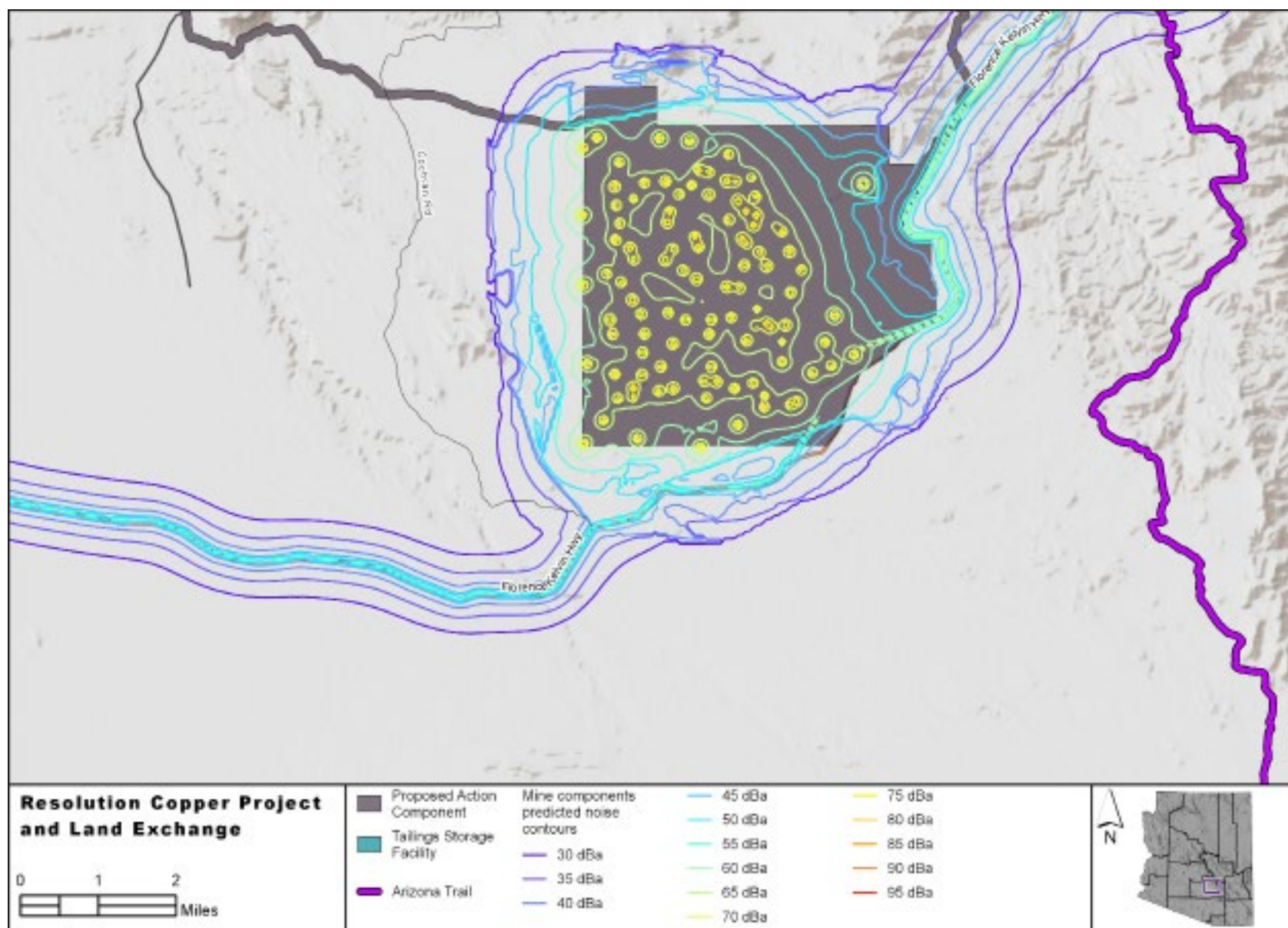


Figure 3.4.4-5. Predicted noise contours associated with operations, Alternative 5

Table 3.4.4-11. Predicted noise impacts during operations, Alternative 6, Leq(h) metric

Project Site	Sensitive Receptors	Future Levels, dBA						
		Project Predicted Levels	Project plus Background Levels			Increase Over Background Levels		
			Min	Avg	Max	Min	Avg	Max
West Plant Site	Noise Measurement Location*	47	47	49	50	3	5	14
	Residences in Superior	47	47	49	50	3	5	14
	Residences U.S. 60 and Main Street†	53	53	55	57	3	4	15
East Plant Site	Noise Measurement Location*	61	61	61	61	11	12	16
	Oak Flat Campground‡	43	43	49	51	1	1	12
	Apache Leap SMA§	46	46	50	51	1	2	15
Filter Plant and Loadout Facility/ MARRCO corridor	Noise Measurement Location*	47	47	48	49	4	6	20
	Westernstar Road	<10	27	42	45	<1	<1	<1
	Lind Road	32	33	43	45	<1	<1	6
	Felix Road	26	30	42	45	<1	<1	3
	Attaway Road	13	27	42	45	<1	<1	<1
Skunk Camp tailings storage facility	Arizona Trail (near Kelvin)§	<10	26	48	51	<1	<1	<1
	Dripping Springs Road	60	60	60	60	10	12	34

Notes: Shaded cells indicate an exceedance at a sensitive receptor of selected threshold of 55 dBA for project plus background levels, and 15 dBA for increase over background levels.

Min = Minimum, Avg = Average, Max = Maximum

* Prediction location is not a sensitive receptor and is included for comparison with the existing measured noise levels (see table 3.4.3-1).

† Lower and upper levels are based on the expected sound levels due to the vicinity of the highway (see table 3.4.3-1).

‡ The expected lower level was applied to be conservative (see table 3.4.3-1).

§ The lower and upper levels are based on the Peg Leg noise measurement location (see table 3.4.3-1).

Table 3.4.4-12. Predicted noise impacts during operations, Alternative 6, Ldn metric

Project Site	Sensitive Receptors	Future Levels, dBA						
		Project Predicted Levels	Project plus Background Levels			Increase Over Background Levels		
			Min	Avg	Max	Min	Avg	Max
West Plant Site	Noise Measurement Location*	54	54	56	57	4	5	11
	Residences in Superior	54	54	56	57	4	5	11
	Residences U.S. 60 and Main Street†	59	59	60	60	6	7	11
East Plant Site	Noise Measurement Location*	67	67	67	67	13	16	26
	Oak Flat Campground‡	50	51	54	55	1	2	10
	Apache Leap SMA‡	52	55	56	56	2	2	4
Filter Plant and Loadout Facility/ MARRCO corridor	Noise Measurement Location*	53	53	54	54	6	8	15
	Westernstar Road	<10	38	46	48	<1	<1	<1
	Lind Road	30	39	46	48	<1	<1	1
	Felix Road	24	38	46	48	<1	<1	<1
	Attaway Road	11	38	46	48	<1	<1	<1
Skunk Camp tailings storage facility	Arizona Trail (near Kelvin)§	<10	34	49	52	<1	<1	<1
	Dripping Springs Road	67	67	67	67	15	18	33

Notes: Shaded cells indicate an exceedance at a sensitive receptor of selected threshold of 65 dBA for project plus background levels, and 15 dBA for increase over background levels.

Min = Minimum, Avg = Average, Max = Maximum

* Prediction location is not a sensitive receptor and is included for comparison with the existing measured noise levels (see table 3.4.3-1).

† Lower and upper levels are based on the expected sound levels due to the vicinity of the highway (see table 3.4.3-1).

‡ The expected lower level was applied to be conservative (see table 3.4.3-1).

§ The lower and upper levels are based on the Peg Leg noise measurement location (see table 3.4.3-1).

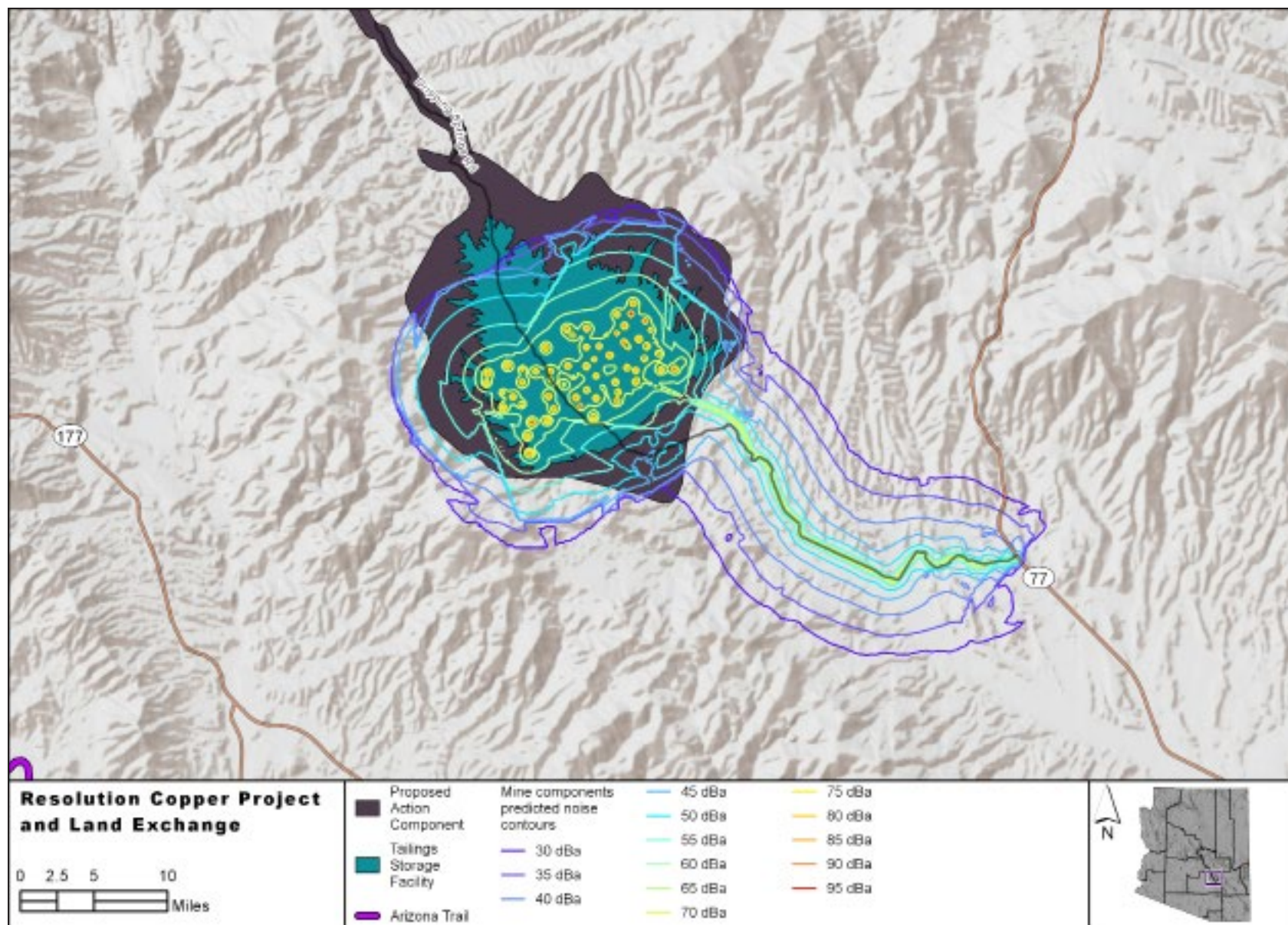


Figure 3.4.4-6. Predicted noise contours associated with operations, Alternative 6

activities onto the Tonto National Forest and extend the life of the mine to 2039. EIS impact analysis is pending; however, continued mine operations associated with the expansion over the next 20 years would contribute to equivalent or possibly increased noise and vibration levels perceptible to nearby residences and/or recreational users of adjacent lands. Because the effects of noise and vibration at the mine property would be relatively limited geographically and quickly attenuate with distance, analysis of those effects as a cumulative effect is not considered necessary. However, noise and vibrations from increased haul truck traffic could contribute to cumulative effects for residences and along major roadways.

- *Silver Bar Mining Regional Landfill and Cottonwood Canyon Road.* AK Mineral Mountain, LLC, NL Mineral Mountain, LLC, POG Mineral Mountain, LLC, SMT Mineral Mountain, LLC, and Welch Mineral Mountain, LLC are proposing to build a municipal solid waste landfill on private property surrounded by BLM land (Middle Gila Canyons area). Site access would require crossing BLM land. The owners/developers and Pinal County have applied for a BLM right-of-way grant and Temporary Use Permit for two temporary construction sites to obtain legal access to the private property and authorization of the needed roadway improvements. The proposed action includes improving a portion of the existing Cottonwood Canyon Road and a portion of the existing Sandman Road in order to accommodate two-way heavy truck traffic to and from the proposed landfill. Traffic generated by the planned landfill would significantly increase the overall annual daily traffic on Cottonwood Canyon Road. Average annual daily traffic would increase by approximately 367 percent (303 percent during winter months and 549 percent in summer). Traffic generated by the landfill would primarily consist of tractor/trailer vehicles with a gross weight of over 80,000 pounds. Mineral Mountain Road and Price Road are likely to be impacted by displaced traffic due to temporary closures and disruption of access on Cottonwood Canyon Road. Noise impacts would be expected

to increase notably on local roads due to increased traffic, with minor impacts from vibration.

- *Ray Land Exchange and Proposed Plan Amendment.* ASARCO is also seeking to complete a land exchange with the BLM by which the mining company would gain title to approximately 10,976 acres of public lands and federally owned mineral estate located near ASARCO's Ray Mine in exchange for transferring to the BLM approximately 7,304 acres of private lands, primarily in northwestern Arizona. It is known that at some point ASARCO wishes to develop a copper mining operation in the "Copper Butte" area west of the Ray Mine. Under the proposed action, noise and vibration impacts on the selected lands would be expected to increase with the development of new mining activity. No specific noise or vibration impacts are anticipated in association with the offered lands, as they would have come under the administration of the BLM, and thus be subject to respective resource management plan strategies.
- *ADOT Vegetation Treatment.* ADOT plans to conduct annual treatments using EPA-approved herbicides to contain, control, or eradicate noxious, invasive, and native plant species that pose safety hazards or threaten native plant communities on road easements and NFS lands up to 200 feet beyond road easement on the Tonto National Forest. It can be reasonably assumed that ADOT would continue to conduct vegetation treatments along U.S. 60 on the Tonto National Forest during the expected life of the Resolution Copper Mine (50–55 years) for safety reasons. The vegetation treatment may result in short-term noise impacts along roadways but generally would be minimal and not cumulative with Resolution Copper Project impacts.

Other unplanned large-scale mine developments in the area are likely to occur during the foreseeable life of the Resolution Copper Mine (50–55 years). Large-scale mining would affect the ambient noise and vibration conditions perceived by sensitive receptors during both the short-term exploration phases and the longer term operational phases. The Tonto National Forest's Travel Management Plan would alter localized traffic

noise slightly, as the plan would include rerouting various NFS roads, which could contribute to cumulative noise impacts. Additionally, construction of other planned and unplanned projects such as pipelines and/or transmission lines could also contribute to noise and vibration, but impacts would be short term and occur only during construction or maintenance.

3.4.4.8 Mitigation Effectiveness

The Forest Service is in the process of developing a robust mitigation plan to avoid, minimize, rectify, reduce, or compensate for resource impacts that have been identified during the process of preparing this EIS. Appendix J contains descriptions of mitigation concepts being considered and known to be effective, as of publication of the DEIS. Appendix J also contains descriptions of monitoring that would be needed to identify potential impacts and mitigation effectiveness. As noted in chapter 2 (section 2.3), the full suite of mitigation would be contained in the FEIS, required by the ROD, and ultimately included in the final GPO approved by the Forest Service. Public comment on the EIS, and in particular appendix J, will inform the final suite of mitigations.

This section contains an assessment of the effectiveness of design features from the GPO and mitigation and monitoring measures found in appendix J that are applicable to noise and vibration.

Mitigation Measures Applicable to Noise and Vibration

Alternate road access to Skunk Camp tailings storage facility (RC-218): Resolution Copper proposes to construct an alternate access route to the Skunk Camp tailings storage facility to reduce noise at residences along Dripping Springs Road. This action seeks to mitigate impacts related to noise, dust, and traffic and is relevant only to Alternative 6. If implemented, the measure would be required by the Forest Service in the final ROD and final mining plan of operations. Several possible routes are considered. A southern route would bypass residences along Dripping Springs Road. This could be used for the life of operations

but may be most beneficial during the initial construction period of the embankment. A northern route would provide access from SR 77 to the northern portion of the tailings storage facility area and completely bypass Dripping Springs Road.

Mitigation Effectiveness and Impacts

Of all expected operational noise impacts, the most substantial impact identified in the analysis was on residences or recreational users along Dripping Springs Road; these impacts would be caused by mine traffic. Rerouting of traffic off this road would be effective at eliminating this noise impact. The construction of the southern alternate access route would potentially require 364 acres of additional ground disturbance based on 1,000 feet of right-of-way for construction and would be 3.1 miles long. The construction of the northern alternate access route would potentially require 1,391 acres of additional ground disturbance based on 1,000 feet of right-of-way for construction and would be 11.9 miles long.

Unavoidable Adverse Impacts

No impacts above selected thresholds were identified from construction blasting noise and vibration (provided explosive loading is appropriately limited), from construction non-blasting noise (beyond 1,000 feet from active equipment), or from operational vibrations (beyond 50 feet from active equipment).

For operational noise, with the exception of Dripping Springs Road, the only impacts identified above selected thresholds were associated with the maximum range of impacts, which is an infrequent and unlikely scenario that suggests that all equipment is running simultaneously and during the quietest period (i.e., lowest background levels observed). Under most conditions, the analysis indicates that no impacts would be expected from project noise.

Application of the mitigation of rerouting traffic from Dripping Springs Road would eliminate those operational noise impacts as well.

After mitigation, no unavoidable adverse impacts are anticipated from noise or vibration.

3.4.4.9 Other Required Disclosures

Short-Term Uses and Long-Term Productivity

Noise and vibration levels did not rise beyond threshold of concern under most conditions, but the noise and vibration associated with the surrounding environment from mining and associated activities would be short term (during the estimated 51- to 56-year life of the mine, including construction, operations, and reclamation) and are expected to end with mine reclamation.

Irreversible and Irretrievable Commitment of Resources

Irretrievable commitment of resources would consist of mine-related noise during the construction, mining, closure, and reclamation phases of the mine. Because the mine-related noise would cease after closure of the mine, noise impacts would not be considered an irreversible commitment of resources.

Overview

Transportation of personnel, equipment, supplies, and materials related to development, operation, and closure/reclamation of the proposed Resolution Copper Mine would, under any alternative, substantially increase traffic in the greater Superior area. The anticipated increase in mine-related traffic on local roads and highways is likely to alter local and regional traffic patterns, levels of service, future transportation-related projects, and may adversely affect users of NFS roads through road closures and other changes to the existing system. Higher traffic volumes may also noticeably contribute to accelerated deterioration of local roadways, requiring higher levels of taxpayer-funded maintenance and more frequent repair of local roads and highways.

3.5 Transportation and Access

3.5.1 Introduction

The analysis presented in this section of the EIS examines the most likely effects on regional and local road transportation systems under each of the alternatives. This section summarizes the roads and intersections in the area, along with their background traffic levels and level of service, and assesses the impacts from mine traffic to traffic volume, level of service, and changes in transportation routes and public access.

Some aspects of the analysis are briefly summarized in this section. Additional details not included are in the project record (Newell 2018h).

3.5.2 Analysis Methodology, Assumptions, and Uncertain and Unknown Information

3.5.2.1 Analysis Area

The transportation and access analysis area for the proposed mine facilities and alternatives includes the roads adjacent to the proposed mine, roads that would provide regional access to the proposed mine and its facilities, roads within or cut off by the perimeter fence that would be inaccessible to the public from mine activities, the proposed primary access roads and utility maintenance roads, as well as numerous less-frequently used and/or recreational routes that may potentially be affected by a general increase in area traffic. This 82,188-acre analysis area is depicted in figure 3.5.2-1. The analysis area for transportation and access issues includes within

its boundaries approximately 141 miles of State highways, 418 miles of Pinal County–owned and local roads, and 533 miles of NFS roads.

Temporary haul and mine operations roads within the mine perimeter fence would not be part of the NFS transportation system. However, in order to capture all potential disturbance, we include any impacts that would result from the creation, use, and disposal of temporary or long-term mine haul and service roads in the total site disturbance acreage calculations in this section.

Figure 3.5.2-1 also depicts several key intersections that are used in the transportation analysis. The intersections where there would be increased traffic because of the mine are the critical locations that most affect the level of service (LOS), which is a qualitative measure of how road capacity is perceived by drivers. Traffic impact modeling focuses on these key intersections.

To support this modeling, existing peak-hour turning movement counts were collected at 16 intersections within the analysis area. Twenty-four-hour bidirectional traffic volume, speed, and classification counts were collected along 16 roadway segments within the analysis area. At ADOT's direction, Resolution Copper collected data during both the summer and winter seasons to provide a conservative estimate of average daily traffic and peak-hour turning movements.

Because we use projections of future growth in non-mine traffic, for traffic impacts we have to assume a specific year at which construction and operations would begin. Traffic projections assume a peak construction year of 2022, with operations beginning in 2027. To minimize the possibility

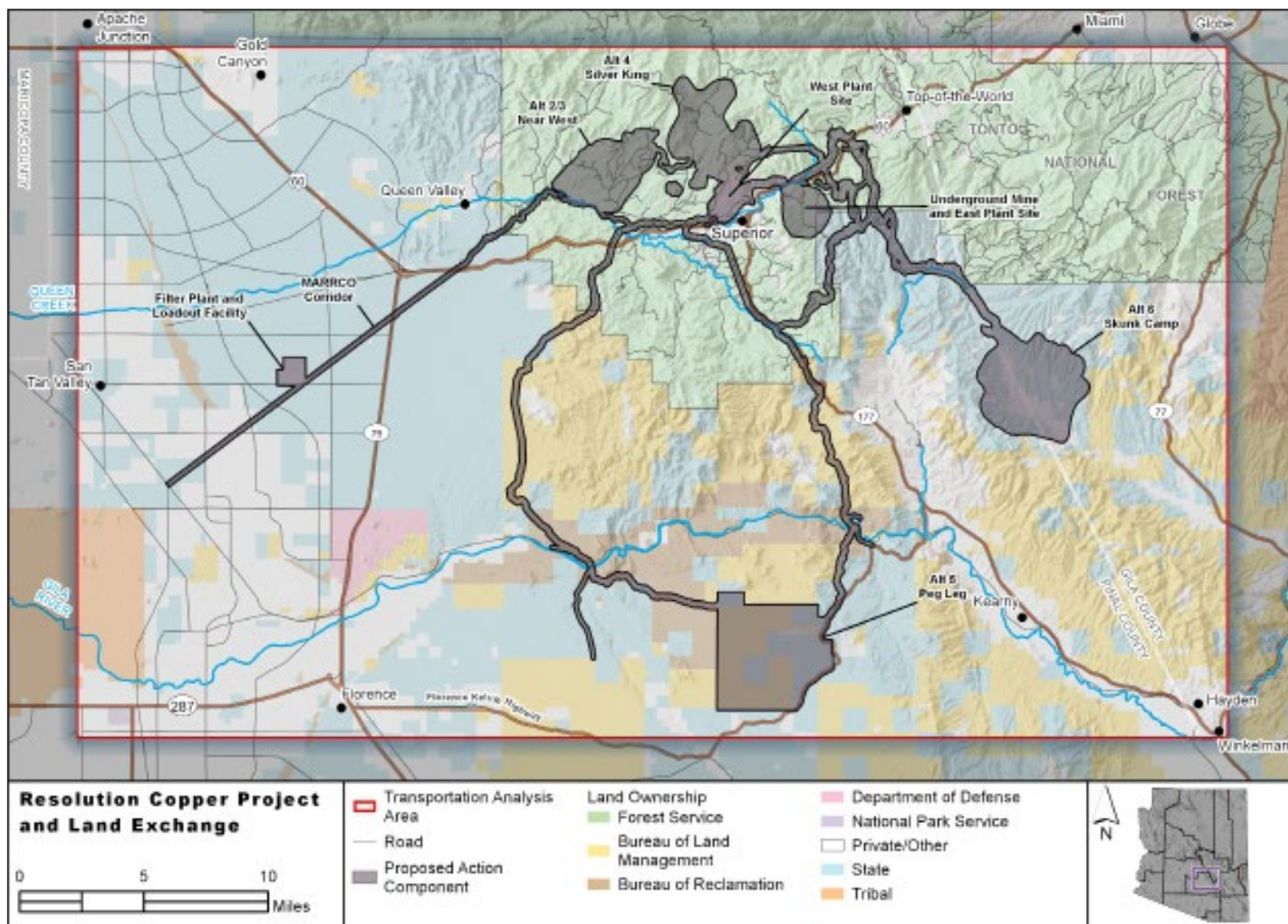


Figure 3.5.2-1. Transportation and access analysis area

of underrepresenting potential traffic and to ensure a conservative analysis of potential traffic impacts, we assumed that the highest number of applicable types of mine-related traffic would use the analyzed transportation network during the peak construction year. To this end, the analysis assumes that the peak construction year (2022) would include concurrent construction of the East Plant Site, the West Plant Site, the tailings storage facility, the filter plant, and the loadout facility. Traffic generated at the peak construction year represents the greatest increase in traffic over background conditions.

We assume regular operations would begin in 2027. Regular operations consist of a combination of employee trips and material supply deliveries for the East Plant Site, the West Plant Site, the tailings storage facility, the filter plant, and the loadout facility. The traffic employee and supply trips generate during normal operations is significantly less than during the peak year of construction.

We estimated the distribution for the project-generated trips based on the relative accessibility of cities and towns near the site. Based on an assumed location of material suppliers and the availability of employee housing, we expect that the trips generated for both the construction and the normal operation of the facility share a similar distribution. Of the trips we expect to be generated, 68 percent would originate from the Phoenix/Mesa metropolitan area via U.S. 60. Another 17 percent would originate from the San Tan Valley/Florence area via SR 79. Based on the data, we believe the trips from these areas would have destinations to either the filter plant and loadout facility or to the mining facilities at the East Plant Site, the West Plant Site, and the tailings storage facility. Trips from the west represent 85 percent of the total trips generated. The remaining 15 percent of generated trips are expected from the east. Of these trips, we expect 10 percent to originate along U.S. 60 toward Globe, and 5 percent from SR 177 south of Superior.

Much of the analysis contained in this section can be found in the traffic impact analysis reports (Southwest Traffic Engineering LLC 2016, 2017, 2018). Many details of NFS roads can be found in the travel management plan prepared by the Tonto National Forest (U.S. Forest Service 2016e).

3.5.3 Affected Environment

3.5.3.1 Relevant Laws, Regulations, Policies, and Plans

Primary Guidance Relevant to the Transportation and Access Analysis

- “Roadway Design Guidelines,” ADOT, May 2012
- “Traffic Guidelines and Processes,” ADOT, June 2015
- “Low Volume Roads Engineering Best Management Practices Field Guide,” Gordon Keller, PE, and James Sherar, PE, July 2003
- Forest Service Handbook 7709.56 (Road Preconstruction), July 2011
- Forest Service Handbook 7709.59 (Road System Operations), February 2009
- Forest Service Manual 7710 (Transportation Planning Handbook), May 1991
- “Guidelines for Geometric Design of Very Low-Volume Local Roads,” American Association of State Highway and Transportation Officials, 2001

Forest Service Guidance

FSH 7709.59, “Road System Operations and Maintenance” (U.S. Forest Service 2009), provides guidance for planning, traffic management, investment sharing (cost share), highway safety, traffic studies, road maintenance, and other NFS road operations and maintenance activities. Such road system operations and maintenance are part of the process of managing NFS roads and road uses to best meet land and resource management objectives.

Before any roads are added to or removed from the NFS road system, they must undergo travel analysis, as described in Forest Service Manual (FSM) 7703.26 (U.S. Forest Service 2010a), “Adding Roads to the Forest Transportation System.” Travel analysis considers the values affected by roads, including access to and use of, protection of, and administration of NFS lands; public health and safety; valid existing rights; and long-term road funding opportunities and obligations. Environmental analysis for roads includes effects on associated ecosystems; introduction of invasive species; effects on threatened and endangered species and areas with significant biodiversity, cultural resources, fish and wildlife habitat, water quality, and visual quality; effects on recreation opportunities; and effects on access to NFS lands. Travel analysis requirements are met for the NFS roads analyzed in this EIS. Roads on private land and roads under the jurisdiction of entities other than the Forest Service are not required to undergo travel analysis. Road width, surfacing, and grades for segments of the access roads that would be NFS roads must meet or exceed Forest Service standards or have appropriate professional engineering justification and Forest Service approval for deviations from Forest Service standards.

NFS lands within the analysis area are generally accessed by high-clearance vehicle roads, known as maintenance level 2 roads. Forest Service upkeep of maintenance level 2 roads typically occurs as needed, depending on funding, and usually in response to damage caused by use and/or erosion. Should the proponent desire or require maintenance to a higher standard to reliably and comfortably allow standard passenger car use, highway-legal truck use, or other specific vehicular use of an

NFS road, the proponent must be authorized in writing to perform such maintenance or provide funding to the Forest Service sufficient to allow the Forest Service to perform or contract for the performance of the needed maintenance.

State and Other Guidance

ADOT has exclusive jurisdiction over State highways, State routes, and State-owned airports, as well as jurisdiction over all State-owned transportation systems or modes. ADOT has the responsibility to contribute the most desirable design parameters consistent with safety, service, environment, and cost effectiveness and to apply these parameters with sound engineering judgment on routes under State jurisdiction. The “Roadway Design Guidelines” (Arizona Department of Transportation 2014), with revisions and amendments, and the “Guidelines for Highways on Bureau of Land Management and U.S. Forest Service Lands” (Wheat Scharf Associates and ADOT/FHWA/BLM/USFS Steering Committee 2008) guide the roadway designer in exercising sound engineering judgment in applying design parameters. The 2014 guidelines are complementary to the American Association of State Highway and Transportation Officials’ “A Policy on Geometric Design of Highways and Streets” (American Association of State Highway and Transportation Officials 2004) and the “Roadside Design Guide” (American Association of State Highway and Transportation Officials 2011) and are to be used in conjunction with these documents. The American Association of State Highway and Transportation Officials’ policies reflect general nationwide practices and are not necessarily applicable to the conditions in Arizona. Where the design values provided in the ADOT manual differ from those presented in the American Association of State Highway and Transportation Officials’ guidelines, the ADOT manual takes precedence. ADOT’s “Guidelines for Highways on Bureau of Land Management and U.S. Forest Service Lands” (Wheat Scharf Associates and ADOT/FHWA/BLM/USFS Steering Committee 2008) are applicable only to ADOT roads on BLM and NFS lands.

Access and Authorizations

The Tonto National Forest and BLM manage Federal lands that are open to access by the public, subject to appropriate management restrictions. The Tonto National Forest currently manages in accordance with the Tonto National Forest Land and Resource Management Plan (1985b), which is in the process of revision. The BLM manages lands in the analysis area under either the “Phoenix Resource Management Plan/Environmental Impact Statement, Record of Decision” (Bureau of Land Management 1989) or under the “Records of Decision, Final Safford District Resource Management Plan and Environmental Impact Statement” (Bureau of Land Management 1991, 1994b). Any roads, pipeline corridors, or power line corridors associated with the project placed on Federal lands must be approved by the appropriate agency, in conformance with management direction. Authorization could occur under several regulations, which will depend on the final decisions by the agency. Authorization of easements for the Tonto National Forest would occur either as part of approval of a mining plan of operations under mineral regulations (36 CFR 228 Subpart) or as a special use authorization under land use regulations (36 CFR 251). Similarly, BLM authorization of easements would occur either as part of approval of a mining plan of operations (43 CFR 3809) and/or as easements (43 CFR 2800).

Arizona State Trust lands are managed under the provisions of the Federal Enabling Act that provided for Arizona’s statehood in 1912. Approximately 9.2 million acres throughout the state are currently held in trust. Although this is at ASLD’s discretion, State Trust lands may be leased as a means of providing annual revenue for 14 officially recognized beneficiary agencies and entities (the largest recipient by far is Arizona K–12 education). Trust lands are less frequently for sale through a process of competitive bidding. For the purposes of this EIS, it is assumed that any State Trust lands underlying the two alternative tailings storage facility locations where State lands are present (Alternative 5 – Peg Leg or Alternative 6 – Skunk Camp) would be sold rather than leased, if that location were to be selected. That same assumption may be applied to the State Trust lands located within the predicted subsidence area at the East Plant Site.

3.5.3.2 Existing Conditions and Ongoing Trends

Highways and Roads Description

The following is a list of existing transportation systems within the analysis area. The systems described include State highways, county roads, and NFS roads. Figure 3.5.2-1 depicts the road facilities in relation to the analysis area.

STATE HIGHWAYS

- U.S. 60 is a four-lane divided highway that has an east-west alignment and a posted speed limit of either 45 miles per hour (mph), 50 mph, or 65 mph in the analysis area. The ADOT facility generally has no curb, gutter, or sidewalks provided in the area. U.S. 60 is considered a regional route linking Superior, Miami, and Globe to the Phoenix/Mesa metropolitan area. Between Silver King Mine Road (NFS Road 229) and SR 177, U.S. 60 includes a two-way left-turn lane.
- State Route 177 is an undivided two-lane roadway beginning at the intersection of U.S. 60/SR 177 and extending to the south toward the town of Kearny, Arizona. The roadway has no curb, gutter, or sidewalk facilities in the analysis area. The posted speed limit on SR 177 is 25 mph at the intersection of U.S. 60/SR 177 and increases to 55 mph as the road leaves the town of Superior.
- State Route 79 has a north-south alignment and is a two-lane, undivided roadway with 10-foot paved shoulders. The posted speed limit on SR 79 is 65 mph. SR 79 provides a route from U.S. 60 south to Florence, Arizona. There are no curb, gutter, or sidewalk facilities along SR 79 within the project boundary. Approximately 2 miles south of U.S. 60, SR 79 crosses the existing MARRCO corridor.
- State Route 77 has a north-south alignment and a posted speed of 50 mph. The facility has one travel lane in each direction.

The roadway has no curb, gutter, or sidewalk facilities in the analysis area.

COUNTY ROADS AND LOCAL ROADS

- Main Street in Superior is an undivided two-lane local roadway with an east-west alignment. Curb, sidewalks, and bike lanes are present along the north and south sides of the roadway. West of Lonetree Road, Main Street is posted 35 mph. East of Lonetree Road, Main Street is posted 25 mph.
- Lonetree Road is a two-lane graded dirt road, providing access to various mining operations north of Main Street. There is no posted speed limit, curb, gutter, or sidewalks along Lonetree Road.
- Magma Avenue is a two-lane paved local roadway along a north-south alignment located in Superior. The roadway provides curb, gutter, sidewalks, and on-street parking along the eastern and western sides of the roadway. The posted speed limit on Magma Avenue is 25 mph.
- Skyline Drive is a two-lane roadway with no curb, gutter, or sidewalk facilities. The speed limit on Skyline Drive is 50 mph west of Quail Run Lane and 45 mph east of Quail Run Lane. There are existing overhead utility lines along the north side of the roadway. Low-density residential development is present on the north side of the roadway between Schnepf Road and Quail Run Lane and south of Skyline Drive east of Quale Run Lane. An RV park is on the south side of the roadway at Sierra Vista Drive. In general, the land surrounding Skyline Drive is largely undeveloped or used as farmland.
- Quail Run Lane is an undivided, two-lane roadway with a posted speed limit of 50 mph. The roadway has a north-south alignment, and does not provide curb, gutter, or sidewalk facilities.

- Sierra Vista Drive is an unpaved, two-lane dirt roadway with a posted speed limit of 25 mph. The roadway has a north-south alignment and no curb, gutter, or sidewalk facilities.
- Schnepf Road is an undivided two-lane roadway with a north-south alignment and a posted speed limit of 50 mph. There are dirt shoulders along both sides of the roadway and no sidewalk facilities.
- Combs Road has an east-west alignment and a posted speed limit of 50 mph. One travel lane is provided in each direction, with dirt shoulders along both sides of the roadway and no sidewalk facilities.
- Florence-Kelvin Highway has an east-west alignment and a posted speed of 50 mph. The roadway is both gravel surfaced and paved; it provides one travel lane in each direction. There are no curb, gutter, or sidewalk facilities along this route within the analysis area.
- Dripping Springs Road has an east-west alignment and no posted speed limit. The roadway is unpaved and provides one lane of travel in each direction. There are no curb, gutter, or sidewalk facilities.

NATIONAL FOREST SYSTEM ROADS

- Silver King Mine Road (also known as NFS Road 229) exists as a graded dirt roadway with a north-south alignment, providing access to State lands and various existing mining operations. There is no posted speed limit on Silver King Mine Road (NFS Road 229). Silver King Mine Road intersects U.S. 60 from the north. South of U.S. 60, the roadway is known as Apache Tear Road (NFS Road 989). Commonly used NFS roads in the project area are shown in figure 3.5.3-1.
- Apache Tear Road (NFS Road 989) is a graded dirt roadway that begins at a cattle guard adjacent to U.S. 60 and extends south, providing access to State lands, various mining

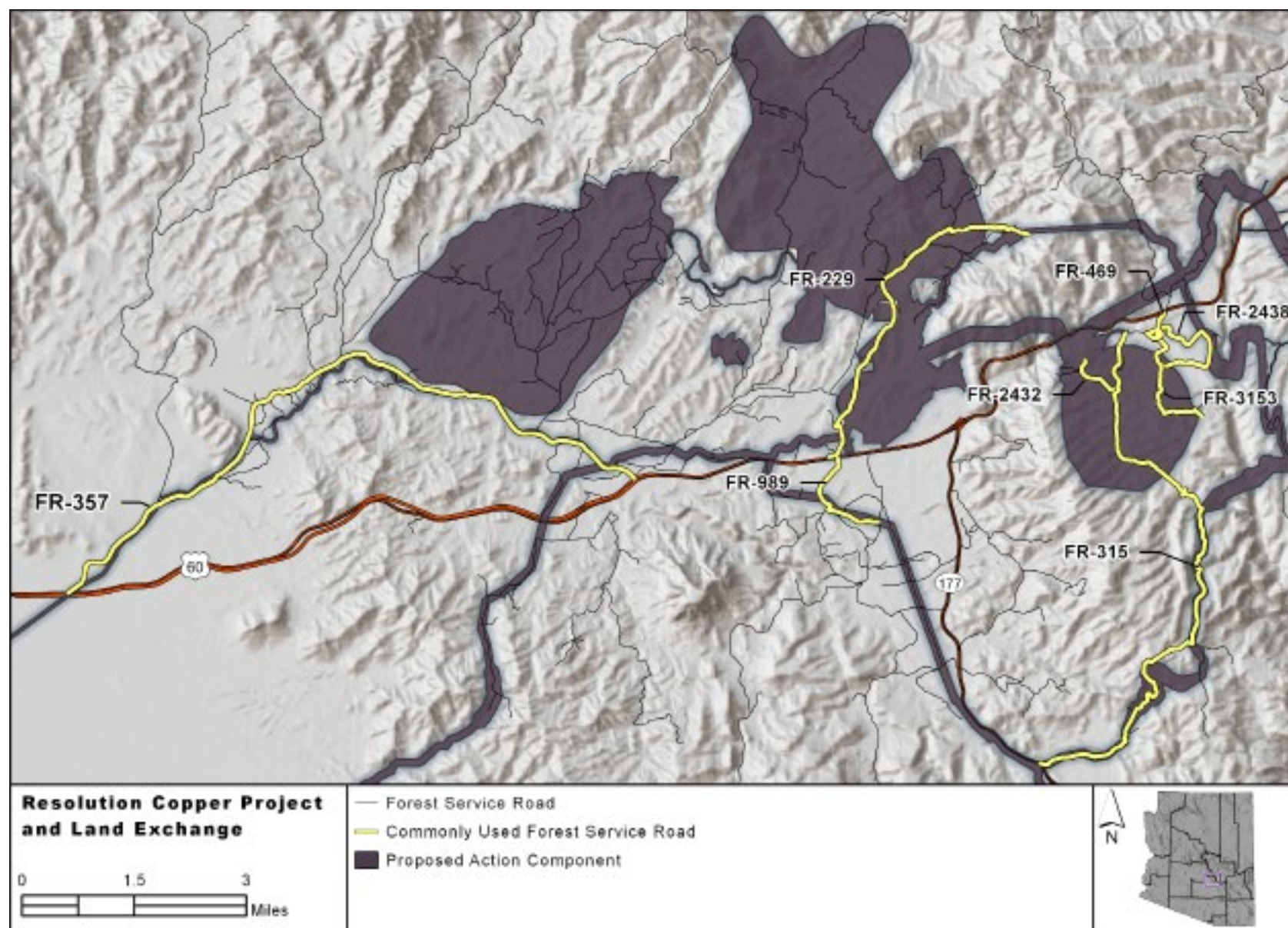


Figure 3.5.3-1. Commonly used NFS roads in the project area

operations, and the Town of Superior's water plant. Apache Tear Road (NFS Road 989) has a posted speed limit of 25 mph.

- Hewitt Station Road (NFS Road 357) is an unpaved, graded dirt road providing access to State lands as well as other recreational and off-road vehicle NFS roads north of U.S. 60. A dirt parking/staging area for recreational users exists on the east side of Hewitt Station Road (NFS Road 357) immediately north of U.S. 60. Cattle guards are located across Hewitt Station Road (NFS Road 357) at the intersection with U.S. 60. There is no posted speed limit. There are currently access restrictions along this road where it crosses private property.
- Magma Mine Road (NFS Road 469) is a two-lane undivided paved roadway with no curb, gutter, or sidewalk facilities which provides access to mining operations south of U.S. 60. The Forest Service classifies Magma Mine Road (NFS Road 469) as a level 4 road. There is no posted speed limit. Beyond its intersection with East Oak Flats Road (NFS Road 2438), Magma Mine Road becomes NFS Road 315 with a level 2 road classification. This section of Magma Mine Road (NFS Road 315) is paved with a single lane. Magma Mine Road splits from NFS Road 315 approximately 5,800 feet from its intersection with East Oak Flats Road (NFS Road 2438), becoming a private road designated as NFS Road 2432.
- East Oak Flats Road (NFS Road 2438). Approximately 1,400 feet from U.S. 60, Magma Mine Road intersects with East Oak Flats Road (NFS Road 2438). East Oak Flats Road (NFS Road 2438) is an unpaved loop road classified as a level 2 road by the Forest Service. There is no posted speed limit.
- NFS Road 3153 intersects East Oak Flats Road (NFS Road 2438) and is an unpaved dead-end road classified as a level 2 road by the Forest Service. There is no posted speed limit. Current Forest Service documentation identifies this road as closed.

Background Traffic Volume Counts

Resolution Copper collected peak-hour turning movement counts in August 2015, to capture summer traffic patterns (Southwest Traffic Engineering LLC 2017, 2018). At ADOT's direction, counts were collected on a Friday between the hours of 7:00 a.m. and 10:00 p.m. Additional counts were collected in November 2016, during the same daily time frame to capture winter traffic patterns. Volume counts collected during the winter period were generally higher than the summer period. We analyzed the larger of the two count periods and adjusted for seasonal factors and background growth to provide for a conservative analysis; in other words, we analyzed more traffic rather than less traffic.

Resolution Copper completed turning movement counts at the following intersections, as shown in figure 3.5.3-2:

- Magma Mine Road (NFS Road 469)/U.S. 60
- SR 177/Eastbound U.S. 60 ramps
- SR 177/Westbound U.S. 60 on-ramp
- Ray Road/Heiner Street/Westbound U.S. 60 off-ramp
- Main Street/U.S. 60
- NFS Road 989/U.S. 60
- Silver King Mine Road (NFS Road 229)/U.S. 60
- Hewitt Station Road (NFS Road 357)/U.S. 60
- Main Street/Lonetree Road
- Main Street/Magma Avenue
- Skyline Drive/Quail Run Lane
- Skyline Drive/Sierra Vista Drive
- Skyline Drive/Schnepf Road
- Combs Road/Schnepf Road

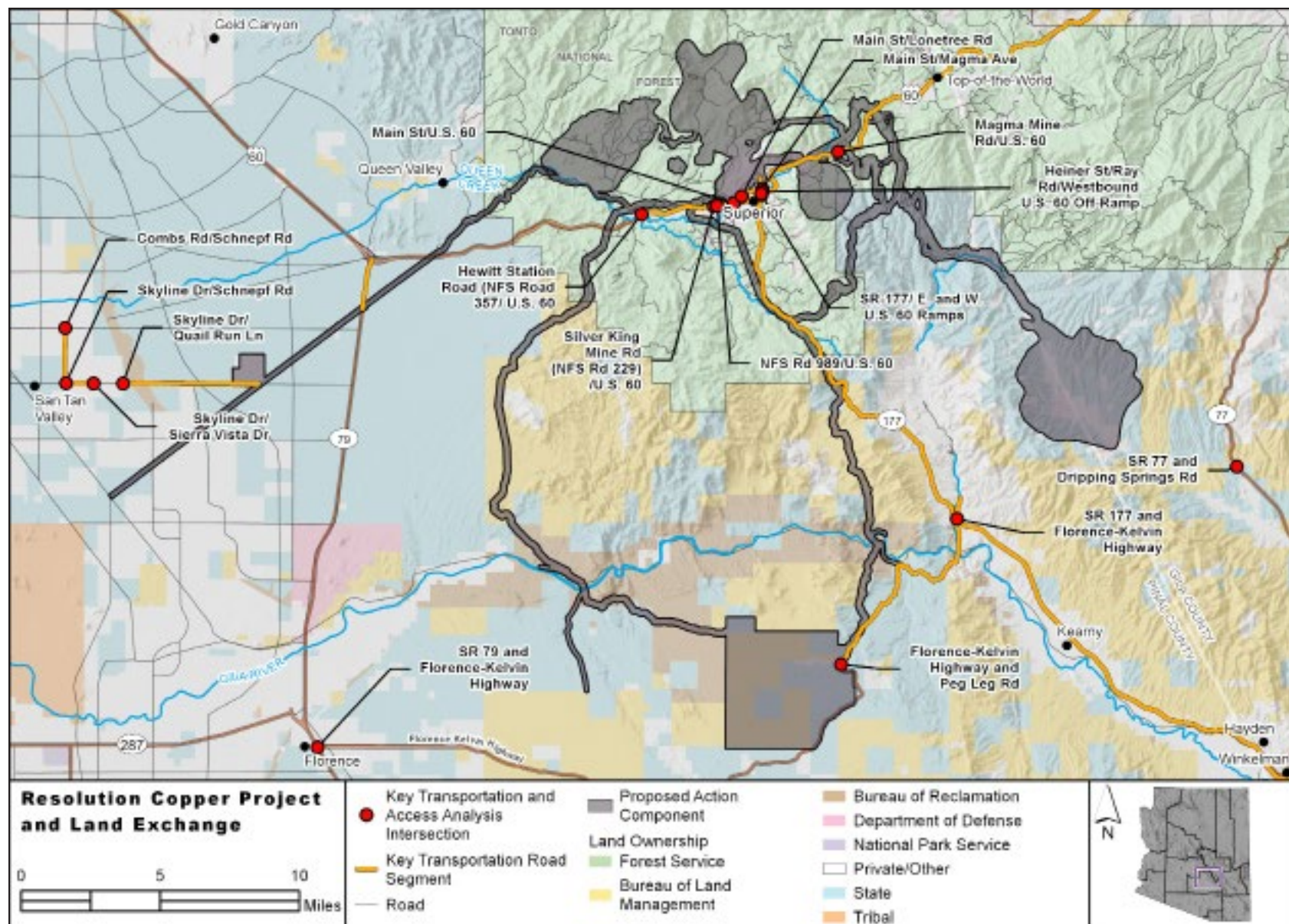


Figure 3.5.3-2. Key intersections and road segments analyzed through traffic counts

- Florence-Kelvin Highway/SR 79
- Florence-Kelvin Highway/SR 177
- Florence-Kelvin Highway/Peg Leg Road
- SR 77/Dripping Springs Road

In addition to intersection vehicle-turning movement counts, 24-hour bidirectional traffic volumes, vehicle speed, and vehicle classification counts were collected along roadway segments within or adjacent to the analysis area. These roadway segments are also depicted in figure 3.5.3-2:

- Magma Avenue, north of Copper Road
- Main Street, east of Pinal Avenue
- Main Street, west of Pinal Avenue
- U.S. 60, west of Silver King Mine Road (NFS Road 229)
- U.S. 60, between Silver King Mine Road (NFS Road 229) and Main Street
- U.S. 60, between Main Street and SR 177
- U.S. 60, west of Magma Mine Road (NFS Road 469)
- U.S. 60, east of Magma Mine Road (NFS Road 469)
- SR 79, between U.S. 60 and the MARRCO Railroad Line
- Skyline Drive, east of Quail Run Lane
- Skyline Drive, between Sierra Vista Drive and Schnepf Road
- Schnepf Road, between Skyline Drive and Hash Knife Draw Road
- Schnepf Road, between Hash Knife Draw Road and Combs Road
- Florence-Kelvin Highway, east of Peg Leg Road

- Florence-Kelvin Highway, east of SR 177
- SR 177, north and south of Florence-Kelvin Highway

Background Level of Service

Resolution Copper conducted an operational analysis of the existing intersections for the weekday peak hour using the nationally accepted methodology set forth in the “Highway Capacity Manual” (Transportation Research Board 2000), and using operational analysis computer software Synchro 9 to calculate the LOS for individual movements, approaches, and for each intersection. In accordance with the Highway Capacity Manual procedures, LOS has been determined by estimating the average vehicular delay of the intersections and the individual intersection movements.

LOS is a qualitative measure of the traffic operations at an intersection or on a roadway segment that is ranked from LOS A (little or no congestion), to LOS F, which signifies severe congestion. ADOT considers LOS D as adequate operational LOS at both signalized and unsignalized intersections in developed areas.

Delay thresholds for a given LOS for unsignalized intersections are lower than those reported for signalized intersections. This difference between intersection control accounts for the greater variability in delay associated with unsignalized movements as well as different driver expectations associated with each type of intersection control. Drivers generally have the expectation that signalized intersections are designed to carry higher traffic volumes and therefore would experience greater delay than might otherwise be expected at an unsignalized intersection.

At unsignalized intersections, LOS is predicted/calculated for those movements which must either stop for or yield to oncoming traffic and is based on average control delay for the movement. Control delay is the portion of total delay attributed to traffic control measure, such as stop signs. The criteria for LOS at unsignalized intersections are shown in table 3.5.3-1.

Table 3.5.3-1. Level of service criteria for unsignalized intersections

LOS Rank	Delay Threshold
A	≤ 10 seconds
B	10 seconds to ≤ 15 seconds
C	15 seconds to ≤ 25 seconds
D	25 seconds to ≤ 35 seconds
E	35 seconds to ≤ 50 seconds
F	> 50 seconds

Existing, or background, LOS were calculated for the study intersections. The resulting delay and associated LOS for each intersection are detailed in table 3.5.3-2.

All intersections in the analysis area currently operate with a LOS C or better for all movements during the peak hour under current conditions.

3.5.4 Environmental Consequences of Implementation of the Proposed Mine Plan and Alternatives

3.5.4.1 Alternative 1 – No Action

Traffic Volume/Level of Service

Under the no action alternative, no mine expansion would occur and the existing transportation patterns and existing infrastructure in the analysis area would continue. Traffic volumes are expected to continue to increase at an average 2 percent annual growth rate over the next 10 to 20 years, resulting in increased traffic levels on all roads in the area (Southwest Traffic Engineering LLC 2017). With increasing traffic, due to normal background growth and development of the area, the intersections in the analysis area are generally expected to operate within an acceptable LOS in the peak construction and operation years 2022 and 2027 (see table 3.5.4-3 later in this section). The Combs Road/Schnepf Road intersection is expected to operate with a side street LOS

E/F by year 2022 through 2027. A traffic signal may be required at this intersection, along with exclusive turn lanes for all approaches, to alleviate delays expected to occur with or without the project.

Transportation Routes

Under the no action alternative, existing transportation routes would not change. There would be no direct, indirect, or cumulative effects on the transportation routes as a result.

Changes in Access

Public access to NFS land and transportation infrastructure would not be impacted under the no action alternative because there would be no new roads, updates to existing roads, or closures of existing roads under this alternative. There would be no direct, indirect, or cumulative effects on changes in access as a result.

3.5.4.2 Impacts Common to All Action Alternatives

Effects of the Land Exchange

The land exchange would have significant effects on transportation and access. The Oak Flat Federal Parcel would leave Forest Service jurisdiction, and with it public access would be lost to the parcel itself, as well as passage through the parcel to other destinations, including Apache Leap and Devil's Canyon. These locations have other means of access, but those routes may not be as direct or convenient. Resolution Copper may keep portions of the property open for public access, as feasible.

The offered land parcels would enter either Forest Service or BLM jurisdiction. The eight parcels would have beneficial effects; they would become accessible by the public and be managed by the Federal Government for multiple uses. Roads and access would be managed in accordance with the appropriate management plans and agency direction.

Table 3.5.3-2. Existing peak hour level of service and delay

Intersection	Peak Hour	
	LOS Rank	Delay (seconds)
Combs Road/Schnepf Road		
Eastbound Left	C	18.9
Eastbound Through/Right	C	15.6
Westbound Left	B	11.4
Westbound Through/Right	B	11.3
Northbound Left	C	15.6
Northbound Through/Right	B	11.6
Southbound Left	B	10.5
Southbound Through/Right	C	24.9
Skyline Drive/Sierra Vista Drive		
Eastbound Left/Through	A	7.7
Southbound Left/Right	A	9.9
Skyline Drive/Quail Run Lane		
Eastbound Left/Through/Right	A	8.1
Westbound Left/Through/Right	A	7.8
Northbound Left/Through/Right	A	8.6
Southbound Left/Through/Right	A	7.4
Hewitt Station Road (NFS Road 357)/Westbound U.S. 60		
Northbound Left/Through	A	0.0
Southbound Through/Right	A	0.0
Hewitt Station Road (NFS Road 357)/Eastbound U.S. 60		
Southbound Left	A	0.0
Silver King Mine Road (NFS Road 229)/U.S. 60		
Eastbound Left	A	0.0
Westbound Left	A	8.4
Northbound Left/Through/Right	C	15.4
Southbound Left/Through/Right	B	14.7
Main Street/Lonetree Road		
Eastbound Left	A	7.3

continued

Table 3.5.3-2. Existing peak hour level of service and delay (*cont'd*)

Intersection	Peak Hour	
	LOS Rank	Delay (seconds)
Southbound Left/Right	A	8.8
Main Street/U.S. 60		
Eastbound Left/Through	A	8.8
Southbound Left	C	24.0
Southbound Right	B	12.7
Main Street/Magma Avenue		
Eastbound Left/Through/Right	A	7.4
Westbound Left/Through/Right	A	7.7
Northbound Left/Through/Right	A	7.9
Southbound Left/Through/Right	A	7.5
Heiner Street/Ray Road/Westbound U.S. 60 Off Ramp		
Eastbound Left/Right	A	9.4
Westbound Left/Through/Right	A	9.6
Northbound Left/Through	A	7.5
SR 177/Eastbound U.S. 60 Ramps		
Eastbound Left/Through/Right	A	9.6
Southbound Left/Through	A	7.6
Magma Mine Road (NFS Road 469)/U.S. 60		
Eastbound Left	A	0.0
Westbound Left	A	7.9
Northbound Left/Through/Right	C	16.8
Southbound Left/Through/Right	A	0.0
Florence-Kelvin Highway/SR 79		
Westbound Left/Right	A	9.8
Southbound Left	A	7.8
Florence-Kelvin Highway/SR 177		
Eastbound Left/Right	A	9.1
Northbound Left/Through	A	7.5

continued

Table 3.5.3-2. Existing peak hour level of service and delay (*cont'd*)

Intersection	Peak Hour	
	LOS Rank	Delay (seconds)
Dripping Springs Road/SR 77		
Eastbound Left/Right	A	9.1
Northbound Left/Through	A	7.4

Effects of Forest Plan Amendment

The Tonto National Forest Land and Resource Management Plan (1985b) provides guidance for management of lands and activities within the Tonto National Forest. It accomplishes this by establishing a mission, goals, objectives, and standards and guidelines. Missions, goals, and objectives are applicable on a forest-wide basis. Standards and guidelines are either applicable on a forest-wide basis or by specific management area.

A review of all components of the 1985 forest plan was conducted to identify the need for amendment due to the effects of the project, including both the land exchange and the proposed mine plan (Shin 2019). A number of standards and guidelines (12) were identified applicable to management of transportation and access. None of these standards and guidelines were found to require amendment to the proposed project, either on a forest-wide or management area-specific basis. For additional details on specific rationale, see Shin (2019).

Summary of Applicant-Committed Environmental Protection Measures

A number of environmental protection measures are incorporated into the design of the project that would act to reduce potential impacts on transportation and access. These are non-discretionary measures and their effects are accounted for in the analysis of environmental consequences.

The GPO (Resolution Copper 2016d) outlined applicant-committed environmental protection measures by Resolution Copper in Appendix K, “Road Use Plan:”

- Public access to the lands in the vicinity of the East Plant Site would be maintained via SR 177 and NFS Road 315 as well as U.S. 60 and NFS Road 469 (until access is no longer possible).
- A number of best management practices for road construction and maintenance were identified in the GPO:
 - To the extent practicable, vegetation will not be removed except from those areas to be directly affected by road reconstruction activities.
 - Cut-and-fill slopes for road reconstruction will be designed to prevent soil erosion.
 - Drainage ditches with cross drains will be constructed where necessary. Disturbed slopes will be revegetated, mulched, or otherwise stabilized to minimize erosion as soon as practicable following construction.
 - Road embankment slopes will be graded and stabilized with vegetation or rock as practicable to prevent erosion.
 - Runoff from roads will be handled through best management practices, including sediment traps, settling ponds, berms, sediment filter fabric, wattles, etc. Design of these features will be based on an analysis of local hydrologic conditions.

- Off-road vehicle travel will generally be avoided.
- During construction and operations, diversions will be constructed around affected areas to minimize erosion. A number of best management practices including check dams, dispersion terraces, and filter fences also will be used during construction and operations.
- Specific NFS road improvements and maintenance are also specified in the GPO; these are summarized here together with known impacts on NFS roads. The GPO notes several replacement roads that provide periphery access around the tailings facility; these roads are anticipated to be located within the fence line that excludes public access and therefore these roads are not considered to replace any through-access lost from the tailings facility.
- Realignment of NFS Road 229/Silver King Mine Road is envisioned under all alternatives. The physical disturbance from this realignment is incorporated into the assessment of impacts. Note that under Alternatives 2, 3, 5, and 6, the realignment of Silver King Mine Road is meant to provide through-access to the highlands north of the West Plant Site. For Alternative 4 this is true as well, but the presence of the tailings facility in this area restricts through-access to administrative uses only.

Two additional measures were identified in the traffic studies as being recommended to improve LOS impacts caused by mine traffic (Southwest Traffic Engineering LLC 2017). These measures would be subject to approval by the appropriate local traffic authorities prior to implementation:

- New stop signs would be installed at minor approaches to intersections as needed and subject to appropriate approval by ADOT.
- If necessary, flaggers or officers would be used to assist with turning movements at major project intersections during peak construction, subject to appropriate approval by ADOT.
- During peak construction, construction traffic or similar advanced warning signs would be used as needed, and subject to appropriate approval by ADOT.

Mine-Related Traffic

Increased traffic associated with the mine during peak construction (2022) and normal operations (2027), includes four main traffic generators:

1. East Plant Site
2. West Plant Site
3. San Tan Valley filter plant and loadout facility
4. Tailings storage facility (four alternate locations)

There are four alternative locations for the tailings and storage facility (located at either the Near West, Silver King, Peg Leg, or Skunk Camp location), with each location having unique access roads, as shown in figure 3.5.4-1. All alternatives, except for Silver King, place the filter plant and loadout facility in the San Tan Valley. The Silver King alternative places the filter plant and loadout facility at the West Plant Site. This section focuses on the impacts that are common to all action alternatives; the impacts associated specifically with each alternative are summarized in the next sections. Table 3.5.4-1 describes the intersections that would be impacted by the East Plant Site, West Plant Site, and the San Tan Valley filter plant and loadout facility.

Transportation of personnel, equipment, supplies, and materials related to mine development, operation, and reclamation has the potential to increase traffic. Moreover, this increased traffic can impact local and regional travel patterns and intersection LOS. In addition, increased volumes of traffic are likely to contribute to earlier and more extensive deterioration of road surfaces, therefore requiring more frequent and higher levels of maintenance.

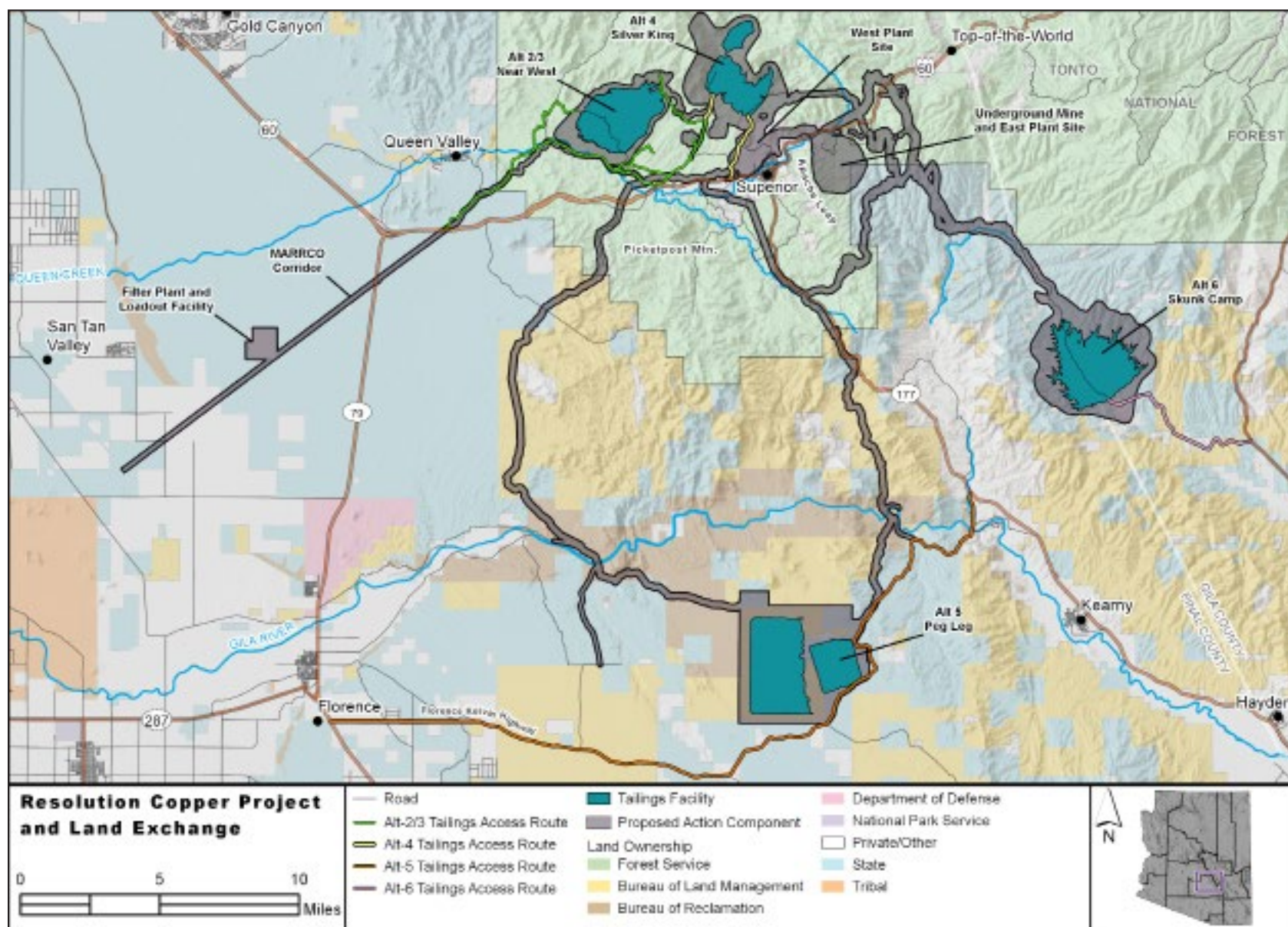


Figure 3.5.4-1. Access roads for alternative tailings storage facilities

Table 3.5.4-1. Intersections impacted by all action alternatives

Facility	Intersections Impacted
East Plant Site	U.S. 60 and Magma Mine Road
West Plant Site	Main Street and Magma Avenue Main Street and Lonetree Road Main Street and U.S. 60 Heiner Street/Ray Road/Westbound U.S. 60 off-ramp SR 177 and eastbound U.S. 60 ramps U.S. 60 and Silver King Mine Road U.S. 60 and Hewitt Station Road
San Tan Valley filter plant and loadout facility (except Silver King alternative)	Skyline Drive and Sierra Vista Drive Skyline Drive and Quail Run Road Schnepf Road and Combs Road

Table 3.5.4-2. Site-generated trips during peak hour

Facility	Peak Construction		Normal Operations	
	Employee Trips	Material/ Equipment Trips	Employee Trips	Material/ Equipment Trips
East Plant Site	438	22	332	22
West Plant Site	1,038	22	336	22
San Tan Valley filter plant and loadout facility	60	16	18	0

Note: Peak hour employee and material/equipment trips are assumed to be 50 percent inbound, 50 percent outbound

Typical road maintenance and repair activities of paved roads due to increased traffic flows include more frequent asphalt resealing, patching, and pothole repair, line repainting, overlay work, and, eventually, complete pavement reconstruction. At present, the costs due to increased mine-related traffic of these activities would be borne solely by the Town of Superior, Pinal County, or ADOT, depending on the particular roadway segment. Please see Section 3.13, Socioeconomics, for a more detailed discussion of the economic effects of increased traffic in the vicinity of the Resolution Copper Project.

Table 3.5.4-2 shows the total number of trips expected during the peak hour during peak construction and normal operations (50 percent of trips are assumed to be inbound and 50 percent outbound during the peak hour). There are 1,596 trips expected in the peak hour during construction and 730 trips in the peak hour during normal operations. In general, traffic impacts are more significant during peak construction than operations, as there are more employee commute trips.

The analysis includes assumptions designed to estimate peak hour employee trips based on the number of employees working at each facility:

- There would be several different employee types and shift times/lengths at the mining facilities. A shift reduction factor of 0.66 was applied to estimate the number of employees traveling to/from the site during the peak hour.
- It was assumed that half of the employees would arrive, and half depart, during the peak hour.
- To factor in employee carpooling, it was assumed that each vehicle entering the site would carry an average of 1.7 employees.

Traffic Volume and Level of Service

Table 3.5.4-3 shows the delay and LOS for each intersection movement, with and without the project, during peak construction (year 2022) and

normal operations (year 2027). A 2 percent annual growth rate was used to estimate projected background traffic volumes in years 2022 and 2027 (Southwest Traffic Engineering LLC 2017).

With increasing traffic, due to normal background growth and development of the area, the intersections in the analysis area are generally expected to operate within an acceptable LOS in years 2022 and 2027 for most intersections (see table 3.5.4-3). Project-related traffic would contribute to decreased LOS at many intersections, but only the following have LOS degraded to LOS E/F status:

- The Combs Road/Schnepf Road intersection, southbound, degrades from LOS E to LOS F; this occurs under the no action alternative as well.
- The Silver King Mine Road/U.S. 60 intersection, northbound, degrades from LOS C to LOS F during construction, and to LOS E during operations. The southbound lanes degrade from LOS C to LOS F during construction, and LOS D during operations.
- The Main Street/U.S. 60 intersection, southbound, degrades from LOS C to LOS F during construction and operations.
- The SR 177/U.S. 60 intersection, eastbound, degrades from LOS A to LOS E during construction.
- The Magma Mine Road/U.S. 60 intersection, northbound, degrades from LOS C to LOS F during operations.

Transportation Routes and Changes in Access

Changes in access to the NFS road system as a result of the proposed activities at the East Plant Site, West Plant Site, and filter plant and loadout facility are shown in table 3.5.4-4. Approximately 8.0 miles of NFS roads are expected to be decommissioned or lost.

The primary impacts occur from the subsidence area development and include large portions of NFS Roads 315 and 3153. These roads provide

access to areas that include Apache Leap and Devil's Canyon as well as connectivity to other NFS roads. Access would still be available to these areas, but those routes may not be as direct or convenient. Resolution Copper may keep portions of the property open for public access, as feasible, but the roads that pass through the Oak Flat Federal Parcel are not expected to remain open.

All alternatives would involve impacts on Silver King Mine Road and NFS Road 229, which provide through travel to the highlands north of Superior, as well as to private inholdings in the Tonto National Forest. All alternatives would maintain access to these areas; for Alternative 4, access would be administrative due to the presence of the tailings storage facility.

Railroads

Increased rail traffic along the MARRCO corridor associated with the mine has the potential to impact traffic patterns in the local area. All alternatives involve use of the MARRCO corridor from the San Tan Valley filter plant and loadout facility to the main rail line. Alternative 4 – Silver King requires approximately two trains per day during peak operations to deliver materials along the MARRCO corridor from the West Plant Site to the main rail line. The trains are expected to arrive and depart during the night shift. Due to their overnight operations, the trains are expected to be inconsequential to the operations of the road network.

For safety purposes, it is recommended that Resolution Copper work with ADOT to update signage at highway and NFS road/railroad-grade crossings.

3.5.4.3 Alternative 2 and Alternative 3 – Near West

Mine-Related Traffic

Table 3.5.4-5 summarizes the facility footprint and intersections impacted by mine-related traffic at each tailings storage facility alternative. For Alternatives 2 and 3, the tailings storage facility is

Table 3.5.4-3. Level of service and delay during peak construction (2022) and normal operations (2027)

Intersection	2022 without Project		2022 with Project		2027 without Project		2027 with Project	
	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)
Combs Road/Schnepf Road								
Eastbound Left	C	24.8	D	25.9	D	31.5	D	31.8
Eastbound Through/Right	C	20.4	C	24.9	D	25.4	D	26.7
Westbound Left	B	12.1	B	12.3	B	12.3	B	12.4
Westbound Through/Right	B	12.3	B	12.6	B	12.8	B	12.9
Northbound Left	C	18.5	C	21.8	C	21.0	C	21.8
Northbound Through/Right	B	12.7	B	12.9	B	13.4	B	13.5
Southbound Left	B	11.1	B	11.3	B	11.5	B	11.5
Southbound Through/Right	E	42.4	E	47.1	F	67.5	F	67.7
Skyline Drive/Sierra Vista Drive								
Eastbound Left/Through	A	7.7	A	7.8	A	7.9	A	7.9
Southbound Left/Right	B	10.1	B	10.4	B	10.6	B	10.7
Skyline Drive/Quail Run Lane								
Eastbound Left/Through/Right	A	8.5	A	9.1	A	8.8	A	8.9
Westbound Left/Through/Right	A	8.0	A	8.4	A	8.1	A	8.2
Northbound Left/Through/Right	A	9.0	A	9.4	A	9.3	A	9.4
Southbound Left/Through/Right	A	7.6	A	7.9	A	7.7	A	7.8
Hewitt Station Road (NFS Road 357)/Westbound U.S. 60								
Northbound Left/Through	A	0.0	A	0.0	A	0.0	A	0.0
Southbound Through/Right	A	0.0	C	15.7	A	0.0	B	12.6
Hewitt Station Road (NFS Road 357)/Eastbound U.S. 60								
Southbound Left	A	0.0	A	0.0	A	0.0	A	0.0
Silver King Mine Road (NFS Road 229)/U.S. 60								
Eastbound Left	A	9.2	B	13.1	A	9.5	B	11.0
Westbound Left	A	8.6	B	11.2	A	8.8	A	9.9
Northbound Left/Through/Right	C	18.6	F	>120	C	20.9	E	45.4
Southbound Left/Through/Right	C	17.8	F	105.7	C	19.4	D	33.1
Main Street/Lonetree Road								

continued

Table 3.5.4-3. Level of service and delay during peak construction (2022) and normal operations (2027) (cont'd)

Intersection	2022 without Project		2022 with Project		2027 without Project		2027 with Project	
	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)
Eastbound Left	A	7.4	A	8.1	A	7.4	A	7.6
Southbound Left/Right	A	8.9	C	15.3	A	8.9	A	9.8
Main Street/U.S. 60								
Eastbound Left/Through	A	9.1	C	15.9	A	9.5	B	11.5
Southbound Left	C	23.3	F	>120	D	27.2	F	70.1
Southbound Right	B	10.9	D	26.3	B	11.3	B	14.6
Main Street/Magma Avenue								
Eastbound Left/Through/Right	A	7.6	B	11.5	A	7.9	A	8.1
Westbound Left/Through/Right	A	7.8	B	10.8	A	8.1	A	8.2
Northbound Left/Through/Right	A	8.0	D	25.6	A	8.4	A	8.8
Southbound Left/Through/Right	A	7.7	C	19.7	A	7.9	A	8.3
Heiner Street/Ray Road/Westbound U.S. 60 Off-Ramp								
Eastbound Left/Right	A	9.6	C	17.1	A	9.7	B	10.2
Westbound Left/Through/Right	A	9.9	B	13.5	A	9.9	B	10.4
Northbound Left/Through	A	7.6	A	8.7	A	7.6	A	7.7
SR 177/Eastbound U.S. 60 Ramps								
Eastbound Left/Through/Right	A	9.8	E	43.5	B	10.0	B	11.1
Southbound Left/Through	A	7.7	A	8.0	A	7.7	A	7.8
Magma Mine Road (NFS Road 469)/U.S. 60								
Eastbound Left	A	0.0	A	0.0	A	0.0	A	0.0
Westbound Left	A	8.0	A	8.3	A	8.1	A	8.2
Northbound Left/Through/Right	C	19.3	D	31.0	C	21.9	F	>120
Southbound Left/Through/Right	A	0.0	A	0.0	A	0.0	A	0.0

Note: Shaded cells indicate an LOS of E or F, which is considered inadequate by ADOT

Table 3.5.4-4. Miles of NFS roads decommissioned and lost for East Plant Site, West Plant Site, and filter plant and loadout facility

Facility	Tonto National Forest NFS Roads Decommissioned and Lost (miles)*	Resolution Copper Applicant-Committed Improvements and Maintenance
West Plant Site: Total Roads	2.54	
NFS Road 1010	0.37	Level 1
NFS Road 229	2.17	Portions reconstructed to level 3
East Plant Site/Subsidence Area: Total Roads	5.45	
NFS Road 2432	0.78	None
NFS Road 2433	0.23	None
NFS Road 2434	0.29	None
NFS Road 2435	0.28	None
NFS Road 2438	0.32	None
NFS Road 3153	1.19	None
NFS Road 3791	0.1	None
NFS Road 315	2.28	None
San Tan Valley Filter Plant and Loadout Facility: Total Roads	0.0	None

Notes: Roads intersected by pipeline corridors or transmission line corridors are considered to remain open.

Level 1 – Basic custodial care; Level 2 – High-clearance vehicles; Level 3 – Suitable for passenger cars

* Includes West Plant Site, East Plant Site, subsidence area, and maximum impact acreage for Silver King Mine Road alignment. Road segments less than 0.05 mile not shown.

Table 3.5.4-5. Footprint and intersections impacted by each tailings storage facility location

Alternative	Footprint within Tailings Storage Facility Fence Line (acres)	Intersections Impacted by Traffic
Alternatives 2 and 3 – Near West	4,903	U.S. 60 and Hewitt Station Road
Alternative 4 – Silver King	5,661	U.S. 60 and Silver King Mine Road
Alternative 5 – Peg Leg	10,782	SR 79 and Florence-Kelvin Highway SR 177 and Florence-Kelvin Highway Florence-Kelvin Highway and Peg Leg Road
Alternative 6 – Skunk Camp	8,647	SR 77 and Dripping Springs Road

located at the same site and the traffic impacts are the same; therefore, the results for these two alternatives have been grouped together.

Table 3.5.4-6 shows the total number of trips expected during the peak hour for each alternative (50 percent of trips are assumed to be inbound and 50 percent outbound during the peak hour). Alternatives 2 and 3 involve 64 trips in the peak hour during construction and 46 trips in the peak hour during normal operations.

Traffic Volume and Level of Service

Table 3.5.4-7 shows the delay and LOS for each alternative, with and without the project, during peak construction (year 2022) and normal operations (year 2027).

For Alternatives 2 and 3, the intersections adjacent to the tailings storage facility alternatives are expected to continue operating at an adequate LOS during both peak construction and normal operations. No right- or left-turn lanes are required at the study intersections providing access to the tailings storage facility alternatives.

Table 3.5.4-6. Site-generated trips during peak hour for each alternative

Alternative	Peak Construction		Normal Operations	
	Employee Trips	Material/ Equipment Trips	Employee Trips	Material/ Equipment Trips
Alternatives 2 and 3 – Near West	42	22	24	22
Alternative 4 – Silver King	66	22	36	22
Alternative 5 – Peg Leg	44	22	24	22
Alternative 6 – Skunk Camp	42	22	24	22

Note: Peak hour employee and material/equipment trips are assumed to be 50% inbound, 50% outbound.

Transportation Routes and Changes in Access

Mine development has the potential to permanently alter, add, or decommission NFS roads or temporarily restrict access to NFS roads and lands, which could impact forest users and permittees. Some roads cut off by the perimeter fence would result in dead-end conditions. Ongoing and future travel management planning would determine which, if any, of these dead-end roads should be closed or decommissioned. These new conditions would result in site-specific and user-specific impacts, depending upon an individual's preference for using an NFS road.

Under all action alternatives, public access would not be allowed on any roads within the perimeter fence for security purposes and in order to protect public health and safety. This may conflict with the ongoing travel management goals of maintaining NFS roads for public use to the degree reasonable. All NFS roads and unauthorized roads on NFS land within the perimeter fence or roads on NFS land outside the perimeter fence that would no longer be accessible would be either decommissioned, rerouted to connect to another road, changed to

administrative-only access, or have a turnaround constructed near the perimeter fence. Roadway decommissioning details would be developed by the Forest Service when the time for permanent closure is closer and more information is available. The NFS roads expected to be decommissioned or otherwise lost to public access for Alternatives 2 and 3 are shown in table 3.5.4-8.

Approximately 21.7 miles of NFS roads are expected to be decommissioned or lost. The roads impacted by the tailings storage facility are largely local to the tailings area and one route does provide through travel to other areas of the Tonto National Forest. Access would still be available to these areas but those routes may not be as direct or convenient.

All NFS roads that would be used by Resolution Copper and also remain open to the public would be maintained by Resolution Copper, and road improvements would be made when needed to maintain public safety. Table 3.5.4-9 describes the disturbance from new access roads associated with each alternative.

3.5.4.4 Alternative 4 – Silver King

Mine-Related Traffic

Table 3.5.4-5 summarizes the facility footprint and intersections impacted by mine-related traffic at each tailings storage facility alternative. Table 3.5.4-6 shows the total number of trips expected during the peak hour for each alternative (50 percent of trips are assumed to be inbound and 50 percent outbound during the peak hour). Alternative 4 involves 88 trips in the peak hour during construction and 58 trips in the peak hour during normal operations. Alternative 4 is unique in that it also involves relocating the filter plant and loadout facility from San Tan Valley to the West Plant Site. Thus, more employees are needed for the Silver King alternative than the other alternatives. In general, more employees are needed during peak construction than normal operations.

Table 3.5.4-7. Level of service and delay for tailings storage facility alternate locations during peak construction (2022) and normal operations (2027)

Alternative	Intersection	2022 without Project		2022 with Project		2027 without Project		2027 with Project	
		LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)
Alternatives 2 and 3 – Near West Location	Hewitt Station Road (NFS Road 357)/Eastbound U.S. 60								
	Northbound Through/Right	A	0.0	A	0.0	A	0.0	A	0.0
	Southbound Left/Through	B	10.6	B	11.3	B	10.9	B	11.4
	Hewitt Station Road (NFS Road 357)/Westbound U.S. 60								
	Northbound Left/Through	C	15.1	C	15.6	C	15.5	C	16.4
	Southbound Through/Right	B	13.7	B	12.1	B	13.9	B	12.9
Alternative 4 – Silver King Location	Silver King Mine Road (NFS Road 229)/U.S. 60								
	Eastbound Left	A	9.2	A	9.4	A	9.5	A	9.7
	Westbound Left	A	8.7	A	8.7	A	8.9	A	8.9
	Northbound Left/Through/Right	C	20.4	C	24.2	C	24.6	D	27.7
	Southbound Left/Through/Right	C	19.6	C	19.4	C	23.9	C	22.7
Alternative 5 – Peg Leg Location	Florence- Kelvin Highway/SR 79								
	Westbound Left/Right	B	10.1	B	10.4	B	10.4	B	10.6
	Southbound Left	A	7.9	A	7.9	A	7.9	A	8.0
	Florence-Kelvin Highway/SR 177								
	Eastbound Left/Right	A	9.3	A	9.9	A	9.5	A	9.9
	Northbound Left/Through	A	7.6	A	7.6	A	7.6	A	7.6
	Florence-Kelvin Highway/ Peg Leg Road								
	Eastbound Left/Right	n/a	n/a	A	8.8	n/a	n/a	A	8.7
	Northbound Left/Through	n/a	n/a	A	7.3	n/a	n/a	A	7.3
Alternative 6 – Skunk Camp Location	Dripping Springs Road/SR 77								
	Eastbound Left/Right	A	9.1	A	9.8	A	9.4	A	9.8
	Northbound Left/Through	B	7.4	A	7.4	A	7.4	A	7.5

Table 3.5.4-8. Miles of NFS roads decommissioned and lost for Alternatives 2 and 3 tailings storage facility

Facility	Tonto National Forest NFS Roads Decommissioned and Lost (miles)	Resolution Copper Applicant-Committed Improvements and Maintenance
Alternatives 2 and 3 – Near West: Total Roads*	21.70	
NFS Road 2386	0.20	Portions restored to level 1
NFS Road 1903	2.68	None
NFS Road 1907	1.82	None
NFS Road 1909	0.36	None
NFS Road 1910	0.41	None
NFS Road 1912	0.54	None
NFS Road 1913	0.29	None
NFS Road 1914	0.29	None
NFS Road 1915	0.39	None
NFS Road 1916	0.22	None
NFS Road 1917	0.40	None
NFS Road 1918	0.23	None
NFS Road 1919	0.40	None
NFS Road 2359	2.22	None
NFS Road 2360	1.33	None
NFS Road 2361	0.37	None
NFS Road 2362	0.31	None
NFS Road 2363	0.37	None
NFS Road 2364	0.59	None
NFS Road 2366	0.05	None
NFS Road 2380	0.96	None
NFS Road 252	3.36	Portions reconstructed to level 2
NFS Road 3450	0.26	None
NFS Road 518	2.41	None
NFS Road 982	1.10	Portions reconstructed to level 2
NFS Road 3455	0.08	None
NFS Road 357	0.06	Maintained (level not specified)

Note: Level 1 – Basic custodial care; Level 2 – High-clearance vehicles; Level 3 – Suitable for passenger cars

* Includes tailings facility (within fence line) and borrow area footprints; does not include pipeline or transmission line corridors, which are assumed to allow roads to remain open. Road segments less than 0.05 miles not shown.

Table 3.5.4-9. New access roads for tailings storage facility alternatives

Alternative	New Access Roads
Alternatives 2 and 3 – Near West	This alternative would include rerouting Silver King Mine Road (NFS Road 229) to maintain through-access.
Alternative 4 – Silver King	This alternative involves rerouting of Silver King Mine Road for deliveries to the West Plant Site. The new access road would be about 1 mile in length. The new access road reduces the use of Silver King Mine Road (NFS Road 229) to 0.4 mile, but infrequent use along NFS Road 229, north of the MARRCO corridor would continue for accessing the SRP substation.
Alternative 5 – Peg Leg	This alternative would include rerouting Silver King Mine Road (NFS Road 229) to maintain through-access. Most access roads would follow existing routes. However, some new access roads would be needed along the tailings conveyance pipeline corridor. There are two alignments under consideration for the pipeline corridor. Additional access roads for the western alignment would include 5.1 miles or 12.4 acres of new disturbance. Additional access roads for the eastern alignment would include 2.2 miles or 5.3 acres of new disturbance.
Alternative 6 – Skunk Camp	This alternative would include rerouting Silver King Mine Road/ NFS Road 229 to maintain through access. New access roads would be needed along the tailings conveyance pipeline corridor. There are two alignment options under consideration for the pipeline corridor. In summary, 4 miles of access roads are needed for the north option, and 6 miles of access roads are needed for the south option. In addition, 20 miles of new access roads are needed along a separate power line corridor.

Traffic Volume and Level of Service

Table 3.5.4-7 shows the delay and LOS for each alternative, with and without the project, during peak construction (year 2022) and normal operations (year 2027). For Alternative 4, the intersections adjacent to the tailings storage facility alternatives are expected to continue operating at an adequate LOS during both peak construction and normal operations.

Transportation Routes and Changes in Access

The NFS roads expected to be decommissioned or otherwise lost to public access for Alternative 4 are shown in table 3.5.4-10.

Approximately 17.7 miles of NFS roads are expected to be decommissioned or lost. The roads impacted by the tailings storage facility provide through-travel to other areas of the Tonto National Forest, including some recreation loops and private inholdings (including Silver King Mine). Access would still be available to the recreation areas but those routes may not be as direct or convenient. Administrative access would be maintained on NFS Road 229 in order to provide through-travel to private inholdings.

All NFS roads that would be used by Resolution Copper and also remain open to the public would be maintained by Resolution Copper, and road improvements would be made when needed to maintain public safety. Table 3.5.4-10 describes the disturbance from new access roads associated with each alternative.

3.5.4.5 Alternative 5 – Peg Leg

Mine-Related Traffic

Table 3.5.4-5 summarizes the facility footprint and intersections impacted by mine-related traffic at each tailings storage facility alternative. Table 3.5.4-6 shows the total number of trips expected during the peak hour for each alternative (50 percent of trips are assumed to be inbound and 50 percent outbound during the peak hour). Alternative 5

involves 66 trips in the peak hour during construction and 46 trips in the peak hour during normal operations.

Traffic Volume and Level of Service

Table 3.5.4-7 shows the delay and LOS for each alternative, with and without the project, during peak construction (year 2022) and normal operations (year 2027). For Alternative 5, the intersections adjacent to the tailings storage facility alternatives are expected to continue operating at an adequate LOS during both peak construction and normal operations.

Transportation Routes and Changes in Access

Alternative 5 would not result in the loss or decommissioning of any additional NFS roads due to the tailings storage facility. BLM estimates that the Alternative 5 footprint would directly affect approximately 29 miles of inventoried routes, with additional indirect effects from through disruption of existing routes. The BLM land in the area is designated under off-highway vehicle (OHV) regulations as “Limited to Existing Roads and Trails.” The area includes existing primitive roads and trails, and the tailings facility would cause the loss of access and disrupt the continuity of existing routes. BLM also has identified potential loss of access to mining activities and grazing facilities as concerns for Alternative 5.

3.5.4.6 Alternative 6 – Skunk Camp

Mine-Related Traffic

Table 3.5.4-5 summarizes the facility footprint and intersections impacted by mine-related traffic at each tailings storage facility alternative. Table 3.5.4-6 shows the total number of trips expected during the peak hour for each alternative (50 percent of trips are assumed to be inbound and 50 percent outbound during the peak hour). Alternative 5 involves 64 trips in the peak hour during construction and 46 trips in the peak hour during normal operations.

Traffic Volume and Level of Service

Table 3.5.4-7 shows the delay and LOS for each alternative, with and without the project, during peak construction (year 2022) and normal operations (year 2027). For Alternative 6, the intersections adjacent to the tailings storage facility alternatives are expected to continue operating at an adequate LOS during both peak construction and normal operations.

Transportation Routes and Changes in Access

Alternative 6 would be located on private lands (after assumed acquisition of State Trust lands) and would impact 5.7 miles of Dripping Springs Road. BLM has identified the potential loss of access to mining activities and grazing facilities as concerns for Alternative 6.

3.5.4.7 Cumulative Effects

The Tonto National Forest identified the following reasonably foreseeable future actions as likely, in conjunction with development of the Resolution Copper Mine, to contribute to cumulative impacts on transportation and access, which may include impacts on the roads adjacent to the proposed mine, roads that would provide regional access to the proposed mine and its facilities, roads within or cut off by the perimeter fence that would be inaccessible to the public from mine activities, and the proposed primary access roads and utility maintenance roads (see figure 3.5.4-1). As noted in section 3.1, past and present actions are assessed as part of the affected environment; this section analyzes the effects of any RFFAs, to be considered cumulatively along with the affected environment and Resolution Copper Project effects.

- *Pinto Valley Mine Expansion.* The Pinto Valley Mine is an existing open-pit copper and molybdenum mine located approximately 8 miles west of Miami, Arizona, in Gila County. Pinto Valley Mining Corporation is proposing to expand mining activities onto an estimated 1,011 acres of new disturbance (245 acres on Tonto National Forest land and 766 acres on private

Table 3.5.4-10. Miles of NFS roads decommissioned and lost for Alternative 4 tailings storage facility

Facility	Tonto National Forest NFS Roads Decommissioned and Lost (miles)*	Resolution Copper Applicant-Committed Improvements and Maintenance
Alternative 4 – Silver King: Total Roads	17.70	
NFS Road 229	1.97	Portions reconstructed to level 3
NFS Road 1010	0.32	None
NFS Road 1053	1.46	None
NFS Road 2358	0.22	None
NFS Road 2371	0.38	None
NFS Road 2374	0.78	None
NFS Road 2375	0.41	None
NFS Road 2386	0.20	Portions restored to level 1
NFS Road 2389	0.82	None
NFS Road 2442	0.39	None
NFS Road 2443	0.12	None
NFS Road 2444	0.18	None
NFS Road 2445	0.61	None
NFS Road 2446	0.14	None
NFS Road 2447	0.65	None
NFS Road 2448	1.18	None
NFS Road 2449	0.25	None
NFS Road 2450	0.06	None
NFS Road 2451	0.12	None
NFS Road 2452	1.43	None
NFS Road 3152	0.55	Portions reconstructed to level 3
NFS Road 3787	0.14	None
NFS Road 650	3.62	None†
NFS Road 982	1.70	None†

Note: Level 1 – Basic custodial care; Level 2 – High-clearance vehicles; Level 3 – Suitable for passenger cars

* Includes tailings facility (within fence line) and borrow area footprints; does not include pipeline or transmission line corridors, which are assumed to allow roads to remain open. Road segments less than 0.05 miles not shown.

† The GPO indicates reconstruction of portions of these roads to level 2, but those actions were specific to the tailings storage facility at the Near West location.

land owned by Pinto Valley Mining Corporation) and extend the life of the mine to 2039. Impact analysis for the EIS is still pending; however, it is reasonable to expect that continued mine operations would contribute to heavy haul truck traffic along U.S. 60 and other roadways in the area, as well as vehicular traffic from mine employees, contractors, and others coming to and from the Pinto Valley Mine.

- *Ripsey Wash Tailings Project.* Mining company ASARCO is planning to construct a new tailings storage facility to support its Ray Mine operations. The environmental effects of the project were analyzed in an EIS conducted by the USACE and approved in a ROD issued in December 2018. As approved, the proposed tailings storage facility project would occupy an estimated 2,574 acres and be situated in the Ripsey Wash watershed just south of the Gila River approximately 5 miles west-northwest of Kearny, Arizona, and would contain up to approximately 750 million tons of material (tailings and embankment material). ASARCO estimates a construction period of 3 years and approximately 50 years of expansion of the footprint of the tailings storage facility as slurry tailings are added to the facility, followed by a 7- to 10-year period for reclamation and final closure. Impacts on transportation include a minor increase of approximately 115 vehicles per day along SR 177 during 3-year construction phase; during operations, only a negligible increase in project-associated vehicular traffic is anticipated. Approximately 1.4 miles of the existing, unpaved Florence-Kelvin Highway would be rerouted to the north and northeast of the tailings storage facility site and replaced with paved (asphalt) road. Cumulative effects associated with this project would be primarily related to the Alternative 5 – Peg Leg tailings storage facility location, with traffic using similar roads.
- *Silver Bar Mining Regional Landfill and Cottonwood Canyon Road.* AK Mineral Mountain, LLC, NL Mineral Mountain, LLC, POG Mineral Mountain, LLC, SMT Mineral Mountain, LLC, and Welch Mineral Mountain, LLC proposed to build a

municipal solid waste landfill on private property surrounded by BLM land in an area known as the Middle Gila Canyons area. There is no way to access the proposed landfill without crossing BLM land. The owners/developers and Pinal County have applied for a BLM right-of-way grant and Temporary Use Permit for two temporary construction sites to obtain legal access to the private property and authorization of the needed roadway improvements. The proposed action includes improving a portion of the existing Cottonwood Canyon Road and a portion of the existing Sandman Road in order to accommodate two-way heavy truck traffic to and from the proposed landfill. Traffic generated by the planned landfill would significantly increase the overall annual daily traffic on Cottonwood Canyon Road. Average annual daily traffic would increase by approximately 367 percent (303 percent during winter months and 549 percent in summer). Greater safety risks may occur on this road due to the mixed use of OHVs and truck traffic to and from the proposed landfill, as the traffic generated by the landfill would primarily consist of tractor/trailer vehicles with a gross weight of over 80,000 pounds. Mineral Mountain Road and Price Road would likely be impacted by displaced traffic due to temporary closures and disruption of access on Cottonwood Canyon Road.

- *Imerys Perlite Mine.* Imerys Perlite Mine submitted a plan of operations in 2013 which included plans for continued operation of the existing sedimentation basin at the millsite; continued use of segments of NFS roads for hauling; and mining at the Forgotten Wedge and Rosemarie Exception No. 8 claims. The proposed action would have Imerys Perlite Mine continuing use of NFS Roads 229, 989, and a portion of NFS Road 2403 throughout the life of the project. Imerys would be responsible for maintaining these roads at a native-surfaced road level. Traffic to and from the millsite would occur on a regular basis.
- *Ray Land Exchange and Proposed Plan Amendment.* ASARCO is also seeking to complete a land exchange with the BLM by

which the mining company would gain title to approximately 10,976 acres of public lands and federally owned mineral estate located near ASARCO's Ray Mine in exchange for transferring to the BLM approximately 7,304 acres of private lands, primarily in northwestern Arizona. It is known that at some point ASARCO wishes to develop a copper mining operation in the "Copper Butte" area west of the Ray Mine; however, no details are currently available as to potential environmental effects, including to transportation and access, resulting from this possible future mining operation. Under the proposed action, holders and lessees of current and existing rights-of-way would negotiate directly with ASARCO regarding their status, terms, and conditions.

- *Tonto National Forest Plan Amendment and Travel Management Plan.* The Tonto National Forest is currently in the process of revising its forest plan to replace the plan now in effect, which was implemented in 1985. Simultaneously, the Tonto National Forest is developing a Supplemental EIS to address certain court-identified deficiencies in its 2016 Final Travel Management Rule EIS. Both documents and their respective implementing decisions are expected within the next 2 years. Both documents would have substantial impacts on NFS roads and transportation routes through Tonto National Forest lands. Based on the proposed travel management changes:
 - A number of routes identified for decommissioning fall within the project footprint; these would have no additional impacts when considered cumulatively with Resolution Copper Project impacts.
 - No transportation routes identified for proposed decommissioning would render invalid any alternative access routes needed to bypass project facilities.
 - Several routes proposed for decommissioning parallel proposed pipeline corridor segments. These would likely come into conflict since access roads are needed along the pipeline corridors. This occurs primarily along the Alternative 5 western pipeline corridor option.
- No new roads proposed by Resolution Copper appear to conflict with roads proposed for decommissioning.
- *Copper King Exploratory Drilling/Superior West Exploration.* This project combines the environmental review of two mineral exploration projects proposed by Bronco Creek Exploration, Copper King, and Superior West. While Bronco Creek Exploration is the mining claimant, the exploration would be funded and bonded by Kennecott Exploration Company (part of the Rio Tinto Group), who would be the operator of record for both Plans of Operations. The combined projects result in a total of 106 unique drill site locations identified, of which the proponent would be authorized to select up to 43 to be drilled over a 10-year period. Existing roads and helicopter would be used to access drill sites. Some additional traffic would occur, but would be unlikely to cumulatively add to Resolution Copper Project impacts.
- *ADOT Vegetation Treatment.* ADOT plans to conduct annual treatments using EPA-approved herbicides to contain, control, or eradicate noxious, invasive, and native plant species that pose safety hazards or threaten native plant communities on road easements and NFS lands up to 200 feet beyond road easement on the Tonto National Forest. It can reasonably be assumed that ADOT would continue to conduct vegetation treatments along U.S. 60 on the Tonto National Forest during the expected life of the Resolution Copper Mine (50–55 years) for safety reasons. The vegetation treatment could impact motorized use along roads from additional traffic and road use, but impacts would be minimal and would be unlikely to cumulatively add to impacts from the Resolution Copper Project.
- *LEN Range Improvements.* Two actions have been proposed relating to the LEN allotment, which is a large grazing allotment in the so-called "Copper Butte" area located south of Superior between SR 177 on the east side and the White Canyon

Wilderness on the west side; the LEN allotment is administered by the BLM Tucson Field Office. The first action would be to renew the grazing permit (#6197). The second action includes redrilling eight existing wells and drilling three new wells; equipping them with solar pumps, storage tanks, and water troughs; and performing maintenance of roads and access to the range improvements. Presently, conditions of some roads on the allotment are in disrepair and are not passable except by high-clearance four-wheel-drive vehicles. The proposed project would include minimal road maintenance and repair to allow drilling equipment into the project sites. This improvement could increase access to the area, but is not expected to be cumulative with Resolution Copper Project impacts, as none of the project disturbance is in this same area.

Other projects and plans are certain to occur or be in place during the foreseeable life of the Resolution Copper Mine (50–55 years). These, combined with general population increase and increase in recreation from mitigation measures coordinated by Resolution Copper (such as the planned outdoor recreation hub at the town of Superior, and the Recreation User Group [RUG] Plan), may cumulatively contribute to future changes to transportation use patterns in the region.

3.5.4.8 Mitigation Effectiveness

The Forest Service is in the process of developing a robust mitigation plan to avoid, minimize, rectify, reduce, or compensate for resource impacts that have been identified during the process of preparing this EIS. Appendix J contains descriptions of mitigation concepts being considered and known to be effective, as of publication of the DEIS. Appendix J also contains descriptions of monitoring that would be needed to identify potential impacts and mitigation effectiveness. As noted in chapter 2 (section 2.3), the full suite of mitigation would be contained in the FEIS, required by the ROD, and ultimately included in the final GPO approved by the Forest Service. Public comment on the EIS, and in particular appendix J, will inform the final suite of mitigation measures.

At this time, no mitigation measures have been identified that would be pertinent to transportation and access. Applicant-committed environmental protection measures have been detailed elsewhere in this section, would be a requirement for the project, and have already been incorporated into the analysis of impacts.

Unavoidable Adverse Impacts

Increased traffic associated with mine worker commuting and truck traffic to and from the mine are expected to result in impacts that cannot be avoided or fully mitigated, including increased traffic congestion and increased risk of traffic accidents. Decreases in LOS to subpar levels (LOS E or F) would occur at several intersections due to mine traffic, unless traffic changes were made to accommodate the increased traffic. The only applicant-committed environmental protection measure that would alleviate impacts on LOS would be the addition of turn lanes at the SR 177/U.S. 60 intersection.

Access to the Oak Flat area, including Devil's Canyon and Apache Leap, would be maintained to an extent, but would use less-direct routes than NFS Road 315, which currently provides the primary access. Loss of access to these areas would be mitigated, but not fully.

Loss of access to the highlands north of the West Plant Site would be fully offset for Alternatives 2, 3, 5, and 6 by rerouting the road. Loss of access to the general public under Alternative 4 would not be mitigated by this measure, as only administrative access would be maintained.

All alternatives, including Alternative 6, could result in some loss of access to mining activities and grazing facilities in the area around the tailings storage facilities.

3.5.4.9 Other Required Disclosures

Short-Term Uses and Long-Term Productivity

Impacts from increased mine-related traffic would be short-term impacts that would cease when the mine is closed.

Irreversible and Irretrievable Commitment of Resources

Irretrievable impacts on transportation and access would occur as a result of an increase of traffic on State, County, and public NFS roads from mining and related activities within the analysis area and from the reduction of public access to roads within the perimeter fence. Because mine-related traffic would cease after mine closure, traffic impacts would not be considered an irreversible commitment of resources. Existing roads that would be decommissioned within the perimeter fence of the mine would constitute both an irreversible and irretrievable commitment of resources. Roads that are permanently covered with tailings or within the subsidence area would be an irreversible commitment, whereas those that are cut off to public access by the perimeter fence could potentially be restored or rerouted following mine closure and therefore are considered to be an irretrievable commitment of resources.

Overview

Motorized mine equipment and vehicles, potential large-scale ground surface disturbance and conveyance, and placement of mine tailings can adversely affect air quality through emissions and wind-borne particulates generated during mining operations. Short- and long-term local air quality monitoring records, as well as regional monitoring of National Ambient Air Quality Standards (NAAQS), ozone (O₃), hazardous air pollutants (HAPs), anticipated effects on visibility, and other Federal and State emissions standards are key factors that help to analyze potential project impacts. Class I and Class II sensitive areas are of specific concern.

3.6 Air Quality

3.6.1 Introduction

Air quality conditions are a valuable resource from an aesthetic and human health perspective, and they are subject to specific regulations that aim to protect that resource. Local and regional aspects of air quality may be affected by the proposed action and alternatives during construction, operations, and closure and reclamation. The applicable regulations and policies establish thresholds for evaluating air quality impacts, and this section includes a description of the existing environment and potential consequences (impacts on air quality) of the proposed action and alternatives under that regulatory framework. The regulatory framework protects aesthetic and human health conditions. Beyond regulation of specific contaminants, the Forest Service has further responsibility to consider the impacts of air quality to special areas like wilderness and national parks, and these effects are also considered in this section. We briefly summarize some aspects of the analysis in this section. Additional details not included are captured in the project record (Newell et al. 2018).

3.6.2 Analysis Methodology, Assumptions, and Uncertain and Unknown Information

3.6.2.1 Analysis Area

The full analysis area consists of the area modeled for potential air quality impacts (the “near field” and “far field” areas) and can be seen in figure 3.6.2-1. The physical nature of the emission, along with the location, operating times, and amount of emissions are developed for each emission source. The ambient air quality impacts are assessed at locations (receptors) that begin at the fence line or ambient air boundary of each of the plant sites (East Plant Site, West Plant Site, tailings storage facility, filter plant and loadout facility). The applicable regulations and policies have established thresholds for evaluating air quality impacts and include special provisions for sensitive areas (Class I areas such as national parks and wilderness areas, and certain sensitive Class II areas); these sensitive areas fall within the analysis area as well.

3.6.2.2 Methodology

Air Quality Modeling and Direct Emission Amounts

The assessment of air quality impacts is a complex process that begins with identifying and characterizing the air emission sources and quantifying emission rates from the proposed action, based on the GPO. Air Sciences Inc. (Air Sciences) identified the physical nature of the emissions,

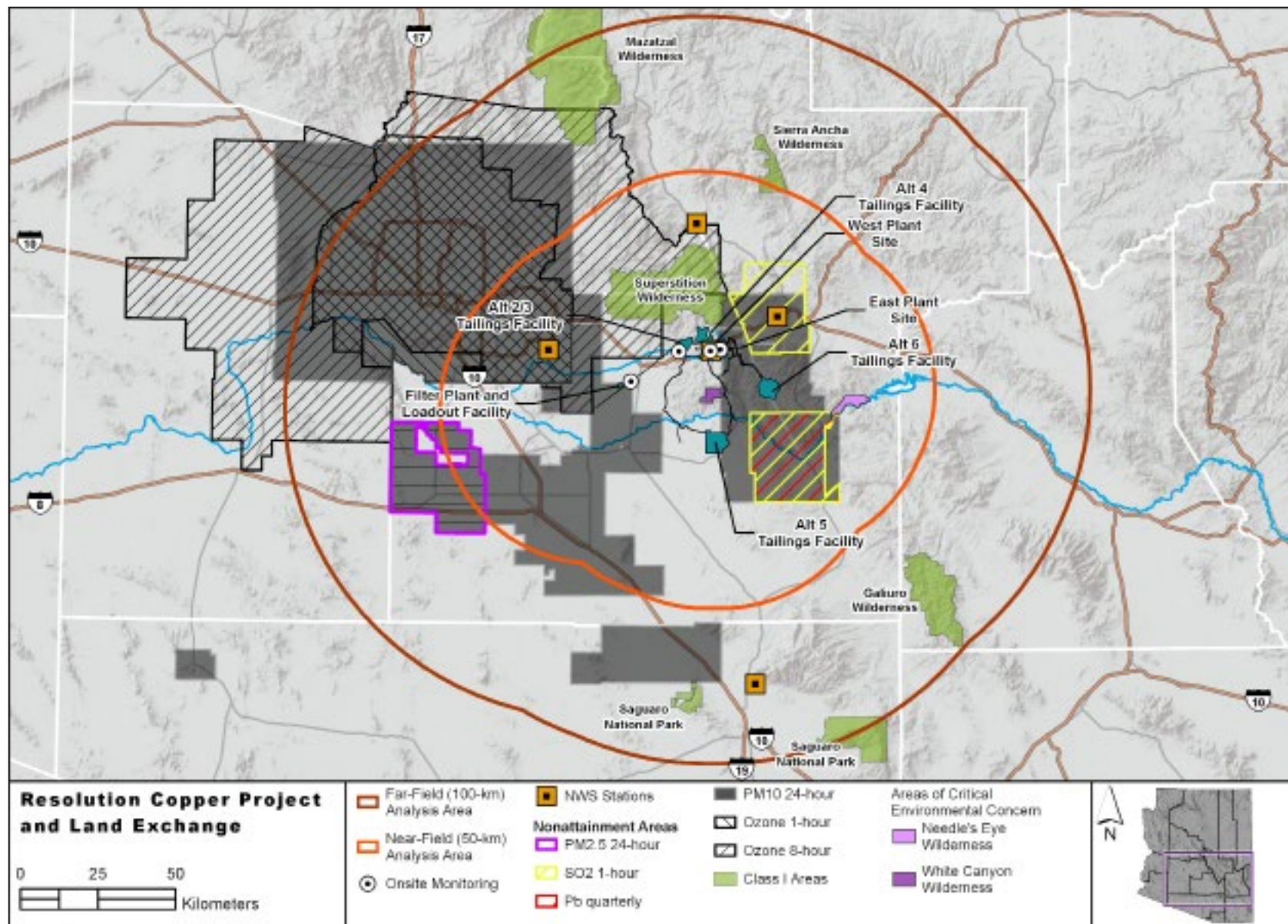


Figure 3.6.2-1. Analysis area showing proposed action and alternatives, sensitive areas, and meteorological monitoring sites

along with the location, operating times, and amount of emissions for each emission source. Modeling of these emissions, combined with background concentrations, is evaluated at the ambient air boundary²⁶ of each plant site (East Plant Site, West Plant Site, tailings storage facility, filter plant and loadout facility). Those boundaries are shown in figure 3.6.2-1.

Based on guidance from the ADEQ, the EPA, 40 CFR Part 51 Appendix W, and the Forest Service, analysts examined the impacts within 50 km (“near field”) of the site locations with one model, and impacts beyond 50 km (“far field”) with a different dispersion model (Arizona Department of Environmental Quality 2015; U.S. Forest Service et al. 2010). The EPA approves the AERMOD modeling system to determine impacts in the near field of the source or facility. A separate model platform, CALPUFF, is used to determine far field impacts from 50 km to 100 km from the facility or operation. Each model requires a separate set of meteorological data to capture the atmospheric dispersion characteristics, and each model produces a gridded output of impacts at ground-level receptors. The dispersion models relies on 2 continuous years of meteorological data collected from the on-site monitors. The AERMOD dispersion models used 2 continuous years of meteorological data collected from the on-site monitors, and the CALPUFF model used 3 years of gridded data (2015–2017).

Emissions vary over the life of the mine, with the maximum potential emissions occurring in year 14 (Air Sciences Inc. 2019). At this point in time, process sources would be operating at maximum capacity. Fundamentally, the dispersion modeling platforms require that emission sources be categorized into one of two groups based on the physical characteristics of the emission source. *Point* sources are used to model emissions that are released through a vent, stack, or opening. *Area*

Table 3.6.2-1. Total annual controlled emissions for proposed action (tons/year)

Source Category	CO	NO _x	PM _{2.5}	PM ₁₀	SO ₂	VOC
Process	20.6	44.4	29.2	49.5	15.0	69.3
Fugitive	28.8	5.5	45.4	276.4	1.8	0.2
Mobile	566.0	68.5	3.2	2.9	1.0	33.2
Total	615.9	118.4	77.8	328.9	17.8	102.7

Notes: Totals may not sum exactly due to rounding.

CO = carbon monoxide; NO_x = nitrogen oxides; PM_{2.5} = particulate matter 2.5 microns in diameter or smaller; PM₁₀ = particulate matter 10 microns in diameter or smaller; SO₂ = sulfur dioxide; VOC = volatile organic compound

sources are used to model fugitive emissions sources such as wind erosion from disturbed surfaces, reentrained dust from roadways, and tailpipe emissions from motor vehicles. Each group involves a different approach to characterizing emissions and estimating impacts at nearby receptors (Air Sciences Inc. 2018b). The total emissions for year 14 are provided in table 3.6.2-1 and include emissions for Alternative 2 (Air Sciences Inc. 2018c).

For an overall comparison of the alternatives, the potential emissions that pose the greatest concern, and represent the greatest potential differences from an air quality perspective, include fugitive dust (particulate matter 10 microns in diameter or smaller [PM₁₀] and particulate matter 2.5 microns in diameter or smaller [PM_{2.5}]) emissions, process PM₁₀ and PM_{2.5} emissions, and emissions of nitrogen oxides (NO_x) from diesel-fired equipment. Total lead emissions would be 0.023 ton/year (46 lb/year), and impacts are not further analyzed (Newell et al. 2018).

26. The “ambient air boundary” represents the location where air quality is modeled, including both background air quality and contributions from the project. National Ambient Air Quality Standards (NAAQS) must be met at this boundary. For this project, the fence line at each facility along with an established area of restricted access was used to represent the ambient air boundary. Public access is excluded within this area. Therefore, ensuring that regulatory standards are met at this point is protective of public health.

In addition to these criteria pollutant²⁷ emissions, there are small amounts of hazardous air pollutants (HAPs) emitted from the proposed project (Newell et al. 2018). The estimated potential HAP emissions from the project are less than the major source thresholds (10 tons/year of any one HAP or 25 tons/year of all HAPs) under the National Emission Standards for Hazardous Air Pollutants (40 CFR 63). Therefore, the project would be classified as an area source and would be subject only to limited Maximum Achievable Control Technology standards for area sources, as listed in that regulation.

To meet regulatory requirements of the Pinal County Air Quality Control District (PACQCD), Resolution Copper performed dispersion modeling and impact analyses in support of their permit application to construct this facility. The proposed action qualifies as a “minor source” for PACQCD permitting purposes. This assessment uses the dispersion modeling analysis to demonstrate compliance with applicable PACQCD and NAAQS within 50 km of the project area. Details of the AERMOD permitting analysis, input, receptor grids, settings, and results are provided in Air Sciences (2018c). The Forest Service is using the same model to understand and disclose impacts in the EIS.²⁸ In addition to the ambient air boundary and surrounding nested receptor grid, impacts are also specifically assessed at identified Sensitive Areas and Class I areas (the Superstition Wilderness Area),²⁹ which are depicted in figure 3.6.2-1.

Within the 50-km distance from the proposed action sites, the analysis also addresses impacts on air quality, acid deposition, and plume blight. Sensitive areas within this range include the Superstition Wilderness, the

White Canyon Area of Critical Environmental Concern (ACEC), and the Needle’s Eye Wilderness.

Impacts on regional haze and acidic deposition at Class I areas beyond 50 km and within 100 km of the project are evaluated using the CALPUFF dispersion model system, approved for use by the EPA. Details of the CALPUFF modeling are provided in Air Sciences (2018c). The Class I areas that Air Sciences evaluated include Galiuro Wilderness, Mazatzal Wilderness, Saguaro National Park and Saguaro Wilderness Area, and the Sierra Ancha Wilderness. The analysis of these areas includes air quality impacts, compared with ambient standards and prevention of significant deterioration (PSD) increments, visibility or haze, and deposition of total sulfur and nitrogen.

Generally, air quality impacts from a source decrease with distance from that source. As a first step, areas are screened from analysis using the standard source/distance (U.S. Forest Service et al. 2010) method based on the total emissions of PM₁₀, sulfur dioxide (SO₂), NO_x, and sulfuric acid (H₂SO₄) in tons per year divided by the distance to the area in kilometers. Using this method, Air Sciences screened several areas as too distant: the Pine Mountain Wilderness, Mount Baldy Wilderness, and Sycamore Canyon Wilderness (Air Sciences Inc. 2018c).

Impacts on visibility and deposition are compared with the established acceptable levels of impact at receptors in each Class I area, using both the 24-hour maximum and the annual emission rates to assess visibility and deposition, respectively. Maximum impacts for each Class I and sensitive Class II area are tabulated for each parameter.

-
27. “Criteria pollutants” are regulated by the Clean Air Act, and each criteria pollutant has a numeric NAAQS that must be met. There are six basic criteria pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO₂), ozone (O₃), particulate matter (further divided into PM₁₀ and PM_{2.5}), and sulfur dioxide (SO₂).
28. Note that while the same air quality model may be used, the specific output may differ between PACQCD permitting requirements and Forest Service NEPA requirements. The results shown in the DEIS reflect the total emissions from the project, regardless of whether they are applicable to the PACQCD permit process.
29. “Class I” areas are defined by the Clean Air Act and receive special consideration for air quality impacts. A Class I area must be specifically designated by the EPA; these usually include national parks, wilderness areas, monuments, and other areas of special national and cultural significance. Most of the rest of the country is considered a “Class II” area. However, in some cases, sensitive Class II areas (such as the White Canyon ACEC) are treated similarly to Class I areas.

Climate Change and Greenhouse Gas Emissions

While global surface air temperatures have increased over the past century, changes in the Southwest have caused markedly increased average annual temperatures and reduced water storage due to early spring snowpack runoff (Garfin et al. 2013; Intergovernmental Panel on Climate Change 2013). It is extremely likely that anthropogenic factors have caused most of the increase in global surface temperatures and emissions of greenhouse gases (Romero-Lankao et al. 2014), which include carbon dioxide (CO₂), nitrous oxide, and methane, among others. The trends in temperature and effects of snowmelt runoff, with declining river flow, are predicted to continue into the foreseeable future (Garfin et al. 2013).

The proposed action would lead to emissions of greenhouse gases based largely on fuel use by mobile sources with a minor contribution from process combustion sources. The total greenhouse gas emissions would amount to 173,328 CO₂ equivalent tonnes/year, based on year 14

Table 3.6.2-2. Total annual indirect emissions for proposed action caused by employee traffic and deliveries (tons/year)

Source Category	CO	NO _x	PM _{2.5}	PM ₁₀	SO ₂	VOC
Employees	64.4	3.0	5.5	22.6	0.2	0.7
Deliveries	1.3	3.7	4.7	19.4	0	0.3
Total	65.7	6.6	10.1	42.0	0.2	1.0

Notes: Totals may not sum exactly due to rounding.

CO = carbon monoxide; NO_x = nitrogen oxides; PM_{2.5} = particulate matter 2.5 microns in diameter or smaller; PM₁₀ = particulate matter 10 microns in diameter or smaller; SO₂ = sulfur dioxide; VOC = volatile organic compound

with the highest emission rates. Project emissions would contribute to ongoing climatic trends.

Indirect Emission Amounts

Modeling for compliance with air quality standards is based on direct emissions from point and area sources for the various components of the project. Additional emissions can be indirectly caused by the project by the expected increase in road traffic for employee travel or deliveries and are estimated in table 3.6.2-2 (Newell et al. 2018).

Health Risk Assessment

For the purposes of the NEPA analysis, the ability to meet air quality standards is considered protective of public health,³⁰ therefore, a separate health-based analysis of individual constituents, particularly those associated with particulate emissions, is not necessary in order to disclose impacts on human health (SWCA Environmental Consultants 2018b). However, the levels of metals deposition associated with particulate emissions were estimated and compared with Regional Screening Levels for which the EPA has derived carcinogenic and/or non-carcinogenic chronic health effects. Where the cancer risk health quotient is less than 1, excess cancer risk is less than 1×10^{-6} , and where the non-carcinogenic chronic health effects health quotient is less than 1, the health index for non-carcinogenic chronic health effects is less than 1. For all alternatives, the estimated human health risk associated with the maximum air concentrations of inorganic metals is less than 1×10^{-6} cancer risk (representing a risk below 1.0 for cancer) and below 1.0 for non-carcinogenic chronic health effects. Further background about these estimations can be found in Newell et al. (2018).

30. The NAAQS are promulgated to protect human health with an adequate margin of safety (see Clean Air Act 109(b) and 40 CFR 50.2).

Presence of Asbestiform Minerals or Naturally Occurring Radioactive Materials

An analysis was conducted to identify the presence of asbestiform minerals that could become part of the tailings, as well as naturally occurring radioactive materials. A summary of these investigations is contained in Section 3.7.2. Groundwater and Surface Water Quality. The investigation determined that substantial information exists to answer these questions, and neither asbestos nor radioactive materials are present in the ore body above typical background concentrations.

3.6.3 Affected Environment

3.6.3.1 Relevant Laws, Regulations, Policies, and Plans

A wide range of Federal, State, and local requirements regulate air quality impacts of mine operations. Many of these require permits before the mine operations begin; others may require approvals or consultations, mandate the submission of various reports, and/or establish specific prohibitions or performance-based standards (Newell et al. 2018; U.S. Forest Service et al. 2010).

3.6.3.2 Existing Conditions and Ongoing Trends

Resolution Copper conducted air quality and meteorological monitoring at the proposed project area. The locations of the monitors are shown in figure 3.6.2-1. Particulate matter (PM₁₀ and PM_{2.5}) has been monitored at the West Plant monitoring site and the East Plant monitoring site. Nitrogen dioxide (NO₂), SO₂, and ozone have been monitored at the East Plant Site. The results of the Resolution Copper air quality monitoring program are shown in figure 3.6.3-1, along with the applicable ambient standards. The data show some year-to-year variability, but there is no evident trend, except for the 1-hour SO₂ levels.

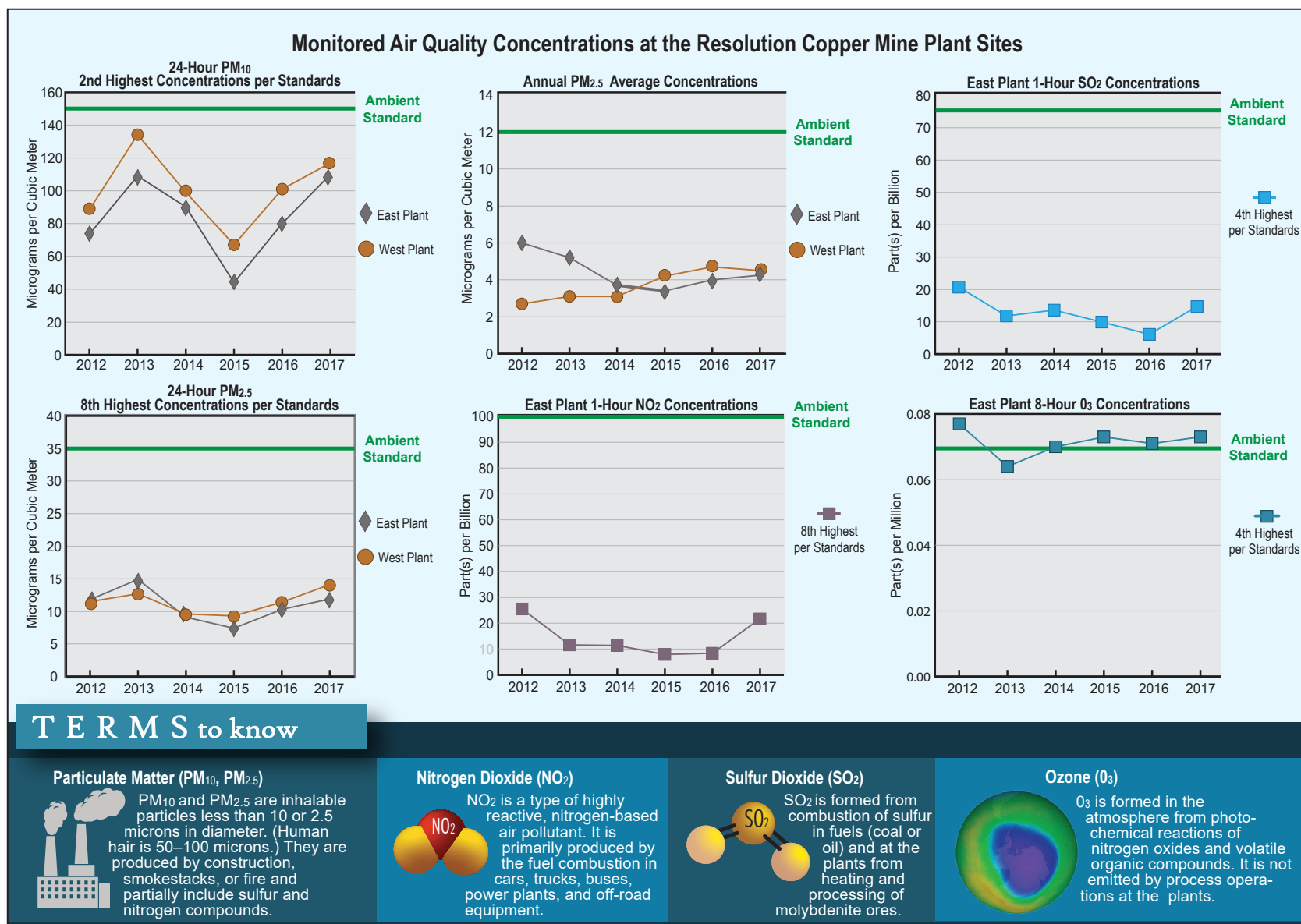
All monitoring data show compliance with the applicable standards, except potentially for ozone (the 3-year average, eighth highest

Primary Legal Authorities Relevant to the Air Quality Effects Analysis

- Pinal County has been delegated responsibility under the Clean Air Act, and County, State, and Federal air quality regulations would be met through issuance of a Class II air permit (West Pinal PM₁₀ Moderate Nonattainment Area, Chapter 4 Article 1 of the PCAQCD Code of Regulations)
- Additional Forest Service guidance for air-quality related values (deposition and visibility) contained in U.S. Forest Service et al. (2010)
- General Conformity Rule (Clean Air Act Section 176(c)(4); implanted in 40 CFR 93); applicable only to Alternatives 5 and 6

daily maximum ozone level, is used to evaluate compliance with the standard). The arithmetic average of the last 3 years of ozone monitoring is 0.072 parts per million (ppm) (truncated), which is above the current ambient standard of 0.070 ppm. The data show the variability over the 5-year period and include relatively high PM₁₀ and PM_{2.5} levels in 2013. Although there is no distinct trend except for the annual PM_{2.5} at the West Plant Site, the West Plant Site shows an annual average increase of 0.4 micrograms per cubic meter (µg/m³) per year in PM_{2.5} concentrations over the monitoring period. The hourly NO₂ and SO₂ levels have steadily declined over this period, until 2017.

Resolution Copper collected meteorological data at three sites near the proposed mine operations, including the East Plant Site, West Plant Site, and Near West location, and used data from 2 years (2015–2016) to conduct the near-field air quality impact analysis. The data include wind speed, wind direction, stability category, and temperature. The data show a strong prevailing wind pattern at all sites with the dominant prevailing wind from the northeast quadrant for the East Plant Site and West Plant Site, and from the southeast quadrant for the Near West location. A

Figure 3.6.3-1. Monitoring results for PM₁₀, PM_{2.5}, NO₂, SO₂, and ozone relative to standards under 40 CFR 50

secondary prevailing wind from the west and southwest is evident at all sites.

Conformity

The General Conformity Rule was established under Clean Air Act Section 176(c)(4) and implemented in 40 CFR 93; it serves to ensure that Federal actions do not inhibit State attainment plans for areas designated as non-attainment or maintenance. The rule effectively applies to all Federal actions that take place in areas designated as non-attainment or maintenance. The near-field project analysis area is located within three counties (Pinal, Maricopa, and Gila Counties, Arizona). The East Plant Site would be partially located in the Hayden PM₁₀ Nonattainment Area and the filter plant and loadout facility would be located in the West Pinal PM₁₀ Nonattainment Area.

The Forest Service has determined that a conformity analysis for this area is not warranted for the alternatives in or near these two Nonattainment Areas (Newell et al. 2018). At the time of publication of the DEIS, the ADEQ is petitioning the EPA to have the Hayden PM₁₀ area designated as Attainment, based on the fact that ambient concentrations have not exceeded the standards for several years (Arizona Department of Environmental Quality 2018b). In addition, modeling results (Air Sciences Inc. 2018c) demonstrate that the impacts from the proposed alternatives do not exceed the ambient air quality standards. The filter plant and loadout facility would be located within the West Pinal PM₁₀ Nonattainment Area, but a formal General Conformity analysis would not be required for this Nonattainment Area, for reasons including that PM₁₀ emissions are well below the 100 tons/year threshold, and dispersion modeling demonstrates that PM₁₀ impacts around this facility are well below the applicable standard.

Regional Climatology

The regional climate is characterized as semiarid; there are often long periods with little or no precipitation (Western Regional Climate Center 2018). Precipitation falls in a bimodal pattern: most of the annual

rainfall within the region occurs during the winter and summer months, with dry periods mainly in the spring and fall. The total average annual precipitation varies between 15.7 inches and 18.8 inches, with 52 percent of the precipitation falling between November and April. Although there may be snow at higher elevations, it does not typically accumulate in the region. Precipitation usually occurs with steady, longer duration frontal storm events during the winter months (December through March). Rain events during the summer months (July to early September) are typically of shorter duration with more intensity associated with thunderstorms.

3.6.4 Environmental Consequences of Implementation of the Proposed Mine Plan and Alternatives

3.6.4.1 Alternative 1 – No Action

Under the no action alternative, there would be no impacts on air quality from proposed mining and associated activities. Existing and ongoing impacts on air quality from fugitive dust and vehicle emissions are expected to increase over time with continued population growth in central Arizona. However, it is expected that monitoring and remedial actions by Maricopa County, Pinal County, and ADEQ would be effective in keeping these gradual changes within NAAQS.

3.6.4.2 Direct and Indirect Effects Common to All Action Alternatives

Effects of the Land Exchange

The land exchange would have limited effects on air quality. The Oak Flat Federal Parcel would leave Forest Service jurisdiction; no significant effects are expected. However, the Tonto National Forest would lose its authority to provide direction and support to management activities in order to meet minimum air standards.

The offered lands parcels would enter either Forest Service or BLM jurisdiction, allowing those agencies to secure authority over

management activities pertaining to air quality. However, it is important to note that the air quality currently existing within the offered lands parcels is unlikely to experience significant change after transfer to Federal jurisdiction. These parcels are primarily inholdings of surrounding Forest Service– or BLM-managed lands and likely reflect air quality of the surrounding areas that are already managed to achieve these air quality standards.

Effects of Forest Plan Amendment

The Tonto National Forest Land and Resource Management Plan (1985b) provides guidance for management of lands and activities within the Tonto National Forest. It accomplishes this by establishing a mission, goals, objectives, and standards and guidelines. Missions, goals, and objectives are applicable on a forest-wide basis. Standards and guidelines are either applicable on a forest-wide basis or by specific management area.

A review of all components of the 1985 forest plan was conducted to identify the need for amendment due to the effects of the project, including both the land exchange and the proposed mine plan (Shin 2019). One standard and guideline was identified applicable to air quality. This standard and guideline was found to not require amendment to the proposed project, either on a forest-wide or management area–specific basis. For additional details on specific rationale, see Shin (2019).

Summary of Applicant-Committed Environmental Protection Measures

A number of environmental protection measures are incorporated into the design of the project that would act to reduce potential impacts on air quality. These are non-discretionary measures, and their effects are accounted for in the analysis of environmental consequences.

From the GPO (Resolution Copper 2016d), Resolution Copper has committed to a variety of measures to reduce potential impacts on air quality:

- Dust control on roads, including regular watering, road base maintenance and dust suppression, paving select access roads to the East Plant Site and West Plant Site with asphalt, and setting reasonable speed limits on access roads within the operational footprint.
- Dust control at the tailings storage facility, including delivering tailings to the storage facility via distribution pipelines and continuously wetting the tailings during active deposition. During non-active periods, dust emissions would be managed by establishing a temporary vegetative cover on construction areas that would be inactive and exposed for longer than 12 months, wetting inactive beaches and embankment surfaces with irrigation from sprinkler systems, and treatment with chemical or polymer dust suppressants, if necessary.
- Dust control at East Plant Site, including periodic water and/or chemical dust suppressant, normal mining controls such as wet drilling and the wetting of broken rock, application of water suppression spray to control dust ore conveyance, dedicated exhaust ventilation systems and/or enclosures for crushers and transfer points underground, performing primary crushing and conveying underground, and saturating underground exhaust ventilation.
- Dust control at West Plant Site, including housing main active ore stockpiles in fully covered buildings, applying water suppression spray to control dust ore conveyance, processing ore in a new enclosed building, and enclosing conveyor transfer points within the concentrator building.
- Dust control during shipping, including bagging molybdenum concentrate at the concentrator facility before shipping and enclosing loadout building and storage shed.

Other applicant-committed environmental protection measures by Resolution Copper include those outlined in the “Final Air Quality Impacts Analysis Modeling Plan” (Air Sciences Inc. 2018a) and Resolution Copper’s current air quality permit, including the following:

- Use of low-sulfur diesel in mobile and stationary equipment;
- Use of a scrubber to control SO₂ emissions from the drying of molybdenum concentrate at the West Plant Site;
- Use of Tier 4 diesel engines (or greater); and
- Use of fencing, berms, locking gates, signage, natural barriers/steep terrain (25 to 30 percent or greater), and site security measures to limit access roads and other locations near areas of heavy recreational use. These same methods would be required to limit public access within the mine site (i.e., the air modeling boundary) to prevent public exposure to mine emissions.

Air Quality Impact Assessment

The dispersion modeling effort described in section 3.6.3 is used to characterize ambient air quality impacts at receptors in the area of each of the proposed facilities (East Plant Site, West Plant Site, filter plant, and loadout facility), as well as the alternative tailings storage facility locations. Air Sciences generated a composite receptor grid of the impacts from the separate model runs for these facilities and used the grid to evaluate impacts; in other words, the emissions from each facility were modeled separately but then combined to assess impacts. The maximum impact for each of the criteria air pollutants over the composite receptor grid determines the direct effects of the proposed action and the alternatives. The impacts include the model results of emissions from the proposed action and alternatives added to a “background” air quality value that represents the ongoing impacts from other sources (including natural sources) in the area, and in effect represents the cumulative impact of the proposed action and other sources (Air Sciences Inc. 2018b). The background concentrations are based in part on the Resolution Copper data from the monitoring sites (see figure 3.6.3-1). These impacts are then compared with the appropriate standard, some of which have specific time components (i.e.,

8-hour average). Details of the analysis are provided in Air Sciences (2018c).

Results of the modeled maximum impacts at all receptors for each of the criteria air pollutants are shown in table 3.6.4-1 for the proposed action (Alternative 2 – Near West Proposed Action). The emissions from the mining and processing operations at the East Plant Site, West Plant Site, and tailings storage facility boundary are taken from the year of maximum ore production (year 14) and added to the impacts from the maximum erodible area for the affected tailings storage facility.³¹ Annual impacts are based on the annual average emission rate for each source; maximum hourly impacts are based on the hourly maximum emission rate for all sources; and 24-hour maximum impacts are based on the maximum 24-hour emission rate for the sources. None of the predicted results are anticipated to exceed the NAAQS at the ambient air boundary/fence line.

Air quality impacts were modeled for each alternative, but the results are largely the same. Maximum impacts for other alternatives would be very similar to those shown in table 3.6.4-1. Detail of the results of other alternative air quality modeling are contained in Newell et al. (2018).

For all alternatives, the maximum total impacts for carbon monoxide (CO), 1-hour NO₂, and short-term SO₂ (24 hours or less) would occur at or near the boundary of the East Plant Site due to the large number of combustion sources at that site. The maximum annual impacts for NO₂ would occur at the filter plant and loadout facility and the maximum annual SO₂ impacts would occur at the West Plant Site, although both impacts would be well below the applicable ambient air quality standards.

As can be noted from table 3.6.4-1, maximum 1-hour NO₂ impacts would be about 78 percent of the standard, based on the average of the daily maximum 1-hour 98th percentile value over a 2-year period. Figure 3.6.4-1 shows the maximum impact for the 1-hour NO₂ design value at receptors around the East Plant Site and West Plant Site for

31. For the tailings facilities, the largest source of contaminants is fugitive dust, which largely depends on the amount of ground disturbed and exposed to wind. Therefore, assuming the largest exposed area—even at years before buildout occurs—ensures that air quality impacts are not underestimated.

Table 3.6.4-1. Maximum air quality impacts for proposed operations and Alternative 2 – Near West Proposed Action

Pollutant	Model Result/Form of Standard	Proposed Action Impact Only ($\mu\text{g}/\text{m}^3$)	Background ($\mu\text{g}/\text{m}^3$)	Total Maximum Impact ($\mu\text{g}/\text{m}^3$)	Standard ($\mu\text{g}/\text{m}^3$)	Total Maximum Impact as a Percentage of Standard
CO_1H	3rd high over 2 years	4,531	3,550	8,081	40,500	20
CO_8H	3rd high over 2 years	1,040	2,519	3,559	10,000	36
NO ₂ _1H	98th percentile over 2 years	138	9	146	188	78
NO ₂ _AN	Max annual over 2 years	2	3	5	100	5
PM ₁₀ _24H	3rd high over 2 years	26	71	97	150	65
PM ₁₀ _AN*	Max annual over 2 years	7	17	25	50	49
PM ₂₅ _24H	98th percentile over 2 years	11	6	18	35	51
PM ₂₅ _AN	Average annual over 2 years	2	4	6	12	49
SO ₂ _1H	99th percentile over 2 years	92	24	117	196	59
SO ₂ _3H	2nd high over 2 years	56	31	86	1,300	7
SO ₂ _24H*	2nd high over 2 years	9	11	20	365	6
SO ₂ _AN*	Max annual over 2 years	1	2	3	80	4

Note: $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter

* Not a Federal standard

Alternative 2 – Near West Proposed Action.³² The overall maximum would occur at the ambient air boundary of the East Plant Site, with the relatively higher values toward the north and east of the East Plant Site. Predicted impacts are reduced substantially with distance from the East Plant Site ambient air boundary. The impacts are analyzed and depicted on a nested grid of receptors (see figure 3.6.4-1).

The maximum design value 24-hour average impacts for PM_{2.5} would occur at the eastern boundary of the East Plant Site, as shown in figure

3.6.4-2 (also for Alternative 2 – Near West Proposed Action). The maximum 24-hour average impacts, as well as the annual average impacts for PM_{2.5} and PM₁₀, occur at or near the boundaries of the East Plant Site, West Plant Site, and tailings storage facility. The predicted highest impacts tend to be captured within the 100-m grid spacing, within 1 km of the ambient air boundary. Impacts at most of the receptors around the East Plant Site and other project sites would be less than one-half of the design value ambient standard.³³ Maximum PM_{2.5}

32. In figures 3.6.4-1 and 3.6.4-2, the impacts are analyzed and depicted on a nested grid, with a sub-grid of receptors at 100-m spacing out to 1 km from the ambient air boundary, a 500-m grid spacing from 1 km to 5 km from the boundary, nested 1,000-km and 2,500-km grid spacing beyond that distance, and 25-m receptors along the ambient air boundaries and nearby roadways. The more densely nested 100-m sub-grid is clearly depicted in the figure, and the higher impacts are captured largely within this sub-grid of receptors.

33. The design value of the ambient air quality standard refers to the calculation of compliance with the standard. For example, the design value of the 1-hour NO₂ standard is the 3-year average of the annual 98th percentile of the highest daily 1-hour ozone concentration.

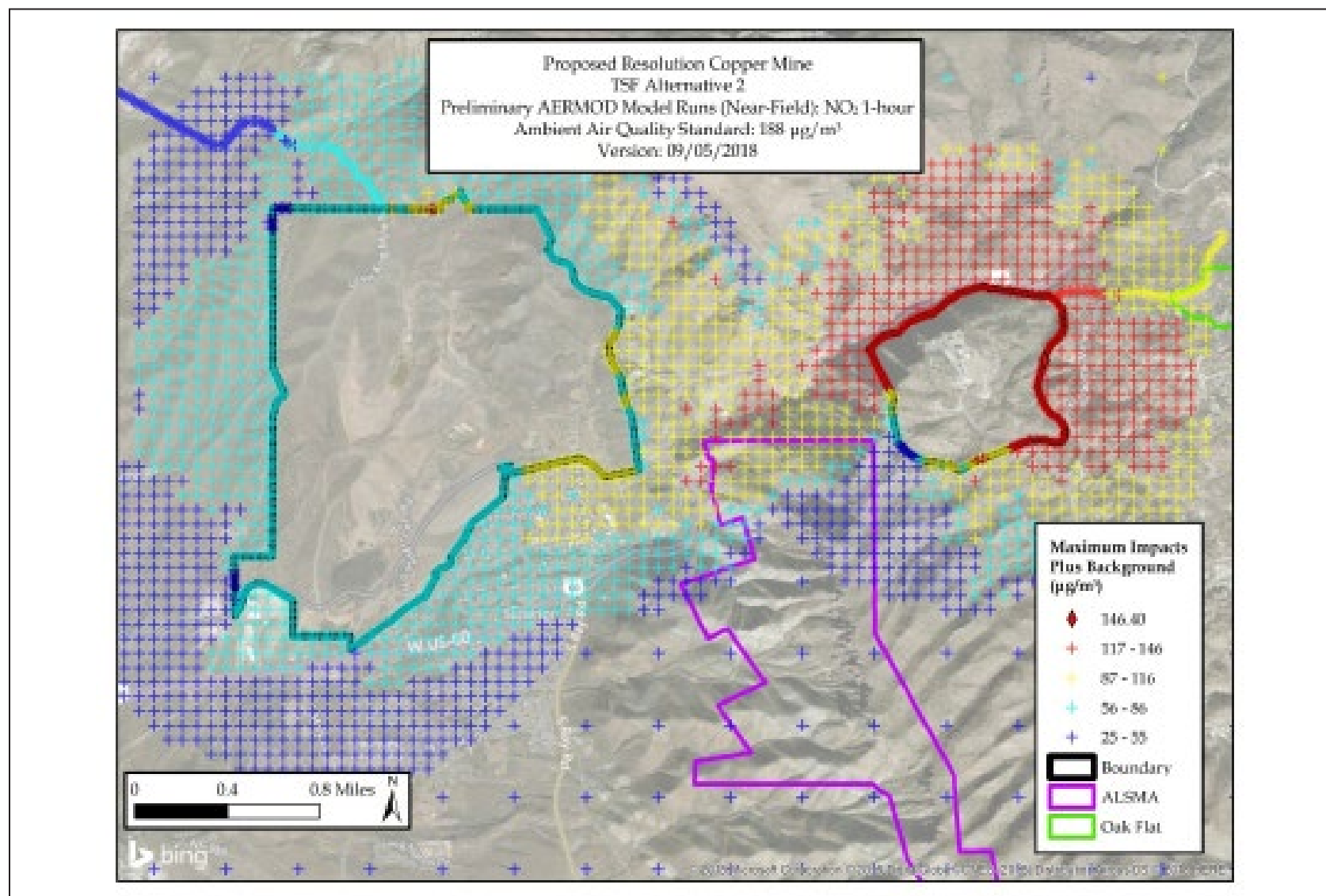


Figure 3.6.4-1. Maximum 1-hour 98th percentile NO₂ impacts at receptors near East Plant Site and West Plant Site for Alternative 2 – Near West Proposed Action

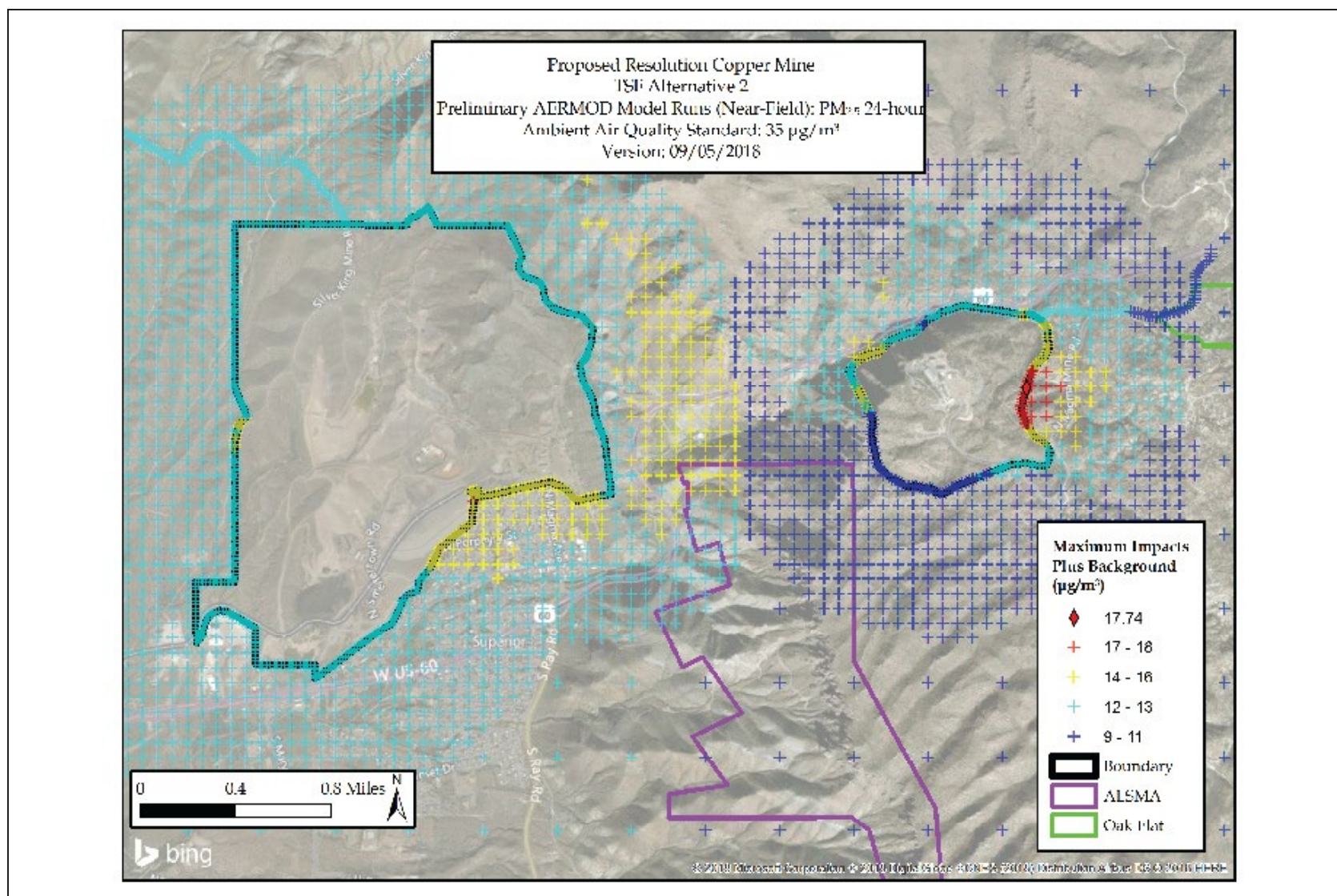


Figure 3.6.4-2. Maximum 24-hour 98th percentile PM_{2.5} impacts at receptors near the tailings storage facility for Alternative 2 – Near West Proposed Action

impacts for the other alternatives are equivalent to Alternative 2, and are also located around the East Plant Site boundary.

A separate analysis of ozone formation and secondary $PM_{2.5}$ formation was conducted (Air Sciences Inc. 2018c) based on total emissions using the thresholds provided by the EPA (2017). Results indicate that the maximum impacts would be below the established thresholds of impact for both of these pollutants, as provided by the guidance. The calculated secondary $PM_{2.5}$ would be $0.23 \mu\text{g}/\text{m}^3$ for the 24-hour maximum impact and $0.008 \mu\text{g}/\text{m}^3$ for the maximum annual impact. Adding these results to the calculations for primary $PM_{2.5}$ impacts would not change the data that are provided in table 3.6.4-1.

Impacts at Sensitive Areas

As designated during the scoping process, the Forest Service identified specific sensitive areas that include Class I areas and Areas of Critical Environmental Concern (ACECs). Areas within 50 km of the proposed action are modeled using the AERMOD platform, and areas from 50 to 100 km are analyzed using the CALPUFF modeling platform. These models use different characterizations to conduct the analyses (see Air Sciences (2018c)).

Table 3.6.4-2 provides the projected maximum incremental air quality impact for any of the alternatives at all receptors in each designated area. Representative background concentrations were not added to the modeled impacts. The analysis focuses on determining whether impacts at the Class I areas and sensitive Class II areas are of concern, and since the air quality impacts are below established significance levels, additional analysis with background concentrations is not warranted. Among the alternatives, and all the Class I areas, the impacts from Alternative 4 are greatest at the Superstition Wilderness, but they remain well below the PSD increments. Impacts represent the maximum among

the alternatives; impacts for the other alternatives are less than the reported value and may be below 50 percent of that impact.

All impacts are projected to be less than the PSD increments at the Class I areas and, except for the Superstition Wilderness, would have an insignificant³⁴ impact at those areas. The highest 24-hour impacts of PM_{10} and $PM_{2.5}$ emissions on air quality at the Superstition Wilderness consume up to 50 percent of the Class I PSD increments for those standards but are well below ambient standards, when background concentrations are added. Impacts are greatest at the area boundary and decrease rapidly with distance toward the remainder of the area. All ambient air quality impacts at the (Class II) White Canyon ACEC are well below the Class II PSD increments. The maximum impacts at this area are for $PM_{2.5}$; PM_{10} is 8 percent of the PSD Class II increments.

Impacts on the deposition of nitrogen (N) and sulfur (S) from the proposed action have also been projected through the same modeling platforms. Impacts are compared with the designated Deposition Analysis Thresholds (DAT) (U.S. Forest Service et al. 2011). The DAT value for S is 5 grams/hectare/year (g/ha/year) and for N is 10 g/ha/year. Results for the maximum deposition at each area among all the alternatives are provided in table 3.6.4-3, for both the S and N deposition estimates for the proposed action. There is little difference among the impacts of the alternatives at each of the sensitive areas.

Visibility impacts are analyzed separately depending on the distance from the source of emissions. Within 50 km, impacts on plume blight³⁵ at the Superstition Wilderness and the White Canyon ACEC are based on designated vistas within those areas. The impacts are generated under the PLUVUE II analysis (U.S. Environmental Protection Agency 1992), which focuses on a single plume and is analyzed only for meteorological conditions during daylight hours. The analysis is directionally dependent, and where appropriate a representative characterization of the 24-hour emissions of SO_2 , NO_x , and PM_{10} were combined into a single

34. Comparisons with the PSD Class I Significant Impact Levels are provided for information only. No formal further analysis is required because the proposed action and alternatives do not trigger review and approval under the PSD regulations.

35. Plume blight is a visual impairment of air quality that manifests itself as a coherent plume.

Table 3.6.4-2. Maximum ambient air quality impacts at identified sensitive areas

Pollutant / Standard*	Class I Areas						Class II Areas		
	PSD Class I Increment ($\mu\text{g}/\text{m}^3$)	Superstition Wilderness ($\mu\text{g}/\text{m}^3$)	Sierra Ancha Wilderness ($\mu\text{g}/\text{m}^3$)	Mazatzal Wilderness ($\mu\text{g}/\text{m}^3$)	Galiuro Wilderness ($\mu\text{g}/\text{m}^3$)	Saguaro National Park ($\mu\text{g}/\text{m}^3$)	PSD Class II Increment ($\mu\text{g}/\text{m}^3$)	White Canyon ACEC† ($\mu\text{g}/\text{m}^3$)	Needle's Eye Wilderness† ($\mu\text{g}/\text{m}^3$)
NO ₂ _AN	2.5	0.109	0.007	0.008	0.009	0.010	25	0.60	0.011
PM ₁₀ _24H	8.0	4.26	0.463	0.394	0.476	0.793	30	2.46	0.454
PM ₁₀ _AN	4.0	0.318	0.018	0.020	0.027	0.028	17	0.168	0.030
PM _{2.5} _24H	2.0	1.57	0.123	0.125	0.139	0.173	9	0.834	0.146
PM _{2.5} _AN	1.0	0.119	0.006	0.009	0.007	0.008	4	0.053	0.010
SO ₂ _3H	25	4.41	0.380	0.294	0.251	0.340	512	2.55	0.334
SO ₂ _24H	5	0.994	0.080	0.076	0.053	0.054	91	0.478	0.066
SO ₂ _AN	2	0.008	0.002	0.001	0.003	0.002	20	0.023	0.003

Notes: $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter; shaded columns show standard for comparison for the Class I and Class II areas evaluated in this table

* See table 3.6.4-1 for more detail on specific standards

† PSD Class II Increments apply to White Canyon ACEC and Needle's Eye Wilderness

Table 3.6.4-3. Maximum deposition analysis impacts at sensitive areas

Constituent	DAT Value (g/ha/year)	Superstition Wilderness (g/ha/year)	White Canyon ACEC (g/ha/year)	Sierra Ancha Wilderness (g/ha/year)	Mazatzal Wilderness (g/ha/year)	Galiuro Wilderness (g/ha/year)	Saguaro National Park (g/ha/year)	Needle's Eye Wilderness (g/ha/year)
Sulfur	5	1.42	0.77	0.16	0.10	0.05	0.02	0.22
Nitrogen	10	4.18	2.94	0.33	0.19	0.15	0.05	1.06

Note: g/ha/year = grams per hectare per year

plume. Results are provided for each of the observer locations in the two areas in table 3.6.4-4, indicating the number of daylight hours per year that a plume is perceptible at the indicated vistas for Alternatives 2 and 3. Perceptibility is based on the absolute contrast threshold, $|C|$, of 0.02 and a color contrast for gray terrain, ΔE , of 1.0 (figure 3.6.4-3).

Over the extended areas, the visibility of a plume against terrain features is affected by the height of the terrain and the position of the observer. The frequencies reported represent a general characterization of plume impacts when viewing terrain; there would be generally a 2 to 6 percent probability of a visible plume during daylight hours in the Superstition Wilderness. The impact at any one location could be different based on the terrain and the distance of the plume from the source(s). The plume may be visible in one direction but not in the opposite direction, for example. The frequency of a visible plume impact against the blue sky, however, would generally decrease with farther distances from the source(s). The effect or frequency of cloudy conditions is not taken into account in this analysis.

Beyond 50 km, visibility impacts are predicted based on regional haze, which is a general condition in the impact area based on maximum concentrations of the impacts at those areas. Data for SO_2 , NO_x , sulfates, and nitrates are used to evaluate these impacts. Annual average natural conditions are added to the predicted impacts that would occur from the proposed action. Results are shown in table 3.6.4-5 for the highest 98th percentile of the daily percent of extinction among the alternatives. A threshold value of 5 percent from a single source is considered a significance threshold for conducting an additional impact analysis, and a 10 percent cumulative impact is considered a perceptible impact. All impacts are well below the 5 percent threshold that requires further analysis, demonstrating that impacts on regional haze at these locations would not be perceptible for any of the alternatives.

The analysis of air quality impacts for the proposed action and alternatives shows that all impacts would be within the ambient air quality standards and well below the PSD increments. The proposed emission sources would comply with applicable regulations, and impacts

Table 3.6.4-4. Annual total and percentage of daylight hours of perceptible plume blight at observer locations in sensitive areas, Superstition Wilderness, and White Canyon ACEC

	$ C $	ΔE	$ C $	ΔE
Observer Location	Sky	Sky	Terrain	Terrain
Montana Mountain (Superstition Wilderness)	206 (4.7%)	189 (4.3%)	170 (3.9%)	136 (3.1%)
Government Hill (Superstition Wilderness)	204 (4.7%)	182 (4.1%)	110 (2.5%)	89 (2.0%)
Iron Mountain (Superstition Wilderness)	194 (4.4%)	177 (4.0%)	177 (4.0%)	143 (3.3%)
Mound Mountain (Superstition Wilderness)	166 (3.8%)	147 (3.4%)	169 (3.8%)	138 (3.1%)
Superstition Mountain ridgeline (Superstition Wilderness)	133 (3.0%)	141 (3.2%)	283 (6.4%)	248 (5.6%)
White Canyon (White Canyon ACEC)	11 (0.2%)	9 (0.2%)	28 (0.6%)	14 (0.3%)

Note: There is a total of 4,386 hours of daylight per year.

Table 3.6.4-5. Impacts of 98th percentile daily regional haze extinction levels in Class I areas

Affected Area	Proposed Action (%)
Threshold	5
Sierra Ancha Wilderness	0.35
Mazatzal Wilderness	0.15
Galiuro Wilderness	0.16
Saguaro National Park	0.17

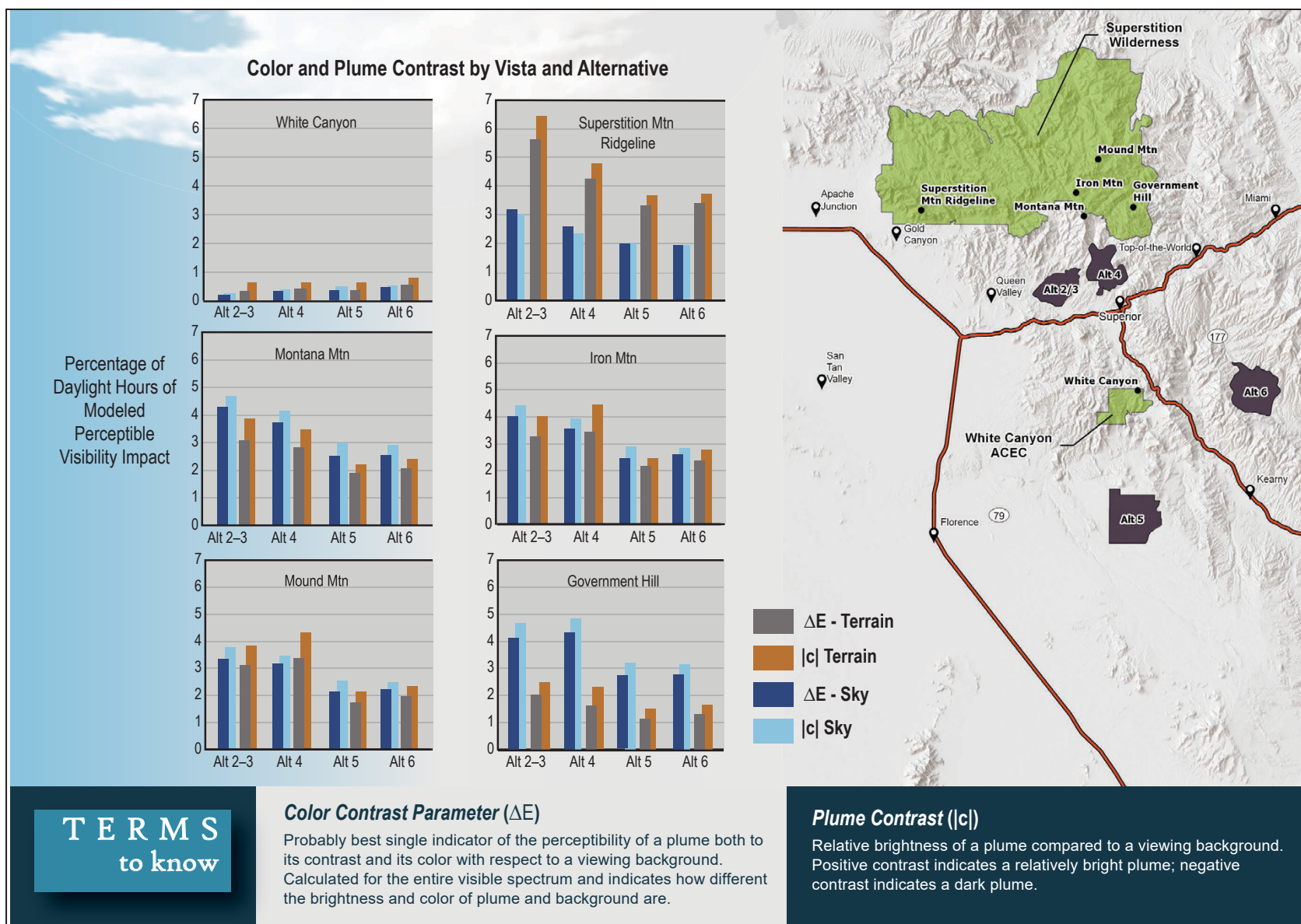


Figure 3.6.4-3. Near-field visibility of plume blight based on the absolute contrast threshold, $|C|$, of 0.02 and a color contrast for gray terrain, ΔE , of 1.0

on air quality-related values would be within the established thresholds for levels of acceptability.

3.6.4.3 Cumulative Effects

The Tonto National Forest identified the following reasonably foreseeable future actions as likely, in conjunction with development of the Resolution Copper Mine, to contribute to cumulative impacts on air quality in the “near field” vicinity of the proposed Resolution Copper Mine and its project alternative component locations (e.g., tailings facilities) as well as at more distant, or “far field,” locations in much of Pinal County, Gila County, and Maricopa County (see figure 3.6.2-1). As noted in section 3.1, past and present actions are assessed as part of the affected environment; this section analyzes the effects of any RFFAs, to be considered cumulatively along with the affected environment and Resolution Copper Project effects.

- Pinto Valley Mine Expansion.* The Pinto Valley Mine is an existing open-pit copper and molybdenum mine located approximately 8 miles west of Miami, Arizona, in Gila County. Pinto Valley Mining Corporation is proposing to expand mining activities onto an estimated 1,011 acres of new disturbance (245 acres on Tonto National Forest land and 766 acres on private land owned by Pinto Valley Mining Corporation) and extend the life of the mine to 2039. This proposed expansion would foreseeably result in construction-related vehicle exhaust emissions (including NO₂, SO₂, and diesel-generated particulate matter) as well as potential increases in airborne particulate matter through large-scale earthmoving, wind effects on newly disturbed and exposed ground, and other activities. However, no data are available at this time to determine how these potential future increases may cumulatively affect overall air quality in the analysis area.
- Ripsey Wash Tailings Project.* Mining company ASARCO is planning to construct a new tailings storage facility to support its Ray Mine operations. The environmental effects of the project were analyzed in an EIS conducted by the USACE and approved in a ROD issued in December 2018. As approved, the proposed tailings storage facility project would occupy an estimated 2,574 acres and be situated in the Ripsey Wash watershed just south of the Gila River approximately 5 miles west-northwest of Kearny, Arizona, and would contain up to approximately 750 million tons of material (tailings and embankment material). ASARCO estimates a construction period of 3 years and approximately 50 years of expansion of the footprint of the tailings storage facility as slurry tailings are added to the facility, followed by a 7- to 10-year period for reclamation and final closure. An air quality analysis conducted for the EIS found the project to be in conformance with the Clean Air Act (i.e., with no exceedances of criteria pollutant thresholds) and also with the relevant State Implementation Plan. The Ripsey Wash tailings storage facility is intended to replace the existing Ray Mine Elder Gulch tailings storage facility, which would be phased out and closed as the Ripsey Wash facility becomes operational; any additive cumulative effects are thus considered negligible.
- Ray Land Exchange and Proposed Plan Amendment.* ASARCO is also seeking to complete a land exchange with the BLM by which the mining company would gain title to approximately 10,976 acres of public lands and federally owned mineral estate located near ASARCO’s Ray Mine in exchange for transferring to the BLM approximately 7,304 acres of private lands, primarily in northwestern Arizona. It is known that at some point ASARCO wishes to develop a copper mining operation in the “Copper Butte” area west of the Ray Mine; however, no details are currently available as to potential environmental effects, including to air quality, resulting from this possible future mining operation. It should be noted that the Copper Butte area lies within current ADEQ nonattainment areas for ozone, lead, and PM₁₀, and that mining development has the potential to generate additional levels of these criteria pollutants.

- *ADOT Vegetation Treatment.* ADOT plans to conduct annual treatments using EPA-approved herbicides to contain, control, or eradicate noxious, invasive, and native plant species that pose safety hazards or threaten native plant communities on road easements and NFS lands up to 200 feet beyond road easement on the Tonto National Forest. It can be reasonably assumed that ADOT would continue to conduct vegetation treatments along U.S. 60 on the Tonto National Forest during the expected life of the Resolution Copper Mine (50 to 55 years) for safety reasons. Activity and traffic could contribute marginally to fugitive dust in the area but would not result in any substantial change when considered with Resolution Copper Project air quality impacts.
- *Tonto National Forest Travel Management Plan.* The Tonto National Forest is currently in the process of developing a Supplemental EIS to address certain court-identified deficiencies in its 2016 Final Travel Management Rule EIS. This document and its implementing decisions are expected within the next 2 years. The Supplemental EIS currently proposes a total of 3,708 miles of motorized routes open to the public, a reduction from the 4,959 miles of motorized open routes prior to the Travel Management Rule. Limiting availability of motorized routes open to the public would result in reduced access to recreational activities currently practiced on NFS lands, including sightseeing, camping, hiking, hunting, fishing, recreational riding, and collecting fuelwood and other forest products. Such a reduction in miles of available motorized routes should have the effect of leading to overall decrease in emissions and impacts from current levels.

Other mining activity, residential growth, government-sponsored projects and public infrastructure development (including construction of new roadways, electrical transmission lines, and other utilities), agricultural activity, and commercial economic activity is certain to occur in this area of south-central Arizona during the foreseeable future life of the Resolution Copper Mine (50–55 years). Each of these developments may cumulatively contribute to future changes to air

quality in the region. Some future expansion or curtailment of presently identified boundaries of nonattainment areas for NAAQS criteria pollutants is also possible, both because of ongoing changes in actual environmental conditions and because the EPA periodically reviews and revises the regulatory standards applicable to these pollutants.

3.6.4.4 Mitigation Effectiveness

The Forest Service is in the process of developing a robust mitigation plan to avoid, minimize, rectify, reduce, or compensate for resource impacts that have been identified during the process of preparing this EIS. Appendix J contains descriptions of mitigation concepts being considered and known to be effective, as of publication of the DEIS. Appendix J also contains descriptions of monitoring that would be needed to identify potential impacts and mitigation effectiveness. As noted in chapter 2 (section 2.3), the full suite of mitigation would be contained in the FEIS, required by the ROD, and ultimately included in the final GPO approved by the Forest Service. Public comment on the EIS, and in particular appendix J, will inform the final suite of mitigations. At this time, no mitigation measures have been identified that would be pertinent to air quality concerns. Applicant-committed environmental protection measures have already been detailed elsewhere in this section, will be a requirement for the project, and have already been incorporated into the analysis.

Unavoidable Adverse Effects

For the proposed action and all alternatives, emissions from project-related activities would meet applicable Federal and State standards for air quality but the increase in air pollutant concentrations would constitute impacts that cannot be avoided.

3.6.4.5 Other Required Disclosures

Short-Term Uses and Long-Term Productivity

Impacts on air quality (increased air pollutant concentrations but below applicable air quality standards) from mining and associated activities would be short term (during the estimated 51- to 56-year life of the mine, including construction, operations, and reclamation) and are expected to end with mine reclamation and return to pre-mining levels, assuming adequate revegetation success to stabilize dust emissions from disturbed areas.

Irreversible and Irretrievable Commitment of Resources

During the construction and mining phases of the project, air pollutant concentrations would be higher throughout the analysis area than current levels but within applicable air quality standards; thus, air quality is not impacted for other uses in the airshed and these effects would not be considered irretrievable. Following mine closure and successful reclamation, pollutant concentrations would return to pre-mining levels, and there would be no long-term irreversible commitment of resources.

Overview

Natural water features are scarce and important to tribes, wildlife, residents, and recreationists. The Resolution Copper Project could affect both water availability and quality in several ways. In order to construct mine infrastructure, dewatering of the deep groundwater system below Oak Flat began in 2009, and would continue through mining. As the block-caving and subsidence progress, eventually the effects of dewatering would extend to overlying aquifers as well. Changes in these aquifers, as well as capture of runoff by mine facilities and the subsidence area, could in turn affect springs, flowing streams, and riparian areas. In addition to loss of water, water quality changes could result from stormwater runoff, tailings seepage, or exposure of rock in the block-cave zone.

3.7 Water Resources

3.7.1 Groundwater Quantity and Groundwater-Dependent Ecosystems

3.7.1.1 Introduction

This section describes the analysis and predicted effects on the groundwater dependent ecosystems (GDEs), public and private water supply wells, and subsidence from dewatering.

Resolution Copper has monitored the quantity and quality of water in streams, springs, and riparian areas as far back as 2003, and dozens of wells have been installed for the sole purpose of understanding the local and regional hydrogeology, not just below Oak Flat but throughout the region. To assess impacts on groundwater resources, the long history of baseline data collection was considered holistically alongside

- the large geographic area involved;
- the complex geology and multiple aquifers, including the incorporation of the block-caving itself, which would fundamentally alter the geological structure of these aquifers over time;
- the long time frames involved for mining (decades) as well as the time for the hydrology to adjust to these changes (hundreds of years); and
- the fact that even relatively small changes in water levels can have large effects on natural systems.

A numerical groundwater flow model is the best available tool to assess groundwater impacts. Like all modeling, the Resolution Copper Mine groundwater model requires great care to construct, calibrate, and properly interpret. The Forest Service collaborated with a broad spectrum of agencies and professionals over several years to assess the groundwater modeling. This diverse group (see section 3.7.1.2) vetted the construction, calibration, and use of the groundwater model, and focused on understanding any sensitive areas with the potential to be negatively affected, including Devil's Canyon, Oak Flat, Mineral Creek, Queen Creek, Telegraph Canyon, Arnett Creek, and springs located across the landscape. The Forest Service refers to such areas as GDEs, which are "communities of plants, animals, and other organisms whose extent and life processes are dependent on access to or discharge of groundwater" (U.S. Forest Service 2012b).

Just as much care was taken to understand the limitations of the groundwater model. Specific model limitations are described in section 3.7.1.2 and reflect a careful assessment of how the results of a groundwater model can reasonably be used, given the uncertainties involved. This reflects a careful assessment of how the results of a groundwater model can reasonably be used, given the uncertainties involved.

The Forest Service undertook a two-part strategy to manage this uncertainty. First, any GDEs were assumed to be connected with the regional aquifers (and therefore potentially affected by the mine) unless direct evidence existed to indicate otherwise. Second, regardless of what the model might predict,

a monitoring plan would be implemented to ensure that actual real-world impacts are fully observed and understood.

This section analyzes impacts on GDEs and local water supplies from dewatering and block-caving, the amount of water that would be used by each alternative, the impacts from pumping of the mine water supply from the Desert Wellfield, and the potential for ground subsidence to occur because of groundwater pumping. Some aspects of the analysis are briefly summarized in this section. Additional details not included here are in the project record (Newell and Garrett 2018d).

3.7.1.2 Analysis Methodology, Assumptions, and Uncertain and Unknown Information

Analysis Area

The analysis area for assessing impacts on groundwater quantity and GDEs comprises the groundwater model boundary for the mine site (figure 3.7.1-1) as well as the groundwater model boundary for the East Salt River valley model (figure 3.7.1-2). Models were run up to 1,000 years in the future, but as described below quantitative results were reasonably applied up to 200 years in the future.

Modeling Process

In September 2017, the Tonto National Forest convened a multidisciplinary team of professionals, referred to as the Groundwater Modeling Workgroup. The Groundwater Modeling Workgroup included Tonto National Forest and Washington-level Forest Service hydrologists, the groundwater modeling experts on the project NEPA team, representatives from ADWR, AGFD, the EPA, the San Carlos Apache Tribe, and Resolution Copper and its contractors. This group included not only hydrologists working on the groundwater model itself, but also the biologists and hydrologists who have conducted monitoring in the field and are knowledgeable about the springs, streams, and riparian systems in the project vicinity. The Groundwater Modeling Workgroup tackled three major tasks: defining sensitive areas, evaluating the model

and assisting the Tonto National Forest in making key decisions on model construction and methodology, and assisting the Tonto National Forest in making key decisions on how to use and present model results.

SELECTED MODEL APPROACH

The groundwater model selected for the project is the MODFLOW-SURFACT program, selected in part because of the ability to change aquifer properties over time because of the effects of the block-caving. The assessment of the model by the Groundwater Modeling Workgroup, as well as the assessment of the conceptual hydrologic model upon which the numerical model is based, can be found in the technical memorandum summarizing the workgroup process and conclusions (BGC Engineering USA Inc. 2018a). A description of the model construction can be found in WSP USA (2019). Predictive and sensitivity results can be found in Meza-Cuadra et al. (2018b) and Meza-Cuadra et al. (2018c).

IDENTIFYING AND DEFINING GROUNDWATER-DEPENDENT ECOSYSTEMS

The Groundwater Modeling Workgroup developed the list of GDEs based on multiple sources of information; it ultimately evaluated in detail 67 different locations (Garrett 2018d). Any riparian vegetation or aquatic habitat around the GDEs is considered an integral part of the GDE.

The source of water for each GDE is important. Most of the 67 GDE locations the Groundwater Modeling Workgroup assessed were identified because of the persistent presence of water, year-to-year and season-to-season. In most cases this persistent water suggests a groundwater connection; however, the specific type of groundwater is important for predicting impacts on GDEs. There are generally two regional aquifers in the area: the Apache Leap Tuff, and the deep groundwater system. Any GDEs tied to these two aquifers have the potential to be impacted by mining. The deep groundwater system is being and would continue to be actively dewatered, and once

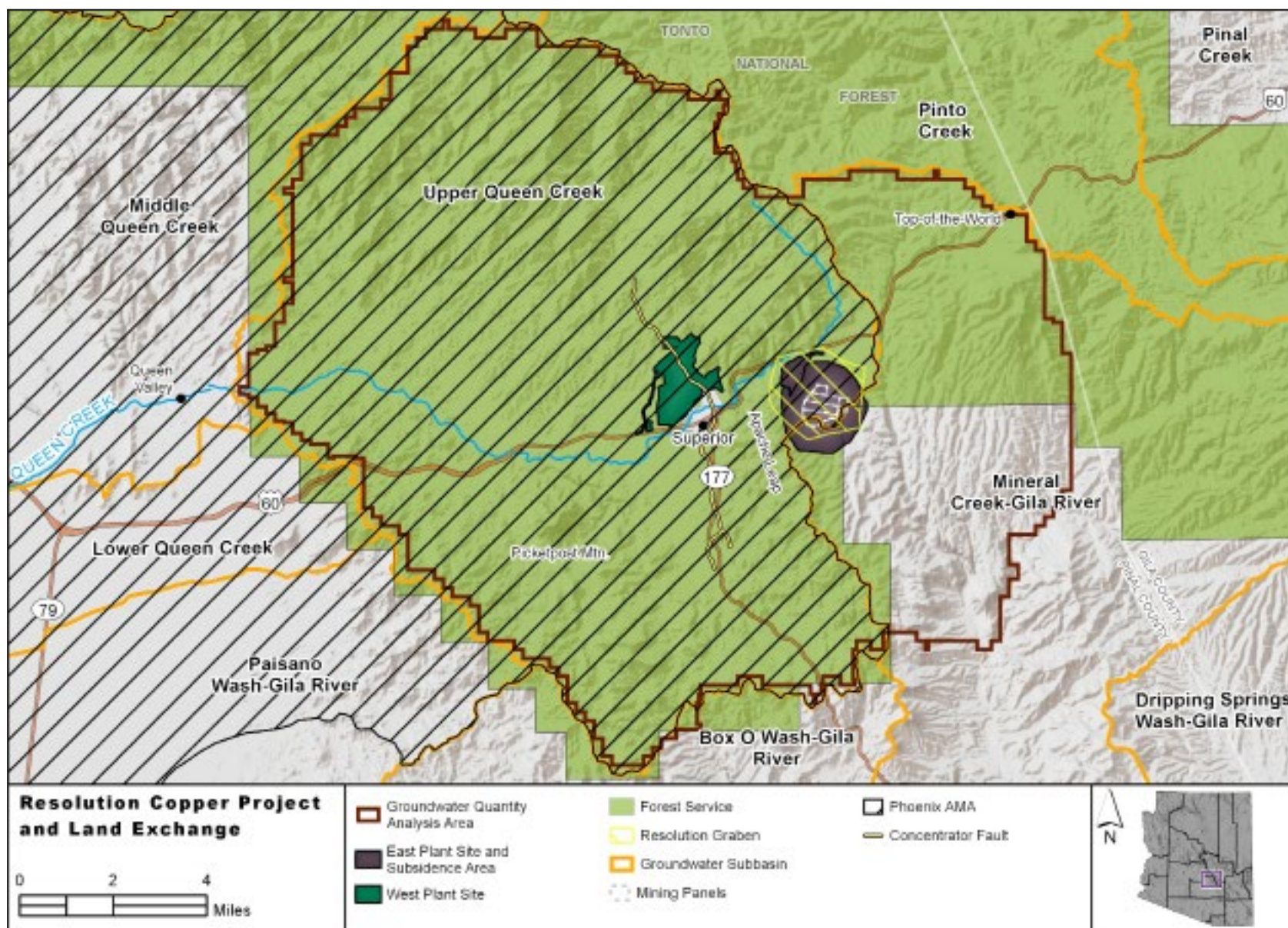


Figure 3.7.1-1. Overview of groundwater modeling analysis area

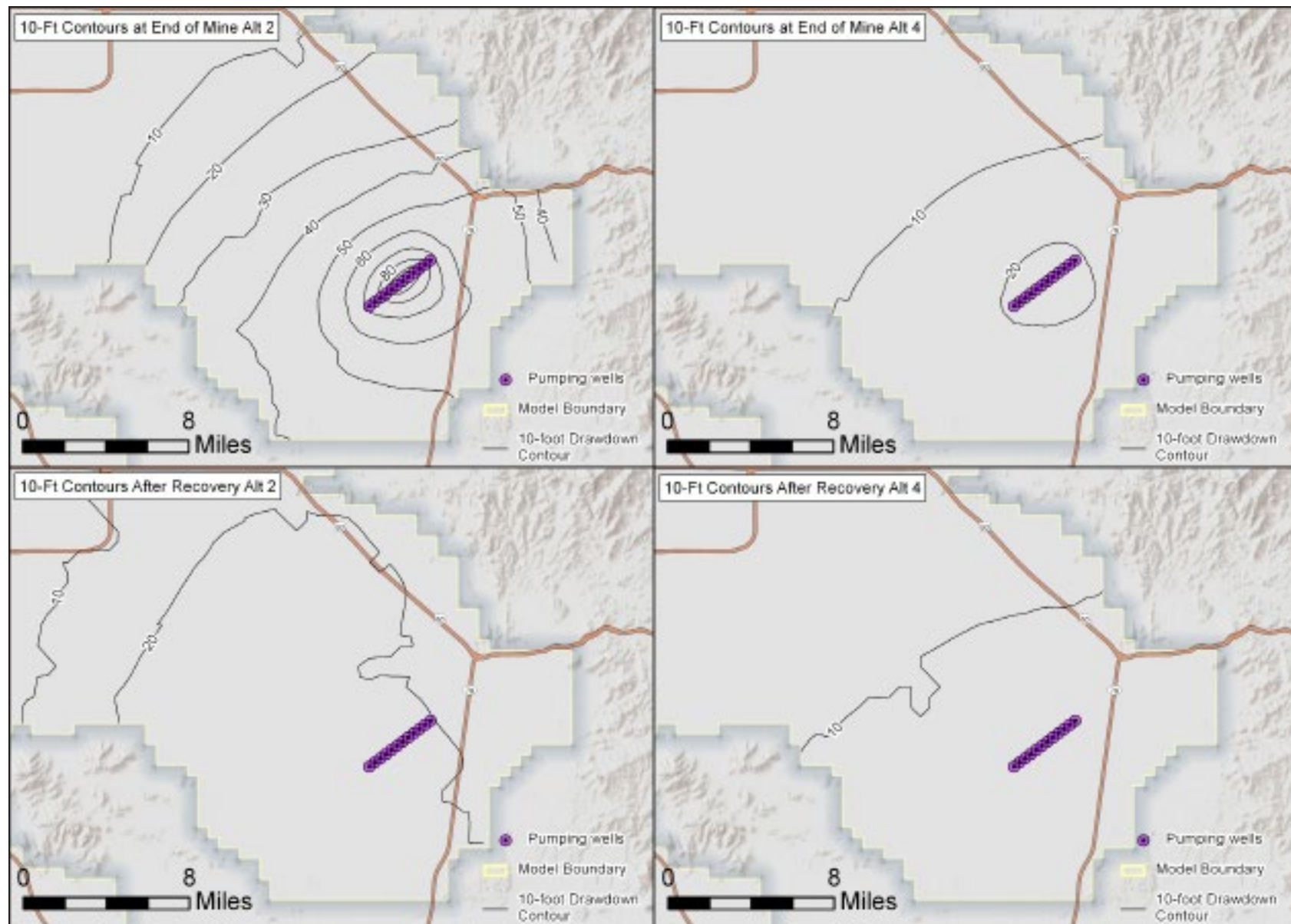


Figure 3.7.1-2. Desert Wellfield modeling analysis area and maximum (Alternative 2, left) and minimum (Alternative 4, right) modeled pumping impacts

block-caving begins the Apache Leap Tuff would begin to dewater as well.

In addition to the regional groundwater systems, another type of groundwater results from precipitation that is temporarily stored in near-surface fractures or alluvial sediments. While temporary, this water still may persist over many months or even years as it slowly percolates back to springs or streams or is lost to evapotranspiration. These near-surface features are perched well above and are hydraulically disconnected from both the Apache Leap Tuff aquifer and the deep groundwater system; therefore, this groundwater source does not have the potential to be impacted by mine dewatering. However, changes in the surface watershed could still affect these shallow, perched groundwater sources. Predictions of reductions in runoff caused by changes in the watershed are discussed in section 3.7.3; these changes are also incorporated into this section (3.7.1) in order to clearly identify all the combined effects that could reduce water available for a GDE.

Identifying whether a GDE derives flow from the deep groundwater system, the Apache Leap Tuff, or shallow, perched aquifers was a key part of the Groundwater Modeling Workgroup's efforts. A number of lines of evidence helped determine the most likely groundwater source for a number of GDEs: hydrologic and geological framework, inorganic water quality, isotopes, riparian vegetation, and the flow rate or presence of water. However, many more GDEs had little or no evidence to consider, or the evidence was contradictory. In these cases the Forest Service policy is to assume that a GDE has the potential to be impacted (Garrett 2018d; Newell and Garrett 2018a). In addition to identifying GDEs, the Groundwater Modeling Workgroup identified three key public water supply areas to assess for potential impacts from the mine.

EVALUATING THE MODEL AND MODELING APPROACH

The Groundwater Modeling Workgroup reviewed the work done by WSP (a contractor of Resolution Copper) and assisted the Tonto National Forest in determining the appropriate methodologies and approaches that should be used. In practice, this consisted of an open, iterative process by which the Groundwater Modeling Workgroup

requested data, the data were prepared and presented, and the results and meaning were discussed in Groundwater Modeling Workgroup meetings. All fundamental parts of developing a numerical groundwater flow model were discussed: developing a conceptual model, numerical model construction, model calibration, model sensitivity, model predictive runs, and model documentation. The results and conclusions of the Groundwater Modeling Workgroup's effort are documented in a final Groundwater Modeling Workgroup report (BGC Engineering USA Inc. 2018d).

The conceptual understanding of the hydrogeology and the geological framework of the area is fundamental to developing a valid groundwater flow model. A separate but related workgroup focused specifically on the geological data collection and interpretation, and the subsidence modeling. The results of this workgroup are discussed in Section 3.2, Geology, Minerals, and Subsidence, and documented in a final workgroup report (BGC Engineering USA Inc. 2018a). Several team members collaborated in both workgroups and facilitated sharing of information.

After receiving input from the Groundwater Modeling Workgroup, the Forest Service and its contractors ultimately determined that WSP's groundwater model, as amended and clarified over the course of the workgroup meetings, is a reasonable and appropriate tool for assessing hydrologic changes.

KEY DECISION ON USE OF MODEL RESULTS – BASELINE CONDITIONS

The Groundwater Modeling Workgroup made four specific key decisions about how the groundwater modeling results would be used:

1. Define appropriate baseline conditions,
2. Select an appropriate time frame for model output,
3. Select an appropriate precision for model output, and
4. Develop a strategy to deal with uncertainties.

The first key decision is how potential impacts from the mine operations are to be defined. With many resources, this is a simple task: predicted conditions during or after mine operations are compared with the affected environment, and the difference is considered the “impact” caused by the mine. In this case, renewed dewatering of the deep groundwater system has taken place since 2009 to allow construction and maintenance of mine infrastructure; this is described further in “Current and Ongoing Pumping and Water Level Trends” later in this section. This dewatering pumping is legal and has been properly permitted by the ADWR (see the “Current and Ongoing Pumping and Water Level Trends” section). Resolution Copper is continuing this dewatering and would continue dewatering throughout the mine life. Further, even if the mine is not operated, Resolution Copper would continue legally dewatering to preserve its infrastructure investment.

The Tonto National Forest made the decision to handle this situation in two ways. First, continued dewatering of the mine would be included as part of the no action alternative. Second, the Tonto National Forest is ensuring that any effects of the past dewatering are disclosed as ongoing trends as part of the affected environment (Garrett 2018c).

As such, two separate models were prepared: a No Action model (with continued dewatering, but no block-caving), and a Proposed Action model (with continued dewatering and block-caving as proposed).

- For the no action alternative, the potential impact from the mine is defined as the drawdown as predicted in the no action groundwater flow model, up to 200 years after the start of mining (see next section for discussion on time frames).
- For the action alternatives, the potential impact from the mine is defined as the drawdown predicted in the proposed action groundwater flow model, up to 200 years after the start of mining (see next section for discussion on time frames). However, some of the GDEs impacted by proposed action drawdown would have been impacted by the no action

alternative as well. The GDEs anticipated to be impacted by both models are disclosed for comparison, to clearly identify which impacts result from ongoing dewatering alone and which impacts result from the block-caving.

KEY DECISION ON USE OF MODEL RESULTS – TIME FRAME

Groundwater models are generally run until they reach a point where the aquifer has sufficient time to react to an induced stress (in this case, the effects of block-caving) and reach a new point of equilibrium. In some systems this can take hundreds or even thousands of years. The groundwater flow model for the Resolution Copper project was run for 1,000 years, or roughly 950 years after closure of the mine, to approach equilibrium conditions. The Groundwater Modeling Workgroup recognized that a fundamental limitation of the model—of any model—is the unreliability of predictions far in the future, and the workgroup was tasked with determining a time frame that would be reasonable to assess. Based on combined professional judgment, the Groundwater Modeling Workgroup determined that results could be reasonably assessed up to 200 years into the future. All quantitative results disclosed in the EIS are restricted to this time frame.

The Groundwater Modeling Workgroup also recognized that while quantitative predictions over long time frames were not reliable, looking at the general trends of groundwater levels beyond the 200-year time frame still provides valuable context for the analysis. In most cases, the point of maximum groundwater drawdown or impact for any given GDE does not occur at the end of mining. Rather, it takes time for the full impacts to be seen—decades or even centuries. Even if quantitative results are unreliable at long time frames, the general trends in modeled groundwater levels can indicate whether the drawdown or impact reported at 200 years represents a maximum impact, or whether conditions might still worsen at that location. These trends are qualitatively explored, regardless of time frame.

KEY DECISION ON USE OF MODEL RESULTS – LEVEL OF PRECISION

Numerical groundwater models produce highly precise results (i.e., many decimal points). Even in a well-calibrated model, professional hydrologists and modelers recognize that there is a realistic limit to this precision, beyond which results are meaningless. The Groundwater Modeling Workgroup was tasked with determining the appropriate level of precision to use for groundwater modeling results.

Based on combined professional judgment, the Groundwater Modeling Workgroup determined that to properly reflect the level of uncertainty inherent in the modeling effort, results less than 10 feet should not be disclosed or relied upon, as these results are beyond the ability of the model to predict. For values greater than 10 feet, the Groundwater Modeling Workgroup decided to use a series of ranges to further reflect the uncertainty: 10 to 30 feet, 30 to 50 feet, and greater than 50 feet. Regardless of these ranges, the quantitative modeled results for each GDE are still provided in the form of hydrographs (see appendix L). Several strategies were developed to help address the uncertainties associated with the groundwater modeling results, as described in the remainder of this section.

The precision of the results (10 feet) also reflects the inability of a regional groundwater model to fully model the interaction of groundwater with perennial or intermittent streams (see BGC Engineering USA Inc. (2018d) for a full discussion). This limitation means that impacts on surface waters are based on predicted groundwater drawdown, rather than modeled changes in streamflow.

KEY DECISION ON USE OF MODEL RESULTS – STRATEGIES TO ADDRESS UNCERTAINTY

Two key strategies were selected to deal with the uncertainty inherent in the groundwater model: the use of sensitivity model runs and the use of monitoring. The model runs used to predict impacts are based on the best-calibrated version of the model; however, there are many other variations of the model and model parameters that may also be

reasonable. Sensitivity model runs are used to understand how other ways of constructing the model change the results. In these sensitivity runs, various model parameters are increased or decreased within reasonable ranges to see how the model outcomes change. In total, 87 model sensitivity runs were conducted, in addition to the best-calibrated version of the model.

Because of the uncertainty and limitations of the model, the Groundwater Modeling Workgroup decided that it would be most appropriate to disclose not only impacts greater than 10 feet based on the best-calibrated model, but also impacts greater than 10 feet based on any of the sensitivity runs. The predicted model results disclosed in this section represent a range of results from the best-calibrated model as well as the full suite of sensitivity runs. These are considered to encompass a reasonable range of impacts that could occur as a result of the project.

As can be seen in figure 3.7.1-3, which shows the 10-foot drawdown contour that encompasses all sensitivity runs (yellow area), some of the sensitivity runs show drawdown abutting the eastern edges of the model domain, which is an undesirable situation for a groundwater model. This result is driven by a single sensitivity run that looked at an increased hydraulic conductivity in the Apache Leap Tuff aquifer. This has been taken into consideration when interpreting the model results. For some GDEs, this particular sensitivity run represents the sole outcome where impact is anticipated; for these, impacts are considered possible but unlikely, given that the base case and all other model sensitivity runs show consistent results.

The Groundwater Modeling Workgroup recognized that while the model may not be reliable for results less than 10 feet in magnitude, changes in aquifer water level much less than 10 feet still could have meaningful effects on GDEs, even leading to complete drying. The Groundwater Modeling Workgroup explored a number of other modeling techniques, including explicitly modeling the interaction between groundwater and surface water to predict small changes in streamflow, but found that these techniques had similar limitations. To address this problem, monitoring of GDEs would be implemented

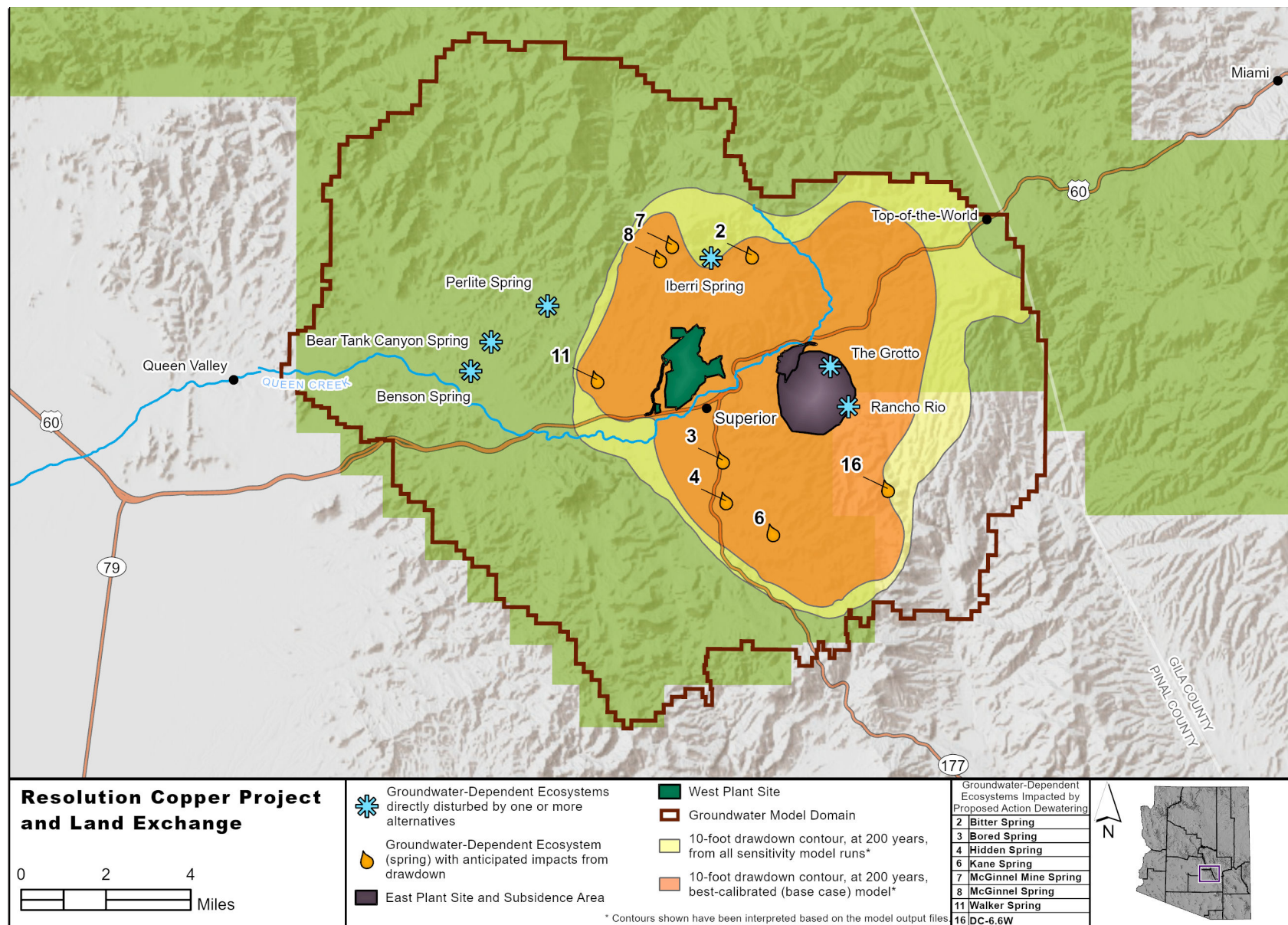


Figure 3.7.1-3. Modeled groundwater drawdown—proposed action, 200 years after start of mine

during mine operations, closure, and potentially beyond. For many of these GDEs, this monitoring effort simply continues monitoring that has been in place from as early as 2003. Details of monitoring conducted to date are available in the project record for springs and surface waters (Montgomery and Associates Inc. 2017d), water quality sampling (Montgomery and Associates Inc. 2016), and well construction and groundwater levels (Montgomery and Associates Inc. and Resolution Copper 2016). If monitoring identifies real-world impacts that were not predicted by the modeling, mitigation would be implemented. Mitigation is not restricted to unanticipated impacts; mitigation may also be undertaken for those GDEs where impacts are expected to occur.

Summary of Models Used for Mine Site Dewatering/Block-Caving Effects

The following groundwater flow models provide the necessary impact predictions. Each of the models included best-calibrated, base-case modeling runs as well as sensitivity runs:

- **No Action model, Life of Mine.** This model assumes that no mining occurs and that therefore no block-caving occurs that connects the Apache Leap Tuff aquifer to the deep groundwater system. While dewatering of the deep groundwater system is assumed to continue, for the most part those dewatering effects are confined to the deep groundwater system, and the Apache Leap Tuff aquifer does not dewater. This model was run for 51 years, until closure of the mine.
- **No Action model, Post-closure.** This model continues after 51 years, with dewatering being curtailed at the end of the Life of Mine model. This model was run to 1,000 years, but quantitative results are only used out to 200 years after start of the model, which is 149 years after closure of the mine. Model results beyond 200 years are still used but are discussed qualitatively.
- **Proposed Action model, Life of Mine.** This model assumes that mining and block-caving occur as proposed, along with

the dewatering necessary to maintain project infrastructure. Under these conditions, the Apache Leap Tuff aquifer becomes hydraulically connected to and partially drains downward into the deep groundwater system. This model was run for 51 years, until closure of the mine. The proposed action model is applicable to all action alternatives.

- **Proposed Action model, Post-closure.** This model continues after 51 years, with dewatering being curtailed at the end of the Life of Mine model. This model was run to 1,000 years, but quantitative results are only used out to 200 years after start of the model, which is 149 years after closure of the mine. Model results beyond 200 years are still used but are discussed qualitatively. The proposed action model is applicable to all action alternatives.

Model Used for Mine Water Supply Pumping Effects

One additional model was part of the analysis process. Resolution Copper also ran a model to predict pumping impacts from the water supply wellfield located along the MARRCO corridor in the East Salt River valley. This groundwater flow model was built from an existing, calibrated, regulatory model prepared by ADWR. In some form, this model has been used widely for basin-wide planning purposes since the 1990s, as well as to estimate project-specific water supply impacts, and therefore did not require as extensive a review as the models prepared specifically for the mine. Since the water balance differs greatly between alternatives, due to operations of the tailings facilities, this model was run separately to reflect each of the action alternatives.

3.7.1.3 Affected Environment

Relevant Laws, Regulation, Policies, and Plans

The State of Arizona has jurisdiction over groundwater use; however, the Forest Service also has pertinent guidance on analyzing groundwater

impacts, disclosing these impacts appropriately during NEPA analysis, and managing GDEs on NFS land.

Primary Legal Authorities Relevant to the Groundwater Analysis

- Arizona Groundwater Management Act of 1980, along with implementing regulations that govern groundwater use within Active Management Areas
- Forest Service Manual 2520 (management of riparian areas, wetlands, and floodplains), 2530 (collecting water resource data), and 2880 (inventory and analysis of GDEs)

Existing Conditions and Ongoing Trends

REGIONAL HYDROLOGIC FRAMEWORK

The project is located within a geological region known as the Basin and Range province, near the boundary with another geological region known as the Arizona Transition Zone. The Basin and Range aquifers generally consist of unconsolidated gravel, sand, silt, and clay, or partly consolidated sedimentary or volcanic materials. These materials have filled deep fault-block valleys formed by large vertical displacement across faults. Mountain ranges that generally consist of impermeable rocks separate adjacent valleys (Robson and Banta 1995), leading to compartmentalized groundwater systems. Stream alluvium is present along most of the larger stream channels. These deposits are about 100 feet thick and 1 to 2 miles wide along the Gila, Salt, and Santa Cruz Rivers in Arizona aquifers (Robson and Banta 1995). The hydrology of the Arizona Transition Zone is generally more complex, characterized largely by fractured rock aquifers with some small alluvial basins.

The semiarid climate in the region limits the amount of surface water available for infiltration, resulting in slow recharge of the groundwater

with an average annual infiltration of 0.2 to 0.4 inch per year (Woodhouse 1997). Much of this recharge occurs as mountain-front recharge, where runoff concentrates along ephemeral channels.

GROUNDWATER IN THE ANALYSIS AREA

The analysis area contains several distinct groundwater systems, as shown on the conceptual cross section in figure 3.7.1-4:

- Groundwater east of the Concentrator Fault:
 - a shallow, perched groundwater system
 - the Apache Leap Tuff aquifer
 - a deep groundwater system
- Groundwater west of the Concentrator Fault in the Queen Creek watershed:
 - alluvial groundwater, primarily in floodplain alluvium along Queen Creek
 - deep groundwater system in poorly permeable basin-fill sediments

The groundwater underlying most of the analysis area is within the Phoenix AMA, as defined by the Arizona Groundwater Management Act, and is in the East Salt River valley groundwater subbasin of the AMA, as shown in figure 3.7.1-1. Groundwater use within the AMA is administered by the ADWR (Newell and Garrett 2018d).

Summaries of the geology of the area are found in Section 3.2, Geology, Minerals, and Subsidence; the following discussion focuses on the hydrology and groundwater of the area.

East Plant Site

The East Plant Site is located on Oak Flat, east of the Concentrator Fault. The Concentrator Fault is a barrier to flow in the deep groundwater

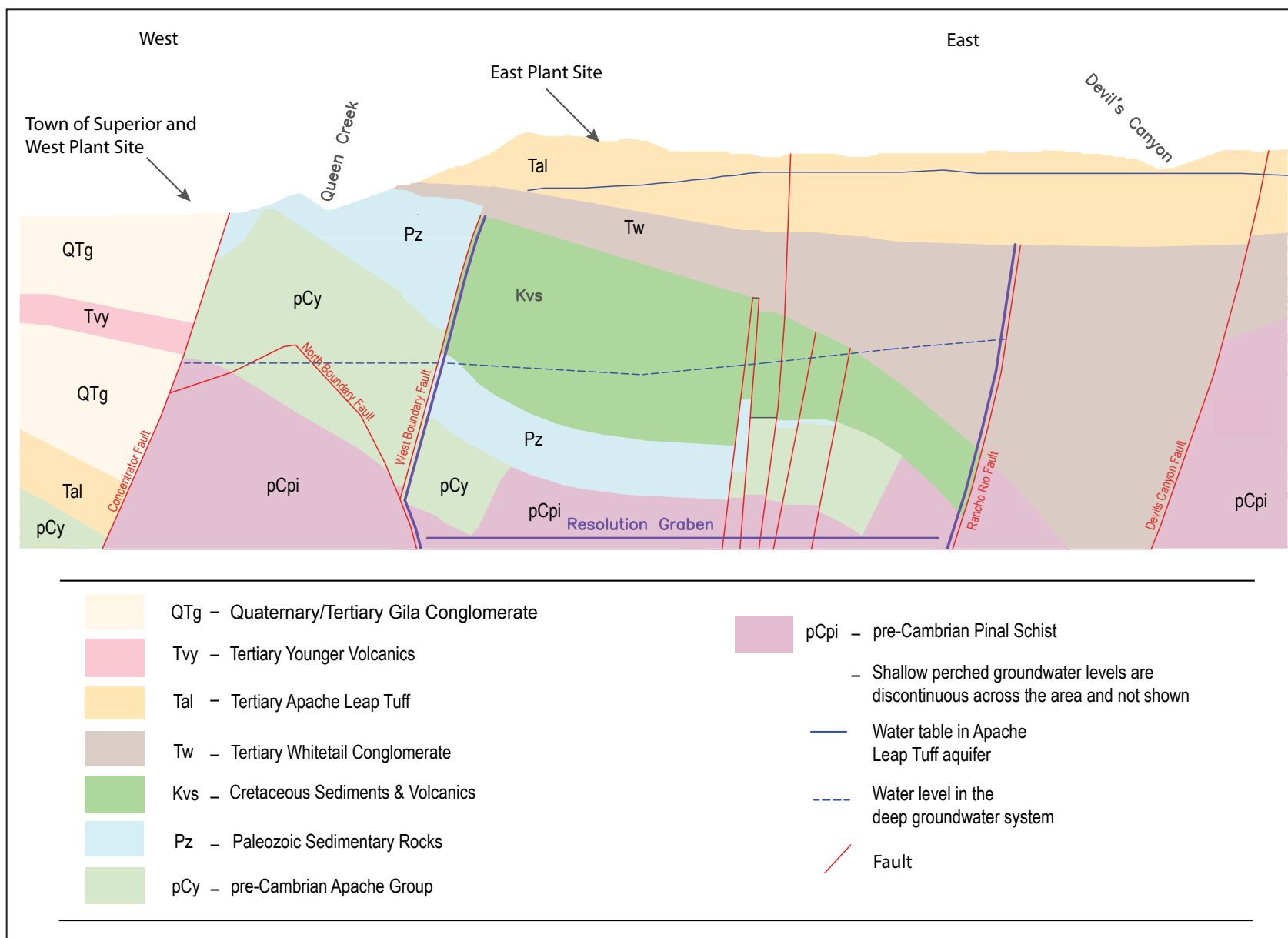


Figure 3.7.1-4. Conceptual cross section of the groundwater systems

systems on either side of the fault. Groundwater characterization wells for the shallow, perched groundwater, the Apache Leap Tuff aquifer, and the deep groundwater system are shown in figure 3.7.1-5.

The shallow groundwater system consists of several shallow, perched aquifers of limited areal extent hosted in alluvial deposits and the uppermost weathered part of the Apache Leap Tuff. The primary shallow aquifers in this area are located near Top-of-the-World and JI Ranch, and to a lesser degree along some of the major drainages such as Hackberry Canyon and Rancho Rio Canyon.

The Apache Leap Tuff aquifer is a fractured-rock aquifer that extends throughout much of the Upper Queen Creek and Devil's Canyon watersheds, and the western part of the Upper Mineral Creek watershed. The Apache Leap Tuff aquifer is separated from the deep groundwater system by a thick sequence of poorly permeable Tertiary basin-fill sediments (the Whitetail Conglomerate). In general, the direction of groundwater movement in the Apache Leap Tuff follows surface drainage patterns, with groundwater moving from areas of recharge at higher elevations to natural discharge areas in Devil's Canyon and in Mineral Creek. Regional water levels in the Apache Leap Tuff aquifer, and general flow directions, are shown in figure 3.7.1-6.

The deep groundwater system east of the Concentrator Fault is compartmentalized, and faults separate individual sections of the groundwater system from each other. Depending on their character, faults can either inhibit or enhance groundwater flow. Based on available evidence, the faults in the project area tend to restrict groundwater flow between individual sections. The ore body and future block-cave zone lie within a geological structure called the Resolution Graben, which is bounded by a series of regional faults. The deep groundwater system in the Resolution Graben is hydraulically connected to existing mine workings, and a clear decrease in water levels in response to ongoing dewatering of the mine workings has been observed (Resolution Copper 2016d).

Three wells monitor the deep groundwater system inside the Resolution Graben (table 3.7.1-1). As noted earlier in this section, groundwater levels in the deep groundwater system below Oak Flat (close to the

pumping, within the Resolution Graben) have declined more than 2,000 feet since 2009 (Montgomery and Associates Inc. and Resolution Copper 2016). The deep groundwater system east of the Concentrator Fault, but outside the Resolution Graben, appears to have a limited hydraulic connection with the deep groundwater system inside the graben. Resolution Copper monitors groundwater levels at eight locations in the deep groundwater system outside the Resolution Graben (see table 3.7.1-1). Outside the graben, groundwater level decreases have been smaller, with a maximum decline of about 400 feet since 2009, while near Superior, water levels associated with similar connected units have declined up to 50 feet since 2009 (Montgomery and Associates Inc. and Resolution Copper 2016).

West Plant Site

At the West Plant Site, shallow and intermediate groundwater occurs in the Gila Conglomerate. In addition, groundwater occurs in shallow alluvium to the south of the West Plant Site and in fractured bedrock (Apache Leap Tuff) on the eastern boundary of the West Plant Site.

Groundwater in the shallow, unconfined Gila Conglomerate discharges locally, as evidenced by the presence of seeps and evaporite deposits. The groundwater deeper in the Gila Conglomerate, below a separating mudstone formation, likely flows to the south or southwest toward regional discharge areas (Resolution Copper 2016d). Several wells monitor the Gila Conglomerate near the West Plant Site. Most of these wells have shown steady long-term declines in water level since 1996. These declines are consistent with water level declines occurring regionally in response to drought conditions (Montgomery and Associates Inc. 2017b).

The deep groundwater west of the Concentrator Fault is hosted in low permeability Quaternary and Tertiary basin-fill deposits, fractured Tertiary volcanic rocks, and underlying Apache Leap Tuff. Four wells monitor the deep groundwater system west of the Concentrator Fault. These wells have shown varying rises and declines (Montgomery and Associates Inc. 2017b).

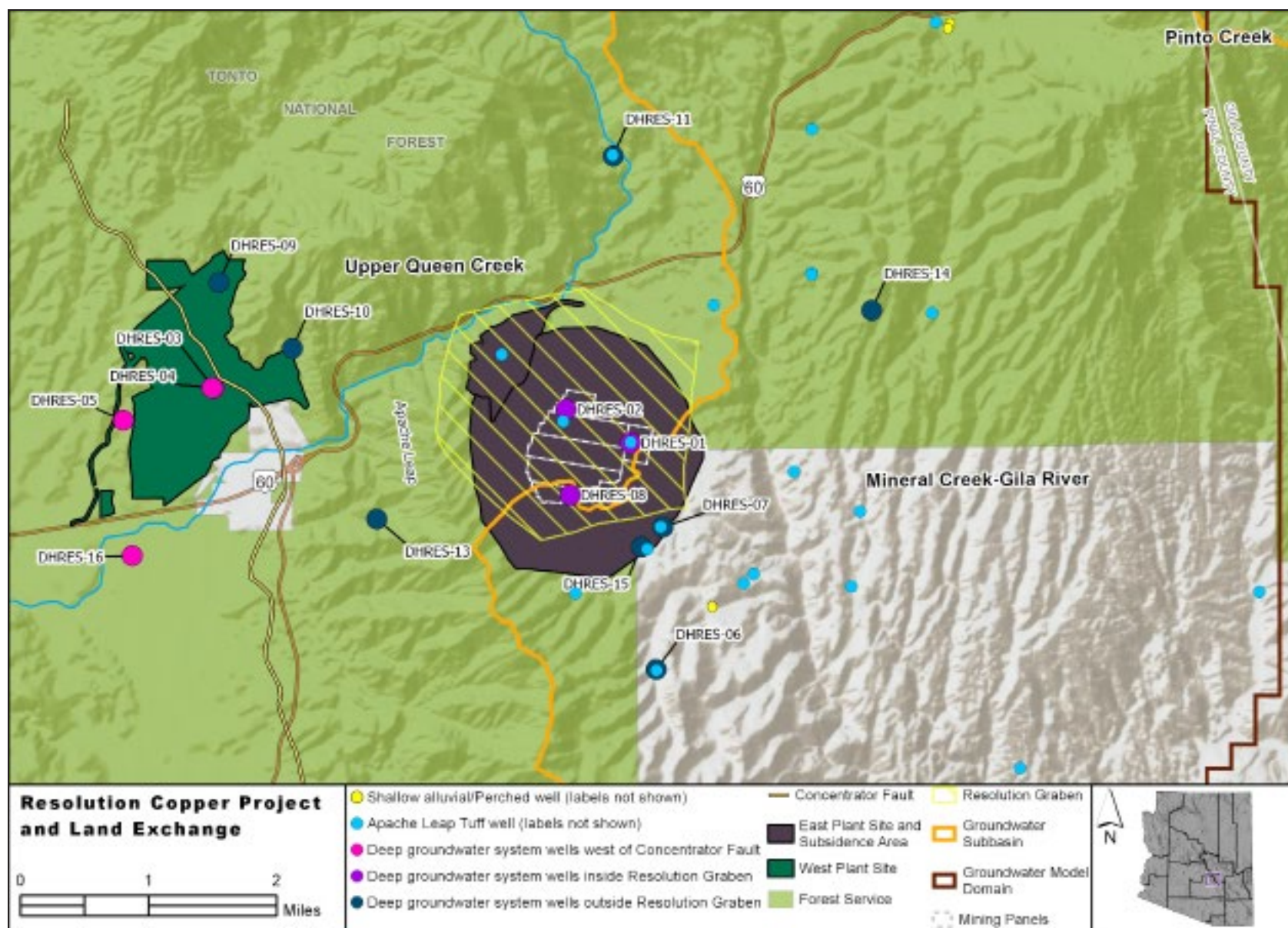


Figure 3.7.1-5. Characterization wells for the shallow, perched groundwater, the Apache Leap Tuff aquifer, and the deep groundwater system

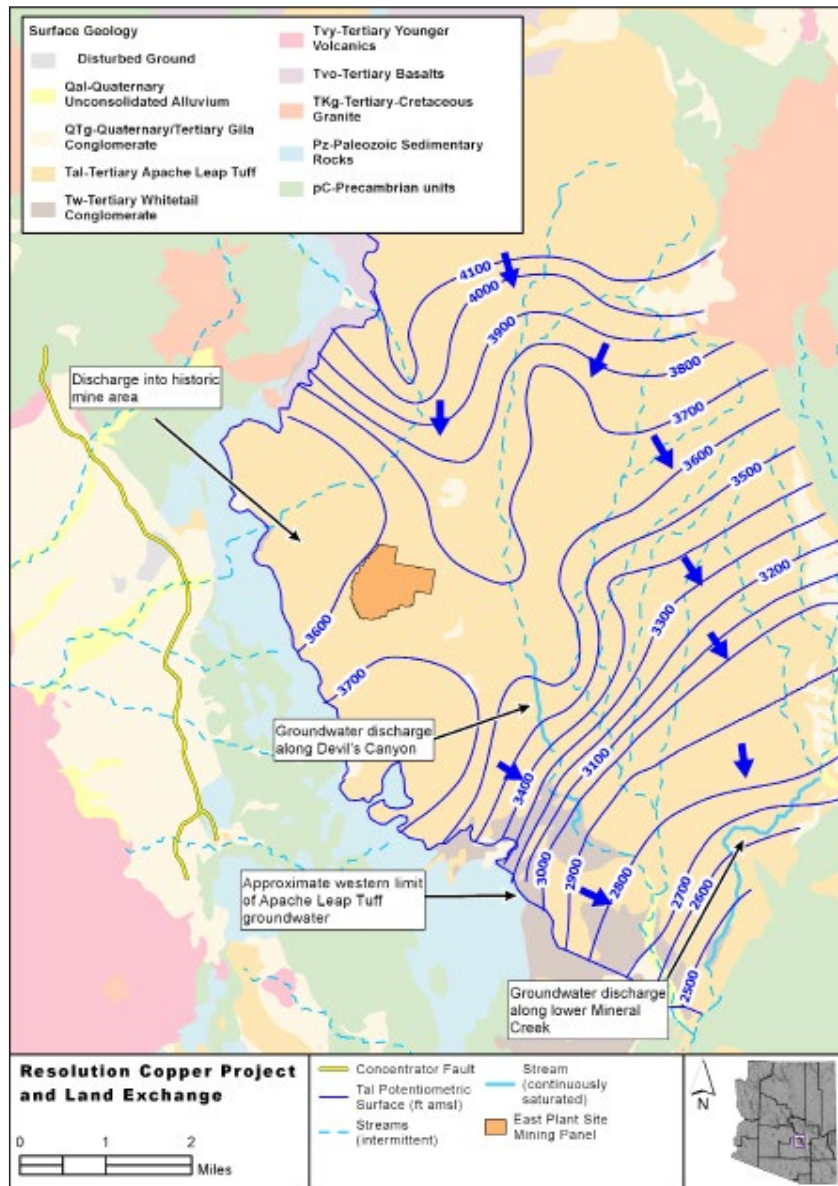


Figure 3.7.1-6. Apache Leap Tuff aquifer water-level elevations and general flow directions

Table 3.7.1-1. Changes in groundwater head in the deep groundwater system due to dewatering

	Earliest Groundwater Head Elevation, in feet amsl (date shown in parentheses)	Groundwater Head Elevation in 2016 (in feet amsl)	Overall Change (feet)
Deep Groundwater System Wells*			
Deep groundwater system wells: east of the Concentrator Fault within the Resolution Graben			
DHRES-01 (water level in Kvs)	2,090 (2009)	-50	-2,140
DHRES-02 (water level in Kvs)	2,100 (2008)	-380	-2,480
DHRES-08 (DHRES-08_-231 in Kvs)	1,920 (2010)	280	-1,640
Deep groundwater system wells: east of the Concentrator Fault outside of the Resolution Graben			
DHRES-06 (water level in Pz [Pnaco, Me, Dm, Cb, pCdiab])	3,254 (2010)	3,242	-12
DHRES-07 (DHRES-07_-108 in Pz [Cb])	3,000 (2010)	2,890	-110
DHRES-09 (water level in pCdsq and pCdiab)	2,990 (2011)	2,944	-46
DHRES-10	N/A	N/A	N/A
DHRES-11 (water level in Pz and pCy)	3,300 (2011)	2,940	-360
DHRES-13 (water level in pCy and pCpi)	2,790 (2011)	2,704	-86
DHRES-14 (water level in Tw and pCpi)	3,508 (2012)	3,484	-24
DHRES-15 (water level in Dm and Cb)	3,210 (2015)	3,240	+30
Deep groundwater system wells: west of the Concentrator Fault			
DHRES-03 (DHRES-03_335 in Tvs)	2,526 (2009)	2,496	-30
DHRES-04 (water level in Tvs)	2,570 (2009)	2,600	+30
DHRES-05B (water level in Tal)	2,620 (2010)	2,578	-42
DHRES-16 (DHRES-16_-387 in Tal)	2,316 (2014)	2,268	-48

Source: All data taken from Montgomery and Associates Inc. and Resolution Copper (2016)

Notes: Some elevations approximated to nearest 10 feet for clarity. N/A = Data not available; amsl = above mean sea level

Tal = Apache Leap Tuff; Tw = Whitetail conglomerate; Tvs = Tertiary sedimentary and volcanic rocks; Kvs = Cretaceous sedimentary and volcanic rocks; Pz = Paleozoic sedimentary rocks (Pnaco = Naco formation; Me = Escabrosa limestone; Dm = Martin formation; Cb = Bolsa quartzite);

pCy = Precambrian Apache Group; pCdiab = Precambrian diabase; pCdsq = Precambrian Dripping Springs quartzite; pCpi = Precambrian Pinal schist

* For wells with multiple monitoring depths, specific monitoring location is shown in parentheses

MARRCO Corridor, Filter Plant and Loadout Facility, and Desert Wellfield

Along much of the MARRCO corridor, groundwater is present in a shallow aquifer within the alluvium along Queen Creek. The groundwater flow direction in this part of the corridor generally follows the Queen Creek drainage to the west.

In the portion of the corridor between Florence Junction and Magma, where the filter plant and loadout facility would be located, the groundwater is present in deep alluvial units. The regional groundwater flow direction in this area is generally toward the northwest (Resolution Copper 2016d).

The makeup water supply³⁶ for the mine would come from a series of wells installed within the MARRCO corridor, drawing water from these deep alluvial units of the East Salt River valley. These wells are known as the “Desert Wellfield.” Although groundwater development in the vicinity of the Desert Wellfield has heretofore been limited, historically areas of the East Salt River valley to the west and south have been heavily used for agriculture. Until the late 1980s to early 1990s, groundwater levels were declining in much of the basin. Passage of the 1980 Groundwater Management Act which imposed limits on pumping, the availability of a renewable source of water, and the development of a regulatory framework allowing for recharge of the aquifer, all of which in combination with reduced agricultural pumping, have contributed to rising water levels. In the New Magma Irrigation and Drainage District (NMIDD) to the southwest, groundwater levels have recovered on the order of 170 feet over the past three decades, with somewhat lesser water level increases occurring in the area of the Desert Wellfield (Bates et al. 2018). Current depths to groundwater in the vicinity of the Desert Wellfield range from 400 to 600 feet below ground surface.

Tailings Storage Facility – Alternatives 2 and 3 – Near West

Thin alluvial deposits on the floors of canyons and washes at the location of the proposed tailings storage facility contain small amounts of shallow, perched groundwater. The majority of the tailings storage facility site is underlain by rocks with little permeability, with no indication of a water within the upper 150 to 300 feet of ground surface (Montgomery and Associates Inc. 2017c). Where those rocks are fractured, they have the potential to store groundwater and allow for groundwater flow. Three springs are in the footprint of the proposed tailings storage facility: the Perlite, Benson, and Bear Tank Canyon Springs (see figure 3.7.1-3). Groundwater flow generally follows the topography toward Queen Creek. Several wells were installed in the tailings storage facility area to provide information on groundwater levels (Montgomery and Associates Inc. 2017c).

Tailings Storage Facility – Alternative 4 – Silver King

Similar to the Near West site, thin alluvial deposits on the floors of canyons and washes, especially in Silver King Wash, contain small amounts of shallow, perched groundwater (Cross and Blainer-Fleming 2012; Klohn Crippen Berger Ltd. 2018c). The majority of the tailings storage facility site is underlain by rocks with little permeability. Groundwater moves generally southwest (Cross and Blainer-Fleming 2012). A number of perennial springs are located near Alternative 4. McGinnel Spring and Iberri Spring are located within the footprint of Alternative 4, and several other perennial springs (McGinnel Mine Spring, Rock Horizontal Spring, and Bitter Spring) are located within 1 mile (see figure 3.7.1-3).

Tailings Storage Facility – Alternative 5 – Peg Leg

A broad alluvial groundwater basin underlies the Peg Leg location (Ludington et al. 2007). Limited site water level data suggest

36. The mine process incorporates numerous means of recycling water back into the process wherever possible. However, for all alternatives, there remains the need for substantial additional fresh water for the processing. The fresh water fed into the processing stream is termed “makeup” water.

that groundwater depths below the facility footprint are relatively shallow, with depths less than 50 feet (Golder Associates Inc. 2018a). Groundwater flow is to the northwest, generally following the ground surface topography. The site is located in the Donnelly Wash groundwater basin, outside of any AMA.

Tailings Storage Facility – Alternative 6 – Skunk Camp

Deposits of sand and gravel less than 150 feet thick underlie the Skunk Camp location and contain shallow groundwater (Klohn Crippen Berger Ltd. 2018d). Regional groundwater is assumed to flow from northwest to southeast within the proposed tailings storage facility area toward the Gila River. Shallow groundwater flow is expected to be primarily through the surface alluvial channels and upper weathered zone of the Gila Conglomerate (Klohn Crippen Berger Ltd. 2018d). The site is located in the Dripping Spring Wash groundwater basin, outside of any AMA.

GROUNDWATER BALANCE WITHIN MODELING ANALYSIS AREA

Groundwater systems are considered to be at steady state when outflow equals inflow. In the modeling analysis area, outflows due to mine dewatering exceed inflows, with the result that the groundwater system is not at steady state and water is removed from storage.

Inflow components of the groundwater balance include recharge from precipitation, groundwater inflows from adjacent groundwater basins, and deep percolation from irrigation and from the Town of Superior Wastewater Treatment Plant. Recharge from precipitation is the largest component of inflow into the groundwater of the analysis area.

Groundwater outflows include mine dewatering, groundwater pumping, subsurface and surface flow at Whitlow Ranch Dam (a flood control structure located on Queen Creek, just upstream of the community of Queen Valley), and groundwater evapotranspiration.

The largest component of groundwater outflow for both the shallow perched groundwater and the Apache Leap Tuff aquifer is groundwater evapotranspiration, primarily from where vegetation has access to near-surface groundwater. The largest component of groundwater outflow for deep groundwater is mine dewatering, primarily from Resolution Copper but also from an open-pit perlite mining operation near Queen Creek. In 2017, mine dewatering removed approximately 1,360 acre-feet of water from the deep groundwater system (Montgomery and Associates Inc. 2018).

ONGOING CLIMATIC TRENDS AFFECTING WATER BALANCE

The annual mean and minimum temperatures in the lower Colorado River Basin have increased 1.8 degrees Fahrenheit (°F) to 3.6°F for the time period 1900–2002, and data suggest that spring minimum temperatures for the same time period have increased 3.6°F to 7.2°F (Dugan 2018). Winter temperatures have increased up to 7.2°F, and summer temperatures 1.6°F. Increasing temperature has been correlated with decreasing snowpack and earlier runoff in the lower Colorado River Basin, with runoff increasing between November and February and decreasing between April and July (April to July is traditionally recognized as the peak runoff season in the basin).

Future projected temperature increases are anticipated to change the amount of precipitation only by a small amount but would change the timing of runoff and increase the overall evaporative demand. Groundwater recharge is most effective during low-intensity, long-duration precipitation events, and when precipitation falls as snow. With ongoing trends for the southwestern United States toward higher temperatures with less snow and more high-intensity rainstorms, more runoff occurs, but groundwater recharge may decline, leading to a decrease in groundwater levels. Increased demand for groundwater, due to higher water demand under higher temperatures, may also lead to greater stresses on groundwater supplies.

CURRENT AND ONGOING PUMPING AND WATER LEVEL TRENDS

Mining near Superior started about 1875, and dewatering of the Magma Mine began in earnest in 1910 as production depths increased. Dewatering continued with little interruption until 1998, after active mining ceased at the Magma Mine. In 2009, Resolution Copper resumed dewatering as construction began on Shaft 10 (WSP USA 2019). Since 2009, Resolution Copper has reported pumping about 13,000 acre-feet of groundwater under their dewatering permit.³⁷ Almost all of this water is treated and delivered to the NMIDD. Most historical dewatering pumping took place east of the Concentrator Fault, primarily at the Magma Mine, but also at the Silver King, Lake Superior and Arizona, and Belmont mines (Keay 2018).

Resolution Copper removes groundwater from sumps in Shafts 9 and 10, effectively dewatering the deep groundwater system that lies below the Whitetail Conglomerate unit (the bottom of Shaft 10 is about 7,000 feet below ground level). Groundwater levels in the deep groundwater system below Oak Flat (close to the pumping) have dropped over 2,000 feet since 2009. These same hydrogeological units extend west, below Apache Leap, and into the Superior Basin. Near Superior, water levels associated with these units have declined roughly 20 to 90 feet since 2009 (Montgomery and Associates Inc. and Resolution Copper 2016).

In the Oak Flat area, the Apache Leap Tuff aquifer overlies the deep groundwater system, and the Whitetail Conglomerate unit separates the two groundwater systems. The Whitetail Conglomerate unit acts as an aquitard—limiting the downward flow of groundwater from the Apache Leap Tuff. Groundwater level changes in the Apache Leap Tuff that have been observed have generally been 10 feet or less since 2009.

Groundwater levels in the Apache Leap Tuff are important because they provide water to GDEs, such as the middle and lower reaches of Devil's Canyon (Garrett 2018d). Resolution Copper has extensively monitored Devil's Canyon since as early as 2003. Most hydrologic indicators show

no significant change over time in Devil's Canyon (Garrett 2019d). A number of other water sources have been monitored on Oak Flat and show seasonal drying, but these locations have been demonstrated to be disconnected from the Apache Leap Tuff aquifer, relying instead on localized precipitation (Garrett 2018d; Montgomery and Associates Inc. 2017a). Other pumping also occurs within the Superior Basin, but is substantially less than the Resolution Copper dewatering, roughly accounting for less than 10 percent of groundwater pumped within the model area (Montgomery and Associates Inc. 2018).

GROUNDWATER-DEPENDENT ECOSYSTEMS

The Tonto National Forest evaluated 67 different spring or stream locations in the project area as potential GDEs. These include the following:

- **Queen Creek watershed.** Areas evaluated include Queen Creek itself from its headwaters to Whitlow Ranch Dam, four tributaries (Number Nine Wash, Oak Flat Wash, Arnett Creek, and Telegraph Canyon), and 29 spring locations.
- **Devil's Canyon watershed.** Areas evaluated include Devil's Canyon from its headwaters to the confluence with Mineral Creek at the upper end of Big Box Reservoir, three tributaries (Hackberry Canyon, Rancho Rio Canyon, and Iron Canyon), and seven spring locations. Four of these springs are located along the main stem of Devil's Canyon and contribute to the general streamflow.
- **Mineral Creek watershed.** Areas evaluated include Mineral Creek from its headwaters to the confluence with Devil's Canyon at the upper end of Big Box Reservoir, and five spring locations. Three of these springs are located along the main stem of Mineral Creek and contribute to the general streamflow.

37. The current mine infrastructure lies almost entirely within the Phoenix AMA. In this area, pumping groundwater requires a groundwater right from the ADWR. Resolution Copper's dewatering right (59-524492) is permitted through 2029 (Rietz 2016b).

After evaluating available lines of evidence for portions of Queen Creek, Devil's Canyon, Mineral Creek, Telegraph Canyon, and Arnett Creek, the Groundwater Modeling Workgroup thought it likely that some stream segments within these watersheds could have at least a partial connection to regional aquifers, and each is described in more detail in the following text of this section. In addition, the Groundwater Modeling Workgroup identified 17 springs that they believe have at least a partial connection to regional aquifers. The remainder of the potential GDEs were eliminated from analysis for various reasons (Garrett 2018d).³⁸ GDEs with a likely or possible regional groundwater source, and therefore analyzed in this section, are listed in table 3.7.1-2 and shown in figure 3.7.1-7.

Devil's Canyon

The upper reach of Devil's Canyon (from above the U.S. 60 bridge to approximately km 9.3) includes a reach of perennial flow from approximately DC-11.0 to DC-10.6. The geohydrology suggests that this section of Devil's Canyon lies above the water table in the Apache Leap Tuff aquifer and is most likely supported by snowmelt or precipitation stored in near-surface fractures, and/or floodwaters that have been stored in shallow alluvium along the stream, before slowly draining into the main channel. Further evaluation of hydrochemistry and flow data support this conclusion (Garrett 2018d). Streamflow in Upper Devil's Canyon is not considered to be connected with the regional Apache Leap Tuff aquifer and would not be expected to be impacted by groundwater drawdown caused by the block-cave mining and dewatering. This portion of Devil's Canyon is also upstream of the subsidence area and unlikely to be impacted by changes in surface runoff.

Moving downstream in Devil's Canyon, persistent streamflow arises again about km 9.3. From this point downstream, Devil's Canyon contains stretches of perennial flow, aquatic habitat, and riparian

galleries. Flow arises both from discrete springs along the walls of the canyon (four total), as well as groundwater inflow along the channel bottom. These reaches of Devil's Canyon also are supported in part by near-surface storage of seasonal precipitation; however, the available evidence indicates that these waters arise primarily from the regional Apache Leap Tuff aquifer. Streamflow in middle and lower Devil's Canyon is considered to be connected with the regional aquifer, which could potentially be impacted by groundwater drawdown caused by the block-cave mining and dewatering. These reaches of Devil's Canyon also receive runoff from the area where the subsidence area would occur and therefore may also lose flow during runoff events.

Queen Creek

The available evidence suggests that Queen Creek from headwaters to Whitlow Ranch Dam is ephemeral in nature, although in some areas above Superior it may be considered intermittent, as winter base flow does occur and likely derives from seasonal storage of water in streambank alluvium, which slowly seeps back in to the main channel (Garrett 2018d). This includes three springs located along the main stem of Queen Creek above Superior.

An exception for Queen Creek is a perennially flowing reach between km 17.39 and 15.55, which is located downstream of Superior and upstream of Boyce Thompson Arboretum. Originally this flowing reach had been discounted because it receives effluent discharge from the Superior Wastewater Treatment Plant. However, discussions within the Groundwater Modeling Workgroup suggested that a component of baseflow supported by regional aquifer discharge may exist in this reach as well. Regardless of whether baseflow directly enters the channel from the regional aquifer, substantial flow in this reach also derives from dewatering discharges from a small open-pit perlite mining operation, where the mine pit presumably intersects the regional aquifer

38. To summarize, potential GDEs were eliminated from analysis using the groundwater flow model because they did not appear to exist within the analysis area (five springs); or had sufficient evidence to indicate a shallow groundwater source instead of a connection to the regional aquifers (19 springs; most of Queen Creek; upper Devil's Canyon; two tributaries to Queen Creek; and three tributaries to Devil's Canyon). Some of these GDEs may still be affected by changes in surface runoff, and these changes are still analyzed in this section.

Table 3.7.1-2. GDEs identified as having at least a partial connection to regional groundwater

Type of Feature	Name/Description*	Type of Impact Analysis Used in EIS
Queen Creek Watershed		
Stream segments	Queen Creek, between km 17.39 and 15.55 (downstream of Superior and upstream of Boyce Thompson Arboretum); approximately 1.2 miles long Queen Creek at Whitlow Ranch Dam Arnett Creek, near the confluence with Telegraph Canyon (km 4.5) and upstream at Blue Spring (km 12.5) Telegraph Canyon, near the confluence with Arnett Creek	Groundwater flow model (all stream segments); Surface water flow model (Queen Creek only)
Springs (10 total)	Bitter, Bored, Hidden, Iberri, Kane, McGinnel, McGinnel Mine, No Name, Rock Horizontal, and Walker	Groundwater flow model
Devil's Canyon Watershed		
Stream segments	Devil's Canyon, from km 9.14 to confluence with Mineral Creek/Big Box Reservoir; approximately 5.7 miles long	Groundwater flow model; Surface flow water model
Springs (4 total)	DC-8.2W, DC-6.6W, DC-6.1E, DC-4.1E	Groundwater flow model
Mineral Creek Watershed		
Stream segments	Mineral Creek from km 8.7 to confluence with Devil's Canyon/Big Box Reservoir, approximately 5.4 miles long	Groundwater flow model
Springs (3 total)	Government Springs, MC-8.4C, MC-3.4W (Wet Leg Spring)	Groundwater flow model

* Many of the stream descriptions reference the distance upstream of the confluence, measured in kilometers. This reference system is also incorporated into many stream/spring monitoring locations. For instance, spring "DC-8.4W" is located 8.4 km upstream of the mouth of Devil's Canyon, on the west side of the drainage.

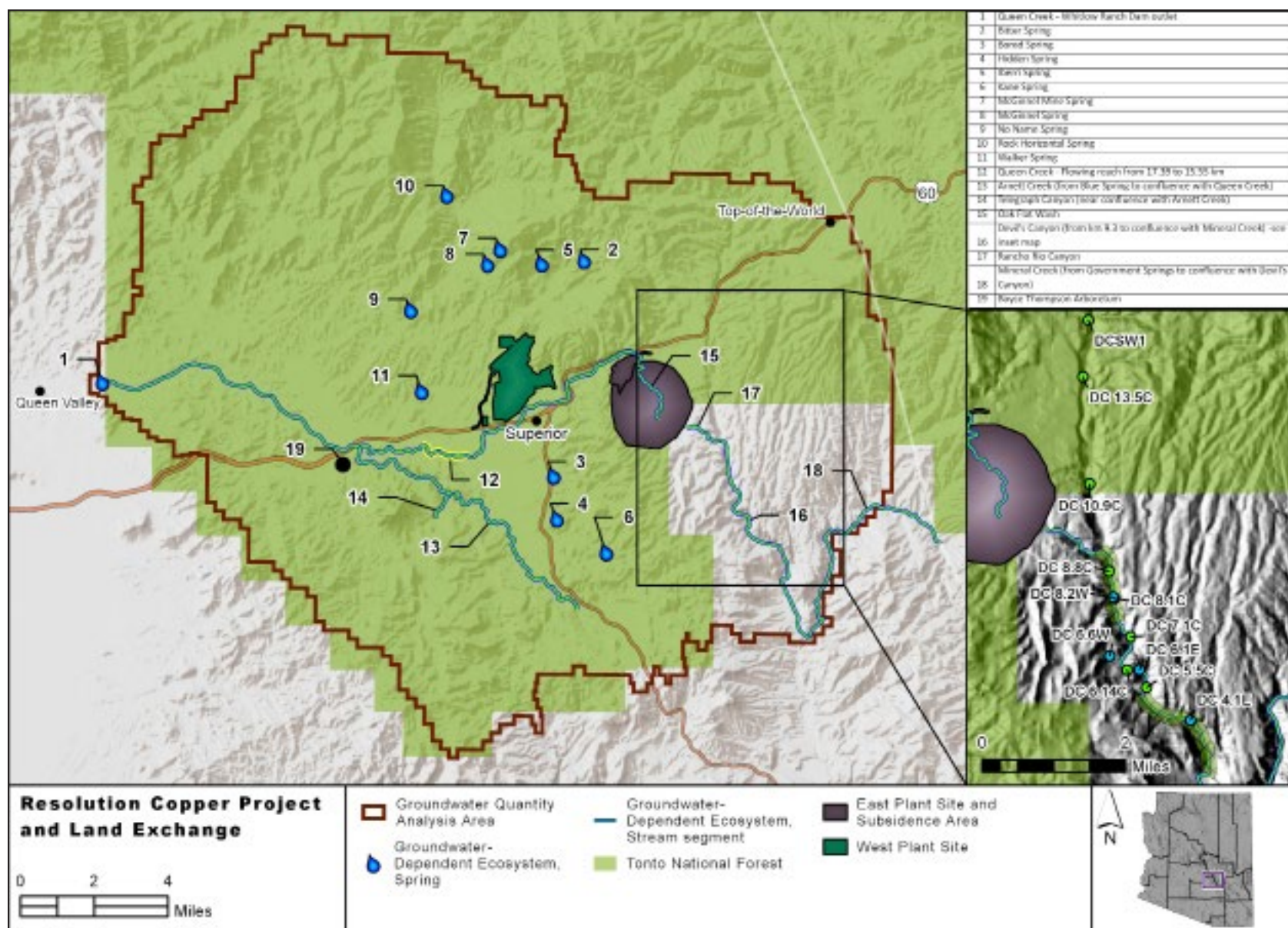


Figure 3.7.1-7. Groundwater-dependent ecosystems of concern

(Garrett 2018d). Therefore, for several reasons, this reach was included as a potential GDE, with the potential to be impacted by regional groundwater drawdown. The AGFD conducted surveys on this reach in 2017 and found that while flow fluctuated throughout the survey reach, aquatic wildlife and numerous other avian and terrestrial species use this habitat, and that aquatic species appeared to be thriving and reproducing (Warnecke et al. 2018).

Queen Creek also has perennial flow that occurs at Whitlow Ranch Dam and supports a 45-acre riparian area (primarily cottonwood, willow, and saltcedar). This location is generally considered to be where most subsurface flow in the alluvium along Queen Creek and other hydrologic units exits the Superior Basin. Queen Creek above and below Superior receives runoff from the area where the subsidence area would occur and therefore may also lose flow during runoff events. Runoff from over 20 percent of the Queen Creek watershed above Magma Avenue Bridge would be lost to the subsidence area (described in more detail in Section 3.7.3, Surface Water Quantity).

Mineral Creek

Mineral Creek is similar in nature to lower Devil's Canyon. While flows are supported in part by near-surface storage of seasonal precipitation, the available evidence indicates that these waters arise partially from the Apache Leap Tuff aquifer and other regional sources. For the purposes of analysis, Mineral Creek is considered to be connected with regional aquifers, which could potentially be impacted by groundwater drawdown caused by the block-cave mining and dewatering; whether this impact is predicted to occur or not is determined using the results of the groundwater modeling.

Approximately the lower 4 miles of Mineral Creek exhibits perennial flow that supports riparian galleries and aquatic habitat. Three perennial springs also contribute to Mineral Creek (Government Springs, MC-8.4C, and MC-3.4W or Wet Leg Spring). Government Springs is the farthest upstream, roughly 5.4 miles above the confluence with Devil's Canyon (Garrett 2018d).

Mineral Creek is designated as critical habitat for Gila chub. The AGFD has conducted fish surveys on Mineral Creek periodically since 2000 and has not identified Gila chub in Mineral Creek since 2000. While the presence of amphibians suggested acceptable water quality in this reach, until 2006 no fish populations were observed despite acceptable habitat. AGFD stocked native longfin dace in Mineral Creek downstream of Government Springs in 2006, and as of 2017, these fish were still present in the stream, though Gila chub have not been seen (Crowder et al. 2014; WestLand Resources Inc. 2018a).

Arnett Creek

Fairly strong and consistent evidence indicates that several reaches of Arnett Creek likely receive some contribution from groundwater that looks similar to the Apache Leap Tuff aquifer, though these units are not present in this area. This includes Blue Spring (located in the channel of Arnett Creek above Telegraph Canyon) and in the downstream portions of Arnett Creek immediately downstream of Telegraph Canyon. Arnett Creek is considered to be connected with regional aquifers, which could potentially be impacted by groundwater drawdown caused by the block-cave mining and dewatering; whether this impact is predicted to occur or not is determined using the results of the groundwater modeling.

Telegraph Canyon

Telegraph Canyon is a tributary to Arnett Creek. Unlike Arnett Creek, there was insufficient evidence to determine whether or not these waters were tied to the regional aquifers. In such cases, the Forest Service policy is to assume that a connection exists; therefore, Telegraph Canyon is also considered to be connected with the regional aquifers, which could potentially be impacted by groundwater drawdown caused by the block-cave mining and dewatering; whether this impact is predicted to occur or not is determined using the results of the groundwater modeling.

Tributaries to Queen Creek and Devil's Canyon

A number of tributaries were evaluated originating in the Oak Flat area and feeding either Queen Creek or Devil's Canyon. These include Number 9 Wash and Oak Flat Wash (Queen Creek watershed) and Iron Canyon, Hackberry Canyon, and Rancho Rio Canyon (Devil's Canyon watershed). Sufficient evidence existed for all of these tributaries to demonstrate that they most likely have local water sources that are not connected to the regional Apache Leap Tuff aquifer (Garrett 2018d).

WATER SUPPLY WELLS

GDEs represent natural systems that could be impacted by the project, but human communities also rely on groundwater sources in the area. In lieu of analyzing individual wells, typical wells in key communities were analyzed using the groundwater flow model (Newell and Garrett 2018d). These areas include the following:

- **Top-of-the-World.** Many wells in this location are relatively shallow and rely on near-surface fracture systems and shallow perched alluvial deposits (see Garrett (2018d), Attachment 7); these wells would not be impacted by changes in the regional aquifers. However, other wells in this area could be completed deeper into the Apache Leap Tuff aquifer. Impacts on well HRES-06 is used as a proxy for potential impacts on water supplies and individual wells in this area.
- **Superior.** The Arizona Water Company serves the Town of Superior; the water comes from the East Salt River valley. Even so, there are assumed to still be individual wells within the town that use local groundwater (stock wells, domestic wells, commercial wells). As with Top-of-the-World, some of these wells may rely on near-surface groundwater and would not be impacted by changes in the regional aquifers. Other wells could be completed in geological units in hydraulic connection to the deep groundwater system. Well DHRES-16_743 is used as a proxy for potential impacts on water supplies and individual wells in this area.

- **Boyce Thompson Arboretum.** The Gallery Well is used as a proxy for impacts on water supplies associated with Boyce Thompson Arboretum. This well likely uses groundwater from local sources, but for the purposes of analysis it is assumed to be connected to regional aquifers.

3.7.1.4 Environmental Consequences of Implementation of the Proposed Mine Plan and Alternatives

Alternative 1 – No Action

ANTICIPATED IMPACTS ON GDES (UP TO 200 YEARS)

Under the no action alternative, which includes continued dewatering pumping of the deep groundwater system, no perennial streams are anticipated to be impacted, but six perennial springs experience drawdown greater than 10 feet. These springs are Bitter, Bored, Hidden, McGinnel, McGinnel Mine, and Walker Springs, as shown in figures 3.7.1-8 and 3.7.1-9, and summarized in table 3.7.1-3. Hydrographs showing drawdown under the no action alternative for all GDEs with connections to regional aquifers are included in appendix L.

The 10-foot drawdown contour shown on figure 3.7.1-8 represents the limit of where the groundwater model can reasonably predict impacts with the best-calibrated model (orange area). GDEs falling within this contour are anticipated to be impacted. GDEs outside this contour may still be impacted, but it is beyond the ability of the model to predict.

It is not possible to precisely predict what impact a given drawdown in groundwater level would have on an individual spring; however, given the precision of the model (10 feet), it is reasonable to assume any spring with anticipated impact of this magnitude could experience complete drying.

Bored Spring has the highest riparian value, supporting a standing pool and a 500-foot riparian string of cottonwood, willow, mesquite,

Table 3.7.1-3. Summary of potential impacts on groundwater-dependent ecosystems from groundwater drawdown

Reference Number on Figure 3.7.1-7	Specific GDE	Drawdown (feet) from Dewatering under No Action (end of mining)	Drawdown (feet) from Dewatering and Block-Cave under Proposed Action (end of mining)	Drawdown (feet) from Dewatering under No Action Alternative (200 years after start of mine)	Drawdown (feet) from Dewatering and Block-Cave under Proposed Action (200 years after start of mine)	Number of Sensitivity Runs with Drawdown greater than 10 Feet (based on Proposed Action, 200 years after start of mine)	Summary of Expected Impacts on GDEs
Queen Creek and Tributaries							
12	Queen Creek – Flowing reach from km 17.39 to 15.55	<10	<10	<10	<10	4 of 87 sensitivity runs show impacts greater than 10 feet; impacts are possible but unlikely	No Action – Drawdown is not anticipated.* Proposed Action – Additional drawdown due to block-caving is not anticipated with the base case model. Drawdown is possible but unlikely under the sensitivity modeling runs.* Reach has two other documented and substantial water sources.
1	Queen Creek – Whitlow Ranch Dam Outlet†	<10	<10	<10	<10	Not available	No Action – Drawdown is not anticipated.* Proposed Action – Additional drawdown due to block-caving is not anticipated.†
13	Arnett Creek (from Blue Spring to confluence with Queen Creek)	<10	<10	<10	<10	0 of 87 sensitivity runs show impacts greater than 10 feet	No Action – Drawdown is not anticipated.* Proposed Action – Additional drawdown due to block-caving is not anticipated.*
14	Telegraph Canyon (near confluence with Arnett Creek)	<10	<10	<10	<10	0 of 87 sensitivity runs show impacts greater than 10 feet	No Action – Drawdown is not anticipated.* Proposed Action – Additional drawdown due to block-caving is not anticipated.*
Devil's Canyon and Springs along Channel							

continued

Table 3.7.1-3. Summary of potential impacts on groundwater-dependent ecosystems from groundwater drawdown (cont'd)

Reference Number on Figure 3.7.1-7	Specific GDE	Drawdown (feet) from Dewatering under No Action (end of mining)	Drawdown (feet) from Dewatering and Block-Cave under Proposed Action (end of mining)	Drawdown (feet) from Dewatering under No Action Alternative (200 years after start of mine)	Drawdown (feet) from Dewatering and Block-Cave under Proposed Action (200 years after start of mine)	Number of Sensitivity Runs with Drawdown greater than 10 Feet (based on Proposed Action, 200 years after start of mine)	Summary of Expected Impacts on GDEs
16	Middle Devil's Canyon (from km 9.3 to km 6.1, including springs DC8.2W, DC6.6W, and DC6.1E)	<10	<10	<10	10–30 (Spring DC-6.6W)	For spring DC6.6W, 76 of 87 sensitivity runs show impacts greater than 10 feet; confirms base case impacts For the main channel (DC8.8C, DC 8.1C) and spring DC8.2W, 1 of 87 sensitivity runs shows impacts greater than 10 feet; impacts are possible but unlikely For spring DC6.1E, 0 of 87 sensitivity runs show impacts greater than 10 feet	No Action – Drawdown is not anticipated.* Proposed Action – Addition drawdown due to block-caving is anticipated in spring DC-6.6W with the base case model and most sensitivity modeling runs (see description of impacts).*† Drawdown is possible but unlikely under the sensitivity modeling runs for main channel groundwater inflow and spring DC6.1E.2
16	Lower Devil's Canyon (from km 6.1 to confluence with Mineral Creek, including spring DC4.1E)	<10	<10	<10	<10	0 of 87 sensitivity runs show impacts greater than 10 feet	No Action – Drawdown is not anticipated.* Proposed Action – Additional drawdown due to block-caving is not anticipated.*
	Mineral Creek and Springs along Channel						

continued

Table 3.7.1-3. Summary of potential impacts on groundwater-dependent ecosystems from groundwater drawdown (cont'd)

Reference Number on Figure 3.7.1-7	Specific GDE	Drawdown (feet) from Dewatering under No Action Alternative (end of mining)	Drawdown (feet) from Dewatering and Block-Cave under Proposed Action (end of mining)	Drawdown (feet) from Dewatering under No Action Alternative (200 years after start of mine)	Drawdown (feet) from Dewatering and Block-Cave under Proposed Action (200 years after start of mine)	Number of Sensitivity Runs with Drawdown greater than 10 Feet (based on Proposed Action, 200 years after start of mine)	Summary of Expected Impacts on GDEs
18	Mineral Creek (from Government Springs [km 8.7] to confluence with Devil's Canyon, including springs MC8.4C and MC3.4W [Wet Leg Spring])	<10	<10	<10	<10	0 of 87 sensitivity runs show impacts greater than 10 feet	No Action – Drawdown is not anticipated.* Proposed Action – Additional drawdown due to block-caving is not anticipated.*
Queen Creek Basin Springs							
2	Bitter Spring	10–30	10–30	<10	10–30	87 of 87 sensitivity runs show impacts greater than 10 feet; confirms base case impacts	No Action – Drawdown is anticipated (see description of impacts).*† Proposed Action – Additional drawdown due to block-caving is anticipated (see description of impacts).*†
3	Bored Spring	30–50	30–50	>50	>50	87 of 87 sensitivity runs show impacts greater than 10 feet; confirms base case impacts	No Action – Drawdown is anticipated (see description of impacts).*† Proposed Action – Additional drawdown due to block-caving is anticipated (see description of impacts).*†

continued

Table 3.7.1-3. Summary of potential impacts on groundwater-dependent ecosystems from groundwater drawdown (cont'd)

Reference Number on Figure 3.7.1-7	Specific GDE	Drawdown (feet) from Dewatering under No Action Alternative (end of mining)	Drawdown (feet) from Dewatering and Block-Cave under Proposed Action (end of mining)	Drawdown (feet) from Dewatering under No Action Alternative (200 years after start of mine)	Drawdown (feet) from Dewatering and Block-Cave under Proposed Action (200 years after start of mine)	Number of Sensitivity Runs with Drawdown greater than 10 Feet (based on Proposed Action, 200 years after start of mine)	Summary of Expected Impacts on GDEs
4	Hidden Spring	10–30	10–30	30–50	>50	87 of 87 sensitivity runs show impacts greater than 10 feet; confirms base case impacts	No Action – Drawdown is anticipated (see description of impacts). ^{*†} Proposed Action – Additional drawdown due to block-caving is anticipated (see description of impacts). ^{*†}
5	Iberri Spring	<10	<10	<10	<10	1 of 87 sensitivity runs show impacts greater than 10 feet; impacts are possible but unlikely	No Action – Drawdown is not anticipated. [*] Proposed Action – Addition drawdown due to block-caving is not anticipated with the base case model. Drawdown is possible but unlikely under the sensitivity modeling runs. [*]
6	Kane Spring	<10	<10	<10	>50	84 of 87 sensitivity runs show impacts greater than 10 feet; confirms base case impacts	No Action – Drawdown is not anticipated. [*] Proposed Action – Additional drawdown due to block-caving is anticipated (see description of impacts). ^{*†}
7	McGinnel Mine Spring	<10	<10	10–30	10–30	86 of 87 sensitivity runs show impacts greater than 10 feet; confirms base case impacts	No Action – Drawdown is anticipated (see description of impacts). ^{*†} Proposed Action – Addition drawdown due to block-caving is anticipated (see description of impacts). ^{*†}

continued

Table 3.7.1-3. Summary of potential impacts on groundwater-dependent ecosystems from groundwater drawdown (cont'd)

Reference Number on Figure 3.7.1-7	Specific GDE	Drawdown (feet) from Dewatering under No Action Alternative (end of mining)	Drawdown (feet) from Dewatering and Block-Cave under Proposed Action (end of mining)	Drawdown (feet) from Dewatering under No Action Alternative (200 years after start of mine)	Drawdown (feet) from Dewatering and Block-Cave under Proposed Action (200 years after start of mine)	Number of Sensitivity Runs with Drawdown greater than 10 Feet (based on Proposed Action, 200 years after start of mine)	Summary of Expected Impacts on GDEs
8	McGinnel Spring	<10	<10	10–30	10–30	85 of 87 sensitivity runs show impacts greater than 10 feet; confirms base case impacts	No Action – Drawdown is anticipated (see description of impacts). ^{*†} Proposed Action – Additional drawdown due to block-caving is anticipated (see description of impacts). ^{*†}
9	No Name Spring	<10	<10	<10	<10	0 of 87 sensitivity runs show impacts greater than 10 feet	No Action – Drawdown is not anticipated. [*] Proposed Action – Additional drawdown due to block-caving is not anticipated. [*]
10	Rock Horizontal Spring	<10	<10	<10	<10	0 of 87 sensitivity runs show impacts greater than 10 feet	No Action – Drawdown is not anticipated. [*] Proposed Action – Additional drawdown due to block-caving is not anticipated. [*]
11	Walker Spring	10–30	10–30	10–30	30–50	87 of 87 sensitivity runs show impacts greater than 10 feet; confirms base case impacts	No Action – Drawdown is anticipated (see description of impacts). ^{*†} Proposed Action – Additional drawdown due to block-caving is anticipated (see description of impacts). ^{*†}

* Regardless of anticipated impacts, monitoring would occur during operations for verification. Predictions of drawdown are approximations of a complex physical system, inherently limited by the quality of input data and structural constraints imposed by the model grid and modeling approach. The groundwater model does not predict changes to flow magnitude and timing at a given GDE. By extension, drawdown contours may not represent the aerial extent of anticipated impacts on GDEs. These contours will be used to inform more site-specific impact monitoring and mitigation.

† For all springs, streams, and associated riparian areas potentially impacted, impacts could include a reduction or loss of spring/stream flow, increased mortality or reduction in extent or health of riparian vegetation, and reduction in the quality or quantity of aquatic habitat from loss of flowing water, adjacent vegetation, or standing pools.

‡ Whitlow Ranch Dam outlet is not modeled specifically, as this cell is defined by a constant head in the model. Output described is based on estimated head levels at this location.

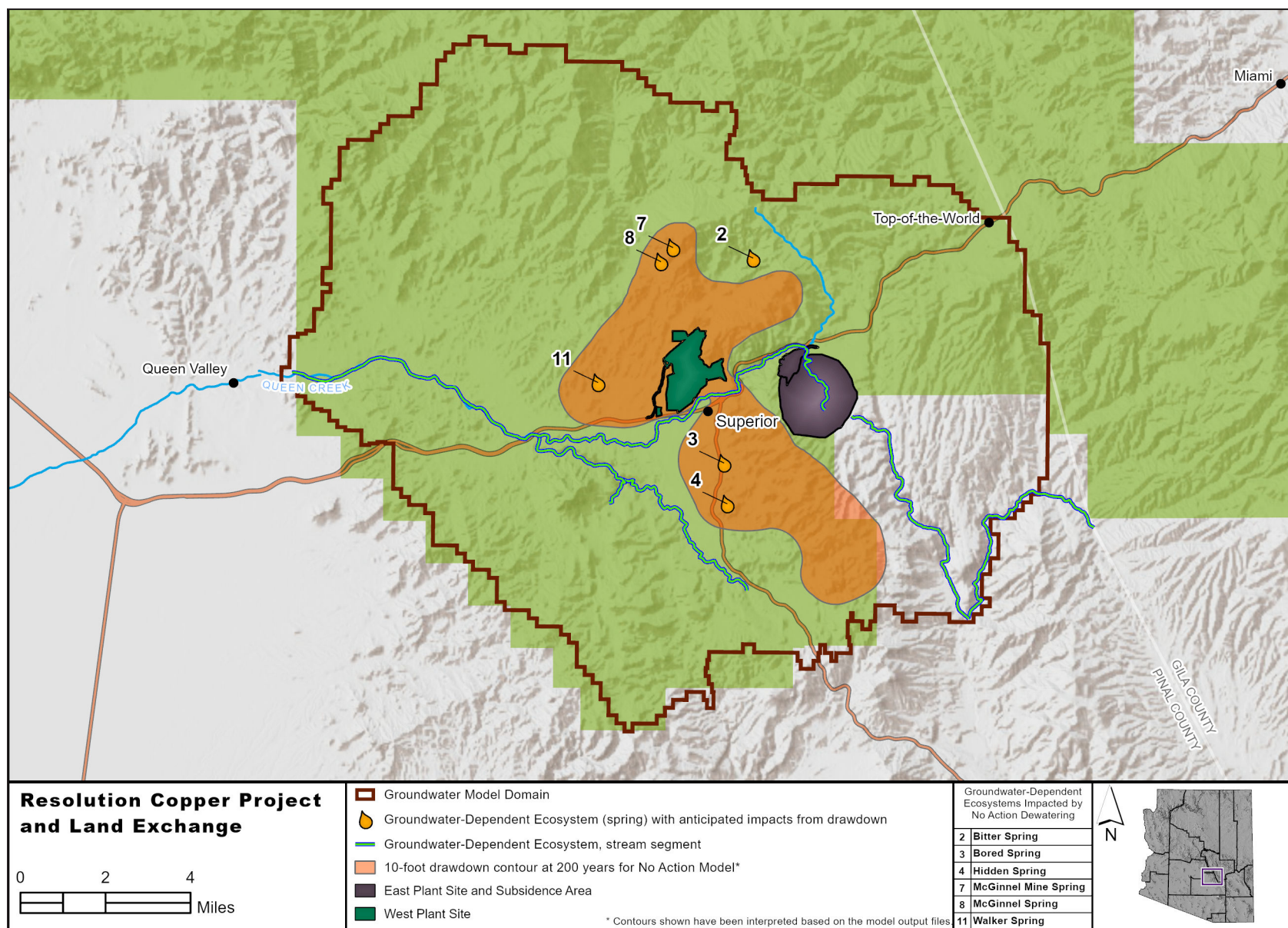


Figure 3.7.1-8. Modeled groundwater drawdown—no action

IMPACTS TO GDEs

No Action

Continued Dewatering

- Bitter Spring
- Bored Spring
- Hidden Spring
- McGinnel Mine Spring
- McGinnel Spring
- Walker Spring



All Action Alternatives

Best-calibrated Model (Impacts are anticipated)

- DC-6.6W Spring
- Kane Spring

All Sensitivity Model Runs (Impacts are possible)

- No Additional GDEs

All Sensitivity Runs (Impacts are possible but unlikely)*

- Middle Devil's Canyon (DC-8.8C, DC-8.82W, DC-8.1C)
- Queen Creek (17.4-15.6)
- Iberri Spring

* Totals shown do not include GDEs with "possible but unlikely" impacts; while at least one model sensitivity run indicates impacts could happen to these GDEs, the great majority of model runs indicate otherwise.

Alternatives

	Subsidence Crater Alone	Alt 2/3 (Near West)	Alt 4 (Silver King)	Alt 5 (Peg Leg)	Alt 6 (Skunk Camp)
Direct Disturbance	<ul style="list-style-type: none"> • Grotto • Rancho Rio 	<ul style="list-style-type: none"> • Benson • Bear Canyon • Perlite 	<ul style="list-style-type: none"> • Iberri • McGinnel 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • None
Surface Water Reductions	<ul style="list-style-type: none"> • Queen Creek (17.4-15.6) • Queen Creek (Whitlow Ranch Dam) • Devil's Canyon 	<ul style="list-style-type: none"> • Queen Creek (Whitlow Ranch Dam) 	<ul style="list-style-type: none"> • Queen Creek (Whitlow Ranch Dam) 	<ul style="list-style-type: none"> • Gila River 	<ul style="list-style-type: none"> • Gila River
Total GDEs Impacted[†]		16	14	14	14

[†] Totals shown include both GDEs impacted by the subsidence crater and GDEs impacted by specific alternatives.

Figure 3.7.1-9. Summary of impacts on GDEs by alternative

saltcedar, and sumac. The loss of water to this spring would likely lead to complete loss of this riparian area.

Bitter, Hidden, McGinnel, McGinnel Mine, and Walker Springs all have infrastructure improvements to some degree and host relatively little riparian vegetation, although standing water and herbaceous and wetland vegetation may be present. The loss of flowing water would likely lead to complete loss of these pools and fringe vegetation.

ANTICIPATED IMPACTS ON WATER SUPPLY WELLS

Many domestic and stock water supply wells in the area are shallow and likely make use of water stored in shallow alluvium or shallow fracture networks. These wells are unlikely to be impacted by groundwater drawdown from mine dewatering under the no action alternative. However, groundwater drawdown caused by the mine could affect groundwater supplies for wells that may draw from either the regional Apache Leap Tuff aquifer or the deep groundwater system. Drawdown from 10 to 30 feet is anticipated in wells in the Superior area, as shown in table 3.7.1-4.

Unlike the action alternative, the applicant-committed environmental protection measures that would remedy any impacts on water supply wells caused by drawdown from the project (discussed later in this section) would not occur under the no action alternative.

LONGER TERM MODELED IMPACTS

The only GDEs impacted under the no action alternative are the six distant springs identified earlier in this section, which are modeled as having connections to the regional deep groundwater system. Based on long-term modeled hydrographs, these springs generally see maximum drawdown resulting from the continued mine pumping within 150 to 200 years after the end of mining; the impacts shown in table 3.7.1-3 likely represent the maximum impacts that would be experienced under the no action scenario.

SUBSIDENCE IMPACTS

Under the no action alternative, small amounts of land surface displacement could continue to occur due to ongoing pumping (Newell and Garrett 2018d). These amounts are observable using satellite monitoring techniques but are unlikely to be observable on the ground.

Impacts Common to All Action Alternatives

EFFECTS OF THE LAND EXCHANGE

The land exchange would have effects on groundwater quantity and GDEs.

The Oak Flat Federal Parcel would leave Forest Service jurisdiction. Several GDEs were identified on the Oak Flat Federal Parcel, including Rancho Rio Canyon, Oak Flat Wash, Number 9 Wash, the Grotto (spring), and Rancho Rio spring. The role of the Tonto National Forest under its primary authorities in the Organic Administration Act, Locatable Regulations (36 CFR 228 Subpart A), and Multiple-Use Mining Act is to ensure that mining activities minimize adverse environmental effects on NFS surface resources; this includes these GDEs. The removal of the Oak Flat Federal Parcel from Forest Service jurisdiction negates the ability of the Tonto National Forest to regulate effects on these resources.

The offered lands parcels would enter either Forest Service or BLM jurisdiction. A number of perennial water features are located on these lands, including the following:

- Tangle Creek. Features of the Tangle Creek Parcel include Tangle Creek and one spring (LX Spring). Tangle Creek is an intermittent or perennial tributary to the Verde River and bisects the parcel. It includes associated riparian habitat with mature hackberry, mesquite, ash, and sycamore trees.
- Turkey Creek. Features of the Turkey Creek Parcel include Turkey Creek, which is an intermittent or perennial tributary to Tonto Creek and eventually to the Salt River at Roosevelt

Table 3.7.1-4. Summary of potential impacts on groundwater supplies from groundwater drawdown

Water Supply Area	Drawdown (feet) from Dewatering under No Action Alternative (end of mining)	Drawdown (feet) from Dewatering and Block-Cave under Proposed Action (end of mining)	Drawdown (feet) from Dewatering under No Action Alternative (200 years after start of mine)	Drawdown (feet) from Dewatering and Block-Cave under Proposed Action (200 years after start of mine)	Potential for Greater Drawdown Based on Sensitivity Runs?	Summary of Expected Impacts on Groundwater Supplies
DHRES-16_743 (Superior)	<10	10–30	<10	10–30	86 of 87 sensitivity runs show impacts greater than 10 feet; confirms base case impacts	No Action – Drawdown is not anticipated. Proposed Action – Additional drawdown due to block-caving is anticipated for water supply wells in this area, except for those completed solely in alluvium or shallow fracture systems. Impacts could include loss of well capacity, the need to deepen wells, the need to modify pump equipment, or increased pumping costs. Applicant-committed remedy if impacts occur.
Gallery Well (Boyce Thompson Arboretum)	<10	<10	<10	<10	0 of 87 sensitivity runs show impacts greater than 10 feet	No Action – Drawdown is not anticipated. Proposed Action – Additional drawdown due to block-caving is not anticipated.
HRES-06 (Top-of-the-World)	<10	<10	<10	<10	17 of 87 sensitivity runs show impacts greater than 10 feet; impacts are possible beyond base case impacts	No Action – Drawdown is not anticipated. Proposed Action – Additional drawdown due to block-caving is anticipated for water supply wells in this area, except for those completed solely in alluvium or shallow fracture systems. Impacts could include loss of well capacity, the need to deepen wells, the need to modify pump equipment, or increased pumping costs. Applicant-committed remedy if impacts occur.

Lake. Riparian vegetation occurs along Turkey Creek with cottonwood, locus, sycamore, and oak trees.

- Cave Creek. Features of the Cave Creek Parcel include Cave Creek, an ephemeral to intermittent tributary to the Agua Fria River, with some perennial reaches in the vicinity of the parcel.
- East Clear Creek. Features of the East Clear Creek Parcel include East Clear Creek, a substantial perennial tributary to the Little Colorado River. Riparian vegetation occurs along East Clear Creek, including boxelder, cottonwood, willow, and alder trees.
- Lower San Pedro River. Features of the Lower San Pedro River Parcel include the San Pedro River and several large, ephemeral tributaries (Cooper, Mammoth, and Turtle Washes). The San Pedro River itself is ephemeral to intermittent along the 10-mile reach that runs through the parcel; some perennial surface water is supported by an uncapped artesian well. The San Pedro is one of the few remaining free-flowing rivers in the Southwest and it is recognized as one of the more important riparian habitats in the Sonoran and Chihuahuan Deserts. The riparian corridor in the parcel includes more than 800 acres of mesquite woodlands that also features a spring-fed wetland.
- Appleton Ranch. The Appleton Ranch Parcels are located along ephemeral tributaries to the Babocomari River (Post, Vaughn, and O'Donnel Canyons). Woody vegetation is present along watercourses as mesquite bosques, with very limited stands of cottonwood and desert willow.
- No specific water sources have been identified on the Apache Leap South Parcel or the Dripping Springs Parcel.

Specific management of water resources on the offered lands would be determined by the agencies, but in general when the offered lands enter Federal jurisdiction, these water sources would be afforded a level of protection they currently do not have under private ownership.

EFFECTS OF FOREST PLAN AMENDMENT

The Tonto National Forest Land and Resource Management Plan (1985b) provides guidance for management of lands and activities within the Tonto National Forest. It accomplishes this by establishing a mission, goals, objectives, and standards and guidelines. Missions, goals, and objectives are applicable on a forest-wide basis. Standards and guidelines are either applicable on a forest-wide basis or by specific management area.

A review of all components of the 1985 Forest Plan was conducted to identify the need for amendment due to the effects of the project, including both the land exchange and the proposed mining plan of operations (Shin 2019). A number of standards and guidelines (16) were identified applicable to management of groundwater resources. None of these standards and guidelines were found to require amendment to the proposed project, either on a forest-wide or management area-specific basis. For additional details on specific rationale, see Shin (2019).

SUMMARY OF APPLICANT-COMMITTED ENVIRONMENTAL PROTECTION MEASURES

A number of environmental protection measures are incorporated into the design of the project that would act to reduce potential impacts on groundwater quantity and GDEs. These are non-discretionary measures and their effects are accounted for in the analysis of environmental consequences.

From the GPO (2016d), Resolution Copper has committed to various measures to reduce impacts on groundwater quantity and GDEs:

- Groundwater levels will be monitored at designated compliance monitoring wells located downstream of the tailings storage facility seepage recovery embankments in accordance with the requirements of the APP program;
- All potentially impacted water will be contained on-site during operations and will be put to beneficial use, thereby reducing the need to import makeup water;

- Approximately one-half of Resolution Copper's water needs will be sourced from long-term storage credits (surface stored underground);
- As much water as possible will be recycled for reuse; and
- The water supply will also include the beneficial reuse of existing low-quality water sources such as impacted underground mine dewatering water.

HYDROLOGIC CHANGES ANTICIPATED FROM MINING ACTIVITIES

The block-caving conducted to remove the ore body would unavoidably result in fracturing and subsidence of overlying rocks. These effects would propagate upward until reaching the ground surface approximately 6 years after block-caving begins (Garza-Cruz and Pierce 2017). It is estimated that the subsidence area that would develop at the surface would be approximately 800 to 1,100 feet deep (see Section 3.2, Geology, Minerals, and Subsidence).

Fracturing and subsidence of rock units would extend from the ore body to the surface. This includes fracturing of the Whitetail Conglomerate that forms a barrier between the deep groundwater system and the Apache Leap Tuff aquifer. When the Whitetail Conglomerate fractures and subsides, a hydraulic connection is created between all aquifers. Effects of dewatering from the deep groundwater system would extend to the Apache Leap Tuff aquifer at this time.

CHANGES IN BASIN WATER BALANCE – MINE DEWATERING

Mine dewatering is estimated to remove approximately 87,000 acre-feet of water from the combined deep groundwater system and Apache Leap Tuff aquifer over the life of the mine, or about 1,700 acre-feet per year (Meza-Cuadra et al. 2018a).

ANTICIPATED IMPACTS FOR GDES (UP TO 200 YEARS AFTER START OF MINING)

As assessed in this EIS, GDEs can be impacted in a number of ways:

- Ongoing dewatering (described in the no action alternative section)
- Expansion of dewatering impacts caused by the block-caving (described in this section)
- Direct physical disturbance by either the subsidence area or tailings storage facilities (described in following sections for each individual alternative)
- Reduction in surface flow from loss of watershed due to subsidence area or tailings facility (described in section 3.7.3 and also summarized in this section)

Six springs experienced drawdown greater than 10 feet under the no action alternative, and these springs are also impacted under the proposed action (Bitter, Bored, Hidden, McGinnel, McGinnel Mine, and Walker Springs). Under the proposed action, the hydrologic changes caused by the block-caving would allow the dewatering impacts to expand, impacting two additional springs: Kane Spring and DC6.6W. Impacts on springs under the proposed action are summarized in table 3.7.1-3 and figure 3.7.1-9 and are shown along with the model results (10-foot drawdown contour) in figure 3.7.1-3. Hydrographs of drawdown under the proposed action for all GDEs are also included in appendix L.

As one strategy to address the uncertainty inherent in the groundwater model, sensitivity modeling runs were also considered in addition to the base case model. The sensitivity modeling runs strongly confirm the impacts on the eight springs listed earlier in this section. Sensitivity runs show additional impact could be possible in Middle Devil's Canyon (locations DC8.8C, DC8.2CW, and DC8.1C), in Queen Creek below Superior, and at Iberri Spring. In each case, however, the large majority of sensitivity runs are consistent with the base case modeling and show

drawdown less than 10 feet. Based on the sensitivity runs, impacts at these locations may be possible but are considered unlikely.

The 10-foot drawdown contour shown on figure 3.7.1-3 represents the limit of where the groundwater model can reasonably predict impacts, either with the best-calibrated model (orange area) or the model sensitivity runs (yellow area). GDEs falling within this contour are anticipated to be impacted. GDEs outside this contour may still be impacted, but it is beyond the ability of the model to predict.

ANTICIPATED IMPACTS ON DEVIL'S CANYON

Groundwater inflow along the main stem of Devil's Canyon is not anticipated to be impacted using the best-calibrated groundwater model; however, tributary flow from spring DC-6.6W along the western edge of Devil's Canyon is anticipated to be impacted. Based on field measurements, flow from this spring contributes up to 5 percent of flow in the main channel downstream at location DC-5.5C (Newell and Garrett 2018d). There is little indication that any other springs along Devil's Canyon or groundwater contribution to the main stem of the stream would be impacted; out of 87 modeling runs, only a single modeling run indicates impact on GDE locations in Devil's Canyon besides spring DC-6.6W.

Potential runoff reductions in Devil's Canyon are summarized in table 3.7.1-5. Percent reductions in average annual flow due to the subsidence area range from 5.6 percent in middle Devil's Canyon to 3.5 percent at the confluence with Mineral Creek; percent reductions during the critical low-flow months of May and June are approximately the same. Combined with loss from spring DC-6.6W due to groundwater drawdown, total estimated flow reductions along the main stem of lower Devil's Canyon caused by the proposed project could range from 5 to 10 percent.

The habitat in Devil's Canyon downstream of spring DC-6.6W and the subsidence area that would potentially lose flow includes a roughly 2.1-mile-long, 50-acre riparian gallery, and a 0.5-mile-long continuously saturated reach that includes several large perennial pools. Riparian

vegetation in this portion of the canyon ranges from 40 to 300 feet wide. Dominant riparian species are sycamore, cottonwood, ash, alder, and willow, as well as wetland species at spring locations.

The anticipated 5 to 10 percent loss in flow during the dry season could contribute to a reduction in the extent and health of riparian vegetation and aquatic habitat. Complete drying of the downstream habitat, loss of dominant riparian vegetation, or loss of standing pools would be unlikely.

ANTICIPATED IMPACTS ON SPRINGS

It is not possible to precisely predict what impact a given drawdown in groundwater level would have on an individual spring; however, given the precision of the model (10 feet), it is reasonable to assume any spring with anticipated impact of this magnitude could experience complete drying.

Bored Spring has the highest riparian value, supporting a standing pool and a 500-foot riparian string of cottonwood, willow, mesquite, saltcedar, and sumac. The loss of water to this spring would likely lead to complete loss of this riparian area.

Hidden, McGinnel, McGinnel Mine, Walker, Bitter, and Kane Springs all have infrastructure improvements to some degree and host relatively little riparian vegetation, although standing water and herbaceous and wetland vegetation may be present. The loss of flowing water would likely lead to complete loss of these pools and fringe vegetation.

ANTICIPATED IMPACTS ON QUEEN CREEK

Impact on the flowing reach of Queen Creek between Superior and Boyce Thompson Arboretum is not anticipated under the best-calibrated model run, and impact is anticipated under less than 5 percent of the sensitivity model runs (4 of 87 sensitivity runs suggest an impact). Impacts on groundwater inflow in this reach are considered possible, but unlikely.

Table 3.7.1-5. Summary of potential impacts on groundwater-dependent ecosystems from surface flow losses

Reference Number on Figure 3.7.1-7	GDE	Summary of Expected Impacts on GDEs
Queen Creek and Tributaries		
Not numbered on figure	Queen Creek above Superior (from confluence with Oak Flat Wash [~km 26] to Magma Avenue Bridge [km 21.7], including springs QC23.6C [Boulder Hole], Queen Seeps, and QC22.6E [Karst Spring])	<p>No Action – No reduction in runoff would occur from subsidence.</p> <p>Proposed Action – Reduction in surface runoff volume due to subsidence is estimated to be 18.6% at Magma Avenue Bridge (see Section 3.7.3, Surface Water Quantity). Reduction in runoff volume could reduce amount of water temporarily stored in shallow alluvium or fracture networks. Impacts above Superior could include a reduction or loss of spring/stream flow, increased mortality or reduction in extent or health of riparian vegetation, and reduction in the quality or quantity of aquatic habitat from loss of flowing water, adjacent vegetation, or standing pools.</p>
Not numbered on figure	Queen Creek below Superior (from Magma Avenue Bridge [km 21.7] to Whitlow Ranch Dam [km 0])	<p>No Action – No reduction in runoff would occur from subsidence or tailings alternatives.</p> <p>Proposed Action/Subsidence – Reduction in surface runoff volume due to subsidence is estimated to range from 13.4% reduction at Boyce Thompson Arboretum to 3.5% reduction at Whitlow Ranch Dam. Channel largely ephemeral and habitat is generally xeroriparian in nature, accustomed to ephemeral, periodic flows. Impacts on this type of vegetation would be unlikely due to surface flow reductions of this magnitude.</p> <p>Alternative 2 and 3 – The combined reduction in runoff volume from subsidence with a reduction in runoff volume due to a tailings storage facility at the Near West location (Alternative 2 or 3) is estimated as 6.5% at Whitlow Ranch Dam. Channel largely ephemeral and habitat is generally xeroriparian in nature, accustomed to ephemeral, periodic flows. Impacts on this type of vegetation would be unlikely due to surface flow reductions of this magnitude.</p> <p>Alternative 4 – The combined reduction in runoff volume from subsidence with a reduction in runoff volume due to a tailings storage facility at the Silver King location (Alternative 4) is estimated to range from a 19.9% reduction at Boyce Thompson Arboretum to an 8.9% reduction at Whitlow Ranch Dam. Reduction in runoff volume could reduce the amount of water temporarily stored in shallow alluvium or fracture networks. Impacts at Boyce Thompson Arboretum could include a reduction or loss of spring/stream flow, increased mortality or reduction in extent or health of riparian vegetation, and reduction in the quality or quantity of aquatic habitat from loss of flowing water, adjacent vegetation, or standing pools.</p>
1	Whitlow Ranch Dam Outlet	<p>No Action – Drawdown is not anticipated.</p> <p>Proposed Action – Additional drawdown due to block-caving is not anticipated, and reduction in surface runoff is anticipated 3.5%, but impacts on riparian vegetation are unlikely due to geological controls on groundwater levels. Location would be monitored during operations for verification of potential impacts.</p>

continued

Table 3.7.1-5. Summary of potential impacts on groundwater-dependent ecosystems from surface flow losses (*cont'd*)

Reference Number on Figure 3.7.1-7	GDE	Summary of Expected Impacts on GDEs
15	Oak Flat Wash	<p>No Action – No reduction in runoff would occur from subsidence.</p> <p>Proposed Action – A portion of the Oak Flat Wash watershed is within the subsidence area, and a reduction in surface water volume is anticipated. These impacts are already incorporated into the quantitative modeling for Queen Creek.</p>
Devil's Canyon and Tributaries		
16	Devil's Canyon (from km 9.3 to confluence with Mineral Creek [km 0]).	<p>No Action – No reduction in runoff would occur from subsidence.</p> <p>Proposed Action – Reduction in surface runoff volume due to subsidence ranges from 5.6% reduction at DC8.1C to 3.5% reduction at confluence with Mineral Creek (see Section 3.7.3, Surface Water Quantity). During critical dry season (May/June), percent reductions are approximately the same. Flow reductions could contribute to a reduction in the extent and health of riparian vegetation and aquatic habitat. Complete drying of the downstream habitat, loss of dominant riparian vegetation, or loss of standing pools would be unlikely.</p>
17	Rancho Rio Canyon (RR1.5C)	<p>No Action – No reduction in runoff would occur from subsidence.</p> <p>Proposed Action – A portion of the Rancho Rio Canyon watershed is within the subsidence area, and a reduction in surface water volume is anticipated. These impacts are already incorporated into the quantitative modeling for Devil's Canyon.</p>

This reach is believed to potentially have three sources of flow (Garrett 2018d):

- groundwater inflow into this reach is possible and assumed, but not certain;
- effluent from the Town of Superior Wastewater Treatment Plant occurs and is estimated at 170 acre-feet per year; and
- discharge of groundwater from a perlite mine pit southwest of Superior is estimated at 170 acre-feet per year.

Aside from groundwater drawdown, this reach of Queen Creek also would see reductions in runoff due to the subsidence area, ranging from about 19 percent in Superior to 13 percent at Boyce Thompson Arboretum (see table 3.7.1-5). The anticipated 13 to 19 percent loss in flow during the dry season could contribute to a reduction in the extent and health of riparian vegetation and aquatic habitat. The complete drying of the downstream habitat, loss of dominant riparian vegetation, or loss of standing pools would be unlikely.

Between Boyce Thompson and Whitlow Ranch Dam, Queen Creek is largely ephemeral, and habitat is generally xeroriparian in nature, accustomed to ephemeral, periodic flows. Impacts on this type of vegetation would be unlikely due to surface flow reductions. The riparian area along Queen Creek at Whitlow Ranch Dam would be impacted by reductions in surface flow of roughly 3.5 percent. The groundwater levels in this area are primarily controlled by the fact that this area represents the discharge point for the Superior basin and the influence of Whitlow Ranch Dam impounding flow. Given this control, a 3.5 percent change in surface flow would be unlikely to greatly affect groundwater levels at this location, nor does the groundwater flow model predict any drawdown at this distance from the mine. Impacts on the riparian area at Whitlow Ranch Dam would not be expected to be substantial.

The location on Queen Creek most at risk is likely above Superior, with possible surface flow losses of more than 19 percent. Reduction in runoff volume could reduce the amount of water temporarily stored in

shallow alluvium or fracture networks. Impacts above Superior could include a reduction or loss of spring/stream flow, increased mortality or reduction in extent or health of riparian vegetation, and reduction in the quality or quantity of aquatic habitat from loss of flowing water, adjacent vegetation, or standing pools.

POTENTIAL IMPACT ON SURFACE WATER RIGHTS FROM GROUNDWATER DRAWDOWN

Arizona law allows for the right to appropriate and use surface water, generally based on a “first in time, first in right” basis. This function is administered by the ADWR, which maintains databases of water right filings, reviews applications and claims, and when appropriate issues permits and certificates of water right. However, water right filings can be made on the same surface water by multiple parties, and at this time almost all Arizona surface waters are over-appropriated with no clear prioritization of overlapping water rights. In addition, the State of Arizona has a bifurcated water rights system in which groundwater and surface water use are considered separately, and state law as of yet provides no clear framework for the interaction between groundwater and surface water uses.

To remedy these issues, a legal proceeding called the General Stream Adjudication of the Gila River is being undertaken through the Arizona court system. Goals of the adjudication include clarifying the validity and priority of surface water rights and providing a clear legal framework for when groundwater withdrawals would impinge on surface water rights. The adjudication has been underway for several decades, and while progress has been made, many issues remain unresolved, including any prioritization or validation of water rights in the analysis area.

Groundwater drawdown associated with the project is anticipated to impact eight GDEs. Known surface water filings associated with these GDEs are summarized in table 3.7.1-6. The Forest Service analysis identifies and discloses possible loss of water to these GDEs; however, the impact on any surface water rights from a legal or regulatory standpoint cannot yet be determined due to the ongoing adjudication.

Table 3.7.1-6. Summary of water right filings associated with GDEs impacted by groundwater drawdown

Specific GDE Potentially Impacted by Groundwater Drawdown	Arizona Water Right Filings
DC-6.6W Spring	Filing of Statement of Claim of Right to Use Public Waters of the State, 36-1757, filed 1986 by Arizona State Land Department
Bitter Spring	Filing of Statement of Claim of Right to Use Public Waters of the State, 36-24054, filed 1979 by Tonto National Forest
Bored Spring	Application for a Permit to Appropriate Public Waters of the State of Arizona #A-2014, filed 1938 by Crook National Forest Permit to Appropriate #A-1376, issued 1939 to Crook National Forest by State Water Commissioner Certificate of Water Right #955, issued 1941 to Crook National Forest by State Water Commissioner
Hidden Spring	Filing of Statement of Claim of Right to Use Public Waters of the State, 36-24052, filed 1979 by Tonto National Forest
Kane Spring	No filings identified
McGinnel Mine Spring	Application for a Permit to Appropriate Public Waters of the State of Arizona, 33-94335, filed 1988 by Tonto National Forest Proof of Appropriation of Water, 33-94335, filed 1989 by Tonto National Forest Permit to Appropriate Public Waters of the State of Arizona, 33-94335, issued 1989 by ADWR Certificate of Water Right 33-94355, issued 1990 by ADWR
McGinnel Spring	Statement of Claim of Right to Use Public Waters of the State, 36-24049, filed 1979 by Tonto National Forest
Walker Spring	No filings identified

ANTICIPATED IMPACTS ON WATER SUPPLY WELLS

Many domestic and stock water supply wells in the area are shallow and likely make use of water stored in shallow alluvium or shallow fracture networks. These wells are unlikely to be impacted by groundwater drawdown from the mine. However, groundwater drawdown caused by the mine could affect groundwater supplies for wells that may draw from either the regional Apache Leap Tuff aquifer or the deep groundwater system. Drawdown from 10 to 30 feet is anticipated in wells in the Superior area, as shown in table 3.7.1-4. In addition, in about 20 percent of sensitivity modeling runs, impacts from 10 to 30 feet could also occur in wells near Top-of-the-World.

The applicant-committed environmental protection measures include remedying any impacts on water supply wells caused by drawdown from the project.

LONGER TERM MODELED IMPACTS – SPRINGS IN THE QUEEN CREEK BASIN

Under the proposed action, drawdown continues to propagate well beyond 200 years. The modeled groundwater level trends generally suggest maximum drawdown does not occur until 600 to 800 years after the end of mining at the distant spring locations (Morey 2018c).

As described earlier in this section, eight of the springs (Bitter, Bored, Hidden, Kane, McGinnel, McGinnel Mine, Walker, and DC6.6W) see impacts great enough under either the no action alternative or proposed action to effectively dry the spring. The remaining springs without anticipated impacts (Iberri, No Name, and Rock Horizontal) may still experience drawdown beyond 200 years, but the magnitude and trends of drawdown observed are unlikely to change the anticipated impacts (see hydrographs in appendix L).

LONGER TERM MODELED IMPACTS – DEVIL'S CANYON

For most of Devil's Canyon (including spring DC-6.6W), drawdown under the proposed action scenario reaches its maximum extent within

50 to 150 years after the end of mining; the impacts shown in table 3.7.1-3 likely represent the maximum impacts under the proposed action scenario.

LONGER TERM MODELED IMPACTS – QUEEN CREEK, TELEGRAPH CANYON, AND ARNETT CREEK

Predicted drawdown at Queen Creek, Telegraph Canyon, and Arnett Creek did not exceed the quantitative 10-foot drawdown threshold, except in a small number of sensitivity modeling runs. However, predicted groundwater level trends indicate that the maximum drawdown would not occur at these locations for roughly 500 to 900 years, suggesting impacts could be greater than those reported in table 3.7.1-3 (Morey 2018c).

For Telegraph Canyon and Arnett Creek, while drawdown may still be occurring beyond 200 years, the magnitude and trends of drawdown observed are unlikely to change the anticipated impacts (see hydrographs in appendix L).

For the flowing reach of Queen Creek below Superior, while the impacts predicted by the best-calibrated model did not exceed the quantitative threshold of 10 feet, trends of drawdown suggest this could occur after 200 years. With consideration to the uncertainties in the analysis, impacts on the groundwater-related flow components of Queen Creek appear to be possible to occur at some point.

LONGER TERM MODELED IMPACTS – WATER SUPPLIES

Potential impacts on groundwater supplies associated with the regional aquifer were already identified as possible for both Top-of-the-World and Superior. The predicted groundwater trends suggest that the impacts shown in table 3.7.1-4 for Top-of-the-World are likely the maximum impacts expected (Morey 2018c). However, the groundwater trends for wells in Superior (represented by well DHRES-16_753) suggest that maximum drawdown would not occur until roughly 600 years after the end of mining. Impacts on groundwater supplies relying on the regional

deep groundwater system near Superior may continue to worsen beyond the results report in table 3.7.1-4.

POTENTIAL FOR LAND SUBSIDENCE DUE TO GROUNDWATER PUMPING

Two areas have the potential for land subsidence due to groundwater pumping: the area around the East Plant Site and mining panels where dewatering pumping would continue to occur, and the area around the Desert Wellfield. While small amounts of land subsidence attributable to the dewatering pumping have been observed around the East Plant Site using satellite techniques (approximately 1.5 inches, between 2011 and 2016), once mining operations begin, any land subsidence due to pumping would be subsumed by subsidence caused by the block-caving (estimated to be 800 feet deep, and possibly as deep as 1,100 feet at the end of mining).

Drawdown associated with the Desert Wellfield would contribute to lowering of groundwater levels in the East Salt River valley subbasin, including near two known areas of known ground subsidence. Further detailed analysis of land subsidence resulting from groundwater withdrawal is not feasible beyond noting the potential for any pumping to contribute to drawdown and subsidence. Subsidence effects are a basin-wide phenomenon, and the impact from one individual pumping source cannot be predicted or quantified.

Alternative 2 – Near West Proposed Action

GROUNDWATER-DEPENDENT ECOSYSTEMS IMPACTED

Three GDEs would be directly disturbed by a tailings facility at the Near West site: Bear Tank Canyon Spring, Benson Spring, and Perlite Spring. All three of these GDEs are believed to be disconnected from the regional aquifers, relying on precipitation stored in shallow alluvium or fracture networks. Benson Spring is located near the front of the facility, potentially under the tailings embankment. Bear Tank Canyon Spring

is located in the middle of the facility under the NPAG tailings, and Perlite Spring is located at the northern edge of the facility, near the PAG tailings cell.

In total, 16 GDEs are anticipated to be impacted under Alternative 2 (see figure 3.7.1-9):

- Six springs are anticipated to be impacted from continued dewatering under the no action alternative.
- Two additional springs are anticipated to be impacted under the proposed action, because of the block-cave mining.
- Two springs are directly disturbed by the subsidence area.
- Three springs are directly disturbed by the Alternative 2 tailings storage facility.
- One perennial stream (Devil's Canyon) is impacted by reduced runoff from the subsidence area.
- Two perennial stream reaches on Queen Creek are impacted by reduced runoff from both the subsidence area and the tailings.

CHANGES IN TAILINGS WATER BALANCE

The substantial differences in water balance between alternatives are directly related to the location and design of the tailings storage facility. There are five major differences, as shown in table 3.7.1-7:

- **Entrainment.** The tailings deposition method affects the amount of water that gets deposited and retained with the tailings. Alternative 2 entrains about the same amount of water as the other slurry tailings alternatives (Alternatives 3, 5, and 6), but substantially more than Alternative 4.
- **Evaporation.** The tailings deposition method also affects the amount of water lost through evaporation, even among slurry tailings. Alternative 2 evaporates a similar amount of water as

Alternatives 5 and 6, but substantially more than Alternatives 3 and 4.

- **Watershed losses.** Watershed losses from the capture of precipitation depend primarily on the location of the tailings storage facility and where it sits in the watershed. Surface runoff losses are summarized in table 3.7.1-5, and are analyzed in greater detail in Section 3.7.3, Surface Water Quantity.
- **Seepage.** Differences in seepage losses are substantial between alternatives. Three estimates of seepage are shown in table 3.7.1-7. The amount of seepage based on the initial tailings designs using only the most basic level of seepage controls is shown, and primarily reflects the type of tailings deposition and geology (WestLand Resources Inc. 2018b). After these initial designs, the engineered seepage controls were refined as part of efforts to reduce impacts on water quality from the seepage (Klohn Crippen Berger Ltd. 2019d). The estimated reduced seepage rates with all engineered seepage controls in place, both during operations and post-closure, are also shown in table 3.7.1-7. Alternative 2 loses more seepage than Alternatives 3 and 4, but less seepage than Alternatives 5 and 6. The effects of seepage on groundwater and surface water quality are analyzed in greater detail in Section 3.7.2, Groundwater and Surface Water Quality.

CHANGES IN DESERT WELLFIELD PUMPING

The water balances for the alternatives are very complex, with multiple water sources and many recycling loops. However, ultimately a certain amount of makeup water is needed, which must be pumped from Desert Wellfield in the East Salt River valley. Alternative 2 requires the most makeup water, roughly 600,000 acre-feet over the life of the mine. The amount of groundwater in storage in the East Salt River valley subbasin (above a depth of 1,000 feet) is estimated to be about 8.1 million acre-feet. Pumping under Alternative 2 represents about 7.3 percent of the available groundwater in the East Salt River valley subbasin.

Table 3.7.1-7. Primary differences between alternative water balances

Alternative	Water Entrained with Tailings (acre-feet, life of mine)	Precipitation or runoff Intercepted (acre-feet, life of mine)*	Percentage Loss to Downstream Waters†	Water Lost to Evaporation from Tailings Storage Facility (acre-feet, life of mine)*	Water Lost as Seepage from Tailings Storage Facility without Engineered Seepage Controls (acre-feet, life of mine)	Water Lost as Seepage to Aquifer after Engineered Seepage Controls during Operations (acre-feet, life of mine)	Water Lost as Seepage to Aquifer, Post-Closure (acre-feet per year)	Makeup Water Pumped from Desert Wellfield (acre-feet, life of mine)
2	271,839	68,780	6.5	307,903	5,741	849	20.7	586,508
3	305,443	60,531	6.5	174,742	2,891	111	2.7	494,286
4	71,017	110,854	8.9	135,102	3,148	369–680	15.2–31.9	175,800
5	308,404	278,639	0.2	384,702	53,184	10,701	261	544,778
6	277,710	205,297	0.3	384,427	17,940	2,665–7,298	202–258	544,858

Source: Ritter (2018). For seepage losses after engineered seepage controls, during operations and post-closure, see Klohn Crippen Berger Ltd. (2019d) and Gregory and Bayley (2019)

* Alternatives 5 and 6 include total precipitation on and evaporation from the tailings beach. However, precipitation onto the tailings beach that evaporates before contributing to the mine water balance is not included in the estimated precipitation and evaporation volumes for Alternatives 2, 3, and 4. These different accounting methods for evaporation and precipitation do not impact the total makeup water demand estimates for the Desert Wellfield

† Alternatives 2, 3, and 4 reflect change in percentage of annual flow in Queen Creek at Whitlow Ranch Dam. Alternatives 5 and 6 reflect change in percentage of annual flow in the Gila River at Donnelly Wash. These numbers only account for precipitation captured by tailings facilities or subsidence area. Water rerouted around the facilities or seepage reappearing downstream is not incorporated.

Projected drawdown would be greatest in the center of the Desert Wellfield, reaching a maximum drawdown of 228 feet, as shown in figure 3.7.1-2. These groundwater levels recover after mining ceases, eventually recovering to less than 20 feet. Drawdown decreases with distance from the wellfield. At the north and south ends of the wellfield, maximum drawdown ranges from 109 to 132 feet, and farther south within NMIDD, maximum drawdown is roughly 49 feet (Bates et al. 2018; Garrett 2018a).

Alternative 3 – near west – Ultrathickened

GROUNDWATER-DEPENDENT ECOSYSTEMS IMPACTED

The GDEs impacted are identical to those impacted under Alternative 2.

CHANGES IN TAILINGS WATER BALANCE

The following water balance components for Alternative 3 are summarized in table 3.7.1-7:

- **Entrainment.** Alternative 3 entrains about the same amount of water as the other slurry tailings alternatives (Alternatives 3, 5, and 6), but substantially more than Alternative 4.
- **Evaporation.** Alternative 3 evaporates less water than Alternatives 2, 5, and 6, and almost matches the filtered tailings alternative (Alternative 4) for reductions in evaporation.
- **Watershed losses.** Watershed losses are the same as Alternative 2.
- **Seepage.** With engineered seepage controls in place, Alternative 3 loses the least amount of seepage of any alternative, including the filtered tailings alternative (Alternative 4).

CHANGES IN DESERT WELLFIELD PUMPING

Alternative 3 requires less makeup water than Alternative 2, roughly 500,000 acre-feet over the life of the mine. Pumping under Alternative 3 represents about 6.1 percent of the estimated 8.1 million acre-feet of available groundwater in the East Salt River valley subbasin (Garrett 2018a).

Maximum drawdown for Alternative 3 reaches about 177 feet, eventually recovering to less than 20 feet. At the north and south ends of the wellfield, maximum drawdown ranges from 87 to 105 feet, and farther south within NMIDD maximum drawdown is roughly 42 feet (Bates et al. 2018; Garrett 2018a).

Alternative 4 – Silver King

GROUNDWATER-DEPENDENT ECOSYSTEMS IMPACTED

Two GDEs would be directly disturbed by a tailings facility at the Silver King site: Iberri Spring and McGinnel Spring. Both of these springs are assumed to be at least partially connected to the regional aquifers; both are located under the NPAG tailings facility.

In total, 14 GDEs are anticipated to be impacted under Alternative 4 (see figure 3.7.1-9):

- Six springs are anticipated to be impacted from continued dewatering under the no action alternative.
- Two additional springs are anticipated to be impacted under the proposed action, because of the block-cave mining.
- Two springs are directly disturbed by the subsidence area.
- Two springs are directly disturbed by the Alternative 4 tailings storage facility; however, one of these was already impacted under the no action alternative.

- One perennial stream (Devil's Canyon) is impacted by reduced runoff from the subsidence area.
- Two perennial stream reaches on Queen Creek are impacted by reduced runoff from both the subsidence area and the tailings.

For the other action alternatives, there was an anticipated 7 to 15 percent loss in flow in Queen Creek below Superior to Boyce Thompson Arboretum. Because of the location of Alternative 4 at the head of the watershed, these flow losses are more substantial, ranging from 7 percent in Superior, to 20 percent at Boyce Thompson Arboretum, to 9 percent at Whitlow Ranch Dam. Reduction in runoff volume could reduce the amount of water temporarily stored in shallow alluvium or fracture networks.

Impacts at Boyce Thompson Arboretum could include a reduction or loss of spring/stream flow, increased mortality or reduction in extent or health of riparian vegetation, and reduction in the quality or quantity of aquatic habitat from loss of flowing water, adjacent vegetation, or standing pools. Substantial impacts on the riparian vegetation at Whitlow Ranch Dam are still unlikely due to the geological controls, although the reductions in runoff are greater under Alternative 4 than other alternatives.

CHANGES IN TAILINGS WATER BALANCE

The following water balance components for Alternative 4 are summarized in table 3.7.1-7:

- **Entrainment.** Because water is filtered from the tailings before placement, Alternative 4 entrains the least amount of water of all alternatives, approximately only one-quarter of that entrained under Alternative 2.
- **Evaporation.** Because Alternative 4 does not have a standing recycled water pond, Alternative 4 also evaporates the least amount of water of all alternatives, approximately only one-half of that of Alternative 2.

- **Watershed losses.** Watershed losses are higher than Alternatives 2 and 3, due to the position of Alternative 4 higher in the Queen Creek watershed, and the need for stringent stormwater control to avoid contact of water with exposed PAG tailings.
- **Seepage.** Alternative 4 loses the least amount of seepage of all alternatives, except for Alternative 3 (ultrathickened).

CHANGES IN DESERT WELLFIELD PUMPING

Alternative 4 requires the least amount of makeup water of all alternatives, roughly 180,000 acre-feet over the life of the mine, or roughly 30 percent of the makeup water required for the slurry tailings alternatives (Alternatives 2, 3, 5, and 6). Pumping under Alternative 4 represents about 2.2 percent of the estimated 8.1 million acre-feet of available groundwater in the East Salt River valley subbasin (Garrett 2018a).

Alternative 4 also results in the least amount of drawdown, as shown in figure 3.7.1-2. Maximum drawdown for Alternative 4 reaches about 53 feet, eventually recovering to roughly 5 feet. At the north and south ends of the wellfield, maximum drawdown ranges from 30 to 35 feet, and farther south within NMIDD maximum drawdown is roughly 17 feet (Bates et al. 2018; Garrett 2018a).

Alternative 5 – Peg Leg

GROUNDWATER-DEPENDENT ECOSYSTEMS IMPACTED

No GDEs have been identified within the vicinity of the Peg Leg site or are expected to be directly disturbed. In total, 14 GDEs are anticipated to be impacted under Alternative 5 (see figure 3.7.1-9):

- Six springs are anticipated to be impacted from continued dewatering under the no action alternative.

- Two additional springs are anticipated to be impacted under the proposed action because of the block-cave mining.
- Two springs are directly disturbed by the subsidence area.
- Three perennial stream reaches in Devil's Canyon and Queen Creek are impacted by reduced runoff from the subsidence area.
- One perennial stream reach of the Gila River is impacted by reduced runoff from the tailings facility.

CHANGES IN TAILINGS WATER BALANCE

The following water balance components for Alternative 5 are summarized in table 3.7.1-7:

- **Entrainment.** Alternative 5 entrains about the same amount of water as the other slurry tailings alternatives (Alternatives 2, 5, and 6), but substantially more than Alternative 4.
- **Evaporation.** Alternative 5 loses the most amount of water to evaporation of all alternatives, about 25 percent more than Alternative 2.
- **Watershed losses.** Watershed losses (as a percentage change in perennial flow) are relatively low for Alternative 5, largely due to the large watershed and flow of the Gila River.
- **Seepage.** Because of the location over a deep alluvial basin, Alternative 5 loses substantially more seepage than all other alternatives.

CHANGES IN DESERT WELLFIELD PUMPING

Alternative 5 requires more water to move the tailings slurry over long distances, and to make up for seepage losses. Alternative 5 uses only slightly less water than Alternative 2, about 550,000 acre-feet over the life of the mine. Pumping under Alternative 5 represents about 6.7 percent of the estimated 8.1 million acre-feet of available groundwater in the East Salt River valley subbasin (Garrett 2018a).

Maximum drawdown for Alternative 5 reaches about 199 feet, eventually recovering to less than 20 feet. At the north and south ends of the wellfield, maximum drawdown ranges from 96 to 115 feet, and farther south within NMIDD maximum drawdown is roughly 46 feet (Bates et al. 2018; Garrett 2018a).

Alternative 6 – Skunk Camp

GROUNDWATER-DEPENDENT ECOSYSTEMS IMPACTED

No GDEs have been identified within the vicinity of the Skunk Camp site based on site-specific information. In total, 14 GDEs are anticipated to be impacted under Alternative 6, the same as under Alternative 5 (see figure 3.7.1-9):

- Six springs are anticipated to be impacted from continued dewatering under the no action alternative.
- Two additional springs are anticipated to be impacted under the proposed action, because of the block-cave mining.
- Two springs are directly disturbed by the subsidence area.
- Three perennial stream reaches in Devil's Canyon and Queen Creek are impacted by reduced runoff from the subsidence area.
- One perennial stream reach of the Gila River is impacted by reduced runoff from the tailings facility.

CHANGES IN TAILINGS WATER BALANCE

The following water balance components for Alternative 6 are summarized in table 3.7.1-6:

- **Entrainment.** Alternative 6 entrains about the same amount of water as the other slurry tailings alternatives (Alternatives 2, 5, and 6), but substantially more than Alternative 4.

- **Evaporation.** Alternative 6 loses almost as much water to evaporation as the alternative with the greatest evaporative losses (Alternative 5), about 25 percent more than Alternative 2.
- **Watershed losses.** Watershed losses (as a percentage change in perennial flow) are relatively low for Alternative 6, largely due to the large watershed and flow of the Gila River.
- **Seepage.** Because of the location over an alluvial basin, Alternative 6 loses substantially more than Alternatives 2, 3, and 4, but still less than Alternative 5.

CHANGES IN DESERT WELLFIELD PUMPING

Alternative 6 requires more water to move the tailings slurry over long distances, and to make up for seepage losses. Alternative 6 uses only slightly less water than Alternative 2, about 550,000 acre-feet over the life of the mine, and about the same as Alternative 5. Pumping under Alternative 6 represents about 6.7 percent of the estimated 8.1 million acre-feet of available groundwater in the East Salt River valley subbasin (Garrett 2018a).

Drawdown from Alternative 6 is nearly identical to that of Alternative 5.

Cumulative Effects

The Tonto National Forest identified the following reasonably foreseeable future actions as likely, in conjunction with development of the Resolution Copper Mine, to contribute to cumulative impacts on groundwater quantity and GDEs. As noted in section 3.1, past and present actions are assessed as part of the affected environment; this section analyzes the effects of any RFFAs, to be considered cumulatively along with the affected environment and Resolution Copper Project effects.

- *Ripsey Wash Tailings Project.* Mining company ASARCO is planning to construct a new tailings storage facility to support its Ray Mine operations. The environmental effects of the

project were analyzed in an EIS conducted by the USACE and approved in a ROD issued in December 2018. As approved, the proposed tailings storage facility project would occupy an estimated 2,574 acres and would be situated in the Ripsey Wash watershed just south of the Gila River approximately 5 miles west-northwest of Kearny, Arizona, and would contain up to approximately 750 million tons of material (tailings and embankment material). ASARCO estimates a construction period of 3 years and approximately 50 years of expansion of the footprint of the tailings storage facility as slurry tailings are added to the facility, followed by a 7- to 10-year period for reclamation and final closure. This project is estimated to result in a reduction of recharge to the Gila River of 0.2 percent. This would be cumulative with losses from either Alternative 5 (estimated reduction in flow in the Gila River at Donnelly Wash of 0.2 percent) or Alternative 6 (estimated reduction in flow in the Gila River at Donnelly Wash of 0.3 percent).

- *LEN Range Improvements.* This range allotment is located near Ray Mine. Under the proposed action, upland perennial sources of water would be provided to supplement the existing upland water infrastructure on the allotment. The supplemental water sources would provide adequate water facilities for existing authorized grazing management activities. While beneficial, these water sources are located in a different geographic area than the GDEs potentially impacted by the Resolution Copper Project.
- *Millsite Range Improvements.* This range allotment is located 20 miles east of Apache Junction, on the southern end of the Mesa Ranger District. The Mesa Ranger District is proposing to add three new 10,000-gallon storage tanks and two 600-gallon troughs to improve range condition through better livestock distribution and to provide additional wildlife waters in three pastures on the allotment. Water developments are proposed within the Cottonwood, Bear Tanks, and Hewitt pastures of the Millsite grazing allotment. These improvements would be beneficial for providing water on the landscape and are within

the same geographic area where some water sources could be lost (Alternatives 2 and 3); they may offset some loss of water that would result because of the Resolution Copper Project tailings storage facility construction.

- *Ray Land Exchange and Proposed Plan Amendment.* ASARCO is also seeking to complete a land exchange with the BLM by which the mining company would gain title to approximately 10,976 acres of public lands and federally owned mineral estate located near ASARCO's Ray Mine in exchange for transferring to the BLM approximately 7,304 acres of private lands, primarily in northwestern Arizona. It is known that at some point ASARCO wishes to develop a copper mining operation in the "Copper Butte" area west of the Ray Mine; however, no details are currently available as to potential environmental effects, including to groundwater quantity and GDEs, resulting from this possible future mining operation. Given the location of this activity, impacts on water could potentially be cumulative with Resolution Copper Project-related impacts on the Gila River for Alternatives 5 and 6.
- *Imerys Perlite Mine.* Imerys Perlite Mine submitted a plan of operations in 2013 which included plans for continued operation of the existing sedimentation basin at the millsite; continued use of segments of NFS Roads 229, 989, and 2403 for hauling; and mining at the Forgotten Wedge and Rosemarie Exception No. 8 claims. Dewatering is necessary to access the ore body in the active mine pit. This groundwater withdrawal would potentially be cumulative with dewatering impacts from the Resolution Copper Project.

Other projects and plans are certain to occur or be in place during the foreseeable life of the Resolution Copper Mine (50–55 years). These, combined with general population increase and ground-disturbing activities, may cumulatively contribute to future changes to groundwater supplies and GDEs.

EAST SALT RIVER VALLEY WATER SUPPLIES

Several reasonably foreseeable future actions were identified during the NEPA process but were determined too speculative to analyze for cumulative effects without detailed plans. These include potential housing developments in the town of Florence, and the ASLD's planned Superstition Vistas development area. A number of approved, assured water supplies were also identified in the East Salt River valley, and these describe future use of water in enough detail to be considered for cumulative effects. All of these potential future actions have the potential to be cumulative in combination with the impacts from the Desert Wellfield, resulting in greater drawdown than projected from the Resolution Copper Project.

RECHARGE AND RECOVERY CREDITS

Arizona water law allows for renewable sources of water to be recharged and stored in aquifers. Ultimately, this water can be recovered for use without needing a groundwater right (minus a 5 percent reduction to improve aquifer conditions).

Resolution Copper has been acquiring storage credits that would offset its future pumping, using various mechanisms. This was identified earlier in this section as an applicant-committed environmental protection measure (to offset approximately half the water supply). However, it is important to note that recharging water and acquiring storage credits is not required under Arizona water law; this is a voluntary measure by Resolution Copper. As such, while Resolution Copper has indicated its intent to do so, there is no guarantee that these credits would be used to offset the mine water supply, nor is there any requirement for the entire water supply to be offset by recharge credits.

- Between 2006 and 2011, Resolution Copper arranged for delivery of about 190,000 acre-feet of CAP water to NMIDD. NMIDD has been permitted as a "groundwater savings facility" through ADWR. At a groundwater savings facility, farmers forgo legal groundwater pumping (allowed with irrigation groundwater rights) and use renewable surface water on crops

instead. This mechanism allows groundwater to stay in the aquifer within the same basin from which the Desert Wellfield would eventually withdraw groundwater. Resolution Copper undertook similar measures for Roosevelt Water Conservation District (located in the East Salt River valley, west of the Desert Wellfield) for an additional 14,000 acre-feet of water.

- Resolution Copper has also physically recharged about 20,000 acre-feet of water at the Tonopah Desert Recharge Project; this facility is located west of the Phoenix metropolitan area and not in the same aquifer, but within the Phoenix AMA.
- Between 2012 and 2017, Resolution Copper also purchased an existing 37,000 acre-feet of storage credits, also stored at the NMIDD groundwater savings facility.
- Resolution Copper also has stored about 60,000 acre-feet water in the Pinal AMA, at the Hohokam Irrigation Drainage District groundwater savings facility.
- Resolution Copper continues to deliver treated water from mine infrastructure dewatering to NMIDD. However, because this amounts to a transfer of groundwater within an AMA, no storage credits are obtained in this manner.

All told, Resolution Copper has acquired 256,355 acre-feet of storage credits within the Phoenix AMA, and 313,135 acre-feet of storage credits between both the Phoenix and Pinal AMAs. This offsets roughly 43 to 52 percent of expected pumping for the slurry alternatives (Alternatives 2, 3, 5, and 6) and 143 percent of pumping for Alternative 4.

The impacts from the Desert Wellfield that are described in this section are based on the physical removal of water from the aquifer as it exists today and are not a reflection of the legal availability of that groundwater. Part of the groundwater physically stored in the aquifer is already legally attributable to other long-term storage credit holders; removal of this groundwater in the future would have a cumulative impact with the pumping from the Desert Wellfield.

REGIONAL WATER SUPPLIES

The area analyzed for assured water supplies incorporates Pinal County south of U.S. 60 through the town of Florence. A total of 239 entities presently hold assured water supply analyses or certificates, accounting for over 100,000 lots, and with a total 100-year groundwater demand of 11.1 million acre-feet. Not all of these entities are going to be drawing water from the same aquifer as the Desert Wellfield, nor would all this pumping happen during the mine life, nor does this list include any water use for anticipated development in the Superstitions Vistas planning area. Considering these uncertainties, it is not possible to quantify the cumulative water use in the area, but it is reasonable to note that groundwater demand is substantial and growing.

Resolution Copper's pumping from the Desert Wellfield represents the use of approximately 2.2 to 7.3 percent of the 8.1 million acre-feet estimated to be physically available in the aquifer (above a depth of 1,000 feet). Cumulatively, the total demand on the groundwater resources in the East Salt River valley is substantial and could be greater than the estimated amount of physically available groundwater.

Mitigation Effectiveness

The Forest Service is in the process of developing a robust mitigation plan to avoid, minimize, rectify, reduce, or compensate for resource impacts that have been identified during the process of preparing this EIS. Appendix J contains descriptions of mitigation concepts being considered and known to be effective, as of publication of the DEIS. Appendix J also contains descriptions of monitoring that would be needed to identify potential impacts and mitigation effectiveness. As noted in chapter 2 (section 2.3), the full suite of mitigation would be contained in the FEIS, required by the ROD, and ultimately included in the final GPO approved by the Forest Service. Public comment on the DEIS, and in particular appendix J, will inform the final suite of mitigations.

This section contains an assessment of the effectiveness of mitigation and monitoring measures found in appendix J that are applicable to groundwater quantity and GDEs.

MITIGATION MEASURES APPLICABLE TO GROUNDWATER QUANTITY AND GDES

Seeps and springs monitoring and mitigation plan (RC-211): One mitigation measure is contained in appendix J that would be applicable to groundwater quantity and GDEs. In April 2019, the Forest Service received from Resolution Copper a document titled “Monitoring and Mitigation Plan for Groundwater Dependent Ecosystems and Water Wells” (Montgomery and Associates Inc. 2019). This document outlines monitoring plan to assess potential impacts on each GDE, identifies triggers and associated actions to be taken by Resolution Copper to ensure that GDEs are preserved, and suggested mitigation measures for each GDE if it is shown to be impacted by future mine dewatering. Note that this plan includes actions both for GDEs and water supply wells.

The plan focuses on the same GDEs described in this section of the EIS, as these are the GDEs that are believed to rely on regional groundwater that could be impacted by the mine. The stated goal of the plan is “to ensure that groundwater supported flow that is lost due to mining activity is replaced and continues to be available to the ecosystem.” The plan specifically notes that it is not intended to address water sources associated with perched shallow groundwater in alluvium or fractures.

The specific GDEs addressed by this plan include

- Bitter, Bored, Hidden, Iberri, Kane, McGinnel, McGinnel Mine, No Name, Rock Horizontal, and Walker Springs;
- Queen Creek below Superior (reach km 17.39 to 15.55) and at Whitlow Ranch Dam;
- Arnett Creek in two locations;
- Telegraph Canyon in two locations;

- Devil’s Canyon springs (DC4.1E, DC6.1E, DC6.6W, and DC8.2W)
- Devil’s Canyon surface water in two locations (reach km 9.1 to 7.5, and reach km 6.1 to 5.4)
- Mineral Creek springs (Government Springs, MC3.4W)
- Mineral Creek surface water in two locations (MC8.4C, and reach km 6.9 to 1.6)

Monitoring frequency and parameters are discussed in the plan, and include such things as groundwater level or pressure, surface water level, presence of water or flow, extent of saturated reach, and phreatophyte area. In general, groundwater level or pressure and surface water level would be monitored daily (using automated equipment), while other methods would be monitored quarterly or annually.

Water supplies to be monitored are Superior (using well DHRES-16_743 as a proxy), Boyce Thompson Arboretum (using the Gallery Well as a proxy), and Top-of-the-World (using HRES-06 as a proxy).

A variety of potential actions are identified that could be used to replace water sources if monitoring reaches a specified trigger. Specific details (likely sources and pipeline corridor routes) are shown in the plan. These include the following:

- Drilling new wells, applicable to both water supplies and GDEs. The intent of installing a well for a GDE is to pump supplemental groundwater that can be used to augment flow. The exact location and construction of the well would vary; it is assumed in many cases groundwater would be transported to GDEs via an overland pipeline to minimize ground disturbance. Wells require maintenance in perpetuity, and likely would be equipped with storage tanks and solar panels, depending on specific site needs.
- Installing spring boxes. These are structures installed into a slope at the discharge point of an existing spring, designed to capture natural flow. The natural flow is stored in a box and

discharged through a pipe. Spring boxes can be deepened to maintain access to water if the water level decreases. Spring boxes require little ongoing maintenance to operate.

- Installing guzzlers. Guzzlers are systems for harvesting rainwater for wildlife consumption. Guzzlers use an impermeable apron, typically installed on a slope, to collect rainwater which is then piped to a storage tank. A drinker allows wildlife and/or livestock to access water without trampling or further degrading the spring or water feature. Guzzlers require little ongoing maintenance to operate.
- Installing surface water capture systems such as check dams, alluvial capture, recharge wells, or surface water diversions. All of these can be used to supplement diminished groundwater flow at GDEs by retaining precipitation in the form of runoff or snowmelt, making it available for ecosystem requirements.
- Providing alternative water supplies from a non-local source. This would be considered only if no other water supply is available, with Arizona Water Company or the Desert Wellfield being likely sources of water.

MITIGATION EFFECTIVENESS AND IMPACTS

Effectiveness of Monitoring

The monitoring as proposed is of sufficient frequency and includes the necessary parameters to not only identify whether changes in GDEs are taking place, but also to inform whether the mine drawdown is responsible. For instance, conducting daily automated monitoring allows for an understanding of normal seasonal and drought-related fluctuations in water level or flow, which can be taken into consideration when evaluating the possible effects from the mine.

Effectiveness of Mitigation

Replacement of water sources using the techniques described (replacement wells or alternative water sources) would be highly

effective for public water supplies. For GDEs, the effectiveness would depend on the specific approach. Engineered replacements like pipelines, guzzlers, or spring boxes would be effective at maintaining a water source and maintaining a riparian ecosystem, but the exact type, location, and extent of riparian vegetation could change to adapt to the new discharge location and frequency of the new water source. Changes in water quality are unlikely to be an issue, since new water sources would likely derive from the same source as natural spring flow (i.e., the Apache Leap Tuff aquifer, or stored precipitation).

While water flow, riparian ecosystems, and associated terrestrial and aquatic habitat would be maintained, there would still likely be a noticeable change in the overall environment that could affect both wildlife, recreationists, and the public. The presence of infrastructure like wells and pipes near some natural areas could change the sense of place and nature experienced in these locations.

Impacts from Mitigation Actions

The mitigation actions identified would result in additional ground disturbance, though minimal. Mitigation for any given GDE would likely result in less than 1 acre of impact, assuming a well pad and pipeline installation, or installation of check dams. If all mitigations were installed as indicated in the plan, impacts could total 20 to 30 acres of additional ground disturbance.

UNAVOIDABLE ADVERSE IMPACTS

Given the effectiveness of mitigation, there would be no residual impacts on public water supplies near the mine site. All lost water supplies would be replaced.

For GDEs expected to be impacted by groundwater drawdown, the mitigation measures described would be effective enough that there would be no net loss of riparian ecosystems or aquatic habitat on the landscape, although the exact nature and type of ecosystems would change to adapt to new water sources. However, impacts on the sense of

place and nature experienced at these perennial streams and springs, rare in a desert environment, would not be mitigated by these actions.

The mitigation plan would not mitigate any GDEs lost directly to surface disturbance, ranging from two to five, depending on the tailings alternative.

Impacts on water supplies in the East Salt River valley in the form of groundwater drawdown and reduction of regional groundwater supply would not be fully mitigated.

Other Required Disclosures

SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

Groundwater pumping would last the duration of the mine life. At the mine itself, groundwater levels would slowly equilibrate over a long period (centuries). Groundwater drawdown from dewatering of the underground mine workings would constitute a permanent reduction in the productivity of groundwater resources within the long time frame expected for equilibrium. Groundwater in the vicinity of the Desert Wellfield would equilibrate more quickly, but there would still be an overall decline in the regional water table due to the Resolution Copper Project and a permanent loss of productivity of groundwater resources in the area.

Seeps and springs could be permanently impacted by drawdown in groundwater levels, as could the riparian areas associated with springs, but these impacts would be mitigated. GDEs or riparian areas directly lost to surface disturbance would be a permanent impact.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Mine dewatering at the East Plant Site under all action alternatives would result in the same irretrievable commitment of 160,000 acre-feet of water from the combined deep groundwater system and Apache Leap Tuff aquifer over the life of the mine.

Changes in total groundwater commitments at the Desert Wellfield vary by alternative for tailings locations and tailings type. Alternative 4 would require substantially less water overall than the other alternatives (176,000 acre-feet, vs. 586,000 acre-feet for Alternative 2). Loss of this water from the East Salt River valley aquifer is an irretrievable impact; the use of this water would be lost during the life of the mine.

While a number of GDEs and riparian areas could be impacted by groundwater drawdown, these changes are neither irreversible nor irretrievable, as mitigation would replace water sources as monitoring identifies problems. However, even if the water sources are replaced, the impact on the sense of nature and place for these natural riparian systems would be irreversible. In addition, the GDEs directly disturbed by the subsidence area or tailings alternatives represent irreversible impacts.

This page intentionally left blank



