RAY MINE TAILINGS STORAGE FACILITY
FACT SHEET AND FINAL EIS CHAPTERS 1-9

Fact Sheet

Project Title: Ray Mine Tailings Storage Facility

Document: Final Environmental Impact Statement

Corps File No: SPL-2011-01005-MWL

Issue Date: September 2018

Project Location: About 10 miles northwest of the community of Kearny in Pinal County, Arizona

Proponent: Asarco LLC
5285 E. Williams Circle – Suite 2000
Tucson, Arizona 85711

Lead Agency: U.S. Army Corps of Engineers
Arizona-Nevada Office
3636 N. Central Avenue, Suite 900
Phoenix, Arizona 85012-1939

Lead Agency Contact: Mr. Michael Langley
Senior Project Manager
Email: Michael.W.Langley@usace.army.mil

Cooperating Agencies: Environmental Protection Agency
Bureau of Land Management
Bureau of Indian Affairs - San Carlos Irrigation Project

Abstract:

This environmental impact statement (EIS) has been prepared in response to a Section 404 permit application that Asarco LLC (Asarco) submitted to the U.S. Army Corps of Engineers (Corps) for the construction and operation of a new tailings storage facility (TSF) that would impact Ripsey Wash and other ephemeral washes located approximately four miles southwest of the present tailings facility at the Ray Mine. Because Ripsey Wash and certain of its tributary drainages are considered “waters of the United States” by the Corps, Asarco must obtain Corps approval to construct and operate a TSF in this drainage. Based on its current mine plan and identified mineral resources of the site, Asarco expects that Ray Mine operations could continue for approximately another 50 years. Asarco has determined the need to store 750 million tons of tailings generated at the Ray Concentrator. Tailings are the finely-ground rock material produced by the milling process, which separates copper-bearing minerals from non-economic material. The existing Elder Gulch TSF is nearing capacity and cannot accommodate this expected quantity of tailings. Further upward expansion of the Elder Gulch TSF within its current footprint is not considered feasible given safety and stability concerns. Asarco will require a new TSF to be fully operational within the next five to seven years to facilitate long-term operations.

This EIS documents the environmental analysis of the proposed new tailings storage facility, discusses the purpose and need for the proposed project, evaluates alternatives, identifies environmental baseline and background conditions within and surrounding the project area, describes environmental impacts, and considers management and mitigation measures associated with the proposed tailings storage.

Record of Decision:

The Corps has a waiting period of 30 days after release of the Final EIS before issuing a Record of Decision on this project and will accept any comments during this period. Comments must be postmarked by (date to be determined). Please address any written comments to the U.S. Army Corps of Engineers, Arizona-Nevada Office, 3636 N. Central Avenue, Suite 900, Phoenix, Arizona 85012-1939: Attention: Michael Langley. Comments can also be emailed to Michael.W.Langley@usace.army.mil.

Table of Contents

List of Tables

List of Graphs

List of Figures

List of Appendices

1.0 PURPOSE OF AND NEED FOR ACTION

1.1 INTRODUCTION

ASARCO LLC (Asarco) plans to construct and operate a new tailings[1] storage facility (TSF) to receive tailings generated at the Ray Mine, which is an existing open pit copper mine located in Pinal County, Arizona about 10 miles northwest of the community of Kearny and approximately 65 miles southeast of the city of Phoenix. See **Figure 1, General Location Map**.

Asarco's proposed TSF site is located in an area that includes Ripsey Wash, approximately four miles southwest of the existing Elder Gulch TSF, the present site being used at the Ray Mine for tailings storage.

The TSF as proposed by Asarco would be constructed primarily on lands that are either currently owned by Asarco or would presumably be owned by Asarco after completion of a pending land sale with the Arizona State Land Department (ASLD). A relatively small portion of the proposed TSF infrastructure (a tailings pipeline, a return-water pipeline, the project powerline), and a re-route of a segment of the Arizona National Scenic Trail (Arizona Trail) would be constructed on lands administered by the Bureau of Land Management (BLM).

In March 2013, Asarco submitted a permit application (that was subsequently revised) to the U.S. Army Corps of Engineers (Corps) for the proposed Ripsey Wash TSF to comply with regulations promulgated under Section 404 of the Clean Water Act. This permit is required because the Corps has determined the Ripsey Wash drainage and other ephemeral washes within the proposed project footprint are "waters of the United States" and subject to Corps jurisdiction under Section 404 of the Clean Water Act. Asarco, as the applicant, is proposing to place fill material within waters of the United States, which triggers the requirement for a 404 permit.

After review of Asarco's 404 permit application and consideration of the factors that are necessary to make that determination, the Corps decided that an environmental impact statement (EIS) would be prepared to comply with the National Environmental Policy Act (NEPA). The Corps is the lead agency for the EIS preparation work. The Environmental Protection Agency (EPA), the BLM, and the Bureau of Indian Affairs - San Carlos Irrigation Project (SCIP) are formal NEPA cooperating agencies on this EIS.

This EIS documents the environmental analysis of the proposed Ripsey Wash TSF, evaluates alternatives[2], describes environmental impacts, and considers management and mitigation measures associated with the proposed action. This EIS also provides a forum for public review and comment on the project and highlights the associated relevant issues, as determined during the NEPA scoping process for the project.

---

[1] Tailings are the finely-ground rock material produced by the milling process, which separates copper-bearing minerals from non-economic material. Tailings should not be confused with overburden or development rock (sometimes referred to as waste rock), which is non-mineralized or uneconomic mineralized material excavated in order to access the copper-bearing ore that is mined and processed to generate a profit.

[2] See Appendix B, Alternative Screening and Clean Water Act Section 404(b)(1) Alternative Analysis.

Additional information about the EIS preparation process for the Ripsey Wash TSF is set forth in **Appendix A, The NEPA Process**.

1.2 SCOPE AND CONTENT OF THE EIS

1.2.1 Scope of Analysis

The Corps has completed this EIS in accordance with procedures specified by the Council on Environmental Quality (CEQ) regulations for NEPA (40 CFR §1500 – 1508), CEQ guidance, the Corps' NEPA Implementation Procedures for the Regulatory Program (33 CFR Part 325, Appendix B), and the South Pacific Division's Standard Operating Procedure for Preparing and Coordinating EIS Documents (12509-SPD).

The NEPA scope of analysis is defined by 33 CFR 325, Appendix B, which states "the district engineer should establish the scope of the NEPA document to address the impacts of the specific activity regarding the DA (Department of the Army) permit and those portions of the entire project over which the district engineer has sufficient control and responsibility to warrant federal review".

The Corps has identified the scope of analysis for the federal review of the Asarco's proposed alternative to consist of impacts to waters of the U.S. that would be associated with construction of the new TSF and its related components, along with the implementation of compensatory mitigation at multiple locations in the project region. The scope of the analysis also includes the review of a relocation of a 69-kV electric transmission line owned and operated by San Carlos Irigation Project (SCIP), the placement of certain TSF-related infrastructure (i.e., tailings and return water pipelines and project powerline), a reroute of a segment of the Arizona Trail, and the use of salable materials from the federal mineral estate for construction and reclamation purposes that would involve lands managed and administered by the BLM.

NEPA requires the Corps to disclose potentially significant direct, indirect and cumulative effects occurring as a result of the permit action. Therefore, the Corps is preparing this EIS for the construction and operation of Asarco's proposed action in its entirety, from where new infrastructure (i.e., tailings and return water pipelines) tie to the existing infrastructure, such as the existing thickener tanks.

The Ray Mine has existing infrastructure associated with its milling activities at the Ray Concentrator and the existing Elder Gulch TSF. No changes to the mining or milling (concentration) processes are being considered in this EIS analysis, which focuses on the proposed new Ripsey Wash TSF and possible TSF alternatives. The ongoing open-pit mining, leach operations and milling activities would remain the same under all alternatives, and any TSF action alternative (including the proposed action alternative) would be supported by the existing Ray Mine operations, which include continued mining, development rock removal and storage, leaching and operation of the solvent extraction/electrowinning (SX-EX) facility, milling at the Ray Concentrator, some ore haulage by railroad to the Hayden Concentrator, and concentrate transport from the Ray Concentrator to the Hayden smelter by railroad.

Many of the Ray Mine on-site facilities and infrastructure associated with the existing Elder Gulch TSF would continue to be used in the future for the proposed action and any other alternative. Activities of the Ray Mine and the existing thickener tanks are not being considered as connected actions under NEPA at 40 CFR 1508.25(a)(1) and thus not included in the analysis of direct effects associated with Asarco's proposed action.

Neither the Corps nor any other federal agency is currently being asked to issue a permit or authorization that would allow future activities and operations to occur at the Ray Mine. Even if no new tailings facility was constructed, mining operations at the Ray Mine would continue for some time into the future. Oxide ore would continue to be leached until the oxide resource is depleted, and sulfide ore would continue to be mined and milled at the Ray Concentrator (with tailings being placed in the existing Elder Gulch TSF until that facility reaches its capacity). Sulfide ore would continue to be shipped to the Hayden Concentrator for milling (with tailings from this concentrator being placed into the Hayden TSF).

In addition, overall federal control and responsibility at the Ray Mine is minimal. The Corps has issued several prior Section 404 permits for the Ray Mine (each with accompanying NEPA analyses), and the BLM administers a small portion of lands within the footprint of the Ray Mine, for which Asarco is operating pursuant to existing approved plans of operation.

The incremental mining activities at Ray Operations (and the effects of those activities) that would not occur without a new tailings storage facility are separated by distance and to some degree time, from the activities subject to the Corps' federal action. These incremental mining activities are indirect effects of the federal action(s) being analyzed. Other mining activities, such as the mining and processing of oxide ore and the mining of sulfide ore with tailings being placed at Elder Gulch or available facilities in Hayden, would continue for some period of time with or without the new TSF; therefore, these facilities and activities are being considered as part of the cumulative impact analysis.

The Corps also does not consider the pending BLM Asarco Ray Land Exchange (Ray Land Exchange) as a connected action with respect to the proposed TSF. This land exchange is addressed as part of the cumulative impact analysis within this EIS. The proposed new TSF project has been separately planned by Asarco to address a different purpose and need, and the TSF project and the Ray Land Exchange have independent utility and can be implemented independently from each other. The proposed TSF project does not trigger the Ray Land Exchange or vice versa.

The purpose of the Ray Land Exchange is to allow Asarco to obtain fee simple title to land in the vicinity of the Ray Mine for the purpose of greater title certainty and to consolidate Asarco's private land holdings. The Ray Land Exchange and the acquisition of fee title is not necessary for Asarco's request for additional tailings storage, nor is such fee title necessary for seeking additional tailings storage under the General Mining Law of 1872, as amended (Mining Law). Even if a TSF alternative site is identified in this EIS that includes some of the selected lands identified in the proposed Ray Land Exchange, Asarco would have the right under the Mining Law to use the site for tailings storage or other mining-related activities, even if the Ray Land Exchange was not completed, provided that Asarco obtain required permits and approvals.

1.2.2 Intended Uses of this EIS

This EIS has been prepared in accordance with applicable federal environmental regulations, policies, and laws to inform federal decision-makers regarding the potential environmental impacts of the issuance of a 404 permit for Asarco's proposed action and other alternatives. As an information document, an EIS does not recommend approval or denial of the project. A draft EIS was provided to the public in 2016 for review, comment, and participation in the analysis process. This final EIS includes responses to comments on the draft EIS received from agencies, organizations, and individuals. The final EIS will be used by the Corps to support the decision on Asarco's 404 permit application and the BLM in its permitting process.

1.3 PURPOSE AND NEED

As documented in **Appendix B, Alternative Screening and Clean Water Act Section 404(b)(1) Alternative Analysis**, current mine plans for the Ray Mine anticipate milling approximately 850 million tons of sulfide ore over the currently project remaining life of the mine[3] (estimated at roughly 50 years based on the presently identified resources and production rates).[4]

Currently, sulfide ores from the Ray Mine are processed at two facilities, the onsite Ray Mine Concentrator and the offsite Hayden Concentrator located approximately 20 miles away. The milling of approximately 850 million tons of sulfide ore is anticipated to result in the production of approximately 850 million dry tons of tailings, less the mineral extracted (less than two percent of total).

For planning purposes, the amount of required tailings storage is estimated to be the amount of sulfide ore that would be processed through the life of mine (850 million tons). The Elder Gulch facility at the Ray Mine has the capacity to accept approximately 100 million more dry tons of tailings before it reaches capacity. The Hayden tailings facilities have approximately 200 million tons of remaining capacity. This leaves a need for approximately 550 million dry tons of additional tailings storage capacity based on current projects or ore resources.

Considering the trends of the past 40 years, which generally have allowed for lower cost recovery of ore and thus have resulted in an increase in resources by allowing lower grade ore to be processed profitably, and considering the world demand for copper, it is reasonable to predict that additional resources would be delineated at the Ray Mine and that additional tailings storage capacity would be required. In addition, a tailings facility requires the construction of a starter dam or embankment using rock as an initial step prior to tailings deposition[5].

In order to allow for possible additional resources to be identified in the future, and to account for starter dam or embankment construction, Asarco has estimated, for the purposes of this analysis, that the new TSF may need to accommodate an additional 200 million dry tons of material, for a total capacity of approximately 750 million tons. **Table 1-1, Future Tailings Storage Capacity Needs for Ray Mine**, summarizes the need for tailings storage capacity for the Ray Mine.

[3] The projected mine life depends on a variety of factors, including the price of copper and the cost of production (which can change with changes in technology). Thus, the current estimate of mine life and available resources may change over time.

[4] The Ray Mine also produces oxide ore, from which copper is extracted through leaching rather than milling and smelting. The production of copper from oxide ore through leaching does not result in tailings.

[5] Later, as the TSF expands, Asarco plans to switch to centerline tailings construction, followed even later by upstream tailings construction. See Chapter 2, Alternatives including the Proposed Action.

Table 1-1, Future Tailings Storage Capacity Needs for Ray Mine

Storage Requirement	Amount (million tons)
Total estimated sulfide ore resource (life of mine) (1)	850
Remaining tailings storage capacity at Elder Gulch TSF	(100)
Remaining estimated tailings storage capacity at Hayden TSF	(200)
Additional tailings storage capacity needed based on current projections and resource identification	550
Contingency capacity to account for changed market conditions and/or future technologies associated with mining, the identification of additional resource through future drilling, and to account for the starter dam and embankment construction (2)	200
Total Capacity Requirement	**750**

Notes:

1. Assumptions and key points:
   - Estimated resource based on a copper price of $3.20 per pound (consistent with long-term price projections).
   - Not based on the rate of mining.
   - The copper price of $3.20 per pound was the price at the time of the Asarco 404 application submittal.
   - The long-term plan for mining is based on reasonable and prudent copper price projections, not on short-term fluctuations in copper prices.
2. This is a reasonable and prudent estimate because:
   - Long-term projections for copper are higher than $3.20 per pound (Wood Mackenzie 2016).
   - Extent of resource has not been fully explored or defined, even at the copper price of $3.20 per pound.
   - Even a modestly higher long-term price significantly increases the identified resource. For example, the resource identified at a copper price of $3.50 per pound would be 985 million tons (see Exhibit 1 in **Appendix B, Alternative Screening and Clean Water Act Section 404(b)(1) Alternative Analysis**).

Therefore, Asarco's purpose and need for the Project is to create additional tailings storage for up to approximately 750 million tons of material (mill tailings produced by the Ray Mine Concentrator and embankment material). Capacity to deposit approximately 750 million tons is required to allow for full utilization of the sulfide mineral resource at the Ray Mine.[6] A peak production rate of approximately 45,000 tons per day (tpd), representing the maximum design capacity of the current Ray Mine concentrator, has been used in analyzing tailings transport requirements.

Asarco's basic project purpose is mine tailings storage, which is not water-dependent,[7] and the development of tailings storage capacity would allow the full utilization of the mineral resource at the Ray Mine, using infrastructure and processes already in existence at the mine.[8]

---

[6] The Ray Mine also produces oxide ore, from which copper is extracted through leaching rather than milling and smelting. The production of copper from oxide ore through leaching does not result in the generation of tailings.

[7] As a general rule, the basic purpose of the project must be known to determine if the project is water-dependent (i.e., requires access to, or siting within, a special aquatic site in order to fulfill its basic purpose). If a proposed project is not water-dependent and would impact a special aquatic site (e.g., a wetland), then there is a strong regulatory presumption that practicable alternatives that do not involve special aquatic sites are available, and that such alternatives have less adverse impact on the aquatic ecosystem. 40 C.F.R §230.10(a)(3); Army Corps of Engineers Standard Operating Procedures for the Regulatory Program, page 15 (July 2009).

[8] See U.S. Army Corps of Engineers Standard Operating Procedures (SOP) for the Regulatory Program, page 15 (July 2009). The Corps SOP states that "the overall project purpose is used to evaluate less environmentally damaging practicable alternatives" and "must be specific enough to define the applicant's needs, but not so restrictive as to constrain the range of alternatives that must be considered under the 404(b)(1) guidelines."

The BLM's purpose in participating in the preparation of this EIS is to respond to Asarco's request to develop portions of a new TSF for the Ray Mine on public lands (including associated infrastructure such as tailings/water return pipelines and electric transmission lines), to relocate a portion of the Arizona Trail onto public lands, and to use salable materials from the federal mineral estate for construction, operational and reclamation purposes. The BLM's need is to comply with regulations under the Mining Law, the Federal Land Policy and Management Act of 1976, as amended (FLPMA), and the Surface Resources Act of 1955.

1.4 DECISION FRAMEWORK

The Corps is the NEPA lead agency responsible for completion of this EIS, which is being prepared to support the Corps' decision-making process for the requested 404 permit. The agency has followed specific procedures that began with scoping and data collection and continued with analysis of data and evaluation of alternatives.

The Corps has considered comments on the draft EIS submitted by the public, interested organizations and government agencies and has responded to those comments in this final EIS[9]. As appropriate, the final EIS reflects changes or updates that resulted from the comments received on the draft EIS.

After the release of the final EIS, the Corps will issue a Record of Decision (ROD) regarding its decision on the proposed action. In the ROD, the Corps may decide to:

- Issue a 404 permit with or without special conditions on the project described in Asarco's 404 permit application or for the project with modifications;
- Deny the 404 permit request; or,
- Allow Asarco to withdraw the 404 permit application.

The BLM and SCIP are NEPA cooperating agencies on this EIS, and these agencies also have decision making requirements. See Section 1.5.2, Bureau of Land Management, and Section 1.5.3, San Carlos Irrigation Project—Bureau of Indian Affairs.

1.5 AGENCY RESPONSIBILITIES AND JURISDICTIONS

A number of federal, state and local permits, easements and rights-of-way (ROWs) are or could be required for the construction and operation of a new TSF at the Ray Mine. See **Appendix C, Agency Jurisdictions (Regulatory Framework)**.

Preparation of an EIS and the actual permitting processes are related but distinctly separate. An EIS is designed to examine possible alternatives and to discuss environmental effects. The permitting or approval processes give individual government decision makers the authority to grant, conditionally grant, or deny individual permit applications. Permits can be granted with requirements and conditions to eliminate and/or mitigate specific adverse impacts pursuant to their individual regulations and guidelines.

[9] See **Appendix L, Draft EIS Comments and Comment Responses**.

1.5.1 U.S. Army Corps of Engineers

The Corps, as the NEPA lead agency, will use this EIS to support its decision on an application for a 404 permit from Asarco. This EIS provides an analysis of the proposed action submitted by Asarco in their 404 permit application along with an analysis of other alternatives, including the no action alternative. This EIS also provides the 404(b)(1) alternatives analysis required for evaluation of a 404 permit. See **Appendix B, Alternative Screening and Clean Water Act Section 404(b)(1) Alternative Analysis**.

1.5.2 Bureau of Land Management

The BLM is a NEPA cooperating agency on this EIS and will use this EIS to support their decision-making processes.

Under the Proposed Action, Asarco would request that the BLM issue three right-of-way grants for the portions of the tailing delivery and reclaim water pipelines, project powerline, and associated road improvements that would be constructed on their administered surface lands. In addition, if the Corps issues a 404 permit for the proposed action in Ripsey Wash, Asarco proposes to re-route the Arizona Trail[10] onto BLM-administered lands, and Asarco would be responsible for funding the construction of the trail and the associated trailhead. The BLM must approve that portion of a relocated Arizona Trail that would cross their managed and administered surface lands.

Where Asarco proposes to quarry rock material from BLM-administered mineral estate for construction, operations, concurrent reclamation (i.e., rock cover on the outer slope of the tailings embankment), and/or closure (i.e., rock cover material over the tailings), the BLM would need to authorize a mineral material sale for that rock material.

If the Hackberry Gulch TSF alternative is selected, the BLM would need to authorize a modification to Asarco's mine plan of operations to incorporate the construction, operation and closure/reclamation of the Hackberry Gulch TSF.

Other BLM approvals may be required depending on whether any alternatives considered in detail in this EIS involve the use or crossing of BLM managed and administered surface lands and mineral estate.

It is expected that the BLM Authorized Officer would be the Tucson Field Manager. In the BLM's ROD on the project, the BLM Authorized Officer will decide to:

- Issue BLM right-of-ways (for the Ripsey alternative) or MPO (for the Hackberry alternative) for Asarco's planned activities in support of the proposed TSF and associated infrastructure on BLM-administered lands;
- Allow Asarco to relocate a segment of the Arizona Trail to a new location on BLM-administered lands;
- Approve Asarco's mineral materials request for federal mineral estate;
- Approve any of the above-listed requests with modifications;
- Deny all or any of the above-listed requests; and/or,
- Allow Asarco to withdraw any of the above-listed requests.

[10] The Arizona Trail traverses north-south across Arizona from Mexico to Utah and was designated as a National Scenic Trail by the Omnibus Public Land Management Act of 2009. It links deserts, mountains, canyons, communities and people.

1.5.3 San Carlos Irrigation Project—Bureau of Indian Affairs

Under the Proposed Action, Asarco must relocate a portion of an existing 69 kV electric transmission line that traverses Ripsey Wash. This line is owned and managed by SCIP, an entity that is organized under the Western Region Office of the U.S. Bureau of Indian Affairs. SCIP is a NEPA cooperating agency on this EIS and would use this EIS to support their decision-making process involved with the relocation of the electric transmission line.

1.5.4 Environmental Protection Agency

EPA has an independent reviewer role for all EIS documents published by federal agencies. In addition, based on its jurisdiction by law and special expertise associated with the Clean Water Act and Clean Air Act, EPA is a NEPA cooperating agency with the Corps on this EIS.

1.6 SCOPING AND PUBLIC INVOLVEMENT

Asarco's March 2013 submittal of an initial 404 permit application to the Corps initiated action under NEPA regulations. As required by NEPA (40 CFR §1501.7), the Corps provided for an early and open process to determine the scope of the issues to be addressed and the extent of the environmental analysis necessary for an informed decision on the proposed Ripsey Wash TSF.

On August 26, 2013, the Corps published their Notice of Intent (NOI) to prepare an EIS for this Project in the *Federal Register*. The Corps allowed for a 60-day comment period to end on October 28, 2013. However, with the October 2013 shut-down of portions of the federal government, the Corps extended the scoping comment period for another 21 days, until November 18, 2013.

In addition to the notice in the *Federal Register*, the Corps also placed public notices in local newspapers (*East Valley Tribune*, *Arizona Silver Belt*, and *Copper Area News*) on September 4, 11 and 18, 2013. These notices announced the Corp's plans to prepare an EIS for the proposed TSF, along with the time and place for the public scoping meetings where the public and interested parties could learn more about the project and provide comments to the Corps.

The Corps held two public scoping "open house" meetings: one on the evening of September 24, 2013, at the Ray Elementary School in Kearny (Arizona) and the other on the evening of September 25, 2013 at the Performing Arts Center at the Apache Junction High School in Apache Junction (Arizona). About twenty people attended both meetings. The Corps provided a court recorder at both meetings for verbal comments, but none were given.

The Corps met with EPA at its offices in San Francisco (California) on September 10, 2013 to discuss the project and solicit input. The Corps also hosted an informational meeting on September 26, 2013 at its Phoenix (Arizona) office for agencies interested in Asarco's proposal and to obtain input on the project and proposed EIS work.

The Corps received 22 letters and emails during the scoping process. Commenters included the EPA, the USDA Forest Service, the Arizona Game and Fish Department (AGFD), Arizona Trail Association, Sierra Club, Gila River Indian Community, White Mountain Apache Tribe, Tohono O'Odham Nation, and numerous individuals.

Scoping documents, containing more detail about the scoping process for the Ray Mine tailings storage facility project EIS, are on file at the Corps Office in Phoenix, Arizona and can be found at http://www.spl.usace.army.mil/Missions/Regulatory/ProjectsPrograms.aspx.

1.7 IDENTIFICATION OF ISSUES

The scoping process produced a number of issues and concerns, which are described below.

1.7.1 Aesthetics and Visual Resources

Identify project-related impacts to visual resources. The area of concern includes how the proposed new TSF might affect the viewshed[13] for: (1) residents of Kearny, Kelvin and Riverside; (2) travelers on State Route 177 and the Florence-Kelvin highway; and (3) recreational users in the area, particularly those on the Arizona Trail.

1.7.2 Air Quality and Climate

Identify project-related air quality impacts. Areas of concern include: (1) compliance with federal and state air quality standards; (2) the effects on air quality from fugitive dust and gaseous emissions; (3) visibility effects to any Class I areas in the vicinity of project; and (4) possible climate change impacts related to the project.

1.7.3 Cultural Resources

Identify cultural resources and conduct Native American consultation. The areas of concern include: (1) the effects to pre-historic and historic cultural resources listed or eligible for listing on the National Register of Historic Places; and, (2) the potential to affect cultural resources, reserved rights, trust issues, traditional cultural properties, and other responsibilities of Native American tribes.

1.7.4 Geology, Geochemistry and Geotechnical

Identify the potential for acid rock drainage and metals transport from the proposed TSF. Address the stability of the proposed TSF. The areas of concern include; (1) short and long-term impacts to the Gila River; (2) potential for release of metals into groundwater from tailings; and (3) the stability of the TSF.

1.7.5 Surface Water Hydrology

Identify any water quality and quantity impacts to the Gila River as a result of the proposed TSF. Address possible impacts to Zelleweger Wash if up-drainage flows from Ripsey Wash are diverted into this wash. The areas of concern include: (1) the alteration of existing hydrologic systems by direct disturbance; (2) the potential for increased sediment levels; (3) the alteration of downstream flow rates and any changes in the downstream water chemistry in the Gila River; and (4) any impacts on existing surface water rights.

1.7.6 Groundwater Hydrology

Identify any impacts to groundwater quality and hydrology within and surrounding the proposed TSF area. The areas of concern include: (1) the potential to alter existing groundwater hydrologic systems by tailings disposal; (2) changes in alluvial and bedrock groundwater chemistry as a result of tailings disposal; and (3) any impacts on existing groundwater rights.

[13] This would include items such as changes to scenic quality, viewing distance and visual sensitivity.

1.7.7 Land Use

Identify land disturbance. Areas of concern include: (1) the acreage of disturbance on federal, state and private lands; (2) the effects on livestock grazing in the area; (3) the effects on the recreational setting of the area; and (4) changes in future (post-project) land use.

1.7.8 Noise

Identify noise impacts. Areas of concern include: (1) level of noise from construction traffic and development activities; (2) level of noise during operations; (3) compliance with federal, state and local noise standards; and (4) disruptions caused by noise to recreational users and wildlife.

1.7.9 Public and Worker Health and Safety

Protect worker health and safety. Areas of concern include: (1) health and safety risks from the construction and operation of a TSF; (2) the possibility of an accident that would necessitate an emergency response; and (3) the potential for an accidental spill of tailings or other substances that could impact the environment, especially to the Gila River.

1.7.10 Recreation

Identify impacts to recreational activities and opportunities. Areas of concern include: (1) effects on the character of the recreation setting; (2) disruption to recreational opportunities along the Arizona Trail (the only developed recreation site within the project area); and (3) disruption to undeveloped recreation activities such as off-road recreation (on primitive roads, especially those that provide access to BLM lands for administrative purposes and public use) and hunting.

1.7.11 Roads / Transportation

Address project construction and operations traffic impacts. Areas of concern include: (1) the amount of road use and traffic on the Florence-Kelvin highway and State Route 177; (2) amount of project-related road maintenance demands during operation; and (3) potential for accidents with any increased road use.

1.7.12 Socioeconomics

Address the social, economic and lifestyle effects on residents in the local communities surrounding the Ray Mine. Areas of concern include project-related construction and operational impacts to the demographics of local communities surrounding the Ray Mine, include impacts to employment, income, housing, utilities, public service, tax and government revenues, and present lifestyles.

1.7.13 Soils

Identify site soil resources and adequacy for reclamation. Areas of concern include: (1) the availability of soils for reclamation; and (2) the potential of increased soil erosion and sedimentation from construction and operational activities.

1.7.14 Vegetation

Address project-related impacts to vegetation. Areas of concern include: (1) the impacts to vegetation communities by the project; (2) the impacts on any threatened, endangered, and candidate plant species as identified by the U.S. Fish and Wildlife Service (USFWS); (3) the impacts to any BLM sensitive plant species; and (4) the control of noxious weeds.

1.7.15 Waters of the U.S.

Address project-related impacts to waters of the U.S. Areas of concern include: (1) the impacts to waters of the U.S.; and (2) changes in the functions and values of on-site jurisdictional waters of the U.S. from tailings disposal operations.

1.7.16 Wildlife

Identify impacts to wildlife and wildlife habitats. Areas of concern include (1) the impacts to wildlife habitat, such as the physical loss of habitat and a reduction in diversity and habitat effectiveness; (2) the impacts to wildlife species found in the area, including those species listed in the Arizona Game and Fish Department's (AGFD) *Species of Greatest Conservation Need* (SGCN) and *Species of Economic and Recreational Importance* (SERI); (3) the impacts on any threatened, endangered, and candidate wildlife species as identified by the USFWS; and (4) the impacts to any BLM sensitive wildlife species.

1.8 CONCERNS OUTSIDE THE SCOPE OF THIS ANALYSIS

Table 1-2, Issues Considered but not Analyzed in Detail, presents those resources or elements of the environment that are not expected to be encountered or affected by the construction and operation of a proposed TSF at the Ray Mine.

1.9 REGIONAL ACTIVITY

The Ray Mine TSF project occurs in a region that contains a number of active or proposed mining operations. See **Appendix D, Regional Activity**.

Regional activities include the ongoing and planned mining activities at the Ray Mine, the Hayden Concentrator, the Hayden Smelter, and the proposed Resolution Copper Project. In addition, other economic development activities (e.g., ranching, the Copper Basin Railroad), dispersed recreation, transportation and conservation activities occur within the region that create the larger regional context within which the Ray Mine TSF Project is proposed. Since 1994, Asarco has been engaged with the BLM on the Ray Land Exchange, which would transfer BLM-administered lands within and surrounding the Ray Mine to Asarco in exchange for other lands that would be provided to the BLM by Asarco. These activities are considered in Chapter 4, Cumulative Effects. In addition, any Asarco activities on any selected public lands that are proposed for exchange in the Ray Land Exchange are treated as BLM-administered lands in this EIS since the final decision on the proposed Ray Land Exchange is pending.

Table 1-2, Issues Considered but not Analyzed in Detail

RESOURCE	RATIONALE
Area of Critical Environmental Concerns	No areas of critical environmental concerns as identified by the BLM would be impacted by Asarco's proposed TSF project. Areas of critical environmental concern present a conservation ecological program managed by the BLM and are addressed in the 1976 Federal Lands Policy and Management Act (FLPMA).
Prime or Unique Farmlands	None present.
Wild and Scenic Rivers	None present.
Woodland/Forestry	None present.
Fuels and Fire Management	Negligible at the proposed TSF site.
Roadless Areas	None.
Mineral Resources	The Arizona State Lands Department (ASLD) has concluded that the condemnation drilling conducted by Asarco in support of the ASLD land acquisition has established a lack of economic mineral potential with Asarco's acquisition area where the State of Arizona controls the mineral estate (Arizona State Lands Department, 2012).. The BLM states that, while reflective of no copper or molybdenum mineralization at the TSF sites, the results of Asarco's condemnation drilling cannot be considered definitive for possible future, currently unknown market conditions for potential minerals and rocks that currently have no economic use. It should be noted that a detailed analysis cannot be provided in this EIS for currently unknown market conditions for minerals and rocks with no current economic use. Federal mineral estate would be covered by both the Ripsey Wash and Hackberry Gulch TSF alternatives. Both the Ripsey Wash and the Hackberry Gulch TSF sites would remain open to mineral entry whether or not a TSF is constructed; however, the construction of tailings facilities over the federal mineral estate may effectively preclude future mineral resource development beneath the facilities. Asarco has filed mining claims on federal mineral estate in accordance with the Mining Law. See Figure 33, Ripsey Wash Alternative Mineral Estate, and Figure 34, Hackberry Gulch Alternative Mineral Estate. Asarco has stated, based on its extensive understanding of the regional geology and the results of exploration drilling conducted throughout the region, that the potential for an economic mineral resource to occur at the proposed Ripsey Wash or Hackberry Gulch TSF alternatives is highly unlikely.
Paleontology	No fossil resources known to exist in the site's geologic formations.
Wild Horses and Burros	None present.

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1 INTRODUCTION

The discussion of alternatives is the foundation of the EIS process (see *40 CFR §1502.14*).

The Corps focused its formulation of TSF alternatives on where and how to develop tailings storage capacity for 750 million tons of tailings, which would accommodate future operations at the Ray Mine and meet the purpose and need for the project, which is described in Section 1.3, Purpose and Need. In addition, as explained in Section 1.6, Scoping and Public Involvement, the Corps conducted internal review and analysis, and public scoping to determine the range of issues to be addressed in the EIS, and these issues helped shape the assessment of TSF alternatives.

The Corps explored and evaluated various ideas and options during the selection and development of TSF alternatives for this EIS. To assist in the alternative selection and analysis processes, the Corps met numerous times with Asarco, conversed with representatives of cooperating and interested government agencies, visited the existing Ray Mine on many occasions to review current tailings storage practices, and scrutinized the area surrounding the mine for possible TSF sites.

The Corps has documented the analysis in compliance with guidelines established under the Clean Water Act [*40 CFR Part 230 §404(b)(1)*] for avoidance and minimization of impacts to jurisdictional waters of the U.S. The results of the Corps' analysis are provided in **Appendix B, Alternative Screening and Clean Water Act Section 404(b)(1) Alternative Analysis**.

The TSF alternatives to be considered in detail for this EIS are the no-action alternative, the proposed action TSF in Ripsey Wash, and the Hackberry Gulch TSF. Since the publication of the Draft EIS, Asarco has included minor changes to the proposed action in response to comments on the Draft EIS. Proposed changes include the following:

- Realignment of the tailings delivery, reclaimed water, and fresh water pipelines and project powerline corridor to reduce greenhouse gas emissions;
- Adjustment to the Florence-Kelvin highway realignment to reduce visual and noise impacts to users of the Arizona Trail north of the Gila River;
- Adjustment of the SCIP 69 kV powerline realignment to reduce visual impacts to users of the Arizona Trail;
- Additional paving of a portion of the Florence Kelvin Highway west of the proposed TSF to reduce dust emissions;
- Slight realignment of the Arizona National Scenic Trail relocation east of the proposed TSF to reduce switchbacks to make the Trail more sustainable and reduce maintenance requirements.

These minor changes have been incorporated into the description of the proposed action throughout this EIS. Details of each TSF alternative are set forth in the following subsections.

2.2 NO ACTION ALTERNATIVE

NEPA regulations (*40 CFR §1502.14(d)*) require that EIS alternative analyses "include the alternative of no action". This alternative serves as a baseline to compare the effects of the proposed action alternatives.

As described in **Appendix D, Regional Activity**, current activities at the Ray Mine include open pit mining, development rock removal and storage, operation of the existing Ray Concentrator (for the beneficiation of sulfide ores), leaching of oxide ores, operation of the solvent extraction/electrowinning (SX-EW) facility, sulfide ore transport to the Hayden Concentrator by railroad, concentrate transport to the Hayden smelter by railroad, and numerous additional support facilities and activities. See **Figure 58, Existing Current Disturbed Areas Ray Mine Complex**.

Under the no action alternative, the Corps would deny the 404 permit or Asarco would withdraw the application. Selection of the no action alternative by the Corps would mean that the construction and operation of a new TSF would not proceed. Asarco would cease to process sulfide ore resources at the Ray Concentrator once the Elder Gulch TSF reaches its capacity. This is projected to occur between 2023 and 2024 (Asarco 2017)[14]. No additional or new Section 404 permits or modifications would be required for the Ray Mine under the no action alternative.

With cessation of tailings placement into the Elder Gulch TSF, Asarco would continue to mine sulfide ore and ship this ore material, via rail, to the Hayden Concentrator, which has a peak processing rate of about 20,000 tpd.

In recent years, full-time employment at the Ray Mine has ranged from approximately 575 to 800 people. With shut-down of the Ray Concentrator operations and no ability to place tailings at the Elder Gulch TSF, full-time direct employment at the Ray Mine would decline to an estimated 280 employees. This would represent a reduction in employment at the Ray Mine of between 295 and 520 people.

Under the no action alternative, it is assumed that sulfide ore mining at the Ray Mine (with associated crushing, waste rock generation and placement) could continue for approximately 32 years[15]. In addition, under the no action alternative (and all of the action alternatives), the mining of oxide ore at the Ray Mine would continue for a minimum of 15 years and associated leaching operations would continue for an estimated minimum of 25 years (Asarco 2017).

2.3 RIPSEY WASH TSF: PROPOSED ACTION

The Ripsey Wash TSF presents Asarco's proposed action. This alternative is labeled as "Ripsey Wash No. 3" in **Appendix B, Alternative Screening and Clean Water Act Section 404(b)(1) Alternative Analysis**, and is considered one of five practicable alternatives. There were three alternatives evaluated at the Ripsey Wash site and two alternatives evaluated at the Hackberry Gulch site in **Appendix B, Alternative Screening and Clean Water Act Section 404(b)(1) Alternative Analysis**. The Ripsey Wash No. 3 alternative would disturb fewer "waters of the U.S." than Ripsey Wash No. 1 and No. 2 alternatives. The Ripsey Wash No.3 alternative is the alternative addressed in this section, and it is simply referred to as the Ripsey Wash TSF alternative.

In addition to the 404-permit application submitted to the Corps, Asarco also submitted an Aquifer Protection Permit (APP) application to the Arizona Department of Environmental Quality (DEQ) for the Ripsey Wash TSF site; the APP application included engineering designs and provides the basis for the descriptions below. The APP for the Ripsey Wash No. 3 alternative has been approved by the Arizona

---

[14] The actual cessation of processing at the Ray Concentrator would depend on sulfide ore production rates from the Ray Mine.

[15] Production rates are based on economics, technology, the new identification of resource, and the processing capabilities. One of the current limiting factors for increased sulfide ore production under the no action alternative is the processing capability of the Hayden Concentrator, along with the logistics of crushing and rail shipment. There is also limited remaining capacity (currently estimated at 200 million tons) at the existing tailings storage facilities at Hayden.

DEQ. This proposed facility would be located within the valley or basin area created by Ripsey Wash (and its tributaries) south of its confluence with the Gila River and approximately four miles southwest of the existing Elder Gulch TSF. See **Figure 2, Site Plan Layout - Ripsey Wash TSF**.

2.3.1 Tailings Operation and Placement Overview

Similar to the ongoing tailings storage operations at the existing Elder Gulch TSF, the Ripsey Wash TSF would be designed and operated as a closed-circuit (zero surface water discharge) facility. Asarco would continue to pump tailings material as slurry from the existing Ray Concentrator through an existing pipeline to the existing thickener, where the tailings would be "thickened"[16]. This process would remain unchanged from the existing operation.

A new pipeline, pumping booster station, a lined drain-down containment pond, a bridge across the Gila River, and other supporting infrastructure would be needed to transport tailings from the existing thickener to the Ripsey Wash TSF. Tailings would be discharged from spigots around the perimeter of the tailings impoundment area. Water would accumulate at the rear of the TSF and would be pumped back to the Ray Concentrator via pipelines for reuse in the milling process. See **Figure 3, Process Flow Sheet - Ripsey Wash TSF**.

Various aspects of Ripsey Wash TSF are summarized in **Table 2-1, Summary of Ripsey Wash TSF Alternative**.

2.3.2 Pre-Tailings Construction

Prior to tailings placement in the Ripsey Wash TSF, Asarco would complete the following tasks:

- Acquire three BLM right-of-way grants (tailings and return water pipelines, powerline, and road improvements for these facilities on BLM administered lands). See **Appendix K, BLM Plans of Development**;
- Relocation of a segment of the Florence-Kelvin highway;
- Relocation of a segment of the SCIP 69 kV electric transmission line;
- Relocation of a segment of the Arizona Trail and Florence-Kelvin Trailhead;
- Construction of surface supporting facilities, including an office, shop, warehouse, workers' change facility, septic system, water tank, and distribution powerline;
- Backfill abandoned mine adits and shafts as appropriate within the footprint of the planned TSF to prevent them from acting as preferential pathways to groundwater;
- Construction of a detention dam, diversion channels and piping infrastructure to route any runoff from undisturbed areas up gradient of the Ripsey Wash TSF around the facility. This work would also involve the installation of energy dissipaters at the outfall locations of the diversion channels and piping network;

[16] Thickeners are tanks of varying capacity where the tailings stream is thickened and settle to the bottom of the tanks, while the water released from the tailings can be captured at the top of the tank and recycled back to the concentrator or mill. The settled tailings stream still contains water that allows the tailings slurry (tailings and water) to the desired consistency that allows pumping to the TSF. The thickener at the Ray Mine is designed and operated to lessen the amount of water in the tailings stream, to lessen pumping costs, lessen evaporation at the TSF, reduce the amount of water that is stored in the TSF, and lessen the amount of water (upon closure) that would need to be evaporated before the facility could be reclaimed.

- Excavation of borrow material within the project footprint and construction of the starter dam embankments;
- Construction of a pumping booster station and lined drain-down containment pond on the north side of the Gila River;
- Construction of pipeline bridge over the Gila River;
- Placement of new tailings, reclaim water pipelines, and project powerline from the existing thickener, across the Gila River bridge, to the Ripsey Wash TSF;
- Allowance for public access to the upper reaches of Ripsey Wash using existing roads;
- Removal of soil and vegetation from the areas of the starter dams;
- Construction of starter dams, seepage trenches and pump-back wells in Ripsey Wash and an unnamed wash to the east of Ripsey Wash;
- Construction of lined reclaim ditches and lined reclaim ponds down-drainage of the starter dams and seepage trenches;
- Installation of monitoring wells down-drainage of the seepage trenches and reclaim ponds; and,
- Implementation of mitigation activities.

Specifics of these tasks are discussed in the following subsections, and an estimated timeline for this construction activity is set forth in Section 2.3.13, Tentative Construction, Operation and Closure Schedule.

Table 2-1, Summary of Ripsey Wash TSF Alternative

BASIC CRITERIA FOR FULL CAPACITY	
Overall Facility Capacity (million tons)	751.3
Final Tailings Embankment Crest Elevation (feet above mean sea level)	2,440
Final Tailings Embankment Height (feet)	625
Number of Washes Needing Starter Dam Embankments	2
Rock Material Required for Starter Dam Embankments (million cubic yards)	5.2
Length of Tailings and Water Pipelines (feet/miles)	20,592/3.9
ESTIMATED SURFACE AREA DISTURBANCE AT FULL CAPACITY (ACRES)	
Tailings Storage Facility	1,974
Stormwater Diversion Infrastructure	123
Onsite TSF Infrastructure	424
Offsite TSF Infrastructure	50
Florence-Kelvin Highway Realignment	37
Florence-Kelvin Highway Paving	22
Arizona Trail Re-Alignment (1)	4
SCIP 69kV Power Line Re-alignment (Outside of onsite TSF infrastructure)	2
Total	2,636

Table 2-1, Summary of Ripsey Wash TSF Alternative (continued)

PROPOSED CONCEPTUAL MITIGATION AREA FOR WATERS OF US (ACRES)		
Sites A, B, C and D (San Pedro River Valley)		97.9
Lower San Pedro River Wildlife Area In Lieu Fee Project		68.78
Total		166.68
LAND OWNERSHIP/ADMINISTRATION AT FULL CAPACITY	**ACRES**	**PERCENTAGE (%)**
Private	54	2.1%
State of Arizona (2)	2,573	97.6%
Bureau of Land Management (3)(4)	9	0.3%
Total	2,636	100%
WATERS OF THE UNITED STATES	**ACRES**	
Area of Direct Waters of U.S. Disturbance at Full Capacity		130.91
Area of Indirect Disturbance to Waters of the U.S.		3.74
Area of Jurisdictional Wetlands Disturbance at Full Capacity		0

Notes:

1. Under an amendment to the National Trails System Act that established the Arizona Trail, the U.S. Secretary of Agriculture is the administering agency of the Arizona Trail, in consultation with the U.S. Secretary of Interior. For the re-aligned section of the Arizona Trail on BLM-administered lands, the BLM is the management agency. On state lands in the area within and surrounding the proposed Ripsey Wash TSF, Pinal County is the managing agency for the Arizona Trail.
2. This acreage represents that the Ripsey Wash TSF site is currently located on lands owned and administered by the state of Arizona (through its ASLD). Asarco is pursuing the purchase of these lands from the state, and that purchase would transfer this ownership to “private property”. The sale by ASLD would be completed through an open auction process, the date for which is pending.
3. Disturbance includes estimated three acres on BLM-administered for the re-routed Arizona Trail and trailhead, and approximately six acres for tailings/water return pipelines and re-routed SCIP powerline rights-of-way.
4. The area designated is for BLM surface administered lands. The BLM also manages and administers approximately 2,300 acres of federal mineral estate beneath the area to be used for the Ripsey Wash TSF; the surface of this area is currently managed and administered by the ASLD. There are no known locatable minerals in this BLM-administered mineral estate; however, salable minerals excavated from within a portion of the footprint of the proposed TSF would be used for construction of the starter dam and as cover material during concurrent reclamation and as part of final closure. The BLM would need to authorize a mineral material sale for that rock material.
5. See **Appendix J, Compensatory Mitigation**

2.3.2.1 Florence-Kelvin Highway

The Florence-Kelvin highway is a 32-mile long, two-lane road that connects State Route 79 south of the town of Florence to State Route 177 near the community of Kelvin and near the entrance to the Ray Mine. Approximately 12 miles of this highway is paved with asphalt from its junction with State Route 79 (near Florence) but most of the remaining portion is a graveled or dirt/rock surface roadway. This road is maintained by Pinal County.

An approximate 1.8-mile long segment of the Florence-Kelvin highway would be eliminated in the area of the proposed Ripsey Wash TSF, and a new segment, approximately 1.4-miles in length, would be re-routed and re-constructed to the north and northeast of the tailings facility. Asarco has discussed the proposed road realignment with officials from the Pinal County Department of Public Works, and Asarco has received tentative approval of its relocation from these officials. Asarco plans to pave the proposed relocation section with asphalt to meet the required standards of Pinal County. In addition, Asarco would pave approximately three miles of the Florence-Kelvin highway east and west of the proposed realigned segment of road. The locations of the proposed relocated route and proposed road paving are shown on **Figure 2, Site Plan Layout - Ripsey Wash TSF**, and a typical roadway section is provided as **Figure 7, Typical Utility Corridor and Roadway Sections - Ripsey Wash TSF**.

The BLM would be responsible to issue a right-of-way grant to Asarco before the company could make any improvements to the Florence-Kelvin highway where this road crosses BLM administered land.

2.3.2.2 Electric Transmission Line (69 kilovolts)

The SCIP (San Carlos Irrigation Project) owns and maintains a 69 kilovolt (kV) electric transmission line that crosses through the area of the Ripsey Wash TSF. Approximately 2.3 miles of the existing transmission line would be eliminated and replaced by an approximate 3.1-mile long transmission line that would be re-constructed around the north side of the Ripsey Wash TSF. The proposed relocation would meet the required standards of SCIP. The location of the proposed relocated 69 kV electric transmission lines is shown on **Figure 2, Site Plan Layout - Ripsey Wash TSF**.

The BLM would be responsible to issue a right-of-way grant to Asarco before the company could install the upgraded 69-kV powerline where it crosses BLM administered land.

2.3.2.3 Arizona National Scenic Trail

The Arizona National Scenic Trail (Arizona Trail) is a recreational and scenic trail that is approximately 800 miles long and crosses Arizona from Mexico to Utah. This trail was added to the National Trails System by Congress in 2009 (P.L. 111-11). See Section 3.9, Recreation.

As shown on Figure 2, Site Plan Layout - Ripsey Wash TSF, a 6.8-mile segment of the Arizona Trail would need to be relocated to allow construction activities and operations of the Ripsey Wash TSF, but the proposed trail realignment is not considered a substantial realignment and does not require authorization by Congress.

A working group comprised of representatives of Pinal County, Arizona Trail Association, BLM, Forest Service, Corps (through its EIS third-party contractor), and Asarco was formed to assess possible relocation alternatives for the Arizona Trail around the proposed Ripsey Wash TSF. This working group held numerous discussions in 2013 and 2014 about the relocation issue, and a trail contractor (Southwest Trail Solutions) was retained to scout possible bypass routes on both the east and west side of the proposed Ripsey Wash TSF.

After consideration of the findings presented by the trail contractor and internal deliberations, the working group recommended an approximate six-mile bypass to the east of the Ripsey Wash TSF should be constructed if this alternative is selected. The relocated portion of the Arizona Trail located on BLM administered lands would require BLM approval.

The recommendations from the working group regarding the relocation of the Arizona Trail has been accepted as part of the Ripsey Wash TSF proposed action. Asarco will relocate the Arizona Trail and move the associated trailhead as part of initial construction activities for the Ripsey Wash TSF. It is planned that relocation of the Arizona Trail and relocation of the associated trailhead would occur prior to the opening of the relocated Florence-Kelvin highway (the construction of which would preclude access to the existing trailhead) and prior to the construction of the eastside diversion (when its construction would physically bisect the existing Arizona Trail). In 2016, Southwest Trail Solutions made minor adjustments to the east bypass alignment at the request of the working group to reduce switchbacks to make the trail more sustainable and reduce maintenance requirements.

Additional discussion about the process followed by the working group and its subsequent recommendations are set forth in **Appendix G, Arizona Trail Relocation Analysis**.

2.3.2.4 Support Infrastructure

Given the distance to the main facilities at the Ray Mine, Asarco would require limited surface facilities at the Ripsey Wash TSF to support the proposed TSF construction and operations. These facilities may include an office, workers' change facility, maintenance shop/warehouse, along with employee and equipment parking areas, water tank and distribution system for dust control, potable water use and fire protection, sanitary waste system, fencing and electric distribution switchgear. The proposed facility area is shown on **Figure 2, Site Plan Layout - Ripsey Wash TSF**.

2.3.2.5 Detention Dams and Diversion Structures

Measures to be used for stormwater runoff control and the infrastructure to divert up-gradient stormwater runoff around the Ripsey Wash TSF are discussed in **Appendix I, Applicant Project Mitigation.**

As part of pre-tailings storage construction activities, Asarco would construct a detention dam in Ripsey Wash up-drainage of the proposed TSF, along with diversion channels to divert stormwater runoff from the undisturbed up-gradient watershed areas around the proposed facility. See **Figure 2, Site Plan Layout - Ripsey Wash TSF**; **Figure 54, Ripsey Wash Detention Dam – Plan View and Typical Section**; and **Figure 55, Ripsey Wash Detention Dam and Stormwater Channels – Typical Sections**.

The detention dam and diversion structures are included in the APP and have been approved by the Arizona DEQ as being in compliance with the state's Best Available Demonstrated Control Technology (BADCT).

The purpose of this detention dam structure would be to prevent up-drainage Ripsey Wash stormwater runoff from entering into the tailings impoundment area. This detention dam structure would be initially designed to handle flows from a 500-year, 24-hour storm event during operation of the TSF. In the unlikely event of a greater storm event, this detention dam structure would be installed with an emergency spillway that would allow flow in excess of the design storm event to discharge into the tailings impoundment. During the operational life of the Ripsey Wash TSF, the embankment of the detention dam would be raised about 60 feet (from 2,380 feet msl (mean sea level) to 2,440 feet msl) to detain the stormwater volume from the probable maximum precipitation (PMP) event and would remain as a permanent feature after the closure and reclamation of the Ripsey Wash TSF. Asarco (or an entity designated by Asarco) would be responsible to maintain the detention dam and associated diversion channels in perpetuity after closure and reclamation.

Water from stormwater runoff that is intercepted by this detention dam would be routed around the Ripsey Wash TSF by pumping through a piping system for eventual release into Zelleweger Wash, a drainage located to the west of Ripsey Wash. A series of smaller interceptor detention dams and diversion channels would be constructed and maintained on the west side of the Ripsey Wash TSF that would intercept up-drainage stormwater runoff flow. When stormwater collects behind these detention dams, Asarco, through its pumping and pipeline infrastructure, would control the water release volume to prevent erosion in Zelleweger Wash.

To intercept up-gradient stormwater runoff flow on the east side of the proposed Ripsey Wash TSF, Asarco would construct an approximate 16,000-foot (about 3-mile long) diversion channel, which would be designed to handle flow from a 100-year, 24-hour storm event. The location of this channel is shown on **Figure 2, Site Plan Layout - Ripsey Wash TSF**. Flow intercepted by this diversion channel would be routed to an unnamed wash to the east of the Ripsey Wash TSF.

Through managed pumping of any stormwater runoff that collects behind the detention dam and the use of an energy dissipater at the outfall location, Asarco would control discharge velocity to reduce the potential for down-drainage erosion in Zelleweger Wash. Similarly, Asarco would use energy dissipater mechanisms to control stormwater flow velocity within the east side stormwater diversion channel and at the outfall of this diversion channel into the unnamed drainage on the northeast side of the Ripsey Wash TSF.

The stormwater diversion structures would require periodic maintenance, including removal of sediment and other debris. Because these stormwater diversion structures would reroute stormwater from existing waters of the U.S. upstream from the proposed TSF to waters of the U.S. downstream from the proposed TSF, the constructed stormwater channels would provide a hydrologic connection and would be considered waters of the U.S. once they become functional. For this reason, the Corps would include maintenance activities for the stormwater diversion structures within the list of activities allowed under the 404 permit.

2.3.2.6 Tailings Starter Dams

As part of pre-tailings storage construction activities, Asarco would construct two starter dams for the Ripsey Wash TSF. The first and largest of the starter dams would be approximately 150 feet high and located in Ripsey Wash near where the Florence-Kelvin highway currently crosses the wash; approximately 5.2 million cubic yards of alluvium[17] and colluvium and Ruin Formation granite bedrock[18] would be used to construct this starter dam. The second starter dam would be approximately 80 feet high and would be located in an unnamed drainage on the eastern side of the Ripsey Wash TSF; approximately 400,000 cubic yards of alluvium/colluvium and granite from the Ruin Formation would also be used to construct this starter dam. The crest elevation of both starter dams would reach approximately 2,135 feet msl. **See Figure 2, Site Plan Layout - Ripsey Wash TSF**.

These two starter dam embankments would create the initial "holding basin" to retain tailings before the subsequent centerline embankment construction technique described in Section 2.3.3.1, Centerline Construction, could be started.

It is anticipated that some drilling and blasting would be required to aid in the removal of Ruin Formation granite, and a portable crusher and screening plant would be utilized during starter dam construction activities to size and screen material for associated facility infrastructure (e.g., bedding material for the liners used under the down-drainage centerline embankment, seepage ditches, and reclaim ponds).

The use of onsite materials for the construction of the two starter dams will require BLM issuance of a sale contract for the use of federal mineral materials.

---

[17] The alluvium and colluvium material are found mainly in the bottom of Ripsey Wash and the unnamed wash to the east of Ripsey Wash, and range from a few feet on the sides of the washes to depths approaching 100 feet in the center of Ripsey Wash.

[18] Ruin Formation granite that would be removed from inside what would become the ultimate footprint of the Florence-Kelvin highway re-route construction area and Ripsey Wash TSF.

2.3.2.7 Hackberry Fault Seepage Mitigation

As explained in Section 3.3, Geology and Geochemistry, and Section 3.6, Groundwater Hydrology, there is a fault system, known as the Hackberry fault, located on the west side of the proposed Ripsey Wash TSF. This Hackberry fault is expressed as a zone of fractures and breccia, and has a higher permeability than the surrounding bedrock.

Prior to the construction of the starter dam in the area of the Hackberry fault zone, Asarco would remove vegetation material for the length of the fault zone, both beneath the starter dam and immediately up drainage of the starter dam along the contour or the "trace" of the fault zone. Asarco plans to remove much of the colluvial/alluvial material above the "trace" of the fault zone beneath the starter dam and would use this alluvial material for construction of the starter dam. Asarco would then compact the surface of the fault zone trace area using a vibratory compactor or similar machine.

Immediately down-gradient of the fault zone, Asarco would construct a containment dam perpendicular to the starter dam. The up-gradient slope of this containment dam would be lined with an 80-mil high density polyethylene (HDPE) or equivalent liner.

A cut-off wall would be constructed up-gradient of the fault zone (still within the footprint of the tailings impoundment area). Any up-gradient stormwater runoff or subsurface flow would be routed around the fault zone and would pass through an engineered channel. See **Figure 4, Hackberry Fault Seepage Mitigation – Ripsey Wash TSF**.

Up-gradient of the internal containment dam, and immediately up-gradient of the "trace" of the fault zone, Asarco would begin placement of tailings material such that the tailings fines (or "slimes", as these fines are typically known as by miners) would act to seal the surface above the fault zone to prevent seepage under the starter dam at the site where the starter dam intersects the Hackberry fault zone.

Asarco has installed a monitoring well down-gradient of the tailings embankment within the Hackberry fault zone. This well would serve as a point of compliance with the Arizona DEQ APP and would be used to characterize and monitor groundwater conditions within the Hackberry fault zone during operations and as part of closure, reclamation and post-closure activities. Existing water quality from this point of compliance well has already been characterized and was used in setting alert levels and aquifer quality limits in the approved APP.

The Arizona DEQ considers the above described Hackberry Gulch seepage mitigation measures to be in compliance with Arizona BADCT and has approved this design in the APP for the Ripsey Wash TSF.

2.3.2.8 Seepage Trenches

Down-gradient of the starter dams, in both the "main" Ripsey Wash and the unnamed drainage on the eastern side of the proposed Ripsey Wash TSF (regularly referred to as the "east drainage"), Asarco plans to install seepage trenches to intercept any water seepage that might migrate under the tailings facility through the alluvium material located above the bedrock. See **Figure 2, Site Plan Layout - Ripsey Wash TSF**, **Figure 5, Main Reclaim Pond and Seepage Control Trench,** and **Figure 56, East Seepage Trench Cutoff Walls**.

These seepage trenches would be excavated into bedrock. As discussed in Section 2.3.2.6, Tailings Starter Dams, Asarco would remove alluvium and colluvium material prior to the construction of the seepage trenches.

The lower portion of the seepage trench would be lined with an 80-mil HDPE, or equivalent, geomembrane liner and filled with granular drain material (i.e., gravel or coarse sand). The pumps and riser would also be installed in the granular drain material. The riser would extend to the surface where piping would route the collected seepage to the reclaim pond. From the reclaim ponds, water would be pumped (recycled) to the Ray Concentrator for use in the milling process.

The Arizona DEQ considers the installation and operation of the seepage trenches to be in compliance with Arizona BADCT and has approved this design in the APP for the Ripsey Wash TSF.

2.3.2.9 Reclaim Ponds

Down-gradient of the seepage trenches, in both the "main" Ripsey Wash and the East drainage, Asarco plans to install reclaim ponds. See **Figure 2, Site Plan Layout - Ripsey Wash TSF**.

These reclaim ponds would be constructed with an engineered double-liner system, using synthetic liner material (80 mil HDPE or equivalent) and have leak detection systems incorporated into their design and operation. The area around these ponds would be fenced with an 8-foot high chain-link fence, designed to thwart people and wildlife from entering the pond area. Asarco would be able to pump (recycle) water from these reclaim ponds to the Ray Concentrator (for reuse) or to the tailings impoundment. Asarco plans to install additional pumping capacity at these sites as a contingency in the event there is a pump failure or there is maintenance being performed on one of the pumps. This pumping capacity will remain after completion of tailings placement operations to serve TSF closure needs and reclamation activities, until released under the terms and conditions of the Arizona DEQ APP. The site's 401 certification requires a redundant power source for the pumping stations to prevent overtopping in the event of electrical failure or loss of power. See **Figure 5, Main Reclaim Pond and Seepage Control Trench**, and **Figure 57, Ripsey Wash TSF Main Reclaim Pond – Plan View**.

Stormwater that contacts the down-gradient slope of the Ripsey Wash TSF embankment and stormwater from areas at the toe of the tailings embankment where Asarco has constructed infrastructure (office, shop, etc.) would be routed to the reclaim ponds and handled the same as TSF seepage water. The reclaim ponds would be able to contain the volume of a 100-year, 24-hour storm event, plus the expected seepage volumes, while maintaining a minimum two feet of freeboard. There would be no surface discharge of water from the reclaim ponds to the Gila River.

The Arizona DEQ considers the construction and use of reclaim ponds to be in compliance with Arizona BADCT and has approved this design in the APP for the Ripsey Wash TSF.

2.3.2.10 Monitoring Wells

Asarco would also maintain or install monitoring wells[19] down-gradient of the tailings embankment to serve as points of compliance for the Arizona DEQ APP. See **Figure 30, Groundwater Hydrology – Ripsey Wash TSF**. The purpose of these down-gradient wells would be to characterize groundwater conditions before construction, and then continue to monitor the groundwater during and after operations to assess any effect that the operation and closure of the TSF has on down-gradient groundwater quality.

[19] Monitoring wells for the Ripsey Wash TSF have been installed.

2.3.2.11 Pumping Booster Station and Tailings Drain-Down Pond

Asarco would construct a pumping station, electric switchgear facility, and a drain-down pond at the low point of the tailings pipeline routing (north of the Gila River and adjacent to the Florence-Kelvin highway). See **Figure 2, Site Plan Layout - Ripsey Wash TSF**.

From this location, the pumping booster station would push tailings through a pipeline across the Gila River and uphill to the Ripsey Wash TSF. Asarco would also line (80-mil HDPE or equivalent, with a leak detection system) the tailings drain-down pond at this site to contain tailings from the pipeline, should an emergency necessitate that situation. This pond would be designed and constructed to hold more than the total volume of tailings slurry potentially contained in the tailings pipeline and the reclaim water pipeline from the Ray Concentrator to the Ripsey Wash TSF.

The electric switchgear facility at this site would provide the energy to operate the tailings pumping booster station, as well as various other pumps to be used at the Ripsey Wash TSF (e.g., seepage trench pumps, reclaim pond pumps and decant water pumps at the rear of the tailings impoundment).

During construction, this site would also serve as a parking area for construction workers and equipment, as well as a storage area for construction-related materials and supplies, such as pipeline segments, culverts, liner material, fencing and pumps. The booster station and the drain-down pond site area would be fenced with an 8-foot high chain-link fence to thwart people and wildlife from entering the site.

The Arizona DEQ considers the tailings drain-down pond and associated booster pump system to be in compliance with Arizona BADCT and has approved the design for these facilities in the Ripsey Wash TSF APP.

2.3.2.12 Pipeline Bridge over Gila River

Asarco would build a bridge across the Gila River for the specific and sole purpose of supporting the tailings and return water pipelines to and from the Ripsey Wash TSF. Pier design and placement for the bridge would minimize disturbance to vegetation and waters of the U.S. A water supply pipeline would also be installed across the bridge to provide site water needed for dust control, domestic use, and fire protection. These pipelines would be elevated above the Gila River and associated wetlands and the Copper Basin Railroad tracks on the north side of the river. See **Figure 6, Gila River Tailings & Water Pipeline Bridge – Ripsey Wash TSF**.

Where they cross the Gila River or where pipelines are located on the surface where a spill could reach the Gila River or Mineral Creek, the pipelines would be sleeved within a larger-diameter, second pipe designed to contain any leaks or spills. In addition, the pipeline bridge across the Gila River would be slightly sloped so any spillage or leakage would be directed toward the drain-down pond on the north side of the pipeline bridge and north of the Gila River. The gradient (or slope) on the pipelines across the bridge would avoid low points and would be installed to maintain positive drainage back to the drain-down pond, which would be important in the event of any spill or leak. Asarco plans to continuously monitor pipeline pressures and flow rates to detect any pressure drops, at which time the pipelines could be shut down and drained to allow maintenance.

2.3.2.13 Tailings and Water Pipelines

Tailings would be conveyed to the Ripsey Wash TSF though contained overland slurry pipelines that would parallel the return water pipeline. These water pipelines would convey water from the tailings impoundment back to the Ray Concentrator. The proposed pipeline routing is shown on **Figure 2, Site**

Plan Layout - Ripsey Wash TSF, and **Figure 7, Typical Utility Corridor & Roadway Sections – Ripsey Wash TSF**.

The BLM would be responsible to issue a right-of-way grant to Asarco before the company could install tailings and water pipelines where they crosses BLM administered land.

The tailings pipeline would be installed from the existing thickener, would cross beneath State Route 177 and allow for minimization in greenhouse gas emissions through the use of a gravity alignment north of the Gila River and run beside the Florence-Kelvin Highway south of the river. The pipelines would cross the Gila River on a bridge to be constructed immediately upstream of the Florence-Kelvin Highway bridge constructed by Pinal County. The decant water pipeline and a fresh water line would be placed adjacent to the tailings pipelines and would follow the same routing back to the existing thickener, where it would be connected to an existing pipeline that returns water to the existing Tank 34, which receives decant water from the existing Elder Gulch TSF.

Additional discussion about pipelines is set forth in Section 2.3.4, Tailings Delivery System.

2.3.2.14 Public Access to Upper Ripsey Wash

Fencing would be installed during construction of the Ripsey Wash TSF to impede public access within and 500 feet beyond the proposed footprint of the facility and related infrastructure in the area of construction and operation of the Ripsey Wash TSF. Standard 4-strand barbed wire livestock fencing would be used. Keep-out signage would be posted.

Future public access into the upper reaches of Ripsey Wash from the Florence-Kelvin highway would be via existing two-track roads on the west side of the proposed TSF. There are several existing two-track roads on state and private lands that would remain open to the public from the Florence-Kelvin highway. These roads pass through Zelleweger Wash, across the divide between Zelleweger and Ripsey washes, and then reconnect with Ripsey Wash up-drainage of the site of the detention pond to be constructed for the Ripsey Wash TSF. See **Figure 36, Regional Recreation Resources**, for two-track road locations.

2.3.3 Tailings Embankment Construction Methods

Two distinct methods of tailings embankment construction would be used during the course of operation at the Ripsey Wash TSF. These methods would be centerline and upstream construction.

2.3.3.1 Centerline Construction

Centerline embankment construction is a common construction method used for tailings facilities. At the Ripsey Wash TSF, tailings would be cycloned and spigotted off the crest of the starter dams. The centerline of the embankment would be maintained as fill and progressive raises would occur on both the beaches (up-drainage side) and the downstream face of the embankment. See **Figure 9, Centerline Tailings Embankment Construction**.

Cyclones are simple mechanical devices used to separate coarse and fine particles from the tailings slurry through centrifugal force. Essentially, cyclones work on the same principle as gravity-based separation devices, except that centrifugal acceleration forces are many times that of gravity.

As the tailings slurry enters the cyclone (under pressure), the fine particles and most of the water would rise to the top outlet. The coarse tailings particles would spiral downward through a conical section of the cyclone and exit the bottom. The overflow is referred to as the separated fine fraction or “slimes”, while the underflow is known as the sand fraction or "sands". See **Figure 9, Centerline Tailings Embankment Construction**.

The overflow (fines or slimes) would be discharged into the tailings impoundment, while the underflow (coarse material or sands) would be used to construct the tailings embankment. The sands readily drain and would be shaped by a bulldozer to form a down-drainage slope configuration of approximately 3 horizontal to 1 vertical (3H:1V).

The centerline embankment would be underlain by a lined (60-80 mil HDPE liner or equivalent) drain system that would allow drainage of water through cycloned sand or coarse material portion of the tailings. This drainage would allow the maintenance of a low phreatic surface in the embankment section. Water seepage from the tailings embankment would be collected by a series of finger and blanket drains within the footprint of the embankment and would be conveyed through a lined containment ditch into a lined reclaim pond located down-drainage of the ultimate embankment footprint. Also, any stormwater runoff that contacts the down-gradient slope of the tailings embankment would be routed to the reclaim ponds and handled as seepage water. See **Figure 2, Site Plan Layout - Ripsey Wash TSF**.

The centerline tailings embankment would be raised in lifts of cycloned tailings concurrent with the actual filling of the tailings impoundment. As each embankment is raised in height, the footprint of the embankment would be expanded down-drainage. Accordingly, the down-gradient embankment underdrain system would also continue to be expanded.

When the centerline construction reaches an elevation approximately 2,200 feet (amsl), Asarco would switch to an upstream method of tailings storage[20]. Upstream construction techniques would be initiated when the tailings impoundment is large enough so that the coarse sand fraction of the tailings has sufficient time to dry or "set-up", thus allowing the upstream construction technique to commence.

Once centerline construction is completed, Asarco would cover the down-gradient embankment with rock as part of concurrent reclamation activities. See Section 2.3.12, Ripsey Wash TSF Closure and Reclamation.

2.3.3.2 Upstream Construction

The upstream method of tailings storage is currently employed by Asarco at the Elder Gulch TSF and is a commonly-used method for tailings embankment construction in low risk seismic areas, such as Arizona. **Figure 10, Upstream Tailings Embankment Construction**, illustrates the process of upstream construction used at the Ray Mine.

In the upstream method, tailings would be discharged from spigots around the crest of the tailings embankment. This would be an activity similar to the centerline method, but the cyclone used for centerline construction would no longer be used. The deposition of tailings would develop a wide tailings beach area composed mainly of coarse tailings material. This beach would become the foundation for the next lift. The coarse fraction of the tailings would settle closest to the spigots, while

[20] As explained in the approved APP for the Ripsey Wash TSF, the Arizona DEQ is requiring that Asarco submit additional geotechnical information that can only be gained during the initial operation of the TSF. The Arizona DEQ will review this information before making any final decision about the implementation of upstream construction. This future APP modification is separate from this EIS analysis.

the fines would migrate with water toward the decant pond at the back of the tailings impoundment. It is the coarse fraction that would be used to construct the next lift.

Once the surface of the tailings beach has sufficiently dried to support equipment, a tracked excavator[21] would maneuver itself onto the wide tailings beach area (approximately 40 feet from the outside toe of the next lift to be constructed) to initiate the next lift. This machine would dig and place excavated tailings in a long, windrowed stockpile that would parallel the crest of the existing dam perimeter.

Following behind the progression of the excavator, a bulldozer[22] would flatten the stockpile of coarse tailings to achieve the 10-foot height required for the next lift in the tailings embankment. The bulldozer would shape the outer (down-drainage) side of the tailings to form a 2H:1V slope. Piping would then be added to extend the tailings outfall spigots to the top of the new lift to allow tailings storage to continue behind the newly-constructed lift.

After three 10-foot lifts, Asarco would leave a 60-foot wide bench, or set-back, before beginning the next 10-foot lift. This 60-foot wide bench would provide a working platform for the tailings delivery pipeline, which would be moved from the previous 60-foot wide bench. This new 60-foot wide bench would serve as an access road for Asarco personnel and equipment and would lessen the overall slope of the tailings embankment to 3H:1V.

To reduce potential for windblown dust, Asarco would spray a binding agent or tackifier[23] on the down-gradient slope of the tailings embankment. After every third lift (with the completion of the 60-foot wide setback, Asarco would cover the lower outside embankment slope with rock material. This rock material would be removed from a borrow source within the footprint of the TSF and hauled to the crest of the completed slope. A bulldozer would push the material down slope to cover the tailings embankment. This activity would be part of the concurrent reclamation practices discussed in Section 2.3.12, Ripsey Wash TSF Closure and Reclamation. See **Figure 10, Upstream Tailings Embankment Construction**.

2.3.3.3 Quality Control and Quality Assurance

As required by Section 1.0 of the approved Arizona DEQ APP, the Ripsey Wash TSF has been designed and would be constructed under the direction and seal of qualified Arizona registered Professional Engineer. Foundation preparation and embankment construction would be completed under a quality control and quality assurance program administered by a third-party contractor. Sections 2.2.3 and 3.0 of the approved APP require that a qualified Arizona registered Professional Engineer certify the construction of the facility for Arizona BADCT compliance and to confirm that appropriate quality

[21] At the Elder Gulch TSF, Asarco currently utilizes a Cat 375 Excavator with an extended boom for long reach. The Cat 375 Excavator or a similar machine would be used for upstream tailings construction work at the Ripsey Wash TSF.

[22] At the Elder Gulch TSF, Asarco currently utilizes a Cat D6 LGP (low ground pressure) bulldozer to construct and shape the next 10-foot lift of the tailings facility. A Cat D6 LGP dozer or a similar machine would be used for upstream tailings construction work at the Ripsey Wash TSF.

[23] The same tackifier that is currently being used to reduce wind-blown tailings at the Elder Gulch TSF would be used for the Ripsey Wash TSF.

assurance and quality control procedures were followed during foundation preparation and construction.

2.3.4 Tailings Delivery System

Tailings would be pumped though a contained slurry pipeline to the Ripsey Wash TSF from a new pumping booster station, located on the north side of the Gila River. The tailings slurry and water return pipelines would be HDPE and/or high-strength steel, with welded joints to ensure long-term operational integrity, and the pipelines would be installed (buried) in a trench in a gravity alignment north of the Gila River and in the road shoulder parallel to the Florence-Kelvin highway or beneath the driving surface of the Florence-Kelvin highway south of the Gila River. See **Figure 7, Typical Utility Corridor and Roadway Sections – Ripsey Wash TSF**.

As explained in Section 2.3.2.12, Pipeline Bridge over Gila River, Asarco would build a bridge to convey the pipelines over the Gila River; this bridge would be adjacent to a new road bridge to be constructed by Pinal County for the Florence-Kelvin highway. See **Figure 6, Gila River Tailings & Water Pipeline Bridge – Ripsey Wash TSF**. The tailings slurry and water return pipelines would be sleeved across the bridge within a larger diameter pipe (pipes-in-pipe) as protection in the event of a pipeline break. Additional break protection would be provided by the lined drain-down pond discussed in Section 2.3.2.11, Pumping Booster Station and Tailings Drain-Down Pond.

A 0.3-mile (approximately 1,500 feet) long segment of the tailings (and return-water) pipeline(s) would cross lands administered by the BLM. See **Figure 8, BLM Administered Lands – Pipelines and Arizona Trail**.

At road crossings, such as State Route 177, the pipelines would be sleeved within a larger diameter pipe, and culverts (pipe-in-pipe) would be installed. The gradient on the pipelines would avoid low points, and positive drainage would be maintained from the existing thickener to the tailings pumping station on the north side of the Gila River, and from the tailings booster pumping station to the Ripsey Wash TSF. The pipeline crossings on State Route 177 would require approvals from the ADOT.

Where pipelines are buried, disturbance would be reclaimed after construction. Reclamation of the construction for pipelines crossing BLM-administered lands would comply with BLM requirements.

2.3.5 Tailings Facility Operation

The tailings facility would be designed and operated as a zero-surface water discharge facility, which is the same method used at the existing Elder Gulch TSF. To achieve a zero-discharge surface water facility, no tailings seepage water captured from beneath the embankment or no tailings decant water would be allowed to flow off-site. Water captured in the reclaim ponds or in the tailings decant pond(s) would be pumped and recycled for use at the Ray Concentrator.

Tailings would be discharged from spigots that surround the perimeter of the tailings storage facility and a tailings beach would be created using thin-layer, sub-aerial deposition techniques. See **Figure 11, Tailings Facility Operation**.

The tailings discharge operations would focus on directing water to the rear of the facility to allow a pool of water to form (known as the decant pond) from which water would be pumped back to the Ray Concentrator. As tailings beaches form, spigot discharges would progress around the perimeter of the facility, and this action would promote drying and increased density of the tailings.

2.3.6 Tailings Facility Support Facilities

The Ripsey Wash TSF would require miscellaneous infrastructure to support operations. This infrastructure would include site support and service roads, power supply for pumps, fencing and a quarry or borrow area for concurrent reclamation and closure rock material.

2.3.6.1 Site Support and Service Roads

Asarco would use existing roads to the extent practical to access the proposed Ripsey Wash TSF.

The tailings delivery and return water pipelines would run from the Ray Mine property along a gravity alignment north of the Gila River and parallel (or be located beneath) the Florence-Kelvin highway south of the Gila River to the east side of the TSF and then continue to the top of the TSF via a short service road. The Florence-Kelvin highway would serve as the primary access road to the Ripsey Wash TSF. There would also be an access and maintenance road constructed along the gravity pipeline alignment north of the Gila River.

Temporary construction roads would be used to haul rock material for the starter dam embankment construction, but they would be mainly located within the footprint of the overall construction and disturbance area for the TSF.

An access service road would be constructed and maintained along the top of the tailings embankment for the pipeline that would deliver tailings. Another access service road would be constructed and maintained around the upper perimeter of the tailings impoundment for the return water pipelines. As the TSF expands upward, Asarco would establish new perimeter access service roads. These perimeter access roads would typically be around 15 to 20 feet wide.

2.3.6.2 Power Supply and Distribution

Electric power would be needed for the tailings pumping booster station on the north side of the Gila River, the water pumps at the reclaim ponds below the tailings embankment, and at the decant water pond at the back side of the tailings impoundment. Water pumps would also located at the detention dam, reclaim ponds and the associated stormwater ponds. Asarco would install electric switchgear at the pumping booster station and would construct distribution lines from this site to serve pumping facilities at the Ripsey Wash TSF (e.g., the pumps at the detention pond, the decant pond(s), the reclaim ponds, and the pump-back wells).

Electric distribution line structures would be single pole structures constructed to Rural Utilities Service (RUS) standards (or equivalent). Asarco would use Avian Power Line Interaction Committee (APLIC) raptor-deterring design measures and/or grounded hardware (or equivalent), as well as insulating or cover up materials, for perch management.

New electric distribution power line construction would involve an estimated 15 to 20 pole structures per mile. New temporary two-track roads, along with existing roads, would be used to gain access for line construction and maintenance.

2.3.6.3 Rock Quarry

Rock used for the starter dam construction would be excavated from within the footprint of the Florence-Kelvin highway realignment and Ripsey Wash TSF. Asarco plans to use inert alluvium/colluvium material and/or inert, non-mineralized granitic rock. This rock material has been characterized and determined to be non-acid-generating. See Section 3.3, Geology, Geotechnical and Geochemistry.

As part of concurrent reclamation, Asarco plans to put rock on the down-gradient slope of the Ripsey Wash TSF embankment, starting after the centerline construction phase is completed, and followed periodically on the slopes created by upstream construction (after three lifts are completed), as explained in Section 2.3.3.2, Upstream Construction. Asarco would use inert, non-mineralized granitic conglomerate rock, again from a borrow source (or quarry) located within the footprint of the planned TSF. Asarco would remove rock material from the quarry as needed and haul it in off-highway trucks for placement on the embankment slopes.

Rock from within the footprint of the TSF would also be used for final closure activities, e.g., covering the tailings impoundment area after the permanent closure of the TSF. Asarco would extract rock material from a quarry area within the footprint of the TSF (prior to closure) and stockpile the material between the East diversion channel and the TSF (within the TSF disturbance footprint). Removing rock material from within the footprint of the existing facility would limit disturbance and add tailings storage capacity to the TSF.

Quarrying of rock from the federal mineral estate would require an approved material sale from the BLM as discussed in **Appendix C, Agency Responsibilities (Regulatory Framework)**.

2.3.6.4 Project Lighting

Any project-related nighttime lighting would be minimal, mostly portable lighting plant(s) for specific project activities areas, with the light focused inward to reduce light trespass into adjacent areas. Most construction activities would be expected to occur primarily during daylight hours. Only minimal mobile equipment would be needed during operations, and use of such equipment (primarily dozers) would be scheduled to occur during daylight hours. Portable light plants could be used at night for emergency maintenance or other work.

2.3.7 Water Use and Management

Water is required to operate the Ray Concentrator and is (and would continue to be) required to pump the tailings slurry to the Ripsey Wash TSF.

Asarco has surface water rights under the Globe Equity Decree, *United States v. Gila Valley Irrigation District*, Globe Equity No. 59 (June 29, 1935) that currently support and would continue to support operation of the Ray Concentrator and pumping of tailings to the TSF. Water in excess of the reclaimed water used for the Ray Concentrator and operation of the existing Elder Gulch TSF and the proposed Ripsey Wash TSF is and would continue to be delivered to the Ray Mine via an existing buried pipeline that originates from the Hayden well field located downstream of the confluence of the Gila and San Pedro rivers near the community of Hayden , approximately 20 miles southeast of the Ray Mine.

The Ray Concentrator is currently and would continue to be operated as a closed-circuit, zero-surface water discharge facility. Process water is presently and would continue to be recycled within the system rather than be allowed to be discharged into the environment.

Tailings are and would continue to be pumped as slurry to the TSF, where the decanted water would be returned to the Ray Concentrator. Some process water would naturally evaporate.

After the decant water clarifies (tailings settle out), Asarco would begin to recycle water from TSF decant pond(s), and the TSF would attain full operational status. However, due to the evaporation and retention of residual water within the tailings, fresh water makeup would continue to be required at the Ray Concentrator throughout the life of the project. Seasonal precipitation and temperature would also play a role in the amount of water recycled to the Ray Concentrator from the TSF.

As Asarco approaches the final cessation of operations, as much water as practical would be drawn from the TSF decant pond(s), and less fresh water would be added to the system to reduce the size of the return-water pond.

Upon conclusion of Ray Concentrator operations, no additional water from the concentrator would be introduced to the TSF, and remaining ponded water in the decant pond(s) at the TSF would be allowed to evaporate naturally, or evaporation would be enhanced through the use of spray evaporators as part of final closure activities.

2.3.8 Stormwater Management

Upstream of the TSF, Asarco would construct diversion channels and detention facilities as described in Section 2.3.2.5, Detention Dams and Diversion Structures. Asarco would also maintain stormwater pollution prevention plans (SWPPPs) to address on-site stormwater runoff, in accordance with the Arizona Mining Multi-Sector General Permit (MSGP) and Construction General Permit (CGP) issued by the Arizona DEQ. See **Appendix C, Agency Responsibilities (Regulatory Framework)** and **Appendix I, Applicant Project Mitigation**.

2.3.9 Work Force Requirements

The construction phases for the Ripsey Wash TSF would require an estimated workforce that would range from approximately 50 to 200 people for the estimated three-year construction period[24]. It is projected that 50% of this workforce would be hired locally.

As the project construction work for the Ripsey Wash TSF is phased out, Asarco would use approximately the same workforce that currently operates and maintains the Elder Gulch TSF to assume the operation and maintenance requirements for the Ripsey Wash TSF.

About half-way through the operation of the Ripsey Wash TSF, Asarco would require an earthmoving construction workforce of 15 to 20 people to move and stockpile cover rock (granitic conglomerate) for final closure. It is expected that 75% of this workforce would be hired locally.

Decommissioning and final closure at the end of the project life would require approximately 20 to 30 people. Asarco would manage this work using a contractor that specializes in earthmoving. It is expected that 95% of this workforce would be hired locally.

2.3.10 Environmental Management and Mitigation

Presuming that the Ripsey Wash TSF is implemented, Asarco would employ and maintain environmental management and mitigation measures to minimize environmental effects during TSF construction, operations and closure activities. See **Appendix I, Applicant Project Mitigation**. Available measures are dictated in part by the nature and scope of a TSF. Proposed environmental protection measures have been incorporated into the project design that are either voluntary or intended to meet applicable standards of regulatory agencies such as Arizona DEQ, the Arizona State Mine Inspector's Office, and the Corps. See **Appendix C, Agency Responsibilities (Regulatory Framework)**.

[24] Construction activities would include the relocation of a 2.1-mile portion of the Florence Kelvin highway, the realignment of a portion of the 69kV SCIP power line and the realignment of a portion of the Arizona Trail.

2.3.10.1 Waters of the U.S.

Asarco would implement the Corps-required compensatory mitigation for the functional losses associated with impacts created by the Ripsey Wash TSF to jurisdictional waters of the U.S. The conceptual plan for compensatory mitigation has been provided in **Appendix J, Compensatory Mitigation**.

Asarco has proposed compensatory mitigation activities at four locations along the Lower San Pedro River, which has been the setting for other mitigation for past 404 permit-related activities. In addition, for the remainder of the mitigation requirements, Asarco would be providing payment to the Lower San Pedro River In-Lieu Fee Program administered by AGFD. A Habitat Mitigation and Monitoring Plan (HMMP) will be submitted prior to permit issuance for approval by the Corps; implementation of the HMMP will be required as a special condition of the 404 permit. The HMMP will provide detailed information on how mitigation will be implemented including the timing of mitigation implementation relative to the timing of impacts to waters of the U.S. The compensatory mitigation plan for the Project would be implemented per the Corps's and EPA's "Final Compensatory Mitigation Rule" dated April 10, 2008 (33 CFR Part 332 and 40 CFR Part 230, Subpart J).

2.3.10.2 Stormwater – Erosion and Sediment Control Measures

Asarco would maintain stormwater pollution prevention plans (SWPPPs) for the TSF site and offsite infrastructure (pipeline and project powerline and associated facilities) and Florence-Kelvin highway realignment construction activities. Stormwater features would include diversion ditches, culverts, sediment traps, stormwater basins, etc. Surface water diversion ditches would route up gradient stormwater around the TSF. Diversions would be constructed and maintained around disturbed areas to minimize erosion. See **Figure 2, Site Plan Layout – Ripsey Wash TSF**.

2.3.10.3 Water Resources

Asarco would comply with the Arizona BADCT management practices and requirements of the APP issued by the Arizona DEQ. These measures include the installation of seepage trenches, reclaim ponds and pump-back wells to capture infiltration through or beneath the TSF embankments, along with the construction of diversion structures and facilities to route up-gradient stormwater runoff around the TSF.

2.3.10.4 Air Quality

Asarco and its contractors involved in construction activities would comply with applicable Pinal County air quality regulations. This would be a condition of Asarco contracts with any TSF contractors. Air quality mitigation practices would be used to control fugitive dust generation. These practices would include application of a tackifier on the down-gradient embankment of the TSF during embankment lift construction (until rock is placed on these slopes), as well as periodic watering of site access roads and construction disturbance areas.

2.3.10.5 Cultural and Historic Resources

Cultural resources inventory surveys have been conducted by Asarco contract archaeologists under guidance from the Arizona State Historic Preservation Office (SHPO), ASLD, and the BLM (on BLM-administered lands). A Historic Properties Treatment Plan (HPTP) will be developed to ensure that any adverse effects of the project on NRHP-eligible sites would be mitigated, but the HPTP would not address mitigation of potential and/or projected cumulative impacts to historic properties outside the scope of the proposed action and APE. A Memorandum of Agreement (MOA) will be developed that will detail the implementation of the HPTP and provide protection for any inadvertent discovery of cultural materials during construction.

2.3.10.6 Wildlife

Two avian species found in habitat along the Gila River have been listed under the Endangered Species Act (ESA); these are the southwestern willow flycatcher (endangered) and the yellow-billed cuckoo (threatened). Mitigation measures are included in the Biological Opinion (BO) prepared by the U.S. Fish and Wildlife Service (USFWS).

Asarco has identified four mitigation sites located along the San Pedro River (Sites A through D) that are approximately 29 river miles upstream from the Project and payment to the Lower San Pedro River Wildlife Area in Lieu Fee Project managed by the AGFD. Proposed mitigation activities are intended to compensate for unavoidable Project impacts to waters of the U.S. and also to enhance habitat for southwestern willow flycatcher and yellow-billed cuckoo.

All proposed mitigation activities are associated with perennial or intermittent aquatic resources, support or have the potential to support high-value mesoriparian and hydroriparian habitats, and provide regional conservation benefit. The San Pedro River mitigation sites are adjacent to existing Corps-approved mitigation projects that have been developed in support of previous Corps permitting efforts at the Ray Mine and are contiguous with or near other conservation properties that have been established by the Bureau of Reclamation, the Salt River Project, and the AGFD. The riparian and aquatic habitats within the mitigation sites will be preserved, enhanced, and/or restored to benefit wildlife, including southwestern willow flycatcher and yellow-billed cuckoo, and potentially northern Mexican gartersnake.

Project construction, including construction of the pipeline bridge and associated infrastructure, relocation of the Florence-Kelvin highway and SCIP powerline, and construction of the seepage collection system in Ripsey Wash, is likely to be determined in large part by the time at which the necessary permits are obtained and the timing of related Project construction activities.

If pipeline bridge construction is required during the breeding season of southwestern willow flycatcher and/or yellow-billed cuckoo, vegetation removal along the Gila River would occur outside the breeding season(s) (April 15 to September 15 for the southwestern willow flycatcher and May 15 to September 30 for the yellow-billed cuckoo). Early clearance of vegetation is intended to preclude southwestern willow flycatcher and/or yellow-billed cuckoo from establishing territories and nest sites in the pipeline bridge construction corridor. Upon the clearance of vegetation within the bridge construction area along the Gila River, the Biological Assessment (BA) anticipates that birds would be expected to move on to other unoccupied sites on the Gila River and that there would be no (direct) mortality of individual southwestern willow flycatchers or yellow-billed cuckoos resulting from the Project.

2.3.11 Environmental Monitoring and Mitigation

Asarco would implement environmental monitoring and mitigation measures required by permits and approvals issued for the TSF, most prominently, the APP issued by Arizona DEQ. See **Appendix I, Applicant Project Mitigation**.

As part of the approved APP, Asarco has begun groundwater sampling of wells down-gradient of the TSF facilities to monitor groundwater conditions at the site during construction, operations and closure. Other APP compliance conditions include:

- Water quality monitoring and compliance with water quality standards;
- Alert levels and action protocols based on water quality monitoring results;
- Requirements for compliance during any temporary cessation of operations; and,
- Requirements for closure and post-closure of the TSF.

Pinal County regulates fugitive dust and gaseous emissions for the Ray Mine, including the TSF. Asarco would be required to maintain compliance with the terms and conditions of its Pinal County Air Quality Title V Permit (#V20542.R01) during the construction, operation and closure of the Ripsey Wash TSF.

2.3.12 Ripsey Wash TSF Closure and Reclamation

Closure and reclamation will be implemented in compliance with federal, state and local requirements. The overall purpose of closure and site reclamation is to prevent undue or unnecessary post-project environmental degradation and restore disturbed areas to be compatible with surrounding landscape.

Asarco's closure and reclamation plan for the Ripsey Wash TSF would include procedures for temporary closure and practices for permanent decommissioning and closure, which would include the removal of support facilities and infrastructure (such as pumps and piping, the reclaim and drain-down of ponds, facility parking and storage areas), the re-contouring of the top of the TSF to establish drainage off the site, and the placement of rock material over the surface of the TSF to reduce the potential for wind and water erosion.

In Arizona, under the jurisdiction of the Arizona State Mine Inspector, closure and site reclamation must consider public safety, which would include stable landforms. APP closure requirements would also focus on reducing the potential for future discharges to groundwater. Additional discussion on regulatory requirements on closure and reclamation is set forth in **Appendix C, Agency Responsibilities (Regulatory Framework)**. Also, see **Appendix I, Applicant Project Mitigation**.

There are many discussions and opinions amongst government and industry experts on the best way to close a TSF for a copper mine in Arizona, and tailings closure technology and practices are evolving and improving. Asarco expects the TSF to function well into the future (50+ years) and would take advantage of future opportunities to explore new closure and reclamation techniques when the time comes to implement site closure and reclamation.

2.3.12.1 Ripsey Wash TSF Concurrent Reclamation

Reclamation completed during active operations is termed "concurrent" reclamation. Concurrent reclamation is designed to provide permanent, low-maintenance achievement of reclamation goals.

Asarco plans to place approximately one foot of rock material on the down-gradient slope of the Ripsey Wash tailings embankment after the centerline construction work is finished and Asarco transitions to up-stream tailings embankment construction. At this point, the face of the centerline tailings embankment would be ready for rock placement work as the embankment slope would remain a permanent feature. This rock material would minimize wind and/or water erosion of the embankment outslope.

Asarco also plans to conduct concurrent reclamation on the slopes of the Ripsey Wash upstream tailings embankment. Approximately one foot of rock material would be placed on the final slope created after three individual lifts are made and the set-back is completed on the third lift. See Section 2.3.3.2, Upstream Construction.

For the Ripsey Wash TSF, the final cover rock material would be granitic material excavated from the borrow area within the tailings impoundment footprint.

Conventional construction equipment would be used for this activity. Front-end loaders would excavate and load off-highway trucks that would transport and deposit the rock material on the bench area above the tailings embankment outslope. Bulldozers would spread the rock over the embankment outslope.

2.3.12.2 Ripsey Wash TSF Temporary Cessation

Although a temporary cessation of the Ripsey Wash TSF operations is not planned and cannot be predicted, circumstances beyond Asarco's control could require temporary cessation of operations. Cyclical production trends or slow-downs are unpredictable due to circumstances that include fluctuation in precious metals prices, labor disputes or costs, production costs, taxes, company profitability, and effects of political, regulatory and economic events.

During any temporary shutdown of the Ripsey Wash TSF, Asarco would continue to implement operational and environmental maintenance activities to ensure the Ripsey Wash TSF meets permit stipulations and requirements for environmental protection. Environmental monitoring requirements would continue, as outlined in the appropriate permit approvals, specifically the APP issued and overseen by the Arizona DEQ. The Arizona DEQ would also require that Asarco submit a Temporary Cessation Plan for review and approval; this is a requirement of the site's approved APP. Environmental reports would be submitted in a timely manner. Regardless of the operating status of the mining, appropriate monitoring and mitigation would continue until compliance with permanent closure requirements is attained. The Arizona DEQ is responsible to ensure that Asarco complies with the APP terms and conditions, even during periods of temporary cessation.

2.3.12.3 Permanent Ripsey Wash TSF Closure Plan

At the permanent cessation of milling operations at the Ray Concentrator, Asarco would dewater, close and reclaim the Ripsey Wash TSF. Their primary objectives for TSF closure are:

1. Implement closure procedures that would prevent potential adverse impacts to human health or the environment;
2. Execute a cost-effective and reliable closure strategy that would minimize future maintenance requirements; and,
3. Prevent impacts to the surface and groundwater hydrology of the site, particularly with respect to the Gila River.

A general description of the proposed tailings facility closure procedures is set forth in the following subsections.

2.3.12.3.1 Elimination of Water from Ripsey Wash TSF Supernatant Pool

As permanent closure approaches, Asarco would minimize the amount of excess water within the Ripsey Wash TSF decant pond. The site's seepage control trenches, pump-back wells and reclaim ponds would continue to be operated and maintained during closure in compliance with APP requirements. Water collected in the trenches would be routed to the reclaim ponds where it would evaporate or be pumped back onto the TSF.

Upon closure, Asarco would allow the remaining water in the TSF to evaporate, and spray evaporation techniques would be used, as necessary, to accelerate the evaporation process. This would cause the surficial layers of the tailings to dry and gain strength, which in turn would allow equipment to operate on the tailings surface for grading and rock material placement. Spray evaporators could be used to enhance evaporation of the existing decant pond(s). It is estimated that 7 to 10 years might be required to achieve final drying and settlement of the tailings material. Fugitive dust would be controlled by periodically applying a tackifier on the dry tailings surface. This is expected to be a condition of the Pinal County Air Permit.

2.3.12.3.2 Permanent Water Diversions, Reclaim Ponds and Draindown Ponds

A permanent diversion channel would remain on the east side of the Ripsey Wash TSF. This diversion structure would be installed as part of the original construction to route up-gradient (eastside) stormwater flows around the TSF. In addition, Asarco would continue to maintain and operate the detention dams and stormwater pumping and piping system designed to route stormwater runoff around the west side of the Ripsey Wash TSF. Asarco (or an entity designated by Asarco) would monitor these systems for continued effective operation. As appropriate, Asarco (or an entity designated by Asarco) would conduct necessary maintenance on these facilities using conventional equipment (i.e., dozers or loaders), in perpetuity, to ensure their proper and appropriate functioning. See **Figure 12, Final Reclamation Topography – Ripsey Wash TSF**.

Upon compliance with APP requirements, which means no seepage from the facility that does not meet water quality standards set by the Arizona DEQ at the time of closure, the reclaim and draindown ponds would be removed as part of the post-closure activities.[25] The liners systems for these ponds would be ripped and buried within the footprint of the ponds, and up to approximately 18 inches of rock material would be used to cover these areas once final grading is completed. This rock material would minimize wind and/or water erosion off these sites.

2.3.12.3.3 Limited Grading of Tailings Surface

Given the inherent operating nature of a TSF, drainage within the actual tailings impoundment would travel on a gentle slope (e.g., approximately 1%) from the embankment back to the rear area of the impoundment (the area of the decant pond); however, the settled and dried tailings surface might not have that consistent slope across the impoundment areas but rather might form an undulating surface.

The final surface to the tailings would probably require some shaping to eliminate the potential for ponding and to provide positive stormwater drainage off the impoundment and into the permanent diversion channels. Construction equipment, such as scrapers and bulldozers would be used to reshape the tailings.

For the Ripsey Wash TSF, the tailings surface would be graded to achieve drainage to the east to the permanent diversion channel (constructed prior to operation of the TSF) that would connect to the unnamed wash on the east side of the facility. No surface runoff from the tailings would be allowed to drain to the permanent diversion channel until the surface of the tailings has been graded and covered by up to 18 inches of inert rock material at final reclamation. See **Figure 12, Final Reclamation Topography – Ripsey Wash TSF**.

[25] EPA recommends the the Final EIS state that the "reclaim and draindown ponds will be needed for a very long time after closure as the seepage trenches will be collecting seepage for decades or centuries."

2.3.12.3.4 Rock Material Cover

Asarco plans to place approximately up to 18 inches of rock material over the TSF once final grading is completed.[26] For the Ripsey Wash TSF, the final cover rock material would be granitic conglomerate[27] excavated from the borrow area within the tailings impoundment footprint. Prior to facility closure, Asarco would excavate and stockpile this rock material along the perimeter and within the footprint of the TSF; this rock material would then be available for final cover material. This rock material would minimize wind and/or water erosion of the tailings material.

Conventional construction equipment would be used for this activity. Front-end loaders would excavate and load off-highway trucks that would transport and deposit the rock material on the graded tailings surface. Bulldozers would spread the rock material to the desired final thickness.

Quarrying of rock from the federal mineral estate would require an approved material sale from the BLM as discussed in **Appendix C, Agency Responsibilities (Regulatory Framework)**.

2.3.12.3.5 Re-vegetation

Asarco does not plan for any active revegetation (such as seeding) for the Ripsey Wash TSF, as the current concept for the post-closure land use would be the use of the site for solar power generation. A photovoltaic array (solar panels) would be placed atop the tailings facility. See Section 8, Closure and Reclamation, in **Appendix I, Applicant Project Mitigation**. The rocked areas would not need to be revegetated, but would be allowed to naturally re-vegetate, so long as such revegetation did not interfere with the post-project land use.

2.3.12.3.6 Closure and Post-Closure Plans and Cost Estimate

Prior to permanent closing of the TSF, Asarco would notify the Arizona DEQ and submit a final closure plan to this agency within 90 days of the notification. This closure plan would include methods, as necessary, to control the discharge of pollutants from the TSF, including operation of any pumpback systems and long-term maintenance of any stormwater diversion structures or channels, as well as methods to secure the TSF and the schedule for implementation of the closure plan and post-closure plan. Post-closure maintenance of stormwater control structures and diversions around the TSFs may be required in perpetuity, and monitoring would be conducted until the approved closure performance standards have been achieved and deemed successful by the Arizona DEQ.

The statutory and regulatory authority of the Arizona DEQ and the Arizona State Mine Inspector, and BLM would require Asarco to execute financial assurance agreements as part of any plan and permit approvals from these agencies. These financial assurances would be intended to ensure that sufficient funds or a sufficient commitment would be available to close the TSF under the terms and conditions of plan and permit approvals issued by the previously mentioned agencies.

The statutory and regulatory authority of the Arizona DEQ requires that individual APPs also include a cost estimate for closure and post-closure of a TSF. The Arizona State Mine Inspector requires estimates

[26] The rock used to cover the graded TSF would be "pit-run" rock (from borrow pit), loosened as necessary by blasting, and loaded by conventional mining equipment (i.e., front end loader) into off-highway trucks. Most of the rock material would be one foot minus (meaning rock fragments from one foot in size – at the high end – to fragments much smaller, such as rock flakes or chips). Depending on the overall efficiencies of the blasting and the general physical characteristics of the rock itself, there would be some rock fragments larger than one foot in size.

[27] Assume loose (meaning blasted) rock density ranging from around 2,800 to 3,300 pounds per cubic yard.

and financial assurance for closure and post-closure under the Arizona Mined Land Reclamation Program. The estimated costs must be based upon the submitted and approved closure and post-closure plans or strategies, and these costs must be produced by an engineer, controller or accountant. The applicant must demonstrate to the satisfaction of the Arizona DEQ that sufficient monies are available to properly close the TSF and conduct post-closure monitoring and other measures called for in the closure strategy or plan to minimize the potential for discharges from the facility.

No tailings facility construction work or tailings storage operations can commence without approval of an APP by the Arizona DEQ and a financial assurance agreement between Asarco and the Arizona DEQ that ensures sufficient closure and post-closure funds would be available for the oversight and implementation of decommissioning and closure of the TSF. The APP statute and regulations require that the financial assurance be maintained throughout the life of the permit, and that the permittee periodically demonstrate that it still is being maintained. The statute also requires that the costs be periodically verified, including an adjustment, as appropriate, for inflation. A.R.S. § 49-243(N)(2)-(4) (as amended in 2014).

2.3.13 Tentative Construction, Operation and Closure Schedule

Asarco plans to begin construction work on a new TSF facility and the associated infrastructure upon completion of the NEPA process and receipt of required approvals and permits. See **Figure 13, Tentative Construction, Operation & Closure Schedule - Ripsey Wash TSF.**

2.4 HACKBERRY GULCH TSF ALTERNATIVE

The Hackberry Gulch TSF Alternative would be located south-southeast of the existing Elder Gulch TSF. See **Figure 14, Site Plan Layout - Hackberry Gulch TSF**. This alternative is identified as the "Hackberry Gulch No. 2" in **Appendix B, Alternative Screening and Clean Water Act Section 404(b)(1) Alternative Analysis**, and is considered one of two practicable alternatives for Hackberry Gulch within the context of the Clean Water Act (40 CFR Part 230). The alternative identified as Hackberry Gulch No. 1 in **Appendix B, Alternative Screening and Clean Water Act Section 404(b)(1) Alternative Analysis**, is not considered in this EIS analysis, because this alternative disturbed more waters of the U.S. and more surface acreage than the Hackberry Gulch No.2 alternative; thus, the Hackberry Gulch No. 2 alternative is carried forward for detailed evaluation in this EIS and is simply labeled as the Hackberry Gulch TSF in this EIS.

The Hackberry Gulch site is partially located on public lands and over federal mineral estate administered by the Bureau of Land Management (BLM). Asarco is currently pursuing a land exchange with the BLM such that most of the Hackberry Gulch TSF would be located on "private property" owned by Asarco. The BLM Ray Land Exchange is pending. The placement of tailings at this site is independent of the land exchange. If the Hackberry Gulch TSF alternative is selected, the BLM would need to authorize a modification to Asarco's Section 3809 mine plan of operations to incorporate the construction, operation and closure/reclamation of the Hackberry Gulch TSF, as well as the use of any rock material for the project that would be quarried from BLM-administered mineral estate. For additional discussion on the Ray Land Exchange, see Section 11.0, Asarco-BLM Ray Land Exchange, in Appendix G, Regional Activity.

Some of the Hackberry Gulch TSF construction, operational, and closure techniques and practices would be the same or similar to those currently used at the existing Elder Gulch TSF or proposed for use at the Ripsey Wash TSF. However, there are considerable differences.

The Hackberry Gulch TSF would cross seven drainages (versus two for the Ripsey Wash TSF), which would mean seven seepage trenches and seven reclaim ponds, plus associated infrastructure such as piping and pump systems.

Because it adjoins the existing Elder Gulch TSF, the Hackberry Gulch TSF would require construction of a major stormwater diversion channel to route upstream drainage between the two TSFs to the Gila River. Given the steep nature of the topography, this diversion channel would require a stilling basin to dissipate energy from water flow, and a new bridge or a large box culvert would be required on or under State Route 177 to allow highway traffic to be segregated from stormwater flow.

The bedrock and the geohydrology at the Hackberry Gulch TSF site is completely different than the Ripsey Wash TSF site, and this difference and the geologic conditions at the Hackberry Gulch TSF would present many challenges for seepage control.

Conversely, under the Hackberry Gulch TSF, segments of the Florence-Kelvin highway, Arizona Trail, and the SCIP 69 kV electric transmission line would not have to be relocated.

Where these techniques and practices differ, they are addressed in this section.

2.4.1 Tailings Operation and Placement Overview

The Hackberry Gulch TSF would be designed and operated as a closed circuit (zero surface water discharge) facility. See **Figure 15, Process Flow Sheet - Hackberry Gulch TSF**.

Asarco would continue to pump tailings material as slurry from the existing Ray Concentrator through an existing pipeline to an existing thickener facility, where the tailings will be "thickened". This process would remain unchanged from the existing operation.

A new pipeline would be needed to pump tailings from the existing thickener to the proposed Hackberry Gulch TSF. In addition, a new service/access road would be constructed around the base of the existing Elder Gulch TSF to provide routing for the new pipeline and to access the new pumping booster station and lined drain-down containment pond, as well as the seepage trenches, reclaim ponds and related facilities located in the seven drainages to be intersected and disturbed by the Hackberry Gulch TSF. From the new pumping booster station, tailings would be pumped up to the TSF and discharged from spigots that surround the perimeter of the tailings areas, and decant water that accumulates at the back of the Hackberry Gulch TSF would be pumped back to the Ray Concentrator via pipelines for reuse in the milling process.

Various aspects of Hackberry Gulch TSF Alternative are summarized in **Table 2-2, Summary of Hackberry Gulch TSF Alternative**.

2.4.2 Pre-Tailings Construction

Prior to tailings placement in a Hackberry Gulch TSF, Asarco would be required to obtain an APP for the Hackberry Gulch TSF and must comply with the Arizona BADCT for the facility. This compliance would include the following tasks and components:

- Construction of detention dams, diversion channels and piping infrastructure to route any up-gradient stormwater runoff from undisturbed areas above the Hackberry Gulch TSF around the facility. This work would involve the installation of piping and pumping stations, two stilling basins, energy dissipaters within the channels and at diversion channel outfall locations, and a bridge or large box culvert over or under State Route 177 to properly route this stormwater flow;

- Construction of an overpass bridge for State Route 177 between tailings impoundment on the northeast side of this highway and seepage trenches/reclaim ponds on southwest side of the highway (the bridge above could be used to segregate TSF-related traffic from highway traffic, but, if a box culvert is installed for stormwater flow, a bridge would still be necessary to segregate highway traffic from TSF construction, operational and closure traffic);
- Installation of box culverts under State Route 177 for passage of stormwater and reclaim watering at least four of the seven intercepted drainages at the Hackberry Gulch TSF. Multiple culverts would be required at each affected drainage to segregate stormwater from lined seepage ditches that connect the tailings embankment to the reclaim ponds;
- Construction of starter dams and seepage trenches in the seven drainages that dissect the Hackberry Gulch TSF and that are tributary to the Gila River;
- Provide continued access, in the form of about a half-mile long primitive road around the proposed TSF, from SR 177 to Kane Spring Canyon;
- Construction of lined ditches and reclaim ponds down-drainage of the seepage trenches and starter dams;
- Construction of a pumping booster station and lined drain-down tailings containment pond;
- Installation of monitoring wells down-drainage of the seepage trenches and reclaim ponds; Placement of new tailings and reclaim water pipelines from the existing thickener to the Hackberry Gulch TSF;
- Fencing of the TSF site; and,
- Establishment of compensatory mitigation sites and implementation of mitigation activities.

Specifics of these tasks are set forth in the following subsections.

Table 2-2, Summary of Hackberry Gulch TSF Alternative

BASIC CRITERIA FOR FULL CAPACITY		
Overall Facility Capacity (million tons)		746.2
Final Tailings Embankment Crest Elevation (feet above mean sea level)		2,535
Final Tailings Embankment Height (feet)		610
Number of Washes Needing Starter Dam Embankments		7
Rock Material Required for Starter Dam Embankments (million cubic yards)		8.2
Length of Tailings and Water Pipelines (feet/miles)		4,622/0.9
ESTIMATED SURFACE AREA DISTURBANCE AT FULLCAPACITY (ACRES)		
Tailings Storage Facility		1,996
Stormwater Diversion Infrastructure		116
Onsite TSF Infrastructure		96
Offsite TSF Infrastructure		28
Borrow Areas		54
Total		2,290
PROPOSED CONCEPTUAL MITIGATION AREA FOR WATERS OF US (ACRES)[1]		
Sites A, B, C and D (San Pedro River Valley)		N/A
Lower San Pedro Wildlife Area ILF Project		N/A
Total		N/A
LAND OWNERSHIP/ADMINISTRATION AT FULL CAPACITY	**ACRES**	**PERCENTAGE (%)**
Private	1,141	49.8%
State of Arizona	0	0.0%
Bureau of Land Management[2]	1,149	50.2%
Total	2,290	100%
WATERS OF THE UNITED STATES[3]	**ACRES**	
Area of Direct Waters of U.S. Disturbance at Full Capacity (Estimated)		71.50
Area of Indirect Disturbance to Waters of the U.S. at Full Capacity (Estimated)		19.80
Area of Jurisdictional Wetlands Disturbance at Full Capacity (Estimated)		0.62

Notes:

1. The compensatory mitigation that would be proposed for the Hackberry Gulch alternative would be similar to that currently proposed for the Ripsey Wash alternative. A Mitigation Ratio Setting Checklist (MRSC) assessment has not been conducted for this alternative, so exact acreages are not available.
2. The Hackberry Gulch site is partially located on public lands and over federal mineral estate administered by the Bureau of Land Management (BLM). Asarco is currently pursuing a land exchange with the BLM such that most of the Hackberry Gulch TSF would be located on “private property” owned by Asarco. The BLM Ray Land Exchange is pending. The placement of tailings at this site is independent of the land exchange. If the Hackberry Gulch TSF alternative is selected, the BLM would need to authorize a modification to Asarco’s Section 3809 mine plan of operations to incorporate the construction, operation and closure/reclamation of the Hackberry Gulch TSF, as well as the use of any rock material for the project that would be quarried from BLM-administered mineral estate. For additional discussion on the Ray Land Exchange, see Section 11.0, Asarco-BLM Ray Land Exchange, in Appendix G, Regional Activity.
3. A formal delineation of Waters of the U.S. was not performed for this alternative. The extent of Waters of the U.S. was estimated from a review of aerial photography of the alternative footprint and some limited fieldwork.

2.4.2.1 Detention Dams and Diversion Structures

As part of pre-tailings storage construction activities, Asarco would construct detention dams and diversion channels to divert stormwater runoff from the undisturbed watershed up-gradient of the proposed Hackberry Gulch TSF around the facility. This infrastructure would be similar to the measures and facilities described in Section 2.3.2.5, Detention Dams and Diversion Structures, and in **Appendix I, Applicant Project Mitigation**.

Asarco would install detention dams in the drainages up gradient of the ultimate footprint of the Hackberry Gulch TSF. See **Figure 14, Site Plan Layout - Hackberry Gulch TSF**.

The purpose of these detention dam structures would be to prevent up-drainage stormwater runoff from entering into the tailings impoundment area. These detention dam structures would be designed to handle flows from a 500-year, 24-hour storm event. In the unlikely event of a greater storm event, these detention dam structures would be installed with emergency spillways that would allow flow in excess of the design storm event to discharge into the tailings impoundment. Given smaller up gradient watershed areas, the up-gradient detention dams for the Hackberry Gulch TSF would be smaller than the Ripsey Wash TSF detention dam; however, the Hackberry Gulch TSF would require at least seven detention dam structures in drainages that are much steeper than Ripsey Wash. In addition, the Hackberry Gulch TSF up-gradient detention dams would require significant armoring given the potential peak flow rates and velocities for which they must be designed to contain.

Stormwater that is intercepted by these detention dam structures would be routed around the Hackberry Gulch TSF by pumping through a piping system and/or by routing through stormwater diversion channels for discharge into either Belgravia Wash on the northwest side of the Hackberry Gulch TSF or into an unnamed drainage on the southeast side of the TSF. Both of these drainages are tributary to the Gila River. See **Figure 14, Site Plan Layout - Hackberry Gulch TSF**.

The stormwater diversion channel would be approximately 22,000 feet (about 4.2 miles) in length and would be designed to handle flows from a 100-year, 24-hour storm event. In the unlikely event of a greater storm event, there would be several emergency spillways installed along the diversion channel that would allow overflow into the tailings impoundment. The location of the diversion channel is shown on **Figure 14, Site Plan Layout - Hackberry Gulch TSF**.

Flow intercepted by this diversion channel would be routed for discharge into Belgravia Wash, located on the northwest side of the proposed Hackberry Gulch TSF.

To reduce the potential for down-drainage erosion from released stormwater, Asarco would control the flow of water through its pumping from the detention dams up-drainage of the Hackberry Gulch TSF. Asarco would install energy dissipater facilities within the diversion channel above Belgravia Wash and at the outfall to the drainage in aforementioned unnamed drainage on the southeast side of the Hackberry Gulch TSF.

Stilling basins would be installed to dissipate energy from potentially high velocity flows in the diversion channels. One basin would be installed on the north side of State Route 177, and the second one would be installed at the end of Belgravia Wash prior to its confluence with the Gila River. As discussed above, flows in this diversion channel would either be routed under a new highway bridge that would need to be constructed for State Route 177 or through box culvert(s) that would need to be installed under State Route 177. Either scenario would require approval from the ADOT.

The stormwater diversion structures will require periodic maintenance to remove sediment and other debris. Because these stormwater diversion structures would reroute stormwater from existing waters of the U.S. upstream from the proposed TSF to waters of the U.S. downstream from the proposed TSF, the constructed stormwater channels provide a hydrologic connection and would be considered waters of the U.S. once they become functional. For this reason, the Corps would include maintenance activities within the list of activities allowed under the 404 permit.

2.4.2.2 State Route 177 Overpass Bridge

To promote long-term safety and to minimize the ingress and egress of traffic from TSF development and operations onto State Route 177, an overpass bridge for State Route 177 would be constructed to link TSF project activities on the northeast and southeast sides of State Route 177. This overpass would allow highway traffic to continue without interference from Asarco personnel and equipment as they access the planned four reclaim ponds and the monitoring/pumpback wells that would be located on the southwest side of State Route 177. See **Figure 14, Site Plan Layout - Hackberry Gulch TSF**.

This overpass bridge would be constructed as part of initial TSF construction and would be designed to meet ADOT standards. A typical view of this overpass bridge is shown on **Figure 16, Typical State Route 177 Overpass Bridge – Hackberry Gulch TSF**. Sufficient clearance and width would be required to allow Asarco equipment and vehicles to pass beneath the highway. There would also need to be adequate allowance for stormwater passage and the separate lined ditches for seepage water from the TSF to the lined, down-gradient reclaim pond.

During bridge construction, a temporary detour would be established to allow normal traffic to continue on State Route 177. This detour would require placement of a temporary culvert in the drainage for stormwater flow and a compacted and graded fill for the roadway. Signage and flag persons would be assigned to the project until the new overpass bridge is completed.

Any new bridge construction for State Route 177 must be approved by the ADOT.

2.4.2.3 Box Culverts beneath State Route 177

A series of box culverts would be placed under State Route 177 to allow segregated stormwater passage under State Route 177 and around the reclaim ponds. Separate lined ditches for seepage water and water that comes into contact with the tailings embankment would be constructed from the TSF to the lined reclaim ponds. These box culverts would be installed as part of initial TSF construction and would be designed to meet ADOT standards. The locations for these new culverts are shown on **Figure 17, Conceptual Box Culverts for State Route 177 – Hackberry Gulch TSF**.

Any box culvert installation beneath State Route 177 must be approved by the ADOT.

2.4.2.4 Tailings Starter Dam

As part of pre-tailings storage construction activities, Asarco would construct a large, elongated starter dam for the Hackberry Gulch TSF that would cross seven major drainages. This long starter dam would be required because the Hackberry Gulch TSF would be a “side-hill” facility (unlike the Ripsey Wash TSF which is essentially a “valley-fill” facility). The crest elevation of the starter dam would reach approximately 2,150 feet above mean sea level (amsl).

The starter dam embankment would serve as the base to retain tailings materials for the centerline embankment construction. Approximately 8.2 million cubic yards of material would be used to construct this starter dam. Rock material to be used to create the embankment would consist of both alluvium/colluvium material and Big Dome Formation conglomerate that would be removed up-drainage of the starter dam and from inside what would become the ultimate footprint of the Hackberry Gulch TSF.

It is anticipated that drilling and blasting would be required to aid in the removal of conglomerate, and a portable crusher plant would be utilized during starter dam construction activities to size and screen material for construction of associated facility infrastructure (e.g., bedding material for the liners used under the down-drainage centerline embankment, seepage ditches, and reclaim ponds).

Conventional construction equipment, such as front-end loaders, compactors, off-highway trucks, and bulldozers, would be used for starter dam construction. Due to the numerous washes that dissect the Hackberry Gulch TSF, multiple temporary haul roads would be needed within and external to, the footprint of the tailings impoundment for construction equipment and activity.

2.4.2.5 Seepage Trenches

Down-gradient of the starter dams, Asarco would install seepage trenches in each of the seven drainages that dissect the area of the proposed Hackberry Gulch TSF. See **Figure 14, Site Plan Layout - Hackberry Gulch TSF**.

The seepage trenches would be similar in design to those proposed for the Ripsey Wash TSF; however, the depth through the alluvial/colluvial material to reach the bedrock of the Big Dome formation is less that the depth to reach the Ruin granite bedrock at the Ripsey Wash TSF.

These trenches would be designed to intercept any water that might pass under the tailings facility through the alluvium material above the bedrock of the Big Dome formation. Pumps and piping would be installed in the seepage trenches to route any collected water to lined reclaim ponds that would be located down-gradient of the seepage trenches.

In addition, given the dip of the Big Dome Formation toward the Gila River and the expectation that tailings water would seep through the Big Dome Formation in fractures zones or in geologic paleo-channels hidden from surface observation beneath alluvium and colluvium material, Asarco may need to include additional seepage collection measures along the entire length of the starter embankment to attempt to capture this seepage. Flows from these additional seepage collection facilities would tie to the main embankment seepage collection trenches, where the seepage water would be pumped or otherwise routed to the reclaim ponds.

2.4.2.6 Reclaim Ponds

Asarco would install reclaim ponds in each of the seven affected washes down gradient of the seepage trenches. See **Figure 14, Site Plan Layout - Hackberry Gulch TSF**.

Given the juxtaposition of State Route 177 with the proposed toe on the northwest side of the Hackberry Gulch TSF, four of the reclaim ponds must be located on west side of State Route 177. These ponds, plus the associated access roads, box culverts, seepage trenches, water pipelines and channels, would be located with the ADOT right-of-way of State Route 177. The ADOT would need to approve these facilities.

Box culverts would be installed under State Route 177 to route seepage water to these four reclaim ponds. See Section 2.4.2.3, Box Culverts Beneath State Route 177. This construction would involve excavation through the highway to install the box culverts. The other three reclaim ponds could be located on the east side of State Route 177.

These seven reclaim ponds would be constructed with an engineered double-liner system, using synthetic liner material (80 mil HDPE or equivalent) and have leak detection systems incorporated into their design and operation. The area around these ponds would be fenced with an 8-foot high chain-link fence to thwart access by people and wildlife. Asarco would be able to pump water from the reclaim ponds to the Ray Concentrator (for reuse) or to the tailings impoundment (if necessary). The seepage trenches would be similar in design as the ones proposed for the Ripsey Wash TSF, and the design criteria for these reclaim ponds would the same as used for the Ripsey Wash TSF reclaim ponds. See **Figure 57, Ripsey Wash TSF Main Reclaim Pond – Plan View.**

2.4.2.7 Monitoring Wells

Asarco would also maintain or install monitoring wells down-gradient of the seven reclaim ponds. These wells would be used to monitor groundwater quality below the seepage trenches before, during and following operations. See **Figure 31, Groundwater Hydrology – Hackberry Gulch TSF**.

2.4.2.8 Pumping Booster Station and Tailings Drain-Down Pond

Asarco would construct a pumping booster station and electric switchgear facility on the northeast corner of the proposed Hackberry Gulch TSF. The existing Elder Gulch drain-down pond would be used in the event the Hackberry Gulch TSF tailings pipeline would require draining. See **Figure 14, Site Plan Layout - Hackberry Gulch TSF**.

From this location, the pumping booster station would pump tailings uphill to the Hackberry Gulch TSF. The drain-down pond should be sufficient to hold the volume of tailings potentially contained in the tailings pipeline from the Ray Concentrator to the Hackberry Gulch TSF.

The electric switchgear facility at this site would provide the electricity to operate the pumping booster station, as well as the various other pumps at the Hackberry Gulch TSF (e.g., seepage trench pumps, reclaim pond pumps, water pumps for the decant pond(s) that form at the rear at the tailings impoundment).

During construction, this site would also serve as a storage area for construction-related materials and supplies, such as storage area for construction-related materials and supplies, such as pipeline segments, culverts, liner material, fencing and pumps.

2.4.2.9 Tailings and Water Pipelines

Tailings would be pumped to the Hackberry Gulch TSF though a contained overland slurry pipeline that would parallel the return water pipeline that would send water from the tailings facility back to the Ray Concentrator. The proposed routing is shown on **Figure 14, Site Plan Layout - Hackberry Gulch TSF**.

The tailings pipeline would be installed from the existing thickener along the new access road in route to the Hackberry Gulch TSF. The return water pipeline would be placed adjacent to the tailings pipeline and would follow the same routing back to the existing thickener, where water would be routed through an existing pipeline to the existing Tank 34, which presently receives decant water from the operation of the Elder Gulch TSF.

Additional discussion about pipelines is set forth in Section 2.4.4, Tailings Delivery System.

2.4.3 Tailings Embankment Construction Methods

Construction of the Hackberry Gulch TSF would use the same two distinct methods of tailings embankment construction planned for Ripsey Wash TSF. These methods are centerline and upstream construction.

2.4.3.1 Centerline Construction

The centerline embankment construction techniques planned for a Hackberry Gulch TSF would be the same as proposed for the Ripsey Wash TSF. However, the estimated volume of the cycloned tailings would not meet the embankment construction volume requirements, so Asarco would require borrow material to supplement centerline construction at the Hackberry Gulch TSF site. It is estimated that the required additional borrow material would exceed 1.5 million cubic yards of rock per year, and it is assumed that borrow material would be quarried from the Big Dome formation at the Hackberry Gulch TSF site.

In addition, given the embankment height required to meet ongoing tailings volume requirements, there would be a delay in the transition from centerline to upstream tailings construction, which would delay concurrent reclamation work on the embankment outslopes. See Section 2.3.3.1, Centerline Construction and **Figure 9, Centerline Tailings Embankment Construction** in this EIS document, as well as Section 4.6.2.2 in **Appendix B, Alternative Screening and Clean Water Act Section 404(b)(1) Alternative Analysis**. When the centerline construction reaches an elevation of approximately 2,300 feet (amsl), Asarco would switch to an upstream method of tailings storage for the Hackberry Gulch TSF.

2.4.3.2 Upstream Construction

The method of upstream construction would be the same as currently used at the existing Elder Gulch TSF and as proposed for the Ripsey Wash TSF. See Section 2.3.3.2, Upstream Construction and **Figure 10, Upstream Tailings Embankment Construction**.

2.4.3.3 Quality Control and Quality Assurance

Quality control and quality assurance measures essentially be the same as those planned for the Ripsey Wash TSF. The TSF would be designed and constructed under the direction and seal of qualified Arizona registered Professional Engineer, which is a requirement of the APP. Foundation preparation, starter dam construction and detention dam construction would be completed under a quality control and quality assurance program administered by a third-party contractor and also under the direction of a quality Arizona registered Professional Engineer.

2.4.4 Tailings Delivery System

Tailings would be pumped though a contained slurry pipeline to the Hackberry Gulch TSF from a new pumping booster station, located on the northwest side of the TSF. The tailings slurry and water return pipelines would be HDPE and/or high-strength steel, with welded joints to ensure long-term operational integrity. The tailings and return-water pipelines would be placed on the surface or, where determined necessary for safety, buried either in the shoulder or beneath the driving surface of site access roads. This would be similar to those proposed for the Ripsey Wash TSF Alternative. See **Figure 7, Typical Utility Corridor & Roadway Sections – Ripsey Wash TSF.**

2.4.5 Tailings Facility Operation

The tailings facility would be designed and operated as a zero-surface water discharge facility. This would be mirror the operation as proposed for the Ripsey Wash TSF. See Section 2.3.5, Tailings Facility Operation.

2.4.6 Tailings Facility Support Facilities

The Hackberry Gulch TSF would require miscellaneous infrastructure to support operations. This would include site support and service roads, power supply for pumps, fencing and quarries or rock material borrow areas for concurrent reclamation and closure rock material. No new infrastructure such as offices, warehouse, change facility and septic system would be required for the Hackberry Gulch TSF given its proximity to similar facilities at the Ray Mine.

Fencing around the reclaim ponds and the drain-down pond would be an 8-foot high chain-link fence, while standard 4-strand barbed wire fencing would be installed around the TSF with keep-out signs posted.

2.4.6.1 Site Support and Service Roads

Asarco would construct a new access road to the Hackberry Gulch TSF near the toe of the existing Elder Gulch TSF. The tailings and return water delivery pipelines would parallel this new road.

Other roads would be required to access the up-gradient detention dams and diversion channels, as well as roads to be used to haul rock material for the starter dam embankment construction. In addition, access roads would be required on both the east and west side of State Route 177 to access the reclaim ponds and the monitoring and pump-back wells. A new overpass bridge would be constructed to link TSF operations on both sides of the highway to allow Asarco personnel and equipment to access facilities without having ingress/egress on the highway.

An access service road would be constructed and maintained along the top of the tailings embankment for the tailings delivery pipeline. Another access service road would be constructed and maintained around the upper perimeter of the tailings impoundment for the return water pipelines. As the TSF expands upward, Asarco would establish new perimeter access service roads. These perimeter access roads would typically be around 15 to 20 feet wide.

2.4.6.2 Power Supply and Distribution

Electric power would be needed for the tailings pumping booster station on the northwest side of the Hackberry Gulch TSF, the water pumps at the reclaim ponds below the tailings embankment, and at the decant water ponds in the TSF impoundment. Asarco would install electric switchgear at the pumping booster station and would construct distribution lines from this site to serve pumping facilities at the Hackberry Gulch TSF (e.g., the pumps at the detention ponds, the seepage trench pumps, the reclaim ponds down-gradient of the seepage trenches). The distribution line structures would be the same as discussed in Section 2.3.6.2, Power Supply and Distribution.

2.4.6.3 Rock Quarries

As part of concurrent reclamation, Asarco would place rock on the face of the Hackberry Gulch TSF embankment, starting after the centerline construction phase is completed, and followed periodically on the slopes created by upstream construction (after three lifts are completed). Because the Hackberry Gulch TSF would be a long and narrow, side-hill constructed facility, there is limited ability to excavate closure rock from within the TSF footprint. For concurrent and final reclamation, Asarco would use Big

Dome Formation conglomerate rock from borrow sources (or quarries) outside the footprint of the planned TSF. See **Figure 14, Site Plan Layout - Hackberry Gulch TSF**.

2.4.6.4 Project Lighting

Any project-related nighttime lighting would be minimal, mostly portable lighting plant(s) for specific project activities areas, with the light focused inward to reduce light trespass into adjacent areas. Most construction activities would be expected to occur during daylight hours. Only minimal mobile equipment will be needed during operations, and use of such equipment (primarily dozers) would be scheduled to occur during daylight hours. Portable light plants could be used at night for emergency maintenance or other work.

2.4.7 Water Use and Management

Water use and management for the Hackberry Gulch TSF would be the same as proposed for the Ripsey Wash TSF. See Section 2.3.7, Water Use and Management.

2.4.8 Stormwater Management

Upstream of the TSF, Asarco would construct elongated diversion channels, pipelines, and detention dams as described in Section 2.4.2.1, Detention Dams and Diversion Structures. These facilities would be similar to the Ripsey Wash TSF where water is routed or pumped around the TSF. As many as seven drainages are located up-gradient from the Hackberry Gulch TSF. These drainages are very steep (+ 25%) and would report runoff from storm events at right angles to the proposed main diversion channel. This would require that detention ponds be constructed at the base of the drainages to mitigate peak _ surface flows prior to entering the diversion channel. As many as seven detention ponds would be required to intercept and detain stormwater flows from the up-gradient drainages.

Due to the steepness of the area above the Hackberry Gulch TSF, construction of the main diversion channel and detention ponds would be difficult. The Hackberry Gulch TSF diversion channel would connect to the approved Elder Gulch TSF diversion. The approved diversion from its connection to the Elder Gulch TSF permanent diversion would be routed to Belgravia Wash and then to the Gila River. The Elder Gulch TSF diversion would need to be re-designed to accommodate the additional design flows associated with the Hackberry Gulch TSF diversion channel. This re-design would require approval from the Arizona DEQ and the Corps.

Stormwater not captured by the permanent diversion channels to be constructed on east side of the Hackberry Gulch TSF would be handled in a similar manner as that planned for the Ripsey Wash TSF. See Section 2.2.4.1, Detention Dams and Diversions.

Stormwater that contacts the TSF embankment or any associated disturbed areas would be routed to the down-gradient reclaim ponds. This captured stormwater would be comingled with TSF seepage water and recycled to the Ray Concentrator. No stormwater routed to the reclaim ponds would be discharged to the Gila River. Stormwater channels for the Hackberry Gulch TSF would be similar to those planned for the Ripsey Wash TSF site. See **Figure 55, Ripsey Wash TSF East Diversion and Contact Stormwater Channels – Typical Channels**.

Asarco would be required to secure permit coverage and maintain a stormwater pollution prevention plan (SWPPP) for the Hackberry Gulch TSF site from the Arizona DEQ. Any stormwater diversions within the ADOT right-of-way of State Route 177 would also require approval from the ADOT.

2.4.9 Work Force Requirements

The construction, operation and closure workforce requirements for the Hackberry Gulch TSF would be expected to be essentially be the same as estimated for the proposed Ripsey Wash TSF. See Section 2.3.9, Work Force Requirements.

2.4.10 Environmental Management and Mitigation

If the Hackberry Gulch TSF is implemented, Asarco would employ and maintain environmental management and mitigation measures which would be the same or similar to those discussed in Section 2.3.10, Environmental Management and Mitigation, and in **Appendix I, Applicant Project Mitigation**.

2.4.11 Environmental Monitoring

Asarco would implement environmental monitoring measures required by permits and approvals issued for the Hackberry Gulch TSF, most prominently, an APP issued by Arizona DEQ. As part of an APP, Asarco would conduct groundwater monitoring in Arizona DEQ-approved and mandated wells down-gradient of the TSF facilities to monitor groundwater conditions at this site during construction, operations and closure.

2.4.12 Hackberry Gulch TSF Closure and Reclamation

Asarco's closure and reclamation plan for the Hackberry Gulch TSF would be similar to the plans for the Ripsey Wash TSF set forth in Section 2.3.12, Ripsey Wash TSF Closure and Reclamation.

2.4.12.1 Hackberry Gulch TSF Concurrent Reclamation

The concurrent reclamation plans for the Hackberry Gulch TSF would be the same as the plans for the Ripsey Wash TSF. However, concurrent reclamation would commence later in the life of the TSF because centerline construction would occur for a longer period to achieve TSF capacity requirements. Once upstream tailings construction begins, Asarco would place approximately one foot of rock material on the down-drainage slope of the tailings. The final rock cover material used at the Hackberry Gulch TSF would be alluvium/colluvium material and/or Big Dome Formation conglomerate excavated from the quarries to the north and east of the tailings impoundment footprint.

2.4.12.2 Hackberry Gulch TSF Temporary Cessation

Temporary cessation of the Hackberry Gulch TSF is not planned, but circumstances beyond Asarco's control could require such action. If temporary cessation occurred for the Hackberry Gulch TSF, it would be handled as set forth in Section 2.3.12.2, Ripsey Gulch TSF Temporary Cessation.

2.4.12.3 Permanent Hackberry Gulch TSF Closure Plan

Permanent closure plans for the Hackberry Gulch TSF would be similar to the plans for the Ripsey Wash TSF, which are set forth in Section 2.3.12.3, Permanent Ripsey Wash TSF Closure Plan.

For the Hackberry Gulch TSF, permanent diversion channels would remain on the north and northwest side of the facility. These diversion structures would be installed as part of the original construction to route stormwater flows. Asarco (or their designated entity) would continue to maintain and operate the detention dams and stormwater pumping and piping system designed to route stormwater around the southeast side of the Hackberry Gulch TSF. These systems would be monitored for continued effective operation and would be maintained, as appropriate, using conventional equipment (i.e., dozers or loaders) by Asarco (or their designated entity) in perpetuity. See **Figure 18, Final Reclamation Topography – Hackberry Gulch TSF**.

The reclaim and draindown ponds would be removed as part of the post-closure activities. The liners systems for these ponds would be ripped and buried within the footprint of the ponds, and up to approximately 18 inches of rock material would be used to cover these areas once final grading is completed. This rock material would minimize wind and/or water erosion off these sites.

As part of permanent closure of the Hackberry Gulch TSF, the tailings surface would be graded to achieve drainage to the north to the permanent drainage channel (constructed prior to operation of the TSF) that connects to the Belgravia Wash. See **Figure 18, Final Reclamation Topography – Hackberry Gulch TSF**.

Asarco plans to place approximately up to 18 inches of rock material over the Hackberry Gulch TSF once final grading is completed. This rock material would minimize wind and/or water erosion of the tailings material. Final cover rock material for this action would be Big Dome Formation conglomerate excavated from the rock quarries to the north and east of the tailings impoundment footprint.

Quarrying of rock from the federal mineral estate would require an approved material sale from the BLM as discussed in **Appendix C, Agency Responsibilities (Regulatory Framework)**.

Asarco does not plan for any active revegetation plan (such as seeding) for the Hackberry Gulch TSF, as the current concept for the post-project land use would be solar power generation. A photovoltaic array (solar panels) would be placed atop the tailings facility. See Section 8, Closure and Reclamation, in **Appendix I, Applicant Project Mitigation**. The rocked areas would not need to be revegetated, but would be allowed to naturally re-vegetate, so long as such vegetation did not interfere with the post-project land use.

Hackberry Gulch permanent closure notice requirements, along with submittal of final closure and post-closure plans to the Arizona DEQ would follow the same procedures as addressed in Section 2.3.12.3.6, Closure and Post-Closure Plans and Cost Estimate.

2.4.13 Tentative Construction, Operation and Closure Schedule

Asarco would begin construction work on the Hackberry Gulch TSF and the associated infrastructure upon completion of the NEPA process and receipt of required approvals and permits. A tentative schedule is set forth in **Figure 19, Tentative Construction, Operation and Closure Schedule – Hackberry Gulch TSF**.

2.5 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED EVALUATION

The Corps considered a number of possible TSF alternatives, but many TSF alternatives were eliminated from consideration because they could not meet the purpose and need for the project, did not address important issues, or were impractical or unreasonable.

Based on the detailed assessment set forth in **Appendix B, Alternative Screening and Clean Water Act Section 404(b)(1) Alternative Analysis**, the Corps has eliminated the following TSF alternatives from detailed evaluation in the draft EIS:

- Tailings storage within the Ray Mine open pit;
- Underground tailings storage;
- Storage of Ray Concentrator tailings at multiple sites;

- Remote tailings storage (with off-site shipment and processing of ore material);
- Tailings storage in Devils Canyon;
- Tailings storage near community of Hayden;
- Tailings storage near Granite Mountain/Copper Butte;
- Tailings storage on the west side of the Ray Mine;
- Dewatered tailings storage ("dry-stack" tailings storage); and,
- Various alternatives at the Ripsey Wash and Hackberry Gulch sites.

These alternatives dropped out during the alternatives screening process for various reasons or did not pass the practicability test consistent with the Clean Water Act Section 404(b)(1) guidelines that the Corps requires for 404 permits.

3.0 ENVIRONMENTAL ANALYSIS

This EIS chapter describes both the existing conditions of and the environmental consequences to the area and resources, based on the alternatives described in Chapter 2.

For ease of presentation and comparison, the analysis discussions are separated into individual resource areas and issues as identified in Chapter 1, such as air quality, soils, geology, surface water, groundwater, etc. Resource specialists compiled existing and available environmental baseline and background information, communicated with government agencies, interacted with technical specialists working for Asarco, visited the proposed tailings alternative sites, and conducted on-the-ground reconnaissance surveys to corroborate information.

Although the anticipated environmental effects of alternatives were analyzed for each resource discipline, impact analyses emphasized those disciplines that relate to the key issues and concerns identified in Chapter 1. Some effects are expressed in quantitative terms, others in qualitative terms.

Impact descriptions are divided into the following categories under each resource area:

- Effects of the no action alternative;
- Effects of the Ripsey Wash TSF alternative (Asarco's proposed action); and,
- Effects of the Hackberry Gulch TSF alternative.

Impacts are evaluated for the alternatives and are defined as follows:

- Direct impacts - Those effects that occur at the same time and in the same general location as the activity causing the effects. For example, TSF construction and operation would have a direct impact on soils and vegetation within the footprint of the facility.
- Indirect impacts - Those effects that occur at a different time or different location than the activities to which the effects are related. For example, traffic from non-work trips made by construction workers that might reside in the region during TSF construction.
- Cumulative impacts - Those effects that result from the incremental impact of the action alternatives when added to other past, present and reasonably foreseeable actions. For example, TSF construction would add to the visual effects created by the existing Ray Mine, the area's highways and roads, the Copper Basin Railroad, electric utility lines, and the structures and housing in nearby residential communities.

Potential impacts can also be described as adverse or beneficial. Adverse means a negative change from desired conditions or appearance, while beneficial would be a positive change in the condition or appearance of a resource.

Impacts can be described in terms of their potential duration.

- Short-term impacts - Those effects that occur for a limited time. For example, the noise from the equipment used to construct starter dams and seepage trenches would be short-term.
- Long-term impacts – Those effects that last beyond operation and closure of the TSF and may not regain their pre-construction conditions for a long period of time. For example, impacts to vegetation would be long-term, as the natural revegetation processes would be slow and may never return the disturbed site to pre-construction conditions.
- Permanent impacts – Those effects where resources would be lost or those effects that would change the site forever. For example, the final topography created by tailings placement would create a permanent change to the landscape of the area.

The intensity of the impact is based on how the proposed project would affect each resource. The levels used to generally describe impact intensity are:

- **Negligible** – An impact at the lowest levels of detection with barely measurable consequences.
- **Minor** – An impact with little loss of resource integrity and with changes that are small, localized, and of little consequence.
- **Moderate** – An impact that would alter the resource but not modify overall resource integrity, or an impact that could be mitigated successfully in the short term.
- **Major** – An impact that would be substantial, highly noticeable, and long term.

Mitigation and monitoring measures that would be required for project permitting or that are voluntarily included as part of the proposed activities are considered in the discussion of effects. By design, the Ripsey Wash and Hackberry Gulch TSF alternatives have built-in mitigation in the form of standard or special stipulations that would be added under various permit approvals. Effective mitigation avoids, minimizes, rectifies, reduces or compensates for potential impacts. After mitigation is applied, any unavoidable adverse effects to each resource area are addressed.

3.1 AIR QUALITY/CLIMATE

***Identify project-related air quality impacts**. Areas of concern include: (1) compliance with federal, state and Pinal County air quality standards; (2) the effects on air quality from fugitive dust and gaseous emissions; (3) visibility effects to any Class I areas in the vicinity of project; and, (4) possible climate change impacts related to the project.*

3.1.1 Affected Environment

3.1.1.1 Regional Climate

The area around the Ripsey Wash and Hackberry Gulch TSF sites has a subtropical desert climate and is described as follows.

The monsoon season, characterized by high temperatures, high winds and rainfall, begins in early July and lasts until mid-September. Moisture-bearing winds from the Gulf of Mexico sweep into the region from the southeast. April, May, and June are the months with the greatest number of clear days and least precipitation. Winter months when the air is calmest are subject to temperature inversions.

Climate data for the area is provided in **Table 3-1, Temperature, Precipitation and Pan Evaporation**. Average daily temperatures in this region range from an average maximum low of around 31°F in January to an average maximum high approaching 99°F in July. Temperatures in the winter can dip below freezing (32°F), while summertime temperatures often climb above 100°F.

Table 3-1, Temperature, Precipitation and Pan Evaporation

Parameter	Source	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Average Max. Temperature (ºF)	1	60.9	64.1	68.5	76.4	86.1	95.6	97.7	95.4	92.3	82.5	69.8	61.6	79.2
	2	64.2	68.2	73.3	81.0	89.5	99.2	99.3	96.7	93.6	84.4	72.6	64.1	82.2
Average Min. Temperature (ºF)	1	43.2	45.4	48.2	54.4	62.7	72.0	75.7	74.2	71.2	62.0	51.1	44.0	58.7
	2	31.2	33.8	38.5	42.9	49.9	59.8	69.5	67.8	60.6	47.6	36.6	30.8	47.4
Average Daily Temperature (ºF)	1	52.0	54.7	58.4	65.4	74.4	83.8	86.7	84.8	81.7	72.3	60.5	52.8	69.0
	2	47.7	50.9	55.9	61.9	69.7	79.5	84.4	82.2	77.1	65.9	54.6	47.5	64.8
Average Total Precipitation (in)	1	2.00	1.98	2.02	0.80	0.34	0.26	1.91	2.80	1.48	1.18	1.41	2.11	18.30
	2	1.36	1.06	0.98	0.46	0.32	0.30	2.04	2.69	1.31	1.03	0.86	1.38	13.79
	3	1.72	1.56	1.29	0.43	0.24	0.17	1.40	2.12	0.94	0.80	0.97	1.58	13.21
	4	1.59	1.35	1.58	0.53	0.27	0.19	1.42	2.19	1.35	1.22	1.10	1.63	14.41
Average Pan Evaporation (in)	5	3.12	4.03	7.00	9.98	12.4	13.9	11.19	9.84	9.56	7.51	4.31	2.94	95.78

Source:

1. Superior, AZ, 1920-2006—Source: www.wrcc.dri.edu/cgi-bin/cliMAIN.pl/az8348
2. Winkelman 6 S, AZ, 1893-1980—Source: www.wrcc.dri.edu/cgi-bin/cliMAIN.pl/az9420
3. Kearny, AZ, 1984-2013—Source: www.wrcc.dri.edu/cgi-bin/cliMAIN.pl/az4590
4. Winkelman 6 S, AZ, 1893-1980—Source: www.wrcc.dri.edu/cgi-bin/cliMAIN.pl/az9420
5. Winkelman 6 S, AZ, 1942-1980—Source: www.wrcc.dri.edu/htmlfiles/westevap.final.html

Annual average precipitation is typically around 13 to 14 inches, with most precipitation occurring during July and August, which are part of the aforementioned monsoon season. The summertime rain can be sporadic and locally intense, often associated with passing thunderstorms.

The Ripsey Wash and Hackberry Gulch TSF sites are located in complex terrain where winds are strongly affected by local topography, the time of day, and the season. Winds typically flow down the Gila River valley during the cooler night-time hours, but the general wind direction generally follows a north-south pattern during the day. High wind and gusts can occur during the monsoon season, associated with approaching thunderstorms, and these high winds and gusts, especially over desert areas, can lead to substantial fugitive dust.

The average annual pan evaporation rate measured at the town of Winkelman, which is approximately 14 miles southeast of the Ray Mine, was nearly 96 inches for the period of record 1942 to 1980. See **Table 3-1, Temperature, Precipitation and Pan Evaporation**.

3.1.1.2 Climate Change

The climate of the Southwest[28] is changing. According to the US Environmental Protection Agency (EPA) (www.epa.gov/climatechange/impacts-adaptation/southwest.html), the average annual temperature over the last century has increased about 1.5°F, and the average annual temperature is projected to climb an additional 2.5°F to 8°F by the end of this century (USGCRP, 2009). Warming in the Southwest is projected to be greatest in the summer.

3.1.1.3 Air Quality Regulatory Framework

The Federal Clean Air Act (CAA), as amended in 1990, established ambient air quality standards and the regulatory agencies to enforce these standards. EPA has developed National Ambient Air Quality Standards (NAAQS) for six principal pollutants to protect the public health (primary standards), as well as, to protect the public welfare (secondary standards) from any known or anticipated adverse effects. These six principal pollutants are generally referred to as "criteria" air pollutants. The list of "criteria" air pollutants includes ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter (less than ten microns in aerodynamic diameter (PM_{10}) and particulate matter less than 2.5 micron in aerodynamic diameter ($PM_{2.5}$), and lead (Pb).

Table 3-2, National, State of Arizona and Pinal County Ambient Air Quality Standards, summarizes the regulatory standards for these pollutants as established by EPA. Also provided within the table are the ambient air quality standards established by the State of Arizona and Pinal County. Under the provisions of the CAA, states and counties that have been delegated regulatory authority by EPA can adopt the EPA National Ambient Air Quality Standards (NAAQS) or develop their own ambient air standards. Enforcement of the NAAQS for projects and activities in Pinal County is the responsibility of Pinal County, to which Arizona DEQ has delegated such authority.

The CAA requires the designated NAAQS enforcement agencies to specify air quality control regions (or portions thereof) as either "attainment/maintenance" or "non-attainment" with respect to each criteria pollutant, based on whether the air quality region complies with the established NAAQS, and to prepare and maintain air pollution control plans with strategies to improve air quality. These plans are referred to as State Implementation Plans (SIPs).

EPA has promulgated, and the State of Arizona has adopted, by reference, Prevention of Significant Deterioration (PSD) regulations to prevent deterioration of air quality in areas that are in attainment with the NAAQS. These regulations establish maximum allowable increases in concentration of a pollutant (increment) above a baseline concentration in an area for both Class I (national parks and other pristine areas) and Class II (most of the analysis region) areas. The nearest Class I area to the Ripsey Wash and Hackberry Gulch TSF sites is the Superstition Wilderness Area located approximately 12 miles north of the Ray Mine. See **Figure 50, Regional Activities**.

[28] The Southwest is bordered by the Pacific Ocean to the west, the Rocky Mountains to the east, and Mexico to the south. It includes the state of Arizona.

Table 3-2, National, State of Arizona and Pinal County Ambient Air Quality Standards

Pollutant	Averaging Time	National		Arizona	Counties
		Primary	Secondary	Primary (unless noted)	Primary (unless noted)
Ozone (O_3)	1 hour	None	None	na	None
	8 hour	0.075 ppm	Same as Primary	0.075 ppm	0.08 ppm
Carbon Monoxide (CO)	1 hour	35 ppm	None	35 ppm	35 ppm
	8 hour	9 ppm	None	9 ppm	9 ppm
Nitrogen Dioxide (NO_2)	1 hour	0.1 ppm	None	0.1 ppm	None
	Annual	0.053 ppm	Same as Primary	0.053 ppm	0.053 ppm
Sulfur Dioxide (SO_2)	1 hour	75 ppb	None	75 ppb	None
	3 hour	None	0.5 ppm	0.5 ppm(*)	0.5 ppm(*)
	24 hour	None	None	0.14 ppm	0.14 ppm
	Annual	None	None	0.03 ppm	0.03 ppm
Particulate Matter (as PM_{10})	24 hour	150 µg/m^3	Same as Primary	150 µg/m^3	150 µg/m^3
	Annual	None	None	None	50 µg/m^3
Particulate Matter (as $PM_{2.5}$)	24 hour	35 µg/m^3	Same as Primary	35 µg/m^3	None
	3-year average of weighted annual mean concentration	None	None	None	15 µg/m^3
	Annual	12 µg/m^3	15 µg/m^3	15 µg/m^3	None
	3-year average of 98th percentile of 24-hour concentrations	None	None	None	65 µg/m^3
Lead	Quarterly Arithmetic Mean	None	None	None	1.5 µg/m^3
Lead	Rolling 3-Month Average	0.15 µg/m^3	Same as Primary	0.15 µg/m^3	None

Notes:
1. Arizona Administrative Code, Title 18, Chapter 2, Article 2.
2. Pinal County Code of Regulations, Chapter 2, Article 1.

* Secondary Standard.

The Ray Mine is located in an area that is non-attainment for PM_{10}. Therefore, increment consumption and PSD review would not apply. The facility is subject to non-attainment new source review.

3.1.1.4 Regional Air Quality

The existing air quality conditions for Ripsey Wash and Hackberry Gulch TSF sites are primarily the result of meteorological conditions and existing emission sources in the region. The TSF sites are located in an area where ambient air quality slightly exceeds the PM_{10} standard; this area, referred to as the "Hayden, AZ" area, is currently classified as "non-attainment" for PM_{10} emissions.

PM_{10} monitoring was conducted in the town of Riverside between 2003 and 2010. The maximum 24-hour PM_{10} value recorded was 100.7ug/m^3 in 2003. This value exceeded the standard for 2003; however, the EPA revoked the annual average (50 ug/m^3) standard in 2006. In the same year, the EPA retained the 24-hour PM_{10} NAAQS of 150 ug/m^3. The highest PM_{10} value from this monitoring was 51 μg/m^3 (24-hr average), which is a value that is below the Pinal County AAQS for PM_{10}.(PCACD 2015)

3.1.1.5 Air Permitting Requirements for Industrial Sources

Industrial sources in Pinal County must secure a Construction Permit from the Pinal County Air Quality Control District prior to commencing construction of any source that has the potential to emit regulated air pollution. See **Appendix C, Agency Responsibilities (Regulatory Framework)**. Asarco currently has a Title V Operating Permit from Pinal County to operate the Ray Mine; this permit includes the operation of the existing tailings facility (Elder Gulch TSF). The Title V Operating Permit has been updated to include the proposed Ripsey Wash TSF. This permit is on file at the Ray Mine and with Pinal County. If the Hackberry Gulch TSF is selected as the preferred alternative, Asarco would be required to update their Title V Operating Permit to include this TSF site.

3.1.2 Environmental Consequences

3.1.2.1 Effects of the No Action Alternative

Under the no action alternative, neither the Ripsey Wash nor the Hackberry Gulch TSF would be constructed. Air quality of the region would remain under the influence of industrial sources (Hayden smelter) and existing land use trends, which include ongoing mining and processing at the Ray Mine, traffic in local communities and on SR 177, the Florence-Kelvin highway and other roads, and continued recreational use, such as OHV traffic, hunting, camping, hiking and sightseeing. This part of Arizona is currently classified as the Hayden area for non-attainment for the PM_{10} standard under the NAAQS and, with current and anticipated land use trends, would probably retain its designation.

Mining and ore processing at the Ray Mine would continue under the no action. When the Elder Gulch TSF reaches its full capacity, which is expected to be in the year 2023 or 2024, the Ray Concentrator would close, resulting in a reduction in production and employment at the Ray Mine. The closure of the Ray Concentrator would not mean a closure of the Ray Mine, as oxide ore would continue to be mined and processed, and sulfide ore, albeit at a reduced rate, would continue to be mined and shipped by rail to the Hayden Concentrator. The reduction of sulfide ore production at the Ray Mine would principally be the result of the processing limitations of the Hayden Concentrator. This production decrease would probably trigger a corresponding drop in Ray Mine-generated fugitive dust and gaseous emissions, which would be further reduced after the reclamation of the Elder Gulch TSF site.

3.1.2.2 Effects of the Ripsey Wash TSF Alternative

Project activities of the Ripsey Wash TSF would create fugitive dust and gaseous emissions, both from vehicular traffic and use of heavy equipment for construction, operational and closure activities. With the exceptions of a portable crushing facility that may be required for initial construction and localized windblown emissions from disturbed areas during windy days, emissions would primarily be from mobile sources rather than those classified as stationary sources.

3.1.2.2.1 Ripsey Wash TSF Fugitive and Gaseous Emissions

Fugitive dust emissions are represented for PM_{10} and $PM_{2.5}$. These emissions would result from heavy equipment (primarily during initial construction and final closure work) and site support vehicles (such as pick-up trucks, vans, and supply trucks).

The estimated annual PM_{10} and $PM_{2.5}$ fugitive dust emissions for the Ripsey Wash TSF are set forth in **Table 3-3, Estimated Fugitive Dust Emissions for Ripsey Wash TSF**(1).

For comparison purposes, the Arizona DEQ projected that the PM_{10} emissions for Pinal County in 2007 to be approximately 51,000 tons per year, with the principal source for these emissions from traffic on county roads. EPA's National Emissions Inventory (NEI) estimated that the 2005 $PM_{2.5}$ emissions for Pinal County to be 4,210 tons per year, with open burning and agriculture crop tilling and livestock dust being the principal sources for these emissions. These Pinal County PM_{10} and $PM_{2.5}$ values are found in the March 2010 report entitled *Arizona Air Quality Designations Technical Support Document – Boundary Recommendations for the Pinal County 24-hour PM_{10} - Nonattainment Area*. The estimated maximum annual Ripsey Wash TSF PM_{10} and $PM_{2.5}$ emissions would occur during TSF construction, but these emissions would be less than 0.2% of those reported for Pinal County.

Table 3-3, Estimated Fugitive Dust Emissions for Ripsey Wash TSF(1)

	PM_{10} (tons per year)	$PM_{2.5}$ (tons per year)
Initial Site Preparation and Construction		
Year 1	85	7
Year 2	94	7
Year 3	92	8
Annual Average	90	7
Centerline Tailings Operations		
Annual Average	12	2
Upstream Tailings Operations		
Annual Average	16	2
Closure and Reclamation(2)		
Annual Average	9	2

Notes:

1. Source: ERM Consultants (2015).
2. There will be minimal Asarco activity at the site following closure and reclamation (mainly periodic maintenance of pumps for water diversion infrastructure). Any air emissions during this activity would be negligible.

The highest annual fugitive dust emissions (specifically PM_{10} and $PM_{2.5}$ in this case) and gaseous emissions would be generated during early site development and construction activities, which are estimated to take approximately three years and would utilize equipment such as drills, front end loaders, trucks, bulldozers, excavators, and motor graders. The early site development and construction work would involve road building, detention dam and diversion ditch installation work, construction of tailings starter dams, and installation of seepage trenches and seepage collection ponds. The contractor hired for the 3-year TSF construction would be required to comply with Pinal County Air Quality permit requirements as a condition of the contract (personal communication with Duane Yantorno of Asarco, Asarco 2017). See **Appendix I, Applicant Project Mitigation**.

Tailings disposal operations would generate PM_{10} and $PM_{2.5}$ fugitive dust and gaseous emissions, although at a reduced level from those during early site development and construction work. These emissions would be generated from traffic on unpaved roads, from ongoing centerline and upstream tailings dam construction using equipment such as bulldozers and excavators (long-reach backhoes), and from wind erosion on the tailings surface. The re-aligned segment of the Florence-Kelvin highway would be paved (it is currently un-paved). The paved surface would serve to reduce dust emissions in the immediate project area, although blowing dust during extreme wind storms could reduce visibility on the relocated Florence-Kelvin highway that would be loaded adjacent to the tailings facility.

During operations, a tackifier would be applied to the dry tailings surface, especially on the outer slope of the tailings embankment, as necessary, to control fugitive dust. The Ray Mine has employees with Method 9 certification to read dust (opacity) in compliance with Pinal County air quality permit requirements. See **Appendix I, Applicant Project Mitigation**. The observers would be able to determine if opacity exceeds 20% at the project boundaries.

Fugitive dust would be controlled during operations by periodically watering the roads used by operations personnel and equipment; this measure is a requirement of the Pinal County Title V Operating Permit for the Ray Mine.

Final closure and reclamation activities would generate PM_{10} and $PM_{2.5}$ fugitive dust emissions from final grading work and placement of rock material over the tailings impoundment, using equipment such as front-end loaders, trucks, bulldozers, excavators, and motor graders. There would also be windblown fugitive dust from the closed tailings impoundment, which would lessen once approximately 18 inches of rock is placed on the tailings surface. At closure, only the top surface of the TSF would require a rock cover since the out-slopes of the TSF would be covered with rock as part of concurrent reclamation activities. There could be as many as 8 to 10 years of inactivity between TSF closure and final reclamation (grading and cover) as the tailings are allowed to settle in the TSF. During this time, a tackifier would be sprayed, as necessary, on the tailings surface to control fugitive dust generation.Gaseous emissions would result from the fuel combustion in the on-site support vehicles and heavy equipment used to support TSF construction, operations and closure. Gaseous emissions include oxides of nitrogen (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), volatile organic compounds (VOC), carbon dioxide (CO_2), methane (CH_4) and nitrogen oxide (NO_2). The later three greenhouse gases are considered contributors to climate change.. All gaseous emissions would result from mobile equipment; there are no gaseous emissions associated with stationary sources for this TSF project.

The estimated annual gaseous emissions for the Ripsey Wash TSF are set forth in **Table 3-4, Estimated Gaseous Emissions for Ripsey Wash TSF**.

Table 3-4, Estimated Gaseous Emissions for Ripsey Wash TSF

	NO_X (tons/yr)	VOC (tons/yr)	CO (tons/yr)	SO_2 (tons/yr)	CO_2 (tons/yr)	CH_4 (tons/yr)	N_2O (tons/yr)
Initial Site Preparation and Construction							
Year 1	4	2.5	35	<1	2607	<0.1	<0.1
Year 2	27	4	47	<1	3605	<0.2	<0.1
Year 3	23	3	35	<1	2721	<0.1	<0.1
Annual Average	18	3	39	<1	2978	<0.1	<0.1
Centerline Tailings Operations							
Annual Average	<1	<1	3	<1	168	<0.1	<0.1
Upstream Tailings Operations							
Annual Average	<1	<1	3	<1	168	<0.1	<0.1
Closure and Reclamation							
Shaping Work	2	1	19	<0.1	1378	<0.1	<0.1
Rock Placement	1	<1	9	<0.1	745	<0.1	<0.1

Source: ERM Consultants (2015).

EPA's NEI estimated that the 2005 NO_X, SO_2 and VOC emissions for Pinal County were 12,545,757 and 9,217 tons per year, respectfully. The primary sources for these emissions are:

- NO_X – vehicle combustion of diesel and gasoline;
- SO_2 – diesel combustion; and,
- VOC – vehicle combustion of gasoline.

The estimated annual Ripsey Wash TSF gaseous emissions for initial site preparation and construction as compared to Pinal County emissions would be approximately 0.1% for NO_X, 0.001% for SO_2, and 0.03% for VOC.

The release of hazardous air pollutants (HAPs), such as benzene, toluene and formaldehyde, would be negligible for the Ripsey Wash TSF (ERM 2015). See **Table 3-5, Estimated Annual Hazardous Air Pollutants (HAPS) for Ripsey Wash TSF**.

HAPs would result from the combustion of fuel in on-site vehicles and heavy equipment, as well as from windblown dust. EPA defines HAPS as toxic pollutants or air toxics, which could cause cancer or other health issues. Major sources are defined as those having the potential to emit 10 tons per year of any individual HAP or 25 tons per year of any combination of HAPs. If HAP emissions qualify as major sources, a project can be subject to Maximum Available Control Technology (MACT), but the proposed TSF construction, operational and closure/reclamation activities would not qualify as major sources and therefore would not be subject to MACT standards. HAP emissions from the Ripsey Wash TSF would not create any adverse effects on regional air quality, nor should they cause any short-term or long-term health problems.

Table 3-5, Estimated Annual Hazardous Air Pollutants (HAPS) for Ripsey Wash TSF

Pollutant	Initial Site Preparation and Construction (tons per year)	Operations (Centerline Construction) (tons per year)	Operations (Upstream Construction) (tons per year)	Closure and Reclamation (tons per year)
Benzene	<0.01	<0.02	<0.04	<0.01
Toluene	<0.01	<0.01	<0.02	<0.01
Xylenes	<0.01	<0.01	<0.01	<0.01
Formaldehyde	<0.01	<0.02	<0.05	<0.01
Acetaldehyde	<0.01	<0.01	<0.03	<0.01
Acrolein	0	0	0	0
Naphtha	0	0	0	0
Source: ERM Consultants (2015).				

Ozone formation due to atmosphere transformation of NO_x and SO_2 from the Ripsey Wash TSF alternative would be negligible. NO_x and SO_2 can react in the atmosphere with ammonia to form "secondary particles" that form a haze that can impact visibility at locations distant from the emission source. However, the TSF emissions that could cause regional haze are low and would dissipate within a short distance from the TSF site given the relatively rugged terrain that surrounds both sites. Therefore, the NO_x and SO_2 emissions from the TSF action alternatives would have a low or negligible effect on regional haze or regional visibility. As a result, no adverse effects are expected on any Class I areas from the construction of the Ripsey Wash TSF.

No adverse effects are expected to air quality from the relocation of the Arizona Trail or the work in the areas proposed for waters of the U.S. mitigation. See **Appendix J, Compensatory Mitigation**.

Some stretches of the relocated segment of the Arizona Trail could probably be constructed or cleared using manual labor, but there would be the short-term need for small equipment such as a skid-steer or compact track loader and a compact excavator to assist in constructing switchbacks or moving large rocks for the relocated trail. This equipment could create some minor fugitive and gaseous emissions, but these emissions would be short-term, localized and negligible.

As explained in **Appendix J, Compensatory Mitigation**, Mitigation Sites A, B, C, D and E would require active management to enhance the riparian habitat values; this action would primarily involve fencing and seeding. A mechanical posthole digger mounted on an off-road vehicle would be used for fence construction. A farm tractor with a cultivator and a drill seed would be used for seeding, although hand seeding could also be used. For Mitigation Site E, and where needed on other proposed mitigation sites to remove tamarisk, a bulldozer (Caterpillar D6 or equivalent) would probably be used to clear and grub burned trees and stumps. The equipment used for riparian habitat improvements would produce some minor fugitive and gaseous emissions, but these emissions would be short-term, localized and negligible.

3.1.2.2.2 Indirect Impacts Associated with Ripsey Wash TSF Alternative

Indirect air quality impacts associated with the Ripsey Wash TSF alternative would be short-term and negligible, primarily associated with vehicular traffic of contractor employees and their families that might reside in the region during the three-year construction phase of the project. It is expected that such traffic would be scattered throughout surrounding communities, such as Kearny, Hayden, Superior, Gold Canyon and Apache Junction, and would not be concentrated in the vicinity of the proposed TSF sites.

3.1.2.2.3 Climate Change Associated with Ripsey Wash TSF Alternative

According to the EPA (http://www.epa.gov/climatechange/basics), human activities over the past century have released large amounts of greenhouse gases (CO_2, CH_4 and N_2O) into the atmosphere. EPA purports that the majority of greenhouse gases come from use of fossil fuels, deforestation, industrial processes and agricultural practices.

Greenhouse gases act like a blanket around Earth, trapping energy in the atmosphere and causing the planet to warm. This phenomenon is called the greenhouse effect and is natural and necessary to support life on Earth. However, the buildup of greenhouse gases can change the Earth's climate and result in effects to the Earth's ecosystems.

Vehicles and construction equipment used for TSF activities would use diesel and gasoline, and the combustion of these fuels would create greenhouse gases. The greenhouse gas emissions generated from the Ripsey Wash TSF would have a negligible effect on climate change. It could be surmised that, even though the emissions would be "barely measurable" from a global standpoint, they would contribute incrementally to climate change. However, because construction is scheduled to be completed in three years, it is doubtful these emissions would have any significant effect on global climate change.

CO_2 is the greenhouse gas commonly presumed to be the foremost contributor to climate change. Construction, operational and closure activities at the TSF would contribute CO_2 and other greenhouse gases to the atmosphere, with the highest annual CO_2 emissions occurring during year 2 of construction. Projected greenhouse gas emissions would incrementally contribute to the estimated worldwide production; however, as shown on the emission tables (above and below), even using maximum emission values, the estimated emissions are minimal. See **Table 3-6, Projected Ripsey Wash TSF CO2 Emissions Comparison**.

Table 3-6, Projected Ripsey Wash TSF CO_2 Emissions Comparison

Source Category	Estimated Annual CO_2 Emissions (tons per year)	Percentage of Worldwide Total
Ripsey Wash TSF[(1)]	3,605	0.00001%
State of Arizona[(2)]	102,230,000	0.29%
United States[(3)]	7,572,000,000	21.3%
Total Worldwide[(4)]	35,483,000,000	100.0%

Notes:

1. Source: ERM Consultants 2015. CO_2 =Carbon Dioxide. For comparison purposes, the table shows the highest annual estimated CO_2 emission for the Ripsey Wash TSF, reported for Year 2 of the project. Other years of the project would have lesser CO_2 emissions.
2. From State Energy CO_2 Emissions, US Environmental Protection Agency, for Arizona 2015. www.epa.gov/statelocalclimate/documents/pdf/CO2FFC_2015.pdf. For consistency, this volume of emissions was converted to tons from the metric tonnes that were reported in the reference.
3. EPA 2012 estimate. www.epa.gov/cimatechange/ghgemissions/usinventoryreport.html. For consistency, this volume of emissions was converted to tons from the metric tonnes that were reported in the reference.
4. Reported 2015 CO_2 emissions from PBL Netherlands Environmental Assessment Agency, Trends in Global CO_2 Emissions 2016 Report. For consistency, this volume of emissions was converted to tons from the metric tonnes that were reported in the reference.

3.1.2.2.4 Clean Air Act Conformity Screening for Ripsey Wash TSF

Under 40 CFR Part 93, Subpart B, general conformity regulations are provided that apply to a federal action (in this case, issuance of a 404 permit) in a nonattainment or maintenance area if the total of direct and indirect emissions of the relevant criteria pollutants and precursor pollutants caused by the federal action equal or exceed certain *de minimis* rates, thus requiring the federal agency to make a determination of general conformity. For a general conformity determination for a Clean Water Act permitting action, the Corps uses a very narrow scope of analysis that only includes those emissions associated with areas of fill within waters of the U.S to determine CAA conformity and excludes associated activities occurring in uplands. Waters of the U.S. that would be impacted by this alternative comprise about 5% of the total disturbance area.

For this project, this only issue involving general conformity pertains to PM10, as this is the only criteria pollutant for which a nonattainment area, in this case a moderate level of nonattainment, has been established for the project area. For PM10 emissions at this location, the *de minimis* threshold is 100 tons per year. **Table 3-3, Estimated Fugitive Dust Emissions for Ripsey Wash TSF[(1)]**, shows a worst-case annual PM10 emissions level of 94 tons per year (Year 2) for the entire project, which is below the *de minimis* threshold. However, this amount applies to all construction activity occurring during that year. For purposes of general conformity screening, only a fraction of that amount would be associated with activities within jurisdictional waters. Thus, the Ripsey Wash TSF Alternative is presumed to conform to the CAA.

3.1.2.3 Effects of the Hackberry Gulch TSF Alternative

The air quality effects of the Hackberry Gulch TSF would essentially be the same as described in Section 3.1.2.2, Effects of the Ripsey Wash TSF Alternative.

3.1.2.3.1 Hackberry Gulch TSF Fugitive and Gaseous Emissions

The estimated annual PM_{10} and $PM_{2.5}$ fugitive dust emissions for the Hackberry Gulch TSF are set forth in **Table 3-7, Estimated Fugitive Dust Emissions for Hackberry Gulch TSF**[(1)].

Fugitive dust emissions are represented for PM_{10} and $PM_{2.5}$. These emissions would result from heavy equipment (primarily during initial construction and final closure work) and site support vehicles (such as pick-up trucks, vans, and supply trucks).

Similar to the Ripsey Wash TSF Alternative, the highest annual fugitive dust emissions (specifically PM_{10} and $PM_{2.5}$ in this case) and gaseous emissions would be generated during early site development and construction activities, which are estimated to take approximately three years for the Hackberry Gulch TSF Alternative and would utilize equipment such as drills, front end loaders, trucks, bulldozers, excavators, and motor graders. The early site development and construction work would involve road building, detention dam and diversion ditch installation work, construction of tailings starter dams, and installation of seepage trenches and seepage collection ponds.

Tailings disposal operations would generate PM_{10} and $PM_{2.5}$ fugitive dust and gaseous emissions, although at a reduced level from those during early site development and construction work. These emissions would be generated from traffic on unpaved roads, from ongoing centerline and upstream tailings dam construction using equipment such as bulldozers and excavators (long-reach backhoes), and from wind erosion on the tailings surface.

Table 3-7, Estimated Fugitive Dust Emissions for Hackberry Gulch TSF(1)

	PM_{10} (tons per year)	$PM_{2.5}$ (tons per year)
Initial Site Preparation and Construction		
Year 1	18	2
Year 2	98	8
Year 3	76	7
Annual Average	64	6
Centerline Tailings Operations		
Annual Average	20	3
Upstream Tailings Operations		
Annual Average	18	3
Closure and Reclamation(2)		
Annual Average	11	2

Notes:
1. Source: ERM Consultants (2015).
2. There will be minimal Asarco activity at the site following closure and reclamation (mainly periodic maintenance of pumps for water diversion infrastructure). Any air emissions during this activity would be negligible.

Fugitive dust would be controlled during operations by periodically watering the roads used by operations personnel and equipment; this would be a requirement of the Pinal County Title V Operating Permit for the Hackberry Gulch TSF.There could be as many as 8 to 10 years of inactivity between TSF closure and reclamation (grading and cover) as the tailings settle in the TSF. During this time, a tackifier would be sprayed, as necessary, on the tailings surface to control fugitive dust generation.

Final reclamation activities (grading and cover) would generate PM_{10} and $PM_{2.5}$ fugitive dust emissions from final grading work and placement of rock material over the tailings impoundment, using equipment such as front-end loaders, trucks, scrapers, bulldozers, excavators, and motor graders. There would also be windblown fugitive dust from the closed tailings impoundment. The top of the graded tailings surface would be covered with approximately 18 inches of rock, which would greatly lessen fugitive dust generation from the reclaimed tailings surface. At closure, only the top of the tailings would require a rock cover since the out-slopes of the TSF would have been previously covered during concurrent reclamation.

Although the Florence-Kelvin highway, the SCIP 69 kV electric transmission line and Arizona Trail would not require relocation under this alternative, the PM_{10} and $PM_{2.5}$ for Year 2 of the Hackberry Gulch TSF construction would be higher than the Year 2 emissions generated for the Ripsey Wash TSF. These elevated emissions would result because of a higher volume of rock material needed to construct the required Hackberry Gulch TSF starter dam and the greater number of seepage trenches and reclaim ponds to be installed.

Given the proximity of the Hackberry Gulch TSF to State Route 177 and the communities of Kelvin and Riverside, fugitive dust emissions (particularly on windy days during site construction work) could create short-term adverse effects to travelers on this highway and residents in these communities.

The estimated annual gaseous emissions for the Hackberry Gulch TSF are set forth in **Table 3-8, Estimated Gaseous Emissions for Hackberry Gulch TSF**[1].

Table 3-8, Estimated Gaseous Emissions for Hackberry Gulch TSF[1]

	NO_X (tons/yr)	VOC (tons/yr)	CO (tons/yr)	SO_2 (tons/yr)	CO_2 (tons/yr)	CH_4 (tons/yr)	N_2O (tons/yr)
Initial Site Preparation and Construction							
Year 1	1	<0.1	9	<0.1	817	<0.1	<0.1
Year 2	35	5	47	<0.1	2815	<0.1	<0.1
Year 3	18	3	27	<0.1	2186	<0.1	<0.1
Annual Average	18	3	28	<0.1	1939	<0.1	<0.1
Centerline Tailings Operations							
Annual Average	0.3	0.1	2	4	183	<0.1	<0.1
Upstream Tailings Operations							
Annual Average	0.3	0.1	2	4	182	<0.1	<0.1
Closure and Reclamation							
Shaping Work	2	<0.1	14	<0.1	2535	<0.1	<0.1
Rock Placement	2	1	19	<0.1	1370	<0.1	<0.1
Source: ERM Consultants (2015).							

EPA's NEI estimated that the 2005 Pinal County emissions were 12,545 tons per year for NO_X, 757 tons per year for SO_2, and 9,217 tons per year for volatile organic compounds (VOC). The primary sources for these emissions are:

- NO_X – vehicle combustion of diesel and gasoline;
- SO_2 – diesel combustion; and,
- VOC – vehicle combustion of gasoline.

The estimated average annual Hackberry Gulch TSF gaseous emissions for initial site preparation and construction when compared to Pinal County 2005 emissions would be approximately 0.1% for NO_X, 0.02% for SO_2, and 0.03% for VOC.

The release of HAPs, such as benzene, toluene and formaldehyde, would be negligible for the Hackberry Gulch TSF alternative (ERM 2015) and would not cause any short-term or long-term health problems. See **Table 3-9, Estimated Annual Hazardous Air Pollutants (HAPS) for Hackberry Gulch TSF**.

Table 3-9, Estimated Annual Hazardous Air Pollutants (HAPS) for Hackberry Gulch TSF

Pollutant	Initial Site Preparation and Construction (tons per year)	Operations (Centerline Construction) (tons per year)	Operations (Upstream Construction) (tons per year)	Closure and Reclamation (tons per year)
Benzene	<0.04	<0.02	<0.04	<0.05
Toluene	<0.01	<0.01	<0.02	<0.02
Xylenes	<0.01	<0.02	<0.01	<0.02
Formaldehyde	<0.012	<0.02	<0.06	<0.07
Acetaldehyde	<0.01	<0.01	<0.04	<0.04
Acrolein	0	0	0	0
Naphtha	0	0	0	0
Source: ERM Consultants (2015).				

Ozone formation due to atmosphere transformation of NO_x and SO_2 from either TSF action alternative would be negligible. NO_x and SO_2 can react in the atmosphere with ammonia to form "secondary particles" that form a haze that can impact visibility at locations distant from the emission source. However, the TSF emissions that cause regional haze are low and would dissipate within a short distance from the TSF sites given the relatively rugged terrain that surrounds both sites. Therefore, the NO_x and SO_2 emissions from the TSF action alternatives would have a low or negligible effect on regional haze or regional visibility; therefore, it is expected that the construction and operation of the Hackberry Gulch TSF would have no adverse effect on any Class I area.

No adverse effects are expected to air quality as a result of the work in the areas proposed for waters of the U.S. mitigation. As explained in **Appendix J, Compensatory Mitigation**, the proposed four mitigation sites would require active management to enhance the riparian habitat values; this action would primarily involve fencing and seeding. A mechanical posthole digger mounted on an off-road vehicle would be used for fence construction, and a farm tractor with a cultivator and a drill seed would be used for seeding, although hand seeding could also be used. For Mitigation Site E, and where needed on other mitigation sites for tamarisk removal, a bulldozer (Caterpillar D6 or equivalent) would probably be used to clear and grub burned trees and stumps. The equipment used for riparian habitat improvements would produce some minor fugitive and gaseous emissions, but these emissions would be short-term, localized and negligible

3.1.2.3.2 Indirect Impacts Associated with Hackberry Gulch TSF Alternative

Indirect air quality impacts associated with the Hackberry Gulch TSF Alternative would be similar to those associated with the Ripsey Wash TSF Alternative. See Section 3.1.2.2.2, Indirect Impacts Associated with Ripsey Wash TSF Alternative. Indirect air quality impacts would be short-term and negligible, primarily associated with vehicular traffic of contractor employees who would reside in the region for the initial site preparation and construction phase of the project. It is expected that such traffic would be scattered throughout surrounding communities, such as Kearny, Hayden, Superior, Gold Canyon and Apache Junction, and would not be concentrated in the vicinity of the proposed TSF sites.

3.1.2.3.3 Climate Change Associated with Hackberry Gulch TSF Alternative

The discussion about climate change as related to the Hackberry Gulch TSF would be similar to the discussion associated with the Ripsey Wash TSF Alternative. See Section 3.1.2.2.3, Climate Change Associated with the Ripsey Wash TSF Alternative. Also see **Table 3-10, Projected Hackberry Gulch TSF CO2 Emissions Comparison**.

Table 3-10, Projected Hackberry Gulch TSF CO_2 Emissions Comparison

Source Category	Estimated Annual CO_2 Emissions (tons per year)	Percentage of Worldwide Total
Hackberry Gulch TSF[(1)]	2,815	0.00001%
State of Arizona[(2)]	102,230,000	0.29%
United States[(3)]	7,572,000,000	21.3%
Total Worldwide[(4)]	35,483,000,000	100.0%

Notes:

1. Source: ERM Consultants 2015. CO_2=Carbon Dioxide. For comparison purposes, the table shows the highest annual estimated CO_2 emission for the Hackberry Gulch Wash TSF, reported for Year 2 of the project. Other years of the project would have lesser annual CO2 emissions.
2. From State Energy CO_2 Emissions, US Environmental Protection Agency, for Arizona 2012. 5www.epa.gov/statelocalclimate/documents/pdf/CO2FFC_2015.pdf. For consistency, this volume of emissions was converted to tons from the metric tonnes that were reported in the reference.
3. EPA 2015 estimate. www.epa.gov/cimatechange/ghgemissions/usinventoryreport.html. For consistency, this volume of emissions was converted to tons from the metric tonnes that were reported in the reference.
4. Reported 2015 CO2 emissions from PBL Netherlands Environmental Assessment Agency, Trends in Global CO2 Emissions 2013 Report. For consistency, this volume of emissions was converted to tons from the metric tonnes that were reported in the reference.

3.1.2.3.4 Clean Air Act Conformity Screening for Hackberry Gulch TSF

As discussed in Section 3.1.2.2.4, Clean Air Act Conformity Screening for the Ripsey Wash TSF, a general conformity screening was also conducted for the Hackberry Gulch TSF Alternative. Waters of the U.S. that would be impacted by this alternative comprise about 4% of the total disturbance area. Again, for this alternative, the only issue involving general conformity pertains to PM10, as this is the only criteria pollutant for which a nonattainment area, in this case a moderate level of nonattainment, has been established for the project area. For PM10 emissions at this location, the *de minimis* threshold is 100 tons per year. **Table 3-7, Estimated Fugitive Dust Emissions for Hackberry Gulch TSF[(1)],** shows a worst-case annual PM10 emissions level of 98 tons per year (Year 2) for the entire project, which is below the *de minimis* threshold. However, this amount applies to all construction activity occurring during that year. For purposes of general conformity screening, only a fraction of that amount would be associated with activities within jurisdictional waters. Thus, the Hackberry Gulch TSF Alternative is presumed to conform to the CAA.

3.2 SOILS

Identify site soil resources and adequacy for reclamation. *Areas of concern include: (1) the availability of soils for reclamation; and (2) the potential of increased soil erosion and sedimentation from construction and operational activities.*

3.2.1 Affected Environment

The soil data and interpretations used to describe the existing edaphic conditions of the proposed Ripsey Wash and Hackberry Gulch TSF sites were primarily obtained from the document entitled *Soil Survey of Eastern Pinal and Southern Gila Counties, Arizona* (McGuire 2009).[29] Additional information regarding soil chemical characteristics, erosion susceptibility, and soil suitability ratings were obtained as adjunct information associated with this survey (Wilson, 2014a and 2014b).

Table 3-11, Pertinent Soil Baseline Characteristics, provides information about dominant soil mapping units that are greater than 10 acres in size within either or both of the proposed disturbed TSF sites. Map units less than 10 acres in size were considered to be too limited to significantly impact the conclusions with respect to the soil discussion. The distribution of soils is shown on **Figure 21, Soils Map**.

[29] This document is available at www.websoilsurvey.sc.egov.usda.gov/App/Homepage.html. The Natural Resource Conservation Service (NRCS) was denied access by private landowners to approximately 550 acres of the Hackberry Gulch TSF site. Therefore, no soil mapping was completed across this acreage (Map Unit 28).

Table 3-11, Pertinent Soil Baseline Characteristics

FAN TERRACES (MIXED FAN ALLUVIAL PARENT MATERIAL)						
	Map Unit 9: Bucklebar – Hayhook complex, 1 to 10% slopes		**Map Unit 27: Delnort – Nahda complex, 3 to 20% slopes**		**Map Unit 92: Stagecoach – Delnorte complex, 5 to 45% slopes**	
Unit Component (% of unit)	Bucklebar (45)	Hayhook (35)	Delnort (50)	Nahda (40)	Stagecoach (55)	Delnorte (35)
Soil Depth (inches)	60	60	13 (petrocalcic horizon)	24 (petrocalcic horizon)	60	13 (petrocalcic horizon)
Soil Texture Range	sl-scl-cl	sl	vgrsl	vgrcl-vgrc	xcosl-xgrsl	vgrsl-vcosl
Drainage Class	well	well	somewhat excessive	well	somewhat excessive	well
Available Water Capacity (AWC)	very high	moderate	very low	low	very low	very low
Runoff Class	medium	very low	high	medium	medium	very high
pH Range	6.6-6.8	6.6-7.6-8.2	8.0-8.2+	7.0-7.6+	7.6-8.0	7.8-8.2+
Wind/Water Erosion Hazard	m-h/m	included	l-m/l	included	not susceptible/l	included
Soil Productivity (lbs. per acre· air dry)	538	included	500	included	368	included
Ecological Site Name, p. z. = precipitation zone	Loamy Upland, 10-13” p. z.	Sandy Loam Upland, 10-13” p. z.	Limy Upland, 10-13” p. z.	Clay Loam Upland, 10-13” p. z.	Limy Sloped, 10-13” p. z.	Limy Slopes, 10-13” p. z.
Source of Topsoil / Limitation(s) / Comments	good/moderate clay content @ 9”	good/pH @ 28”	poor/coarse fragments, pH	poor/coarse fragments	poor/coarse fragments, slope	poor/coarse fragments, pH

Table 3-11, Pertinent Soil Baseline Characteristics (continued)

FAN TERRACES (MIXED FAN ALLUVIAL PARENT MATERIAL)				
	Map Unit 96: Topawa very gravelly loam, 2 to 20% slopes	**Map Unit 48: Gran-Rock Outcrop-Pantano complex, 20 to 60% slopes**		
Unit Component (% of unit)	Topawa (80)	Gran (65)	Rock outcrop (20)	Pantano (15)
Soil Depth (inches)	60	14 (weathered granite)	Rock outcrop consists of barren rock as ledges and near vertical cliffs of granite as well as soils less than 4.0 inches to bedrock.	15 (weathered granite)
Soil Texture Range	xgrsc-xgrsl	vgrsl-vgrc		vgrsl-xgrsl
Drainage Class	well	well		Well
Available Water Capacity (AWC)	low	very low		very low
Runoff Class	high	very high		very high
pH Range	6.6-8.0	6.4-6.6		7.6-7.8
Wind/Water Erosion Hazard	l-m/l	l-m/l		Included
Soil Productivity (lbs. per acre· air dry)	500	378		included
Ecological Site Name, p. z. = precipitation zone	Loamy Upland, 10-13” p. z.	Shallow Hills, 10-13” p. z.		Shallow Hills, 10-13” p. z.
Source of Topsoil / Limitation(s) / Comments	poor/coarse fragments	poor/clay content, slope		poor/slope, coarse fragments

Table 3-11, Pertinent Soil Baseline Characteristics (continued)

FLOODPLAINS (MIXED STREAM ALLUVIUM)		
	Map Unit 78: Queencreek soils and Riverwash, 0 – 5% slopes	
Unit Component (% of unit)	Queencreek (variable)	Riverwash
Soil Depth (inches)	60.0	River wash consists of very deep, excessively drained, stratified sands, gravels, and cobbles. Unstable, subject to flooding and does not support vegetation due to constant scouring and shifting conditions.
Soil Texture Range	xgrsi-vgrs	
Drainage Class	excessive	
Available Water Capacity (AWC)	very low	
Runoff Class	negligible	
pH Range	7.6-7.8	
Wind/Water Erosion Hazard	not susceptible/l	
Soil Productivity (lbs. per acre· air dry)	0	
Ecological Site Name, p. z. = precipitation zone	Sandy Wash 10-13” p. z.	
Source of Topsoil / Limitation(s) / Comments	poor/texture, coarse fragments	

Table 3-11, Pertinent Soil Baseline Characteristics (continued)

HILLS AND MOUNTAINS (SLOPE ALLUVIUM AND/OR GRANITIC OR LIMESTONE RESIDUUM)							
	Map Unit 15: Cellar – Anklam – Rock outcrop complex, 20 to 70% slopes			**Map Unit 55: Holguin-Rock outcrop Complex, 15 to 60% slopes**	**Map Unit 40: Fig family – Topock complex, 5 to 50% slopes**		
Unit Component (% of unit)	Cellar (45)	Anklam (30)	Rock outcrop (20)	Holguin (50)	Rock outcrop (35)	Fig family (55)	Toprock (35)
Soil Depth (inches)	11 (bedrock)	14 (weathered granite)	Rock outcrops consists of barren rock occurring as ledges and nearly vertical cliffs of limestone bedrock as well as soils less than 4.0 inches to bedrock.	15 (limestone bedrock)	Rock outcrop consists of barren rock that occurs as ledges and nearly vertical cliffs of limestone bedrock as well as soils less than 4.0 inches to bedrock.	16 (weathered granite)	24 (weathered granite)
Soil Texture Range	vgrsl	grsl-grscl		vgrl-vcocl		grsl-vgrsl	grsl-sc-grsc
Drainage Class	somewhat excessive	well		well		well	well
Available Water Capacity (AWC)	very low	very low		very low		very low	very low
Runoff Class	very high	very high		very high		very high	very high
pH Range	6.8-7.6	6.4-7.2		7.8		6.6-6.8	6.2
Wind/Water Erosion Hazard	l-m/l	included		not susceptible/l		l-m/l	included
Soil Productivity (lbs. per acre· air dry)	513	included		382		650	included
Ecological Site Name, p. z. = precipitation zone	Shallow Hills, 10-13" p. z.	Shallow Hills, 10-13" p. z.		Limestone Hills, 12-16" p. z.		Shallow Hills, 10-13" p. z.	Shallow Hills, 10-13" p. z.
Source of Topsoil / Limitation(s) / Comments	poor/coarse fragments, depth	poor/coarse fragments, slope		poor/coarse fragments, depth		poor/slope, coarse fragments, depth	poor/clay content, slope

Table 3-11, Pertinent Soil Baseline Characteristics (continued)

HILLS AND MOUNTAINS (SLOPE ALLUVIUM AND/OR GRANITIC OR LIMESTONE RESIDUUM)		
Map Unit 17: Cellar – Rock outcrop complex, 2 to 20% slopes		
Unit component (% of unit)	Cellar (60)	Rock outcrop (30)
Soil Depth (inches)	6 (granite bedrock)	Rock outcrop consists of barren rock that occurs as outcroppings and boulder piles of granite and where the depth of soil is less than 4.0 inches to bedrock.
Soil Texture Range	vgrsl	
Drainage Class	somewhat excessive	
Available Water Capacity (AWC)	very low	
Runoff Class	very high	
pH Range	6.8-7.6	
Wind/Water Erosion Hazard	l-m/l	
Soil Productivity (lbs. per acre· air dry)	513	
Ecological Site Name, p. z. = precipitation zone	Granitic Hills 10-13 p.z.	
Source of Topsoil / Limitation(s) / Comments	Poor/coarse fragments, depth	

Notes:

1. Soil characteristics and interpretations are included in this table for soil map units within the proposed disturbed areas and for soil map units that are greater than 10 acres in size within the expected disturbed areas.
2. vgrs = very gravelly sand, sl = sandy loam, grsl = gravelly sandy loam, vgrsl = very gravelly sandy loam, xgrsl = extremely gravelly sandy loam, vcosl = very cobbly sandy loam, xcosl = extremely cobbly sandy loam, vgrl = very gravelly loam, scl = sandy clay loam, grscl = gravelly sandy clay loam, cl = clay loam, vgrcl = very gravelly clay loam, vcocl = very cobbly clay loam, sc = sandy clay, grsc = gravelly sandy clay, vgrc = very gravelly clay, xgrsc = extremely gravelly sandy clay, xgrc = extremely gravelly clay
3. l = low, m = moderate, h = high
4. Soil chemical and physical date taken from: 1.) McGuire C.E., W. A. Sveltlik, Jr. and C. A. Prink. 2009. Soil Survey of Eastern Pinal and Southern Gila Counties, Arizona. NRCS. www.nrcs.usda.gov. 357 pp. + appendices and maps. 2.) Wilson, r. Personal Communication. State Resources Inventory Coordinator. Natural Resources Conservation Service. April 4, 2014. 3.) Wilson, R. Personal Communication. State Resources Inventory Coordinator. Natural Resources Conservation Service. April 17, 2014.
5. The NCRS was denied access to Map Unit 28 at the Hackberry Gulch TSF site. There are approximately 550 acres of Map Unit 28 at the Hackberry Gulch Alternative site. No information on this mapping unit available.

3.2.1.1 General Soil Characteristics

Soil characteristics vary according to the location at which they are developing. Three general areas are considered:

- Fan terraces;
- Hills and mountains; and,
- Floodplains.

3.2.1.1.1 Soils Overlying Fan Terraces

These soils are developing in mixed fan alluvial parent materials on slopes typically ranging from 1 to 20 percent, though slopes up to 45 percent can occur and are present in comparatively moderate acreages on both the Ripsey Wash and Hackberry Gulch TSF. Soil depths range from 60+ inches to bedrock and from 13 to 24 inches to a cemented (petrocalcic) horizon. Rock fragments (gravels, cobbles, and/or stones) typically overlie 80 to 95 percent of the soil surface. Soil textures are highly variable ranging from sandy loams to very gravelly clays to extremely cobbly sandy loams with a higher percentage of profile rock fragments most common. These soils are typically well to somewhat excessively drained, have very low to moderate available water capacities, and medium to very high runoff potentials with no flooding hazard. Soil pH values range from 6.2 to 8.2+. The productivity of these soils ranges from 368 to 538 air-dry lb./acre and includes all vegetation whether or not palatable to livestock.

3.2.1.1.2 Soils Overlying Hills and Mountains

Soils overlying hill and mountain features are developing in slope alluvium and residuum geologic materials on slopes ranging from 5 to 70 percent, with steeper slopes most common. These are the most common and dominant soils at both the Ripsey Wash and Hackberry TSF sites. They are typically 11 to 16 inches deep over weathered granite bedrock. The soil surface is overlain with 60 to 80 percent rock fragments. Soil textures range from very gravelly sandy loams to extremely gravelly sandy loams to sandy clays. Rock outcrops make up a notable percentage of the majority of the units mapped. Well drained soils with very low available water capacities and very high runoff potentials are the norm. Soil pH values range from 6.2 to 7.8. The productivity of these soils ranges from 378 to 650 air-dry lb./acre.

With a minor exception of the area immediately adjacent to the Gila River, the entire proposed realignment of the Arizona Trail lies within Map Unit 40.

3.2.1.1.3 Soils Overlying Floodplains

Floodplain soils have been mapped at both the Ripsey Wash and Hackberry Gulch TSF sites. These soils are developing in mixed stream alluvium at 0 to 5 percent slopes and are typically 60+ inches deep. Rock fragments typically cover up to 85 percent of the surface. Soil profile textures range from extremely gravelly sandy loams to very gravelly sands resulting in a very low available water capacity and excessive drainage characteristics. The flooding hazard is frequent and brief from July through September. The profile pH ranges from 7.6 to 7.8. The U.S. Natural Resource Conservation Service (NRCS) does not recognize the map unit delineated across these floodplains as having a reportable productivity value.

The soils of all map units overlying the Ripsey Wash and Hackberry Gulch TSF sites are non-saline (1.0 mmhos/cm) and non-sodic (Sodium Adsorption Ratio = 0.0).

3.2.1.2 Reclamation Suitability of Soils

The suitability for topsoil is rated as "poor" for the majority of the soils of the map units overlying the Ripsey Wash and Hackberry Gulch TSF sites. Floodplain soils are considered to be a poor source of topsoil due to texture and coarse fragment surface cover and profile content. Soils of hills and mountains are typically of poor quality due to surficial and profile coarse fragment content as well as a shallow depth to bedrock or weathered granite. Soils of the fan terraces are also typically rated as a poor source of topsoil due to the presence of coarse fragments with the exception of Map Unit 9 at the Ripsey Wash TSF site. Map Unit 9 soils are rated as "good" having a low coarse fragment content, gentle slopes and moderate profile textures.

3.2.1.3 Erosion Hazards of Soils

In terms of the wind erosion potential of in-place soils, the soil map units overlying the alternatives have been classed in Wind Erodibility Groups (WEG) 3, 5, 6 and 8. Map Unit 9 has a "moderate" to "high" susceptibility rating (WEG 3). WEG 5 and 6 can be considered to have "low" to "moderate" wind erosion potentials based on their profile textures and clay content. Map Units 15, 27, 40, 48 and 96 fall into this group. WEG 8 includes soils that are not susceptible to wind erosion due to rock fragments occurring across the soil surface. Map Units 55, 78 and 92 are classed as WEG 8 soils.

Soil susceptibility to sheet and rill erosion by water is based on the "K-factor for whole soil" as determined by soil texture, organic matter, soil structure, and saturated hydraulic conductivity. K-factors range from 0.02 to 0.69. With all other factors (i.e. slope angle and length, climate, conservation practices, etc.) being equal, the higher the K-factor the greater susceptibility to erosion. K-factors of whole soil for the map units overlying the Ripsey Wash and Hackberry Gulch TSF sites range from 0.05 to 0.24. All but one map unit have calculated K-factors of 0.15 or less resulting in a "low" susceptibility. Map Unit 9 has a K-factor of 0.24 with a "low" to "moderate" susceptibility to sheet and rill erosion.

3.2.2 Environmental Consequences

3.2.2.1 Effects of the No Action Alternative

Under the no action alternative, neither the Ripsey Wash nor the Hackberry Gulch TSF would be constructed. The soil overlying these sites would continue to develop and support the existing vegetation communities and land uses at present soil productivity levels. Barring any foreseeable future developments or changes in grazing policies, future soil impacts would parallel historic impacts.

3.2.2.2 Effects of the Ripsey Wash TSF Alternative

The Ripsey Wash TSF construction and operation would directly impact 2,636 acres of soils in the area of disturbance. See **Table 2-1, Summary of Ripsey Wash TSF Alternative**. The area impact on each soil type is shown on **Figure 21, Soils Map**. Site soils would be buried by tailings and from the construction of various TSF support facilities, such as diversion structures, seepage trenches, and reclaim ponds. As a result, the productivity of these soils, in terms of vegetation production, would be permanently lost.

Soil materials beneath the starter embankments of the Rispey Wash TSF would be removed during the construction phase. The soil material could be used for construction, if deemed geotechnically suitable. If not deemed suitable, the soil material would be hauled and deposited within the TSF footprint. Soils up-gradient of the starter dam would be covered with tailings as tailings are incrementally deposited within the TSF. Any soil material exposed on the surface up-gradient of the tailings embankment and tailings storage area would be exposed on the surface and be subject to natural erosion through time until covered by tailings.

Because soils within the proposed TSF sites are typically classed as "poor" quality as a source of "topsoil" for reclaiming disturbed sites, their loss would not have a major impact on post TSF closure establishment of vegetation.

The potential for increased soil erosion and sedimentation from construction and operational activities would be minimized via the implementation of control measures required by the Arizona Mining MSGP.

Only a small area of soils (approximately 4 acres) would be disturbed with the re-route of the Arizona Trail (see **Table 2-1, Summary of Ripsey Wash TSF Alternative**), and efforts were made to reduce the impacts to soils via route selection. Proposed trail grades would typically be about 10 percent or less, although steeper grades would be necessary where the natural topography is steep. Soil stabilization techniques including retaining walls, water bars and constructed drains to control water will be employed as necessary. These techniques have been used on the existing Arizona Trail and have been successful in stabilizing the affected soils. However, some rills and small gullies are likely to develop in the trail re-route area as a result of the erosive forces of incident precipitation combined with trail use. These impacts should be limited in scope, and widely intermittent along the trail given the planned trail design criteria. In the direct traffic area of the planned trail, soils would be compacted and vegetation productivity lost. The document, *Arizona National Scenic Trail - Ripsey Gradeline Survey Project Report* prepared by Southwest Trail Solutions, includes mitigation measures to promote surficial stabilization during and following construction.

No adverse effects are expected to soils as a result of the work in the areas proposed for waters of the U.S. mitigation. See **Appendix J, Compensatory Mitigation**. Mitigation techniques to be applied to Mitigation Sites A through D include excluding livestock grazing, wood harvesting restrictions and decreasing off-road access depending upon the site. Some site enhancements will also include tamarisk removal and seeding, as at the Lower San Pedro River Wildlife In Lieu Fee Project Area. Mitigation sites are, all or in part, included within existing fenced areas and will be protected by conservation easements. Additional fencing will be constructed as necessary. If it rains or floods during the clearing and grubbing of the tamarist removal activities or after the various lands under all mitigation sites (A through D) have been cultivated and newly seeded, there could be some minor short-term and localized soil erosion, but the potential for this situation would be low, and any associated effects would be limited. As part of the mitigation work, stormwater management BMPs would be implemented as required under a SWPPP for the areas, and these BMPs would limit any adverse effects. With the completion of the 404-mitigation work, there would be a beneficial effect to the soils in the mitigation areas (i.e., decrease in the potential for soil erosion, improvement in vegetative cover, etc.).

Indirect impacts to soils would be limited to potential offsite sedimentation resulting from soil erosion occurring during TSF construction and operation.

3.2.2.3 Effects of the Hackberry Gulch TSF Alternative

The effects resulting from the proposed project activities would be essentially the same for this alternative as addressed in Section 3.2.2.2, Effects of the Ripsey Wash TSF Alternative, with the exception of the discussion on the Arizona Trail, which would remain in its existing location under this alternative. Estimated disturbance (2,290 acres) for the Hackberry Gulch TSF is set forth by project element in **Table 2-2, Summary of Hackberry Gulch TSF Alternative**.

The potential for increased soil erosion and sedimentation from construction and operational activities would be minimized by the implementation of control measures required by the Arizona Mining MSGP.

There would be no adverse effects to soils from the mitigation work at the proposed for waters of the U.S. mitigation areas for the same reasons set forth in Section 3.2.2.2, Effects of Ripsey Wash TSF Alternative.

3.3 GEOLOGY, GEOTECHNICAL AND GEOCHEMISTRY

Identify the potential for acid rock drainage and metals transport from the proposed TSF. Address the stability of the proposed TSF and other associated structures. *The areas of concern include; (1) short and long-term impacts to the Gila River; (2) potential for release of metals into groundwater from tailings; and, (3) the stability of the TSF.*

3.3.1 Affected Environment

3.3.1.1 Ripsey Wash TSF Site Geology

The general geology of the area within and surrounding the Ripsey Wash TSF site is shown on **Figure 22, Geology - Ripsey Wash TSF.** A typical geologic cross-section through the proposed Ripsey Wash TSF site is shown as **Figure 23, Schematic Geologic Cross-Section - Ripsey Wash TSF**.

3.3.1.1.1 Ripsey Wash TSF Site Bedrock

The Ripsey Wash TSF site is underlain by the Ruin granite formation of Precambrian age (Schmidt 1971). This formation consists primarily of coarse-grained, porphyritic granite and aplite porphyry. Although the composition of this formation can vary, the Ruin granite is generally classified as quartz monzonite.

The Ruin granite has been intruded by numerous porphyry dikes of Laramide age. These dikes average about 50 feet in thickness, but can range in thickness from several inches to nearly 150 feet. They form sinuous paths that can be several miles in length and are commonly terminated and/or offset by mid-Tertiary faults (Schmidt 1971).

The Tertiary-age San Manuel formation lies unconformably over the Ruin granite and intrusive dikes. This formation is a thick sequence of sedimentary rocks separated into an upper member of massive, poorly-sorted boulder conglomerate and a lower member of well-defined tuffaceous sandstone.

3.3.1.1.2 Ripsey Wash TSF Site Quaternary Deposits

Erosion of bedrock surfaces contemporaneous with the tectonism associated with the Basin and Range physiographic period has led to the development of present-day pediment surfaces and deposits of alluvium and gravel within the area's drainages. Quaternary deposits at the site consist of two units (Schmidt 1971 and AMEC 2014a):

- Older Gravels (Qog) – comprised of sand, gravel and cobbles with some silt found on gently-sloping sediment surfaces and terraces, and channels in the San Manuel Formation; and,
- Alluvial Deposits (Qal) – comprised of sand and gravel with varying amounts of silt and boulders found in Ripsey Wash and its tributaries, Zelleweger Wash, the east drainage and the Gila River.

3.3.1.1.3 Ripsey Wash TSF Site Geologic Structure

The dominant geologic structure at the Ripsey Wash TSF site is the San Manuel Formation graben, whose long axis generally trends north-northwest, following Ripsey Wash. This graben was formed and is bounded by the Ripsey fault on the east and the Hackberry fault on the west. See **Figure 22, Geology - Ripsey Wash TSF**. Both are normal faults of post-Larmide age; they trend approximately N 30°W with a 40° dip to the west and are only locally exposed at the surface.

Within the Ripsey fault zone, the Ruin granite is highly to moderately weathered near the surface but becomes less weathered at depth. The Ripsey fault appears to be tight with no open fractures.

The Ruin granite within the Hackberry fault is decomposed to highly weathered, locally sheared and brecciated, and contains soft fault gouge. Similarly, the tuffaceous sandstone (lower member of the San Manuel Formation) within the Hackberry fault zone also ranges from slightly to highly weathered, and is soft to very soft (AMEC 2014a). Thus, the Hackberry fault could act as a preferential pathway for groundwater and leachate movement.

3.3.1.2 Hackberry Gulch TSF Site Geology

The general geology of the area within and surrounding the Hackberry Gulch TSF site is shown on **Figure 24, Geology - Hackberry Gulch TSF.**

3.3.1.2.1 Hackberry Gulch TSF Site Bedrock

The Hackberry Gulch TSF site is underlain by the Big Dome Formation of late Miocene age and is exposed throughout the TSF area with only isolated covers of Quaternary colluvium and alluvium within the major drainages. The Big Dome Formation is estimated be nearly 1,000 feet thick (Cornwall and Krieger, 1975) and consists of gradational and inter-fingering conglomerate and tuff beds.

The conglomerates consist of a well-cemented matrix of alluvium, colluvium, and gravel. The matrix is comprised of pebbles, cobbles, and boulders of Precambrian schist, granite, sedimentary rocks, and diabase; Paleozoic sedimentary and limestone rocks; and Mesozoic and Tertiary volcanic rocks. The conglomerate in the uppermost reaches of the site is dominated by clasts of Palezoic limestone, whereas the remainder of the conglomerate is made up of a diverse variety of clast types. The westernmost portion of the site contains some sandstone beds. (AFW,2016b). Bedding of the conglomerate within the TSF footprint generally dips to the southwest toward the Gila River at between 10 and 20 degrees. Studies conducted for design of the adjacent Elder Gulch TSF revealed the presence of coarser grained, more permeable zones within the Big Dome formation that could provide pathways for seepage (Appendix D to the Section 404(b)(1)). Examination of Big Dome formation exposures within the footprint of the Hackberry Gulch TSF revealed similar coarse gradations. These coarser-grained zones would also likely create preferential pathways for seepage migration and would present challenges for seepage control at the Hackberry TSF site (Appendix D to the Section 404(b)(1)).

3.3.1.2.2 Hackberry Gulch TSF Site Quaternary Deposits

Compared to the Ripsey Gulch TSF site, Quaternary deposits at the Hackberry Gulch TSF site are limited. Portions of lower Hackberry Gulch, Kane Spring Canyon, and other ephemeral washes at and west-southwest of the TSF site are overlain by thin (generally less than 10 feet) veneers of pediment and older gravels. The pediment gravels consist of clayey to sandy gravel with considerable cobbles and boulders. The older gravels are composed largely of limestone pebbles, cobbles, and small boulders. The older gravels were deposited mainly in channels incised into conglomerates after development of the Gila River drainage (Cornwall and Krieger, 1975).

3.3.1.2.3 Hackberry Gulch TSF Site Geologic Structure

The Big Dome formation forms a north to northwest trending asymmetrical synclinal structure with the axis occurring beneath the western face of the Hackberry Gulch TSF site. Bedding is discontinuous with no single horizon traceable along the strike for any substantial distance.

The Big Dome formation has been moderately deformed by tilting along northwest-striking normal faults (Cornwall and Kreiger, 1975). The faults dip to the northeast and southwest at angles ranging from vertical to 45 degrees. In 2014, AMEC conducted a limited field reconnaissance to observe and document 26 previously mapped faults within the footprint of the Hackberry Gulch TSF site (see Appendix D to the Section 404(b)(1)). Findings from this survey are summarized below:

- Most of the faults shown on the Kearny geologic quadrangle map (USGS, 2010) within the area studied were confirmed.
- Observed faults are high-angle normal faults with little to no geomorphic expression at the surface. However, most are easily observed in side-wall exposures where they intersect drainages.
- Fracture apertures ranged from zero to 6 inches.
- Several faults were closed, healed, or cemented with calcium carbonate.
- Several faults exhibited open fractures, disrupted and parted bedding planes, and partially-open fractures.
- Additional unnamed faults were identified.

Most of the faults and fractures are essentially perpendicular to the washes and drainages that dissect the Hackberry Gulch TSF site, and all have the potential to act as preferential conduits for groundwater and/or leachate movement. As many as 12 deeply incised channels along the downstream toe of the proposed impoundment would require individual cut-off systems to prevent tailings seepage from migrating toward the Gila River.

AMEC also assessed the possible presence of paleo-channels paralleling existing drainage pathways within the Hackberry Gulch TSF site that could preferentially convey groundwater and leachate (Appendix A and F to the Section 404(b)(1)). Older gravel deposits are present in unknown thicknesses (some areas over 50 feet thick exposed in the side walls of deeply incised channel) may constitute paleo-channels cut into the early Big Dome conglomerate. Stranded remnants of the paleo-channels are now subtle traces due to erosion over time, but likely contain deep gravel deposits that may connect to the subsurface, acting as preferential pathways for groundwater and leachate movement. These might prove difficult to identify without extensive investigation, and hinder development of effective seepage collection systems.

3.3.1.3 Geotechnical Considerations

Seismic (or earthquake) activity in this region of Arizona is low.

U.S. National Seismic Hazard Maps (NSHM) have been assembled by the United States Geologic Survey (USGS). These maps and supporting data are science-based products on earthquake ground motions that are used for building codes and risk assessments. These hazard maps are an important component of seismic design regulations for buildings, bridges, highways, railroads and other structures, including mine tailings facilities. The NSHM depict earthquake ground-shaking exceedance levels for various probabilities over a 50-year time period.

Asarco has retained AMEC, a professional engineering contractor, to design the Ripsey Wash TSF. This engineering firm reviewed NSHM as part of their design process to ensure tailings embankment stability. A geotechnical analysis, prepared by AMEC, has been included in the APP permit application that Asarco submitted to the Arizona DEQ, who is responsible for reviewing and approving the overall design of the tailings facility to ensure long-term stability.

The TSF design must comply with the Best Available Demonstrated Control Technology (BADCT) guidance from the Arizona DEQ. See Section 3.16, Design Considerations, Accidents and Spills.

3.3.1.4 Geochemistry

This section documents test methods used for geochemical characterization, as well as summarizes results for the geochemical testing of the tailings (both solids and liquids) that are proposed for placement in a future TSF for the Ray Mine. The assessment for tailings geochemistry focused on the potential for the formation of acid rock drainage (ARD) and the possibility that certain metals could be generated in the tailings leachates, which could impact surrounding groundwater and surface water quality. A discussion of geochemical characterization results including associated analytical laboratory data can be referred to in Geochemical Characterization Report, that is Appendix B to the Draft Hydrogeological Characterization Reportprepared by AMEC Environmental and Infrastructure, Inc. (AMEC 2014a) and Humidity Cell Test Results (52 Weeks) Geochemical Characterization (AMEC 2015).

ARD, also commonly known as acid mine drainage (AMD), refers to acidic water that is created when sulfide minerals are exposed to air and water and, through a natural chemical reaction, produce sulfuric acid. The Global Acid Rock Drainage (GARD) Guide defines acidic water as having a pH less than 6 (http://www.gardguide.com); (Hutchison and Ellison, 1992) demarcate acidic water as having a pH less than 4.5. Low pH (acidic) water has the potential to mobilize heavy metals.

For tailings to generate ARD and/or leach contaminants, several conditions must be present:

1. Sufficient sulfide material must be present in the tailings to react chemically to form acid leachate at a rate faster than can be neutralized by any alkaline compounds contained in the tailings. Ore delivered to the Ray Concentrator contains three main sulfide minerals: chalcopyrite, chalcocite, and pyrite. Chalcopyrite is the dominant copper sulfide, and chalcocite is the subordinate copper sulfide. Pyrite occurs in association with both chalcopyrite and chalcocite. In addition to the three sulfides, limited amounts of iron oxide are present in the Ray Mine ore as a result of weathering;
2. There must be pathways for oxygen and water to contact the sulfide minerals. Sulfides form under anoxic (oxygen-poor) conditions and, when exposed to an oxic (oxygen-rich) environment (such as would occur during ore processing) can become unstable and break down chemically. This can result in the production of acidity;
3. The tailings must contain metals or other substances that can be leached under the environmental conditions present at the site; and,
4. A mechanism (usually water) must be present to transport any acidity and/or contaminants away from the source material and into the surrounding environment.

The objectives for the tailings geochemical characterization work were as follows:

1. Characterize the geochemical properties of the tailings to be placed in a future TSF;
2. Characterize the geochemical properties of the borrow materials that would be used to construct starter dams, seepage trenches, and other components of the TSF; and,
3. Provide information to assess potential environmental impacts to groundwater and surface water from tailings solids, tailings liquids, and construction and reclamation borrow materials.

The following geochemical tests were performed to characterize the tailings geochemistry (solids and liquids) and borrow materials to be used for the construction of TSF starter dams:

1. X-ray diffraction to identify tailings mineralogy;
2. Acid Base Accounting (ABA) to quantify acid neutralization potential (ANP) and acid generating potential (AGP);
3. Water quality analyses of existing tailings liquids and decant water from the Elder Gulch TSF;
4. Meteoric Water Mobility Procedure (MWMP) tests on tailings and borrow materials to assess potential leachate quality; and,
5. Humidity Cell Tests (HCT) to simulate weathering and to allow for further prediction and characterization of potential leachate quality.

The geochemical testing and characterization conformed to the requirements presented in the Arizona Mining Guidance Manual for Best Available Demonstrated Control Technology (BADCT) and the Arizona DEQ Quality Management Plan. In addition, the characterization work adhered to the geochemical guidance by the International Network for Acid Prevention (INAP) and Mine Environment Neutral Drainage (MEND).

Materials sampled consisted of tailings (solids and liquids) that are representative to those that would be placed for storage in a future TSF and the borrow materials that would be used in construction. Tailings materials are considered representative to both the proposed Ripsey Wash and Hackberry Gulch TSF sites. Borrow materials from both the proposed Ripsey Wash and Hackberry Gulch TSF sites were included. Understanding the geochemical behavior of the borrow materials and their interactions with the tailings was considered important to assess potential off-site impacts to water quality.

3.3.1.4.1 Ore Types

Ore processed at the Ray Concentrator is comprised of four rock types:

1. Diabase – The major rock-forming minerals in this unit are hornblende, plagioclase and biotite; minor minerals are magnetite and quartz. Other minerals that occur in small quantities (less than 5 percent) are chlorite, ilmenite, apatite, hematite, montmorillonite, sphene and epidote.
2. Pinal Schist - The major rock-forming minerals in this unit are quartz, orthoclase, plagioclase, sericite and biotite.
3. Sedimentary Rocks – The rock units include the Pioneer Formation; Dripping Springs Quartzite; and the Scanlan, Barnes, Whitetail, Gila and Big Dome conglomerates. These units are comprised of limestone, siltstone, sandstone, and conglomerate material.
4. Porphyry Rocks – The rock units include Granite Mountain porphyry, Ruin granite, diorite porphyry, rhyodacite and dacite. The major rock-forming minerals in this unit are quartz, orthoclase, plagioclase, biotite and sericite.

After copper has been extracted and concentrated at the Ray Concentrator, the remaining rock types would form the tailings material. As shown in **Table 3-12, Comparison of Past and Future Ore Types**[1], the major rock types milled in the past and the major rock types to be mined in the future are very similar, with Diabase and Pinal Schist accounting for 82% of the rock types that have been historically milled versus 84% projected for future milling through 2042. Projections for percentages of rock types to be mined will remain essentially the same for the life of the project.

Table 3-12, Comparison of Past and Future Ore Types[1]

Ore Types	Concentrator History (1994-2012) (%)	Future Estimate (2014-2042)[3] (%)
Diabase	52	57
Pinal Schist	30	27
Sedimentary Rocks		
Pioneer Formation	9	5
Dripping Springs Quartzite	5	4
Porphyry Rocks		
Granite Mountain Porphyry	2	4
Ruin Granite	2	3
Other[2]	<1	<1
Total	100	100

Notes:

1. From AMEC Environmental & Infrastructure, Inc. (2013).
2. Other ore types range from 0.44% to 0.02% of total and include Scanlin conglomerate, Barnes conglomerate, Gila/Big Dome conglomerate, Apache leap tuff and various porphyry dike rocks.
3. Projections from Asarco Ray Mine Engineering Department.

3.3.1.4.2 Sampling and Testing Strategy

Sampling and testing procedures for the proposed Ripsey Wash TSF were outlined in the Geochemical Characterization Sampling and Analysis Plan prepared by AMEC Environmental and Infrastructure, Inc. (AMEC, 2013). The geochemistry sampling and testing program centered on tailings materials, tailings water, and borrow material that would be used for construction and reclamation purposes. Tailings decant water from the Elder Gulch TSF was utilized in the geochemical testing program as it served as a water quality analog for the proposed TSF. Seepage from the Elder Gulch TSF was not used to predict future water quality as it has been impacted by materials used in construction at the base of the facility documented in Technical Memorandum Elder Gulch Construction Material Geochemistry (Asarco , 2016).

3.3.1.4.2.1 Tailings Material

Geochemical testing was conducted on tailings generated from Diabase and Pinal Schist, the two rock types that comprise the largest percentages of future tailings. Based on past ABA testing results (AMEC 2013), Diabase and Pinal Schist also have the highest acid generating potential (AGP). Tailings samples were collected from the Ray Concentrator, and the collection was coordinated with mine operations to assure the target rock type was being processed at the time of collection. Seven discrete samples of tailings derived from Diabase and eight discrete samples of tailings derived from Pinal Schist were collected for ABA testing. Two composite samples were generated for MWMP and HCT from the individual discrete samples to assure representative samples for both Diabase and Pinal Schist. To further simulate representative tailings a sample was generated by compositing Diabase and Pinal Schist in the percentages expected to be present in the TSF (65% Diabase and 35% Pinal Schist). .

3.3.1.4.2.2 Tailings Water

To determine the quality of water in the tailings pond, four samples[30] of actual tailings slurry water were collected from the tailings stream at the same time the tailings solids were collected. The Elder Gulch TSF tailings decant water quality is set forth in **Table 3-13, Tailings Water Analyses** (AMEC 2014a). These analyses show that the existing tailings water quality complies with the Arizona Aquifer Water Quality Standards (AAWQS).

Table 3-13, Tailings Water Analyses

ANALYTE(1)	DIABASE 1	DIABASE 2	PINAL SCHIST 1	PINAL SCHIST 2	DECANT	AAWQS(5)
Field Measurements(2)						
pH	10.7	7.3	7.5	10.6	6.0	---
Electrical Conductivity	1,705	3,064	3,346	1,882	3,303	---
Temperature	79.2	71.4	83.5	71.1	49.5	---
General Inorganics(3)						
Alkalinity as $CaCO_3$	48	21	23	27	28	---
Biocarbonate Alkalinity as $CaCO_3$	<6	21	23	<6	28	---
Carbonate Alkalinity as $CaCO_3$	43	<6	<6	24	<6	---
Hydroxide Alkalinity as $CaCO_3$	<6	<6	<6	<6	<6	---
Calcium	630	470	570	610	560	---
Chloride	190	160	200	230	180	---
Fluoride	3.2	3.3	3.6	3.6	2.9	4
Magnesium	<2	39	44	44	35	---
Nitrate as N	NA	4.9	8.5	4.0	2.9	10
Nitrite as N	NA	0.33	0.99	0.38	0.58	1
Nitrate-Nitrite as N	4.4	5.2	9.5	4.4	3.5	10
Potassium	60	44	65	70	47	---
Sodium	390	350	420	350	360	---
Sulfate	2200	2000	2400	2200	2100	---
Total Dissolved Solids	3600	3200	3800	3300	3500	---

[30] Two samples of tailings slurry water were taken when Diabase ore was being processed; Diabase #1 was taken on November 8, 2013, Diabase #2 on January 9, 2014. Two samples of tailings slurry water were taken when Pinal Schist ore was being processed; Pinal Schist 1 on October 29, 2013 and Pinal Schist on December 18, 2013.

Table 3-13, Tailings Water Analyses (continued)

ANALYTE[1]	DIABASE 1	DIABASE 2	PINAL SCHIST 1	PINAL SCHIST 2	DECANT	AAWQS[5]
Dissolved Metals[3]						
Antimony	0.0046	<0.0021	<0.003	<0.0042	<0.0021	0.006
Arsenic	0.0039	<0.0018	<0.003	<0.0036	<0.0036	0.05
Barium	0.076	0.095	0.071	0.056	0.050	2
Beryllium	<0.001	<0.0002	<0.001	<0.0002	<0.0002	0.004
Cadmium	<0.001	<0.0005	<0.001	<0.0005	<0.0005	0.005
Chromium	0.011	0.01	<0.01	<0.0012	<0.0012	0.1
Cobalt	<0.04	<0.0009	<0.04	<0.0009	<0.0009	---
Copper	<0.01	0.087	<0.01	<0.0062	<0.0062	---
Lead	<0.015	<0.0073	<0.015	<0.0073	<0.0073	0.05
Manganese	<0.01	0.23	0.14	<0.0022	0.14	---
Mercury	<0.0005	<0.00003	<0.0005	<0.00003	<0.00003	0.002
Nickel	<0.01	<0.0014	<0.01	<0.0014	<0.0014	0.1
Selenium	0.026	0.016	0.019	0.017	0.013	0.05
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Zinc	<0.05	<0.0052	<0.05	<0.0052	<0.0052	---
Radiochemicals[4]						
Gross Alpha	2.0±0.9	3.0±1.8	<1.0	3.3±1.3	0.6±0.2	15
Radium 226 + Radium 228	1.4±0.1	<0.7	1.2±0.1	1.0±0.3	1.4±0.9	5
Total Uranium	<1.6	2.9±0.4	3.4±0.5	<0.4	1.2±0.3	---

Notes:

1. Parameters are same as required by Arizona DEQ under existing Ray Mine Consolidated Aquifer Plan (APP) permit.
2. The pH, electrical conductivity (EC) and temperature were measured at the time of collection. The pH in standard unity (s.u.); EC in microsiemens per centimeter (us/cm); and temperature in degrees Centigrade (^{o}F).
3. General inorganics and dissolved metals reported in milligrams per liter (Mg/l).
4. Radiochemicals reported in picoCuries per liter (pCi/l).
5. AAWQS are Arizona Aquifer Water Quality Standards set by Arizona DEQ.

3.3.1.4.3 Borrow Materials

Samples of alluvium and bedrock materials that would be used in the TSF construction and for reclamation were collected for analysis using standard penetration testing (SPT) methods and open-end drive samples. Bedrock samples were collected using diamond coring methods and grab samples from outcrops exposed within the proposed TSF footprint. Two discrete samples for each of the following rock types were collected and tested for ABA and MWMP as part of the alluvium and borrow material analytical program for the TSF sites[31]:

- Quaternary alluvium
- Quaternary older gravels
- Tertiary cobble conglomerate
- Tertiary tuffaceous sandstone
- Precambrian Diabase
- Precambrian ruin granite
- Big Dome conglomerate

3.3.1.4.4 X-Ray Diffraction

Samples of both Diabase and Pinal Schist were analyzed by Asarco's Bruker D2 Phaser X-Ray Diffraction (XRD) Spectrometer to identity the mineralogy of the material. The Diabase analyses detected the presence of the acid-neutralizing mineral Calcite and the acid-generating minerals Alunite and Pyrite. The Pinal Schist analyses detected the presence of the acid-neutralizing mineral Calcite and the acid-generating minerals Alunite, Pyrite and Chalcopyrite.

3.3.1.4.5 Acid Base Accounting

Acid base accounting (ABA) is a geochemical analytical procedure that assesses the acid-generating potential (AGP) and acid-neutralizing potential (ANP) of the material being analyzed. AGP is a determination of acidity based upon the amount of pyritic sulfur present in the sample while ANP is a measure of the carbonate available to neutralize that acidity. Because it provides no information about the speed (or kinetic rate) with which acid generation or neutralization might proceed, ABA is recognized as "static testing" and used as a screening tool to assess whether kinetic testing is needed to further characterize the potential for acid generation. ABA averages and ranges for the various tested materials are summarized in **Table 3-14, ABA Values for Tailings and Alluvium/Borrow Materials** and are discussed as follows. Based on guidance from the Arizona Mining BADCT[32] Guidance Manual issued by the Arizona DEQ, the following criteria were used to interpret the ABA results:

- The potential for acid generation using the ratio of ANP to AGP has a tiered classification:
  - If the ratio is greater than 3:1, there is a low risk for acid rock drainage (ARD);
  - If the ratio is between 3:1 and 1:1, uncertainty arises and there is a potential for ARD; or,
  - If the ratio is less than 1:1, it is likely acid generation would occur.
- The potential for acid generation using the Net Neutralizing Potential (NNP), which is calculated by subtracting AGP from ANP, has a tiered classification:
  - If the NNP is greater than +20 tons of calcium carbonate per 1,000 tons of rock ($TCaCO_3/KT$), the material is considered non-acid generating;
  - If the NNP is between -20 and +20 $TCaCO_3/KT$, the material is considered to be potentially acid generating; or,
  - If the NNP is less than -20 $TCaCO_3/KT$, the material is considered to be acid generating.

[31] All samples, except for the Big Dome conglomerate were taken at the Ripsey Wash TSF site. The Big Dome conglomerate samples were taken at the Hackberry Gulch TSF site.

[32] BADCT is the acronym for Best Available Demonstrated Control Technology.

Although not specifically addressed in the Arizona Mining BADCT Guidance Manual, paste pH is also an indicator of readily available acidity and can be used in conjunction with total pyritic sulfur content and ANP/AGP ratios as another assessment tool. If the paste pH is greater than 5.5 (s.u.) with a pyritic sulfur content less than 0.3%, there is a low risk for ARD to develop (Price and Errington 1998).

Although most of the tailings samples had a paste pH greater than 8, all of the tailings samples had pyritic sulfur content in excess of 0.3%, which indicates there is a potential for acid generation. Similarly, the average ANP/AGP ratios for tailings ranged from 1:1 to 1.4:1, which also puts the tailings materials in the uncertain area for acid generation. In addition, based on the NNP classification, where the NNP values for the tailings samples ranged from -18.9 to +14.7, the tailings would be considered "potentially acid generating". Given that the various ABA tailings sample values appear in the inconclusive or potential category of acid generation, further kinetic testing of the tailings was warranted and undertaken (See Section 3.3.1.4.7, Humidity Cell Testing).

All borrow material samples had a paste pH greater than 8, and all of these samples, with the exception of the Precambrian Diabase samples taken in the Ripsey Wash TSF area, had negligible pyritic sulfur. The two Precambrian Diabase samples had pyritic sulfur contents of 0.95% and 0.09%; however, the ANP/AGP ratios for this rock type were greater than 3:1, and NPP classifications were in excess of +20 $TCaCO_3$/KT, which indicate a low potential for acid generation.

The Quaternary alluvium samples reported NNP values ranging from +9 to +13.3 $TCaCO_3$/KT, but the ANP/AGP ratios for these rock types averaged nearly 37.5:1, well above the 3:1 ratio for acid generation, and indicative of very high neutralization potential.

The ABA results for the all the samples of borrow rock types, which comprise the materials to be used for Ripsey Wash and Hackberry Gulch TSF construction (especially the starter TSF dams) and for cover material for reclamation activities, reveal negligible potential for acid generation.

Table 3-14, ABA Values for Tailings and Alluvium/Borrow Materials

	TAILINGS			RIPSEY WASH		HACKBERRY GULCH
	Diabase(1)	Pinal Schist(2)	Composite(3)	Alluvium(4)	Borrow(5)	Big Dome(6)
Paste pH (standard units)						
Average	8.3	8.1	8.2	8.3	8.5	8.3
Range	8.13-8.41	7.85-8.30	8.21-8.25	8.3-8.38	7.92-9.79	8.13-8.40
Pyritic Sulfur (%)						
Average	1.28	0.70	0.98	<0.01	0.095	<0.01
Range	1.05-1.79	0.38-1.39	0.82-1.13	<0.01	<0.01-0.95	<0.01
Acid Neutralizing Potential (ANP) as $TCaCO_3/KT$						
Average	39.0	29.7	36.5	11.3	32.5	29.6
Range	27.0-52.0	12.2-54.6	34.2-38.8	9.2-13.3	9.2-91.8	17.6-41.6
Acid Generating Potential (AGP) as $TCaCO_3/KT$						
Average	40.0	21.8	30.5	<0.3	3.0	<0.3
Range	32.8-55.9	11.9-43.4	25.6-35.3	<0.3	<0.3-29.7	<0.3
Net Neutralizing Potential (NNP) as $TCaCO_3/KT$						
Average	-1.0	+7.81	+6.1	+12.3	+29.8	+29.3
Range	-18.9 to +6.0	-5.3 to +14.7	+3.5 to +8.6	+9.2 to +13.3	+9.2 to +62.1	+17.3 to +41.3
Acid Neutralizing Potential (ANP) to Acid Generating Potential (AGP) Ratio						
Average	1.0:1	1.4:1	1.2:1	37.5:1	74:1	98.7:1
Range	0.6:1 to 1.3:1	0.7:1 to 2.2:1	1.1:1 to 1.3-1	30:1 to 44:1	3.1:1 to 181:1	58:1 to 138:1

Notes:

1. Seven individual tailings samples derived from the Diabase rock type were collected and tested.
2. Eight individual tailings samples derived from the Pinal Schist rock type were collected and tested.
3. There were two composite tailings samples comprised of 65% Diabase and 35% Pinal Schist.
4. Alluvium sample consisted of two samples of Quaternary alluvium (Qal).
5. Borrow material consisted of two samples of Quaternary alluvium (Qal), Quaternary older gravels (Qog), two samples of Tertiary cobble conglomerate (tcg), two samples of Tertiary tuffaceous sandstone (Trt), two samples of Precambrian Diabase (Pdb), and two samples of Precambrian ruin granite (prg).
6. Only minor amounts of alluvium material would be used for Hackberry TSF starter dam. Two samples of the Big Dome conglomerate (Bd) were sampled and tested.

3.3.1.4.6 Meteoric Water Mobility Procedure

The Meteoric Water Mobility Procedure (MWMP) using ASTM E2242-12a standard is a short-term leach test used to evaluate the potential for dissolution and mobility of certain constituents from a rock sample by meteoric water. The MWMP was developed in the state of Nevada in the 1980s as part of mine waste characterization programs, and this test is now an American Society for Testing and Materials (ASTM) procedure. ASTM E2242-12a was the test procedure used on actual Ray Mine tailings samples, as well as the borrow materials that would be used for TSF starter dam construction and reclamation cover material (AMEC 2014a).

3.3.1.4.6.1 Tailings Materials

MWMP tests were completed on composite samples of Diabase and Pinal Schist tailings, and combined composite tailings samples represented by 65% Diabase and 35% Pinal Schist. Given the low permeability of tailings, the MWMP required a “bottle roll” instead of a single pass column leach. The bottle roll testing procedure allowed for full mixing of the sample with simulated meteoric water before extraction, ensuring that the sample surface area was exposed for possible dissolution and constituent mobilization. MWMP averages for the various tailings materials are summarized in **Table 3-15, Meteoric Water Mobility Procedure Results for Tailings**.

MWMP tailings analytical results were compared to Arizona Aquifer Water Quality Standards, Elder Gulch tailings decant and tailings slurry water quality. MWMP concentrations of metals and radiochemical parameters were either below detectable limits or similar in quality to decant and tailings slurry water quality. There was no significant difference in concentrations between rock types or variations of rock type composites. Tailings MWMP results indicate that the probability for dissolution and mobilization from a single exposure to meteoric water is low. The results indicate that the sample leachates comply with Arizona Aquifer Water Quality Standards.

3.3.1.4.6.2 Borrow Materials

MWMP tests were also completed on composite samples of the Ripsey Wash alluvium and borrow material rock types that would be used for construction (e.g., starter dam) and reclamation (e.g., cover rock material) as listed above. Samples of these rock types were crushed and screened to produce a size less than or equal to 2 inches and then tested using a single pass column leach.

Two Quaternary alluvium (Qal) samples were averaged and summarized individually for MWMP analyses and selected for HCT as this material would comprise the base of the tailings impoundment. Two Quaternary older gravel (Qog) samples were also averaged and summarized individually as it was the only borrow material with uncertain acid generating potential. All other borrow material samples were averaged and presented together. The MWMP average concentrations of metals for the Ripsey Wash alluvium and borrow materials were generally below detectable limits, and the results of the testing indicate compliance of the leachates with Arizona Aquifer Water Quality Standards. MWMP averages for the alluvium and borrow materials are summarized in **Table 3-16, Meteoric Water Mobility Procedure Results for Ripsey Wash Alluvium and Borrow Materials**.

Table 3-15, Meteoric Water Mobility Procedure Results for Tailings

ANALYTE	DIABASE[4]	PINAL SCHIST[5]	TOTAL COMPOSITE[6]	ELDER GULCH DECANT[7]	TAILINGS SLURRY WATER[7]	AAWQS
pH[1]	7.6	7.8	7.8	6.0	9.0	---
General Inorganics [2]						
Alkalinity as CaCO3	26	26	26	28	30	---
Biocarbonate Alkalinity as CaCO3	26	26	26	28	14	---
Carbonate Alkalinity as CaCO3	<6.0	<6.0	<6.0	<6	20	---
Hydroxide Alkalinity as CaCO3	<6.0	<6.0	<6.0	<6	<6.0	---
Calcium	467	567	560	560	570	---
Chloride	37	45	40	180	195	---
Fluoride	0.85	0.93	0.87	2.9	3.4	4
Magnesium	19	30	26	35	32	---
Nitrate as N	<1.0	<1.0	<1.0	2.9	5.8	10
Nitrite as N	<1.0	<1.0	<1.0	0.58	0.57	1
Nitrate-Nitrite	<2.0	<2.0	<2.0	3.5	5.9	10
Potassium	34	48	39	47	60	---
Sodium	143	130	140	360	380	---
Sulfate	1500	1800	1750	2100	2200	---
Total Dissolved Solids	2400	2800	2750	3500	3500	---
Dissolved Metals[2]						
Antimony	<0.003	<0.004	<0.006	<0.0021	0.0035	0.006
Arsenic	<0.003	<0.006	<0.006	<0.0036	0.0031	0.05
Barium	0.053	0.041	0.05	0.050	0.075	2
Beryllium	<0.001	<0.001	<0.001	<0.0002	<0.001	0.004
Cadmium	<0.001	<0.001	<0.001	<0.0005	<0.001	0.005
Chromium	<0.01	<0.01	<0.01	<0.0012	0.008	0.1
Cobalt	<0.04	<0.04	<0.04	<0.0009	<0.04	---
Copper	<0.01	<0.01	<0.01	<0.0062	0.028	---
Lead	<0.015	<0.015	<0.015	<0.0073	<0.015	0.05
Manganese	0.053	0.123	0.074	0.14	0.096	---
Mercury	<0.0002	<0.0002	<0.0002	<0.00003	<0.0005	0.002
Nickel	<0.01	<0.01	<0.01	<0.0014	<0.01	0.1

Table 3-15, Meteoric Water Mobility Procedure Results for Tailings (continued)

ANALYTE	DIABASE(4)	PINAL SCHIST(5)	TOTAL COMPOSITE(6)	ELDER GULCH DECANT(7)	TAILINGS SLURRY WATER(7)	AAWQS
Dissolved Metals(2)						
Selenium	0.0068	0.0065	0.0067	0.013	0.02	0.05
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Zinc	<0.05	<0.05	<0.05	<0.0052	<0.05	---
Radiochemicals(3)						
Radium 226 + Radium 228	<0.5	<0.5	<0.5	0.6±0.2	1.1±0.2	5
Gross Alpha	1.17±0.5	1.03±0.5	2.5±0.5	1.4±0.9	2.3±1.3	15
Total Uranium	2.7±0.6	3.5±0.6	1.5±0.6	1.2±0.3	2.1±0.5	---

Notes:

1. The pH in standard units. Measure in lab for MWMP testing. Tailings slurry and decant pH measure in field.
2. General inorganics and dissolved metals reported in milligrams per liter (mg/l).
3. Radiochemicals reported in picoCuries per liter (pCi/l).
4. Three composite samples of Diabase were tested and averaged.
5. Three composite samples of Pinal Schist were tested and averaged.
6. There were two composite tailings samples comprised of 65% Diabase and 35% Pinal Schist.
7. See Table 3-13, Tailings Water Analyses.

Table 3-16, Meteoric Water Mobility Procedure Results for Ripsey Wash Alluvium and Borrow Materials

Analyte	Ripsey Wash Alluvium (Qal) [4]	Ripsey Wash Borrow (Qog)[5]	Ripsey Wash Borrow Material[6]	AAWQS
General Inorganics [1]				
Alkalinity as $CaCO_3$	71	99	34	---
Biocarbonate Alkalinity as $CaCO_3$	71	99	34	---
Carbonate Alkalinity as $CaCO_3$	<6.0	<6.0	<6.0	---
Hydroxide Alkalinity as $CaCO_3$	<6.0	<6.0	<6.0	---
Calcium	17	21	4.7	---
Chloride	16	40	2.9	---
Fluoride	2.5	2.9	0.48	4
Magnesium	2.2	2.8	<2.0	---
Nitrate-Nitrite as N[2]	<2.0	<2.0	<2.0	10
Potassium	<2.0	<2.0	2.2	---
Sodium	36	76	15	---
Sulfate	28	61	8.2	---
Total Dissolved Solids	180	320	67	---
Dissolved Metals[1]				
Antimony	<0.003	<0.003	0.0035	0.006
Arsenic	0.0101	0.0225	0.0034	0.05
Barium	0.11	0.119	0.074	2
Beryllium	<0.001	<0.001	<0.001	0.004
Cadmium	<0.001	<0.001	<0.001	0.005
Chromium	<0.01	<0.01	<0.01	0.1
Cobalt	<0.04	<0.04	<0.04	---
Copper	<0.01	0.01	<0.01	---
Lead	<0.015	<0.015	<0.015	0.05
Manganese	<0.010	0.015	0.010	---
Mercury	<0.0002	<0.0002	<0.0002	0.002
Nickel	<0.01	<0.01	<0.01	0.1
Selenium	<0.002	<0.002	0.0023	0.05
Thallium	<0.001	<0.001	<0.001	0.002
Zinc	<0.05	<0.05	<0.05	---

Table 3-16, Meteoric Water Mobility Procedure Results for Ripsey Wash Alluvium and Borrow Materials (continued)

Analyte	Ripsey Wash Alluvium (Qal) [4]	Ripsey Wash Borrow (Qog)[5]	Ripsey Wash Borrow Material[6]	AAWQS
Radiochemicals[3]				
Radium 226 + Radium 228	<0.5	<0.05	<0.05	5
Gross Alpha	0.9±1.3	2.4±1.0	0.8±0.4	15
Total Uranium	3.7±0.7	1.7±0.5	4.8±0.5	---

Notes:
1. General inorganics and dissolved metals reported in milligrams per liter (mg/l).
2. Nitrate and nitrate were not analyzed separately because of laboratory holding times.
3. Radiochemicals are reported in picoCuries per liter (pCi/l).
4. Results are the average of the results from two Quaternary alluvium (Qal) samples.
5. Results are the average of the results from two Quaternary old gravels (Qog) samples. Results are the average from two samples of Tertiary tuffaceous sandstone (Trt), two samples of Precambrian Diabase (Pdb), and two samples of Precambrian ruin granite (Prg).

3.3.1.4.7 Humidity Cell Testing

Humidity cell testing (HCT) using ASTM D5744-13 is the most widely used test to mimic natural oxidation reactions of the field setting. The HCT was designed to enhance or accelerate the rate of acid generation in sulfide-bearing materials. HCT better evaluate variables such as reaction rates and the availability of neutralizing alkalinity at mid-range pHs than ABA. Consequently, they are useful to determine whether materials having uncertain ABA acid generating status (ANP:AGP ratios between 3:1 and 1:1 or net APP values between -20 and +20 TCaCO3/KT) are likely to generate acid. See ABA testing discussed in Section 3.3.1.4.5, Acid Base Accounting.

HCT were performed on Ray Mine tailings samples and Ripsey Wash alluvium samples by McClelland Laboratories, Inc. in Sparks, Nevada (AMEC 2015). Standard HCT were completed on six samples, four samples of tailings and two samples of alluvium. The tailings samples consisted of one composite of two individual Diabase samples, a composite of two individual Pinal Schist samples and two separate composites each containing 65% Diabase and 35% Pinal Schist tailings. Two samples of Quaternary Alluvium were also tested as this material would comprise the base of the tailings impoundment. Splits of the six samples were also subjected to a modified HCT. The modified HCT was designed to simulate interactions of the tailings and alluvium materials with actual tailings decant water to more accurately represent field conditions. The samples included for HCT are summarized in the following list:

1. Composite sample of Diabase tailings (D1/D2 Comp)
2. Composite sample of Pinal Schist tailings (P1/P2 Comp)
3. Composite sample of 65% Diabase and 35% Pinal Schist (D65/P35-1 Comp)
4. Composite sample of 65% Diabase and 35% Pinal Schist (D65/P35-2 Comp)
5. Composite sample of Quaternary alluvium (Qal-1)
6. Composite sample of Quaternary alluvium (Qal-2)

The six samples listed above were tested using both standard and modified methods for a period of 10 weeks, resulting in 12 sets of analytical results. HC testing was continued on Samples D65/P35-1 Comp, D65/P35-2 Comp, D65/P35-2 Comp (mod) and Qal-1 (mod) from Weeks 11 through 52. Leachate samples were collected and tested for pH, sulfate, calcium, magnesium, iron, acidity, alkalinity, electrical conductivity and oxidation/reduction (redox) potential on a weekly basis.

Leachate samples were also collected during weeks 0, 1, 2, 4, 6, 8 and 10 for all of the tests and additionally at weeks 12, 16 and monthly thereafter for the remaining tests conducted for 52 weeks. These samples were analyzed for an additional suite of parameters, the same suite as used to characterize the tailings water (see **Table 3-13, Tailings Water Analyses**) and the same as MWMP samples were subjected to consisting of general inorganics, dissolved metals and radiochemicals.

HCT are generally conducted in a 4-inch inner diameter (ID) by 8-inch cell with samples crushed to a size of -1/4 inch. The alluvium samples were tested in this manner. The tailings samples consisted of very finely grained material that did not require crushing and required a larger diameter cell size of 8-inch ID by 4 inch to ensure full percolation and exposure of water to material surfaces.

HCT procedures subject the individual sample to alternating cycles of dry and moist air for a six-day period to simulate precipitation cycles then are saturated with deionized water on the seventh day. Water percolates through the sample then is collected for analyses. The modified HCT followed the same alternating dry and moist air cycle but was saturated with Elder Gulch tailings decant water in place of deionized water as it was felt this would more accurately represent field conditions. The Elder Gulch tailings decant water used for the modified HCT work was also similar in quality to the average tailings water quality data.

Tailings ABA results indicated an uncertain potential for acid generation. HCT results however for all twelve tests indicate that the tailings and the alluvium are non-acid generating. Ranges for select weekly parameters are summarized in **Table 3-17, Weekly Humidity Cell Test (HCT) Results for Tailings and Alluvium Materials**. The pH was neutral for all tests. Redox potential was oxidizing, as materials exposed to air and water would be in the field. Iron concentrations were low. Sulfate concentrations were variable and more pronounced in the modified tests. Acidity concentrations were low decreasing to below detectable limits and consistently less than alkalinity concentrations.

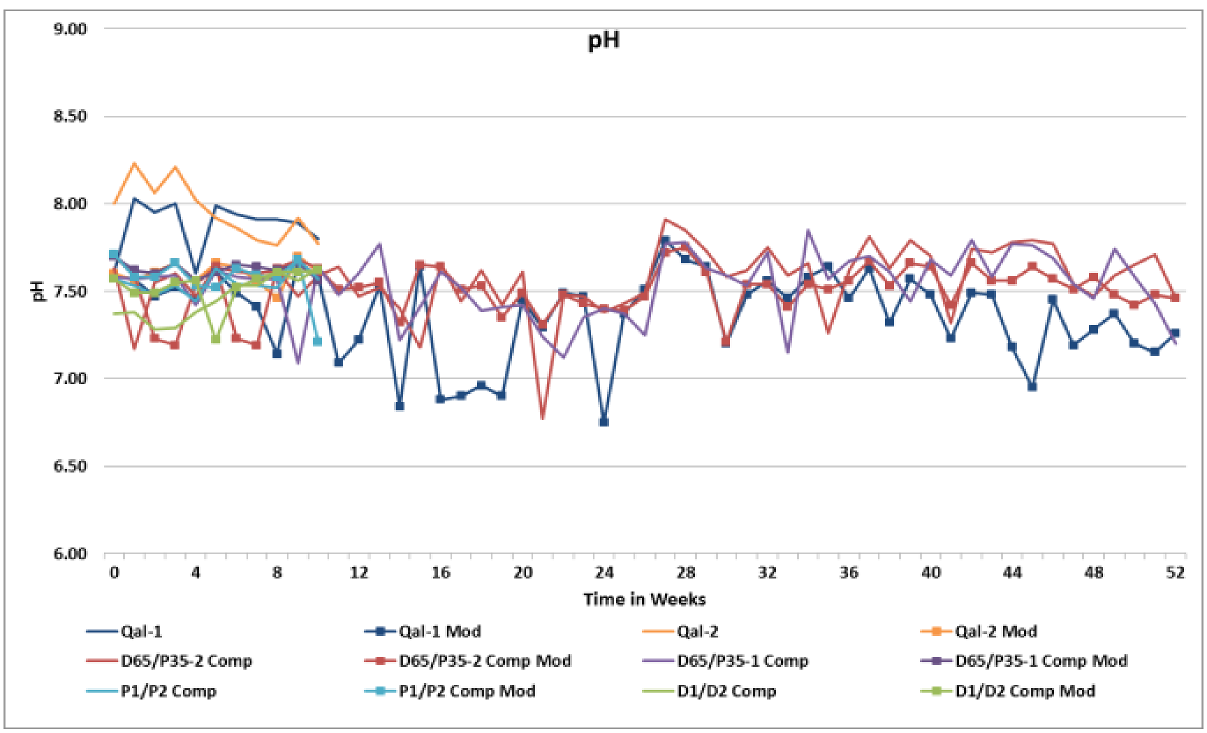
HCT weekly results evaluated over time from test initiation to end also support that both the tailings and alluvium material are non-acid generating as illustrated in **Graphs 3-1 – 3-6**. The graphical representation of the change in concentrations over time is presented with the ten-week tests on a separate axis from the 52 week tests so trends are also apparent for the shorter duration tests. Sample results measured below detectable limits were plotted with concentrations at the detection limit. Concentration trends were similar regardless whether the test was run for ten weeks or 52 weeks.

The pH remained neutral throughout testing. Redox potential was oxidizing and did not reach levels necessary to oxidize sulfidic minerals (>450mV). Redox potential did not follow an increasing trend over time but peaked and then dropped during testing for all twelve tests. Iron concentrations followed a similar trend to redox potential with highest concentrations generally occurring mid testing. Iron concentrations were generally below detectable limits in the alluvium samples as would be expected based upon mineralogy. Sulfate concentrations were highest at the beginning of testing and followed a decreasing trend as testing progressed. Sulfate concentrations were generally higher in the modified tests and was attributable to the higher concentration of sulfate in the decant water as compared to deionized water. Sulfate concentrations were notably lower in the standard HCT alluvium samples. Acidity concentrations decreased over time, decreasing to below detectable limits after 38 weeks of testing whereas alkalinity concentrations were variable with no increasing or decreasing trends, remaining in excess of acidity throughout testing.

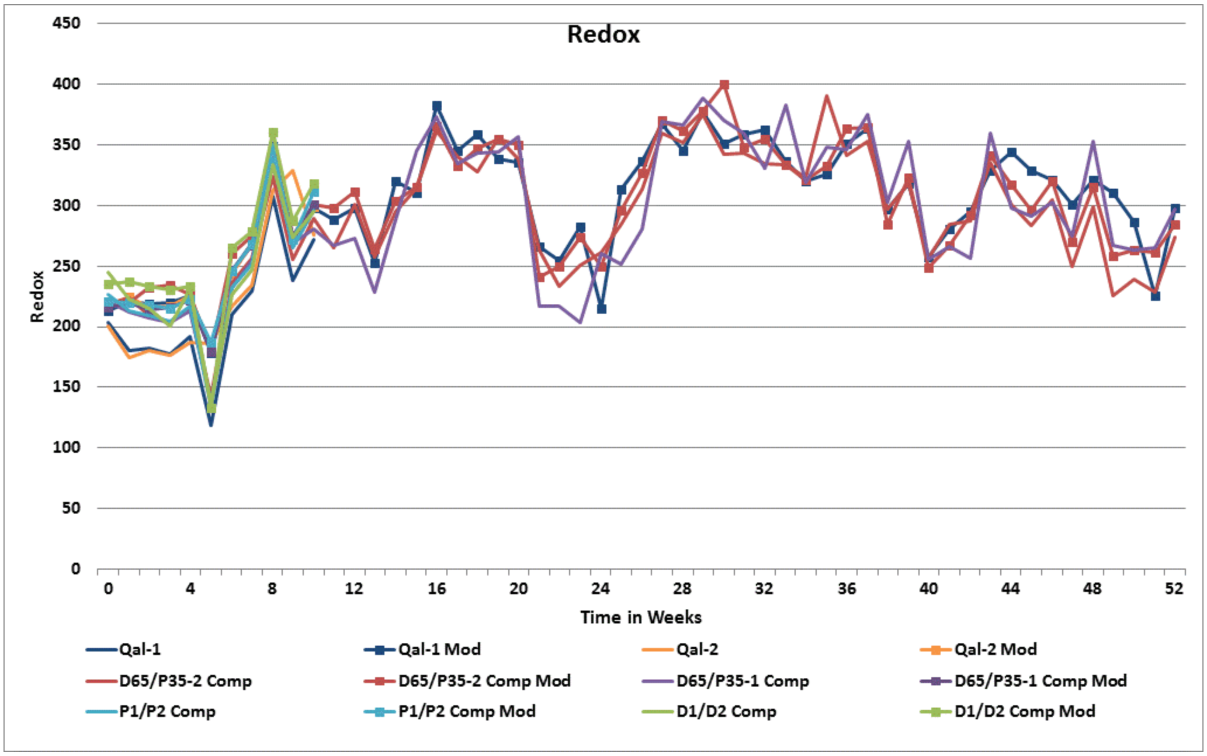
Table 3-17, Weekly Humidity Cell Test (HCT) Results for Tailings and Alluvium Materials

	pH (SU)	Redox (mV)	Iron (mg/l)	Sulfate (mg/l)	Acidity (mg/l)	Alkalinity (mg/l)
52 Week Tests						
D65/P35-1 Comp	7.09-7.85	139-388	<0.1-1.7	10-2700	0-6	13-49
D65/P35-2 Comp	6.77-7.91	143-390	<0.1-0.7	10-3100	0-6	12-55
D65/P35-2 Comp Mod	7.19-7.75	179-400	<0.1-3.8	1000-3600	0-20	29-67
Qal-1 Mod	6.75-7.79	178-383	<0.1-2.4	1000-3500	0-10	25-46
10 Week Tests						
D1/D2 Comp	7.28-7.63	137-333	<0.1-1.3	500-2900	0-4	20-38
D1/D-2 Comp Mod	7.22-7.62	133-360	<0.1-0.8	1400-3800	0-12	44-52
P1/P2 Comp	7.44-7.68	134-338	<0.1-1.3	1000-2800	0-4	29-37
P1/P2 Comp Mod	7.21-7.71	187-348	<0.1-0.7	800-3800	0-13	47-56
D65/P35-1 Comp Mod	7.56-7.7	179-347	<0.1-1.4	1200-3300	0-4	46-53
Qal-1	7.6-8.03	119-307	<0.1-<0.1	1-8	0-0	30-45
Qal-2	7.76-8.23	175-329	<0.1-<0.1	1-42	0-0	32-71
Qal-2 Mod	7.46-7.7	182-342	<0.1-0.6	1800-3300	0-1	37-52

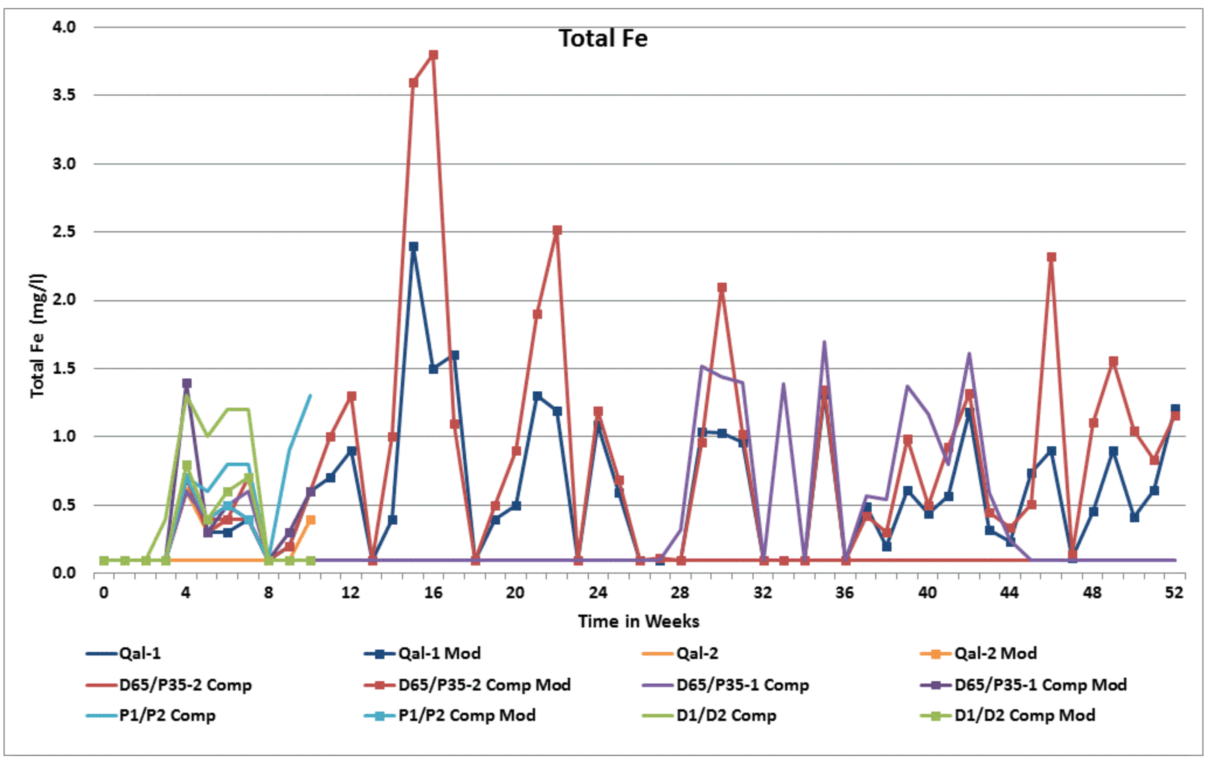
Graph 3-1, pH



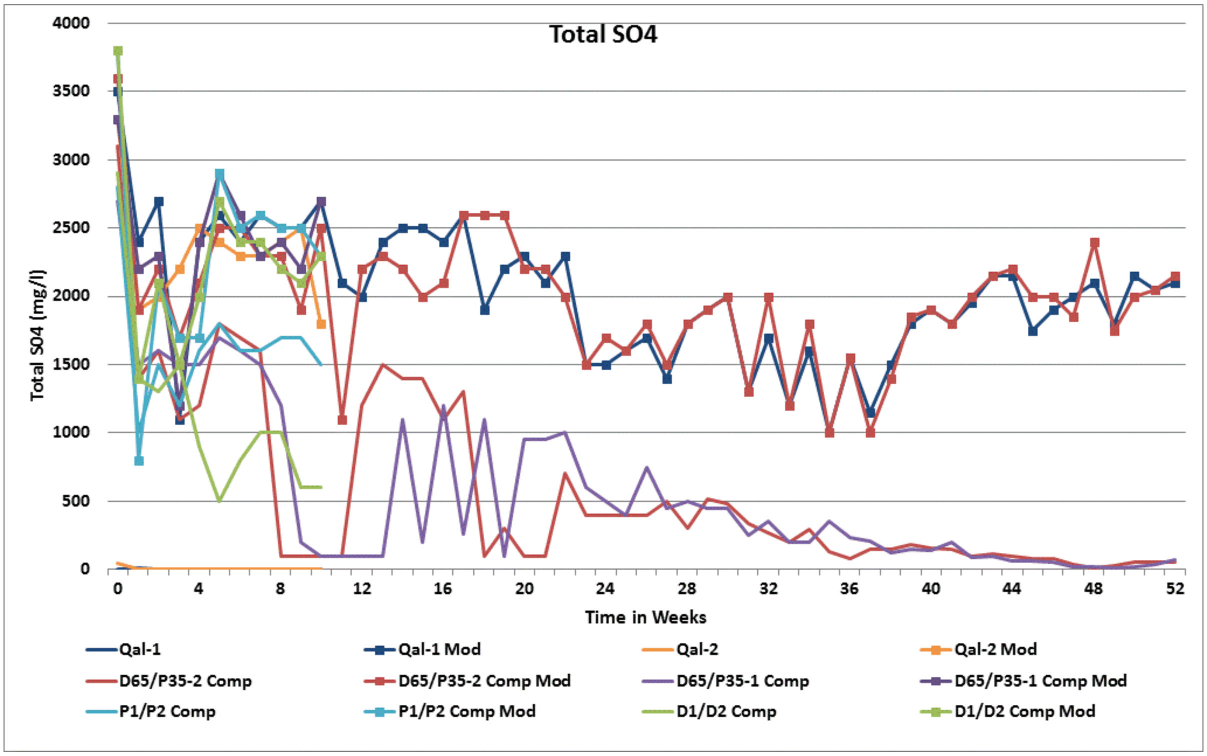
Graph 3-2, Redox



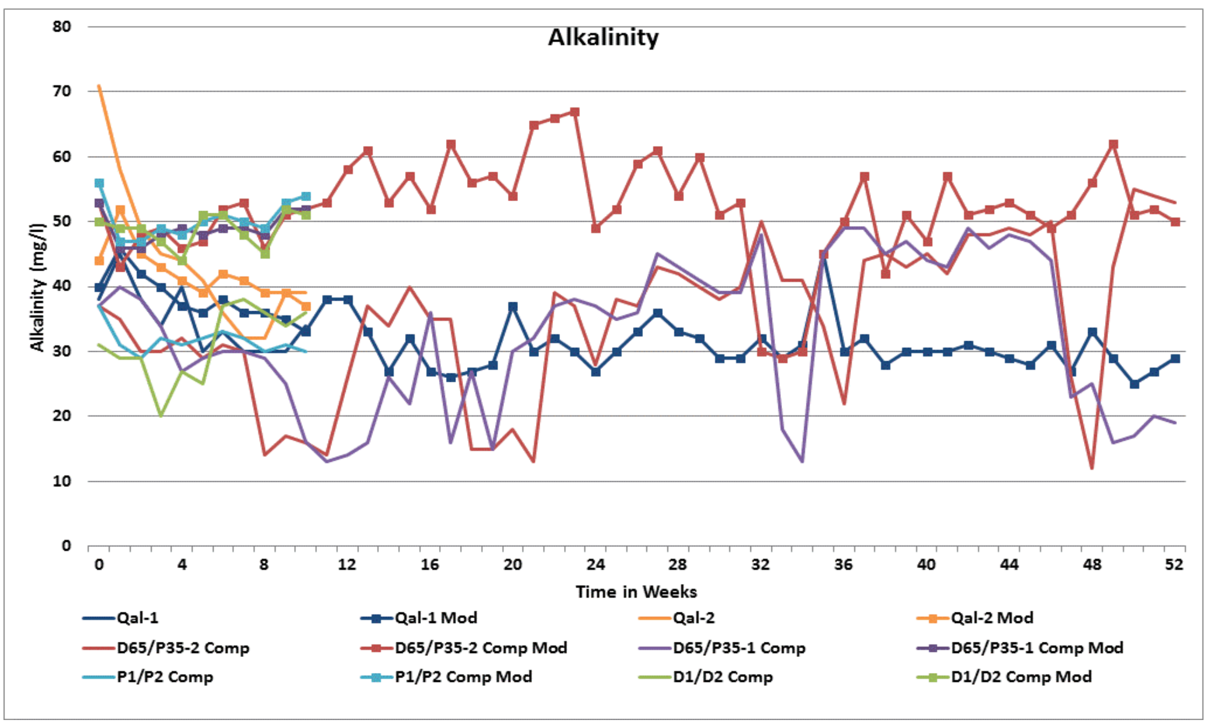
Graph 3-3, Total Iron



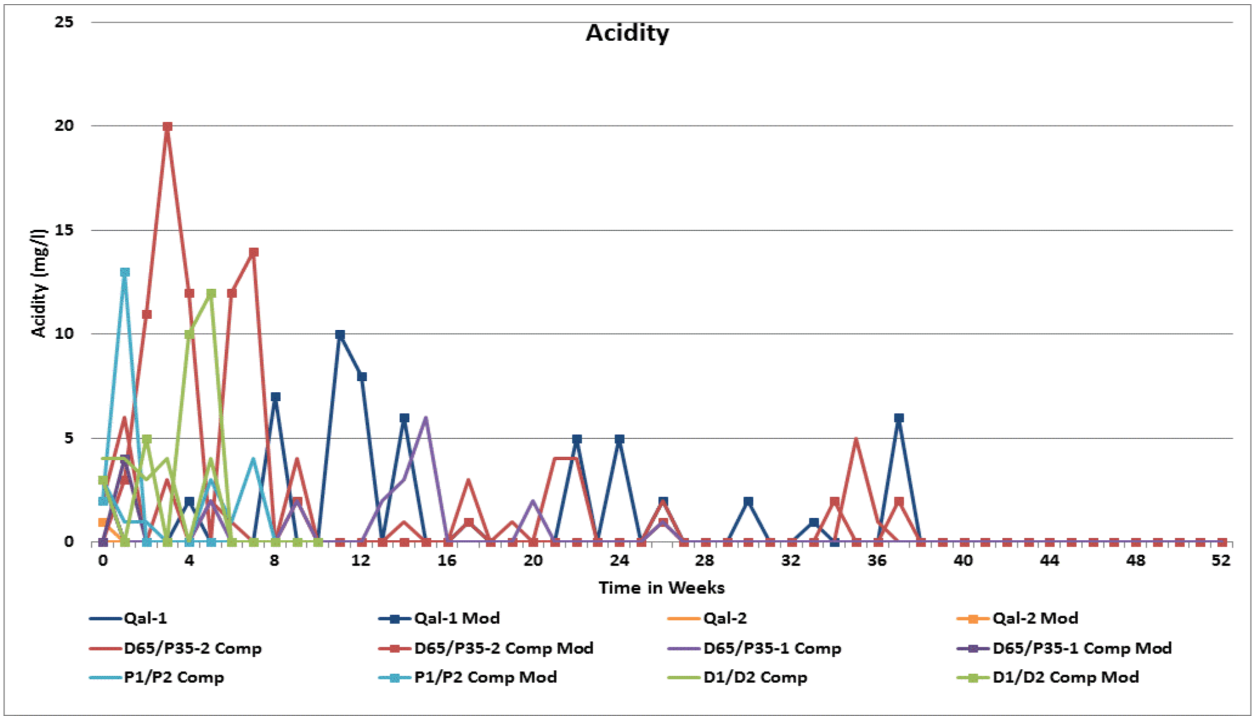
Graph 3-4, Total Sulfate



Graph 3-5, Alkalinity



Graph 3-6, Acidity



HCT also consisted of sampling for an additional suite of analytical parameters that are summarized in **Table 3-18, Dissolved Metals Humidity Cell Test (HCT) Results for Tailings and Alluvium Materials.**

Additional analytical sampling for HCT was conducted to evaluate the potential for dissolution and mobility from tailings and alluvium materials. The suite of analytical parameters is detailed in **Table 3-13, Tailings Water Analyses**, consisting of general inorganics, dissolved metals and radiochemicals. General inorganic results are not discussed further as weekly sampling results described above cover several of those parameters. Radiochemicals were only analyzed at test initiation because subsequent extract volumes were not sufficient for the required analytical method. All radiochemical results obtained were compliant with AAWQS. Minimum and maximum dissolved metals concentrations and corresponding method detection limits (MDL) are presented in **Table 3-18, Dissolved Metals Humidity Cell Test (HCT) Results for Tailings and Alluvium Materials.**

MDLs varied during testing and at times were greater than the constituent AAWQS. The higher detection limits were due to dilution required at the laboratory because of matrix interference. After week 8 of testing, analytical methods were switched in order to obtain lower MDLs. Minimum and maximum MDLs are presented to illustrate the differences. There were two measurable exceedances of the AAWQs during the 52 weeks of testing. Week 1 extract from Sample D65/P35-1 Comp exceeded the AAWQS of 0.05 mg/l for arsenic with a result of 0.062 mg/l. Week 12 extract from alluvium material Sample Qal-1(mod) exceeded the AAWQS of 0.006 mg/l for antimony with a result of 0.0064 mg/l.

All other results were below their respective AAWQS. Additionally, dissolved metals concentrations from extract solutions were evaluated for trends in concentration changes over time. There were no observable increasing concentration trends during the course of testing. Concentrations remained stable or slightly decreased as testing progressed indicating low metals mobility. Concentrations of barium, copper, manganese, nickel, selenium and zinc were slightly higher in the modified tests but still well below the AAWQS. Antimony and arsenic the two parameters with concentrations above the AAWQS are presented respectively in **Graphs 3-7** and **3-8**. Sample results measured below detectable limits were plotted with concentrations at the method detection limit.

Antimony concentration changes over time are presented in **Graph 3-7**. There was one measured exceedance of the AAWQS that occurred at week 12 in the alluvium modified test, sample Qal-1 mod. All other results for this sample were well below the AAWQS with no observable concentration trend. It appears that antimony concentrations peaked near the beginning of testing however, the spikes on the graph occur where less than detectable results are plotted at the detection limit. This occurred at weeks one, six and 40 when MDLs of 0.012 mg/l and 0.006 mg/l were used due to sample dilution. Other than the one exceedance, concentrations of antimony were less than the AAWQS and stable throughout testing in both standard and modified tests for both tailings and alluvium samples.

Table 3-18, Dissolved Metals Humidity Cell Test (HCT) Results for Tailings and Alluvium Materials

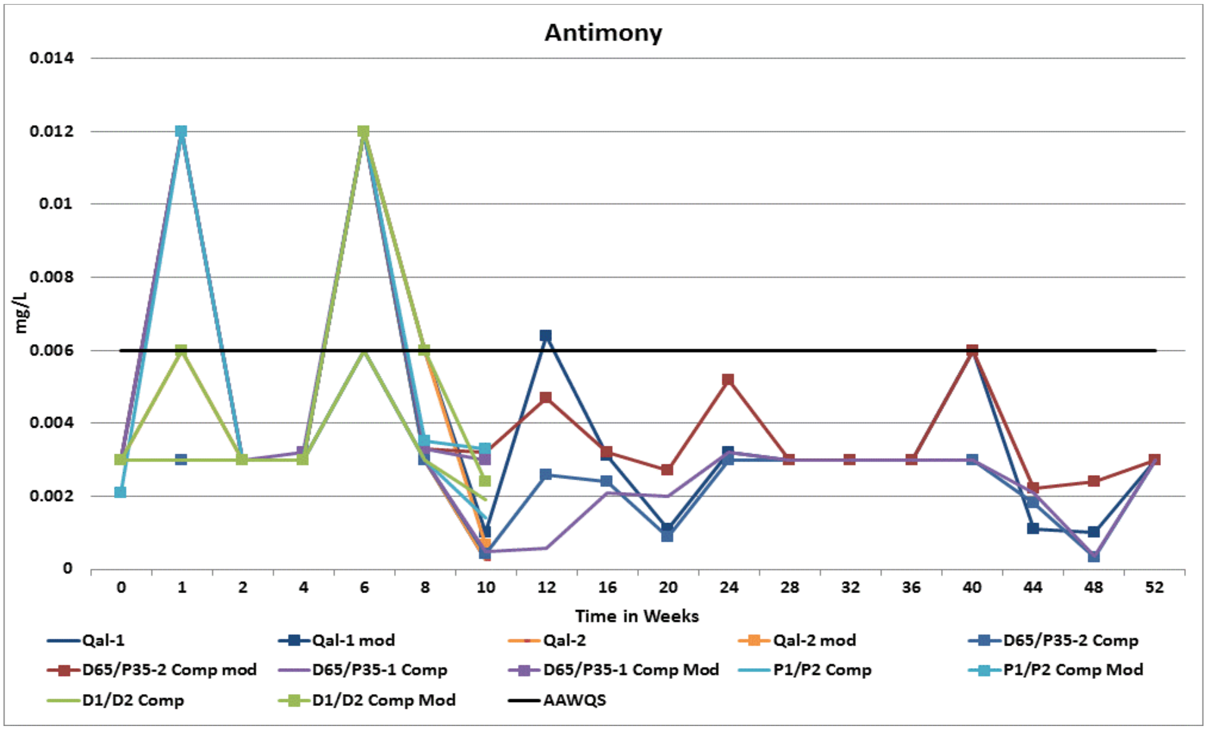
Analyte	Tailings[1]		Alluvium[2]		Method Detection Limit		AAQWS
	Min	Max	Min	Max	Min	Max	
Dissolved Metals							
Antimony	0.00034	0.0052	0.00027	0.0064	<0.0021	<0.012	0.006
Arsenic	0.00083	0.062	0.0015	0.012	<0.0007	<0.012	0.05
Barium	0.0021	0.06	0.028	0.084	<0.01	<0.1	2
Beryllium	<0.0002	<0.01	<0.0002	<0.001	<0.0002	<0.01	0.004
Cadmium	0.00011	0.00054	0.00014	0.00022	<0.0001	<0.001	0.005
Chromium	0.0011	0.024	0.0075	0.011	<0.0005	<0.025	0.1
Cobalt	0.00047	0.0019	<0.0003	<0.04	<0.0003	<0.05	---
Copper	0.00092	0.042	0.0012	0.016	<0.003	<0.1	---
Lead	0.00012	0.015	0.00013	0.025	<0.0001	<0.015	0.05
Manganese	0.0016	0.42	0.0011	0.076	<0.0008	<0.1	---
Mercury	<0.00003	<0.0002	<0.00003	<0.0002	<0.00003	<0.0002	0.002
Nickel	0.00039	0.15	0.0014	0.022	<0.0003	<0.01	0.1
Selenium	0.00026	0.016	0.012	0.015	<0.002	<0.008	0.05
Thallium	<0.0002	0.00024	<0.0002	<0.004	<0.0002	<0.004	0.002
Zinc	0.0055	0.031	0.0062	0.025	<0.01	<0.05	---

Notes:
1. Tailings minimum and maximums were evaluated from standard and modified test samples D1/D2 Comp, P1/P2 Comp, D65/P35-1 Comp and D65/P35-2 Comp.
2. Alluvium minimums and maximums were evaluated from standard and modified test samples Qal-1 and Qal-2.

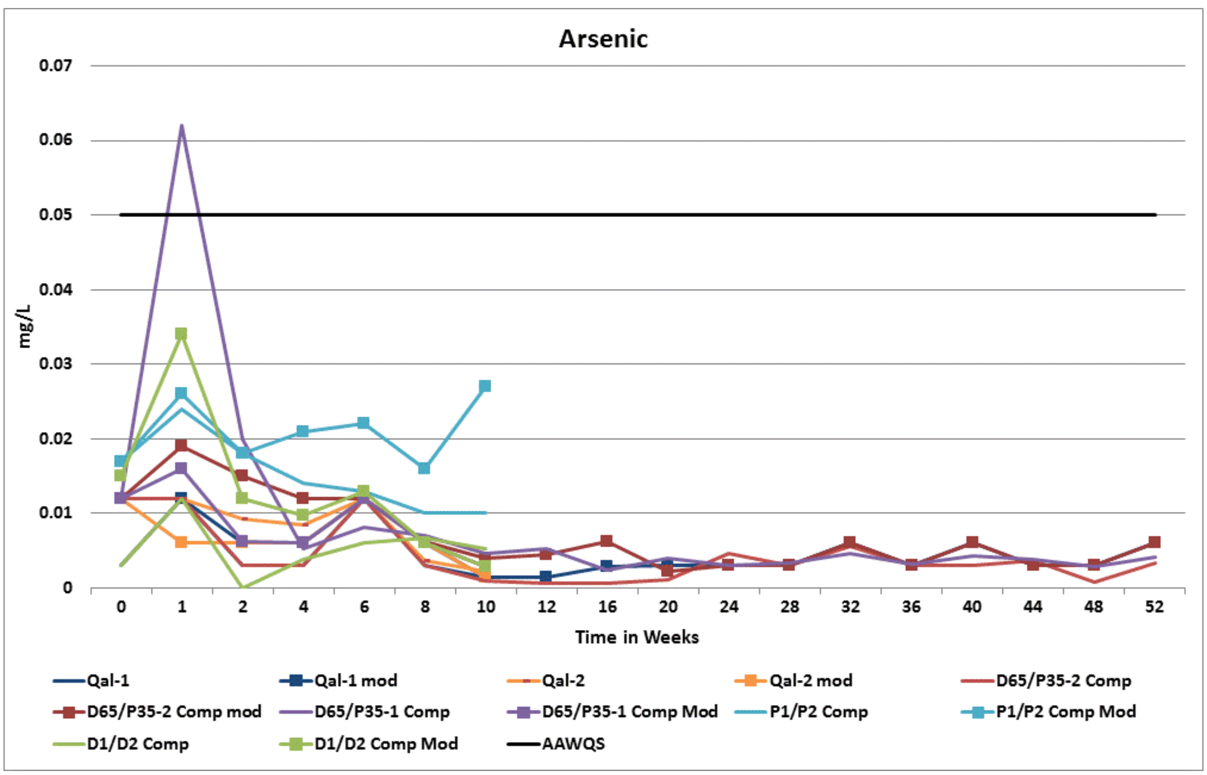
Arsenic concentration changes over time are presented in **Graph 3-8**. There was one exceedance of the AAWQS that occurred at week one in a standard test composite tailings sample of 65% Diabase and 35% Pinal Schist, sample D65/P35-1 Comp. Arsenic followed a slight decreasing trend in concentration over time for all but one sample. Sample P1/P2 Comp mod, a modified test on a composite tailings sample of

Pinal Schist had slightly variable concentrations. Other than the one exceedance concentrations of arsenic were less than the AAWQS in all tests.

Graph 3-7, Antimony



Graph 3-8, Arsenic



Understanding the geochemical behavior of the tailings and their interactions with the alluvium was considered important to assess potential off-site impacts to water quality. HCT were performed to characterize the acid rock drainage potential and leachability of the tailings and alluvium materials. The amounts of sulfide materials present in the tailings placed them in the uncertain acid generating range. However, kinetic testing indicated that the tailings would not generate acid and the potential for dissolution is low in a natural-weathering environment. Kinetic testing also indicated that the alluvium was not acid generating and did not increase the potential for dissolution and mobility. The use of Elder Gulch TSF decant water for the modified testing did not appear to have a significant effect on the test results with the possible exception of higher sulfate, fluoride, nitrate as N, barium, copper, manganese, nickel, selenium and zinc concentrations associated with the decant water solution.

3.3.2 Environmental Consequences

3.3.2.1 Effects of the No Action Alternative

Under the no action alternative, neither the Ripsey Wash nor the Hackberry Gulch TSF would be constructed. The surface geology of these sites would remain and would not be covered with tailings material. The possibility of a moderate earthquake remains; however, given the local geological conditions of the area, any large-scale slope instabilities and mass wasting are not likely.

3.3.2.2 Effects of the Ripsey Wash TSF Alternative

The rock material from which copper is extracted would become the tailings that would be deposited in the Ripsey Wash TSF site. This deposition would cover the existing geologic structure and lithology of the site. The approval of the Ripsey Wash TSF would result in permanent changes to the topography of the area. The TSF would create long-term, permanent transformation of the existing topography. The visual aspects of the Ripsey Wash TSF are discussed in Section 3.14, Visual Resources.

The results of geochemistry characterization and testing for the tailings materials to be placed in the Ripsey Wash TSF and for the borrow materials to be used to construct starter dams and other TSF components are set forth in Section 3.3.1.4, Geochemistry. Kinetic testing of tailings revealed a low potential for any acid generation from tailings materials and confirmed that alluvium material to be used for construction activities are not acid-generating. The meteoric water mobility testing on both tailings and alluvium material also revealed that the probability for dissolution and mobilization of leaching minerals from these materials is low. Additional information about water quality effects is set forth in Section 3.4, Surface Water Hydrology, and Section 3.6, Groundwater Hydrology.

Slope stability of the Ripsey Wash TSF is not expected to pose a credible risk. Tailings pore pressures, elevated phreatic surfaces, and earthquake induced accelerations are aspects of the TSF that require due consideration and design, but they are not inordinate for the Ripsey Wash TSF. However, this assessment is the responsibility of Asarco and must be reviewed and approved by the Arizona DEQ for the site's APP permit.

Geologic events, such as earthquakes, could result in damage to the Ripsey Wash TSF, and the damage or destruction would vary depending on the severity of the event. The release of tailings into the environment could result from the occurrence of a major geologic event. The damage, destruction or tailings contamination would vary depending on the severity of the event and could lead to direct and indirect impacts. Although it is possible for an earthquake to occur in this region of Arizona, the potential for damage to the TSF and the release of tailings material to down-gradient drainages, including the Gila River, would be remote if proper TSF engineering design, construction and operation is implemented.

Possible catastrophic consequences associated with a tailings dam failure from an earthquake event greater than the MCE are discussed in Section 3.16, Accidents and Spills. If an earthquake of great magnitude occurred in this area, with or without the development of either the Ripsey Wash TSF, it would probably result in property destruction, loss of electric and other utility services, and possible loss of life.

No adverse effects are expected to geology or geochemistry as a result of the relocation of the Arizona Trail or the work in the areas proposed for waters of the U.S. mitigation (see **Appendix J, Compensatory Mitigation**). There are no major landform alterations or mine-related activities that would occur in these areas that would generate any adverse effects.

3.3.2.3 Effects of the Hackberry Gulch TSF Alternative

Even though the Hackberry Gulch TSF site has different geology than the Ripsey Wash TSF site, the geologic, geochemistry and geotechnical effects would be essentially the same as discussed in Section 3.3.2.2, Effects of the Ripsey Wash TSF Alternative. However, the design, construction and operation of the Hackberry Gulch TSF are and would be more complicated than the Ripsey Wash TSF given the multiple and incised watersheds involved at the Hackberry Gulch TSF site.

There would be no adverse effects to geology or geochemistry from the mitigation work at the proposed for waters of the U.S. mitigation areas for the same reasons set forth in Section 3.3.2.2, Effects of Ripsey Wash TSF Alternative. Under this alternative, the Arizona Trail would not be relocated, so there would be no impacts to this trail.

3.4 SURFACE WATER HYDROLOGY

Identify any water quality and quantity impacts to Gila River and other surface waters as a result of the proposed tailings storage facility. Address possible impacts to Zelleweger Wash if up-drainage flows from Ripsey Wash are diverted into this wash. *The areas of concern include: (1) the alteration of existing hydrologic systems by direct disturbance; (2) the potential for increased sediment levels; (3) the alteration of downstream flow rates and any changes in the downstream water chemistry in the Gila River; and (4) any impacts on existing surface water rights.*

3.4.1 Affected Environment

3.4.1.1 Regional Setting

The proposed Ripsey Wash and Hackberry Gulch TSF sites are located within the Basin and Range physiographic province of Arizona, which is characterized by few perennial streams and low rainfall (ADWR 2009). See Section 3.1, Air Quality/Climate.

The Gila River is the principal drainage in the region. See **Figure 25, Regional Surface Water**. It is tributary to the Colorado River and has its headwaters in New Mexico. The drainage area of the Gila River at its confluence with the Colorado River is approximately 60,000 square miles (Huckleberry 1996).

The San Carlos Reservoir, located approximately 40 miles upstream of the Ray Mine, impounds the Gila River behind the Coolidge Dam, which is operated by SCIP to meet downstream water demands. SCIP releases an average of approximately 260,000 acre-feet per year from the San Carlos Reservoir to the Gila River and water levels in the reservoir are subjected to considerable fluctuations (AWDR 2009). A hydroelectric station generated electricity for SCIP at the Coolidge Dam until 1983 when a flood rendered the station inoperable. The San Pedro River is located approximately 17 miles upstream of the Ray Mine, near the town of Winkleman. See **Figure 27, Hydrologic Unit Boundaries**.

Downstream of the Ray Mine, SCIP operates the Ashurst-Hayden Diversion Dam, which is located on the Gila River about 10 miles east of the town of Florence. SCIP diverts water from the Gila River at this facility to meet irrigation water demands. Below this diversion dam, the Gila River is typically dry until it reaches its confluence with the Salt River near Phoenix.

Since 1911, the United States Geological Survey (USGS) has maintained a stream gaging station on the Gila River near the town of Kelvin. The drainage area of the Gila River at this gage is approximately 18,000 square miles. Annual flows in the Gila River at this gage are extremely variable because of natural variability, withdrawals for irrigation, and water discharge regulation from the Coolidge Dam. See **Table 3-19, Gila River Flow at USGS Kelvin (AZ) Gaging Station (USGS 09474000)**.

Table 3-19, Gila River Flow at USGS Kelvin (AZ) Gaging Station (USGS 09474000)

	Water Year 2016	Water Years 1911 -2016
Annual total (cfs) (1)	79,570	-
Annual mean (cfs) (2)	217.4	486.9
Highest annual mean (cfs)	-	3,281 (1993)
Lowest annual mean (cfs)	-	69.0 (2012)
Highest daily mean (cfs)	881.0 (January 8)	105,000 (January 20,1916)
Lowest daily mean (cfs)	14.0 (November 13)	0 (June and July 1913, August 2000, June, July and August 2002, September, October, November 2003, October, November 2007, October, November 2011, June, July, August, November 2012, June, July 2013
Annual runoff (cfs per square mile)	0.012	0.027
Annual runoff (inches)	0.164	0.368

Notes:

1. The sum of the daily mean values of discharge for the year.
2. The arithmetic mean of the individual daily mean discharges for the year noted or for the designated period of record.

Source: USGS 2016

The Gila River is an example of a dry-land river that is relatively unstable and prone to changes in channel configuration because of flood events. In the 1870's, the Gila River was contained in a single, relatively wide, sandy channel with little vegetation. Periods of flooding in 1905 and 1926 created several branching channels within the wide floodplain. A subsequent dry period in the 1930s, that followed the completion of the Coolidge Dam in 1928, caused a decline in large flood events downstream of the Coolidge Dam and resulted in the development of a heavily vegetated flood plain with a single, narrow, low flow channel. A flood in October 1983 with a peak discharge at the Kelvin station of 100,000 cfs and its relatively short duration did not produce any long-lasting changes to the channel configuration. However, a January 1993 flood with a peak discharge at Kelvin of 74,290 cfs and a relatively long duration resulted in dramatic changes in the Gila River channel configuration (Huckleberry 1996).

The Gila River near the Ray Mine is confined in a channel with steep banks along most of the corridor from the Kelvin gage downstream to the river's confluence with Zelleweger Wash. Some portions of the channel's banks are composed of bedrock, but generally they are earthen with mixed gravel, cobble and rock. Bank stability is low, and sloughing is commonly observed (WestLand 2013a).

The Federal Emergency Management Agency (FEMA) has mapped floodplains along the Gila River (FEMA 2014). The National Flood Hazard Layer (NFHL), which FEMA updates monthly, delineates the 1-percent-annual-chance flood event to determine the 100-year floodplain for drainages in the U.S. The Gila River near the Ray Mine has a 100-year floodplain that ranges from approximately 0.1 to 0.7 miles in width. See **Figure 25, Regional Surface Water**. Most of the Gila River floodplain in this area is designated as Zone A[33], but there are sections near the communities of Riverside and Kearny that are designated as Zone AE[34].

The only major tributary to the Gila River between the Coolidge Dam and the Ashurst-Hayden Diversion Dam is the San Pedro River. See **Figure 25, Regional Surface Water**. The San Pedro River has a drainage area of nearly 4,500 square miles and joins the Gila River near the town of Hayden, downstream of the Coolidge Dam and about 20 miles upstream of the Ray Mine. Portions of the San Pedro River are perennial. Water is diverted for irrigation from the San Pedro River; however, the river is undammed. Asarco owns property along the floodplain of the lower San Pedro River. Along a 40-mile stretch of upper San Pedro River, the BLM manages nearly 57,000 acres of public land at the San Pedro Riparian National Conservation Area, with its goal to protect and enhance the desert riparian habitat.

3.4.1.2 Regional Surface Water Quality

Federal regulations ensure the protection of water resources under the Safe Drinking Water Act (SDWA) and the Clean Water Act (CWA). The roles of government agencies that oversee or regulate surface water resources in Arizona are discussed in **Appendix C, Agency Responsibilities (Regulatory Framework)**.

The ArizonaDEQ has developed surface water quality standards that define water quality goals for Arizona and provide the basis for controlling discharge of pollutants to surface waters. The Ripsey Wash and Hackberry Gulch TSF sites are located along a segment of the Gila River for which the Arizona DEQ has delineated beneficial uses that include fish consumption (FC), full body contact (FBC), aquatic and wildlife use in warm water (A&WW), agricultural livestock watering (AgL), and agricultural irrigation (AgI).

Section 303(d) of the CWA requires each state to develop a list of water bodies with one or more of the designated beneficial uses that are impaired by pollutants. A 19.8 mile segment of the Gila River from its confluence at the San Pedro River to its confluence with Mineral Creek is listed on the Arizona 303(d) list as impaired for suspended sediment concentration (ADEQ 2014). This classification applies to the Gila River near the Hackberry Gulch TSF site but not at the Ripsey Wash TSF site, as the Ripsey Wash TSF site is located downstream of the confluence of Mineral Creek and the Gila River.

---

[33] FEMA defines Zone A as those areas subject to inundation by the 1-percent-annual-chance flood event generally determined by approximate methodologies. Because detailed hydrologic analyses have not been performed, no base flood elevations (BFEs) or flood depths are shown on FEMA maps.

[34] FEMA defines Zone AE as those areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. BFEs or flood depths are shown on FEMA maps.

Mineral Creek from Devil's Canyon to the confluence with the Gila River is listed on the Arizona 303(d) list as impaired for dissolved copper, dissolved oxygen, and selenium. Impaired reaches are shown on **Figure 25, Regional Surface Water.** The Gila River downstream of the Mineral Creek confluence is not impaired.

Water quality data were obtained from the National Water Quality Monitoring Council data portal (NWQMC 2015). Two stations were located for the Gila River at Kelvin in the NWQMC data set. The USGS station 09474000 has a period of record from 1974 through 2006. Arizona DEQ (station number 21ARIZ_WQX-MGGLR313.73) has a period of record from 2008 to 2009.

Table 3-20, Gila River Water Quality from USGS Kelvin (AZ) Gaging Station (USGS 09474000) presents a summary of the data obtained by query from the NWQMC dataset. Inorganic constituents, such as calcium, magnesium, etc., have been measured routinely at this gaging station from the mid-1950s, with metals being measured from the mid-1970s. No data are available from this station after 2006. Method detection limits were higher in earlier data, but have become lower in more recent data as analytical equipment has become more sensitive.

Table 3-20, Gila River Water Quality from USGS Kelvin (AZ) Gaging Station (USGS 09474000)

Constituents (in mg/l unless noted)	Min	Median	Mean	Max	Number measurable results (1)	Number of samples with non-detect	Percent sample with measurable concentration	Period of record
Antimony, Dissolved	0.00015	0.0005	0.00043	0.0005	5	12	29%	2001-2006
Arsenic, Dissolved	0.001	0.004	0.0042	0.0096	1483	0	100%	1974-2006
Barium, Dissolved	0.04	0.068	0.085	0.3	24	3	89%	1977-2004
Beryllium, Dissolved(2)	0.00003	0.0005	0.00036	0.0005	0	17	0%	2001-2006
Cadmium, Dissolved(3)	0.00002	0.00025	0.0007	0.01	5	28	15%	1974-2006
Chromium, Dissolved(3)	0.0005	0.0005	0.0042	0.02	5	24	17%	1974-2004
Chromium, Recoverable	0.0005	0.01	0.051	0.75	25	28	47%	1974-2006
Copper, Dissolved	0.001	0.003	0.0052	0.02	18	7	72%	1974-2006
Lead, Dissolved (4)(5)	0.00004	0.001	0.0007	0.001	3	22	12%	1974-2006
Manganese, Dissolved	0.0017	0.005	0.115	2.48	53	25	68%	1974-2004
Manganese, Recoverable	0.08	0.41	2.873	36	65	0	100%	1974-2006
Mercury, Dissolved	0.000005	0.00005	0.00013	0.0005	5	36	12%	1974-2006
Nickel, Dissolved	0.0005	0.001	0.0011	0.002	10	3	77%	1980-2004
Selenium, Dissolved	0.0005	0.0005	0.00086	0.003	15	23	39%	1974-2004
Selenium, total	0.0003	0.0005	0.00093	0.003	26	32	45%	1976-2006
Thallium, Dissolved	0.001	0.001	0.001	0.001	0	12	0%	2001-2004
Zinc, Dissolved(6)	0.0009	0.01	0.017	0.15	30	11	73%	1974-2006
Calcium, Dissolved	24.2	108	142	989	1032	0	100%	1950-2006

Table 3-20, Gila River Water Quality from USGS Kelvin (AZ) Gaging Station (USGS 09474000) (continued)

Constituents (in mg/l unless noted)	Min	Median	Mean	Max	Number measurable results (1)	Number of samples with non-detect	Percent sample with measurable concentration	Period of record
Magnesium, Dissolved	5.9	24	30	180	1032	0	100%	1950-2006
Potassium, Dissolved	1.2	6.6	7.661	42	363	0	100%	1950-2006
Carbonate, Total	(7)							
Fluoride, Dissolved	0.1	1	1	2.5	436	0	100%	1950-2006
Fluoride, total	(7)							
Sulfate, Dissolved	10	196	284	1840	502	0	100%	1950-2006
Sulfate, Total	(7)							
Nitrogen, mixed forms (NH3), (NH4), organic, (NO2) and (NO3), Dissolved	0.125	0.425	0.58	1.8	33	15	69%	1977-1998
Hardness, Ca-Mg(8)	(7)							
Hardness, Ca-Mg, Total	(7)							
Total hardness -- SDWA NPDWR, mg/l CaCO3(9)	84.6	370	477	2600	1033	0	100%	1950-2006
Suspended sediment concentration (SSC), Suspended	5	417.5	11096	200000	326	0	100%	1960-2006

Notes:
1. One half of the detection limit was used for calculations for constituents reported as less than detection.
2. Not detected in any samples.
3. No detection limit listed in data from 1974-1980. Not used for statistics.
4. Notations in data suggesting "detected, not quantified" from 1974 - 1981. Not used for statistics.
5. No detection limit listed for data from 1975-1979. Not used for statistics.
6. No detection limit listed for data from 1975-1977. Not used for statistics.
7. No results for this parameter included in dataset.
8. No fraction identified in dataset.
9. SDWA NPDWR - Safe Drinking Water Act, National Primary Drinking Water Regulations.

Source: Data from NWQMC 2015. National Water Quality Monitoring Center at www.waterqualitydata.us.

An additional two years of data have been collected by Arizona DEQ at their station designated 21ARIZ_WQX-MGGLR313.73, Gila River at Kelvin. Data from the period 2008 through 2009 are summarized in **Table 3-21, Gila River Water Quality from Kelvin (AZ) Gaging Station (Arizona DEQ-21ARIZ-WQX-MGGLR313.73)**.

Table 3-21, Gila River Water Quality from Kelvin (AZ) Gaging Station (Arizona DEQ-21ARIZ-WQX-MGGLR313.73)

Constituents (in mg/l unless noted)	Min	Median	Mean	Max	Number measurable results (1)	Number of samples with non-detect	Percent sample with measurable concentration	Period of record
Antimony, Dissolved(2)	0.0025	0.0025	0.0025	0.0025	0	22	0%	2008-2009
Arsenic, Dissolved(2)	0.0025	0.0025	0.0033	0.005	0	22	0%	2008-2009
Barium, Dissolved	(3)							
Beryllium, Dissolved(2)	0.00025	0.00025	0.00025	0.00025	0	22	0%	2008-2009
Cadmium, Dissolved	0.00025	0.00025	0.00031	0.0005	0	22	0%	2008-2009
Chromium, Dissolved	(3)							
Chromium, total(2)	0.005	0.005	0.005	0.005	0	28	0%	2008-2009
Copper, Dissolved	0.0001	0.0038	0.0036	0.0056	16	17	48%	2008-2009
Lead, Dissolved	0.000025	0.000055	0.001038	0.0025	16	17	48%	2008-2009
Manganese, Dissolved	(3)							
Manganese, total	0.11	0.3	0.311	0.65	28	0	100%	2008-2009
Mercury, Dissolved(4)	0.00000025	0.00000025	3.07E-05	0.0001	5	28	15%	2008-2009
Nickel, Dissolved	(3)							
Selenium, Dissolved	(3)							
Selenium, Total(2)	0.0025	0.0025	0.0025	0.0025	0	28	0%	2008-2009
Thallium, Dissolved	(3)							
Zinc, Dissolved(2)	0.025	0.025	0.025	0.025	0	23	0%	2008-2008
Calcium, Dissolved	49	58	81.17857	200	28	0	100%	2008-2009
Magnesium, Dissolved	17	18	26.04	63	28	0	100%	2008-2009
Potassium, Dissolved	5.1	5.2	5.8	7.7	4	0	100%	2008-2009
Carbonate, Total	1	1	1.86	3	12	16	43%	2008-2009
Fluoride, Dissolved	(3)							
Fluoride, total	0.96	1.2	1.15	1.3	28	0	100%	2008-2009
Sulfate, Dissolved	(3)							
Sulfate, total	90	120	207.86	650	28	0	100%	2008-2009
Nitrogen, mixed forms (NH3), (NH4), organic, (NO2) and (NO3), Dissolved	(3)							
Hardness, Ca-Mg(5)	200	220	327	790	10	0	100%	2008-2009

Table 3-21, Gila River Water Quality from Kelvin (AZ) Gaging Station (continued)

Constituents (in mg/l unless noted)	Min	Median	Mean	Max	Number measurable results (1)	Number of samples with non-detect	Percent sample with measurable concentration	Period of record
Hardness, Ca-Mg, Total	200	230	310.87	760	23	0	100%	2008-2009
Total hardness -- SDWA NPDWR, mg/l CaCO3 (6)	200	210	311.74	790	23	0	100%	2008-2009
Suspended sediment concentration (SSC), Suspended	2.5	15	37.23	91	34	9	79%	2008-2009

Notes:
1. One half of the detection limit was used for calculations for constituents reported as less than detection.
2. Not detected in any samples.
3. No results for this parameter included in dataset.
4. No detection limit listed for data from 1975-1977. Not used for statistics. Maximum value is half detection limit for one result with detection limit of 0.0002 mg/l. Maximum value for 5 results were all 1.4 ng/l or 0.0000014 mg/l.
5. No fraction identified in dataset.
6. SDWA NPDWR - Safe Drinking Water Act, National Primary Drinking Water Regulations.

Source: Data from NWQMC 2015. National Water Quality Monitoring Center at www.waterqualitydata.us.

Water quality data from these tables were not compared to water quality standards because of the large number of parameters that were as not detected and a wide range of reported detection limits.

3.4.1.3 Ripsey Wash TSF Site Surface Water Hydrology

Surface drainages within the Ripsey Wash TSF site are ephemeral and flow only in response to precipitation events. The Ripsey and Zelleweger washes, along with an unnamed wash designated East Wash on **Figure 26, Surface Water Features - Ripsey Wash TSF** and located to the east of Ripsey Wash, are tributary to the Gila River. These washes are generally braided, sandy-bottomed channels interspersed with upland vegetation and cacti. The washes can carry heavy sediment loads downstream toward the Gila River. Tributaries to these washes tend to have relatively confined channels but form large, broad alluvial fan deposits at the confluences with the main channels. **Table 3-22, Drainage Characteristics - Ripsey Wash TSF Site**, provides watershed information.

Table 3-22, Drainage Characteristics - Ripsey Wash TSF Site

Wash Name	Drainage Area (square miles)	Basin Length (miles)	Approximate Maximum Elevation (feet amsl)	Approximate Minimum Elevation (feet amsl)	Basin Slope (ft/mile)
Ripsey Wash	18.1	10.0	3920	1740	218
Zelleweger Wash	4.2	9.0	3170	1740	158
East Wash	2.2	1.6	3400	1740	1018

Ripsey Wash is the largest watershed at the Ripsey Wash TSF Site. Soils in the watershed range from clay loam to coarse loam; see Section 3.2, Soils. The average vegetative cover of Ripsey Wash is approximately 20%. Section 3.12.1.1, Upland Vegetation Communities, includes discussion of the upland vegetation communities found in Ripsey Wash.

Zelleweger Wash is located directly west of Ripsey Wash, and this watershed is 25% of the size of Ripsey Wash. The Zellweger Wash basin slope is less than that at Ripsey Wash. The type of soils, vegetation, and percent vegetative cover in Zelleweger Wash are similar to Ripsey Wash.

The Eastern Wash has a much steeper basin slope than either Ripsey Wash or Zelleweger Wash. The type of soils, vegetation, and percent vegetative cover in this unnamed wash are similar to those in Ripsey and Zelleweger Washes.

Ripsey Wash and Zelleweger Wash have FEMA designated floodplains that are narrow and range from 0.03 to 0.1 miles wide. The floodplains extend approximately three to four miles up-drainage from their confluence with the Gila River. See **Figure 25, Regional Surface Water**, and **Figure 26, Surface Water Features - Ripsey Wash TSF**.

3.4.1.4 Hackberry Gulch TSF Site Surface Water Hydrology

Hackberry Gulch, Kane Springs Canyon, Belgravia Wash, and several unnamed ephemeral washes are tributary to the Gila River. See **Figure 28, Site Drainages - Hackberry Gulch TSF**. These ephemeral drainages are smaller, steeper and more incised than the Ripsey and Zelleweger washes. There are perennial or intermittent stretches found in several of the drainages. There are two of these stretches located in B Wash, five in Hackberry Gulch, and one in Kane Springs Canyon. **Table 3-23, Drainage Characteristics - Hackberry Gulch TSF Site**, provides watershed information.

Table 3-23, Drainage Characteristics - Hackberry Gulch TSF Site

Wash Name	Drainage Area (square miles)	Basin Length (miles)	Approximate Maximum Elevation (feet amsl)	Approximate Minimum Elevation (feet amsl)	Basin Slope (ft/mile)
Hackberry Gulch	2.9	4.6	4289	1800	536
Kane Springs Canyon	3.0	5.8	4289	1800	427
Belgravia Wash	0.5	1.2	2260	1800	380
B Wash	1.0	2.2	2920	1800	519
C Wash	0.5	2.0	2480	1800	340
D Wash(1)	0.9	0.7	2120	1800	457
E Wash	1.1	2.8	2920	1800	394
F Wash	0.7	2.3	2560	1800	335
G Wash	0.6	1.7	2320	1800	313
H Wash	0.3	1.8	2461	1800	361

Notes:
1. Watershed D located entirely downstream of the Hackberry Gulch TSF.

Soil and vegetative types for the watersheds at the Hackberry Gulch TSF Site are similar to those at the Ripsey Wash TSF Site, but the average percent vegetative cover is about 30% (as compared to about 20% for the Ripsey Wash TSF site).

There are no FEMA designated floodplain areas associated with drainages at the Hackberry Gulch TSF site.

3.4.1.5 Surface Water Rights

Water use in Arizona is administered by the ADWR and claims to surface water resources may be located in the ADWR database "SWRfilingActive" (ADWR, 2014). It should be noted that registering a surface water right with the ADWR does not mean that the right is valid or has been adjudicated and that there is an appropriable surface water right at that location found on ADWR's website or as claimed by the applicant. In addition, the point of use and the point of diversion provided to ADWR are usually only accurate to within 10 acres of the claimed location of use and diversion. For water rights points of use where nothing is found on the surface, it is possible that no surface water source has been appropriated.

There are no in-stream flow rights on the Gila River near the Ray Mine. Asarco has not filed an Application to Appropriate Surface Waters for either the Ripsey Wash TSF or the Hackberry Gulch TSF. All surface water to be utilized by Asarco has been previously appropriated and adjudicated from the Gila River by Decree in the Globe Equity 59 case. Registered water rights within drainages affected by the Ripsey Wash and Hackberry Gulch TSF sites are discussed below.

3.4.1.5.1 Ripsey Wash TSF Site

Surface water rights from the ADWR database for the Ripsey Wash, Zelleweger Wash and Eastern Wash are tabulated in **Table 3-24, Surface Water Rights - Ripsey Wash TSF Site**, and their locations are shown on **Figure 26, Surface Water Features - Ripsey Wash TSF Site**.

No springs or seeps were identified within the proposed footprint of the Ripsey Wash TSF. There is a spring, located about a mile up-drainage (south) of the proposed facility that provides water to several livestock watering points that are located within the proposed tailings footprint.

Table 3-24, Surface Water Rights - Ripsey Wash TSF Site

Basin Name	Located within TSF Footprint	Surface Water Feature	Application Numbers for this Location	Holder	Located in Field (1)	Visible Water (1)	Use
Zelleweger Wash	No	ADWR 1	1935 - 91661	ASLD	No	Unknown	Wildlife
Zelleweger Wash	No	ADWR 2	1933 - 91659	ASLD	No	Unknown	Wildlife
Eastern Wash	No	ADWR 3	1924	ASLD	No	Unknown	Wildlife
Ripsey Wash	Yes	Stock 2 (2)	2838	Private	Yes	Yes	Stock watering
Ripsey Wash	No	ADWR 4	105036 - 96589	BLM	No	Unknown	Wildlife
Ripsey Wash	Yes	Tank 3	1929 - 91656 - 2129	ASLD	Yes	No	Wildlife - Stock watering
Ripsey Wash	No	Spring	1932 - 2838	ASLD	Yes	Yes	Wildlife
Ripsey Wash	Yes	ADWR 5	1926	ASLD	No	Unknown	Wildlife
Ripsey Wash	Yes	Stock 1 (2)	1928	ASLD	Yes	No (3)	Wildlife
Ripsey Wash	Yes	ADWR 6	104877	ASLD	No	Unknown	Stock watering
Ripsey Wash	Yes	Tank 1	1930 - 2127-91657	ASLD	Yes	No	Wildlife
Ripsey Wash	Yes	Tank 2	1931 - 2127-91658	ASLD	Yes	No	Wildlife
Eastern Wash	Yes	Stock 3 (2)	1925	ASLD	Yes	No	Wildlife
Ripsey Wash	No	ADWR 7	2017 - 2839	ASLD	No	Unknown	Wildlife
Ripsey Wash	No	ADWR 8	2018 - 2128	ASLD	No	Unknown	Wildlife
Ripsey Wash	No	ADWR 9	2019	ASLD	No	Unknown	Wildlife
Ripsey Wash	No	ADWR 10	17435	BLM	No	Unknown	Wildlife

Notes:

1. Based on field work by WestLand (WestLand 2014a).
2. Fed by a spring, located about a mile up-drainage (south) of the proposed footprint area of the Ripsey Wash TSF.
3. No visible water at time of site visit. Valve closed.

3.4.1.5.2 Hackberry Gulch TSF Site

Surface water rights from the ADWR database for the Hackberry Gulch TSF and surrounding areas are tabulated in **Table 3-25, Surface Water Rights - Hackberry Gulch TSF Site**. Asarco has not proposed to apply for additional water rights in the Hackberry Gulch drainage.

There are several springs or seeps within or adjacent to the footprint of the proposed Hackberry Gulch TSF. The springs are found in Hackberry Gulch, in areas where bedrock is exposed in the bottom of the channel. These springs produce surface flows that quickly disappear into down-drainage alluvium. Seeps are located in Kane Springs Gulch, Belgravia Wash, and in separate, unnamed drainages that discharge directly to the Gila River. See **Figure 28, Site Drainages – Hackberry Gulch TSF**.

Table 3-25, Surface Water Rights - Hackberry Gulch TSF Site

Basin Name	Located within TSF Footprint	Surface Water Feature	Application Numbers for this Location	Holder	Located in Field (1)	Visible Water (1)	Use
Hackberry Gulch	Yes	ADWR 11	2184	Private	No	Unknown	Stock watering
Hackberry Gulch	Yes	Seep 1 (2)	None found	-	Yes	No	-
Hackberry Gulch	Yes	Seep 2	20748	BLM	Yes	Yes	Recreation
Wash B	Yes	Seep 3 (2)	None found	-	Yes	Yes	-
Belgravia Wash	Yes	Seep 4 (2)	None found	-	Yes	No	-
Kane Springs Canyon	Yes	Seep 5	21174	Private	Yes	Yes	Stock watering
Wash E	Yes	Seep 6 (2)	None found	-	Yes	Yes	-
Hackberry Gulch	Yes	Seep 7	20707	BLM	Yes	Unknown	Recreation
Hackberry Gulch	Yes	Spring 1 (2)	None found	-	Yes	Yes	-
Hackberry Gulch	Yes	Spring 2	21185	Private	Yes	Yes	Stock watering
Hackberry Gulch	No	ADWR 12	68737	Private	Yes	Unknown	Stock watering
Hackberry Gulch	No	ADWR 13	90066-68736	BLM	No	Unknown	Stock watering
Hackberry Gulch	No	ADWR 14	90058	BLM	No	Unknown	Stock watering
Hackberry Gulch	No	ADWR 15	68738	Private	No	Unknown	Stock watering
Kane Springs Canyon	No	ADWR 16	21177	Private	No	Unknown	Stock watering
Kane Springs Canyon	No	ADWR 17	90241	BLM	No	Unknown	Stock watering
Hackberry Gulch	No	ADWR 18	68762	Private	No	Unknown	Stock watering
Wash E	No	ADWR 19	21173	Private	No	Unknown	Stock watering
Kane Springs Canyon	No	ADWR 20	20714	BLM	No	Unknown	Recreation
Kane Springs Canyon	No	ADWR 21	20705	BLM	No	Unknown	Recreation
Kane Springs Canyon	No	ADWR 22	90245	BLM	No	Unknown	Stock watering
Kane Springs Canyon	No	ADWR 23	68748	Private	No	Unknown	Stock watering
Kane Springs Canyon	No	ADWR 24	68742	Private	No	Unknown	Stock watering
Kane Springs Canyon	No	ADWR 25	68747	Private	No	Unknown	Stock watering
Kane Springs Canyon	No	ADWR 26	20746	BLM	No	Unknown	Recreation
Kane Springs Canyon	No	ADWR 27	90242	BLM	No	Unknown	Stock watering
Kane Springs Canyon	No	ADWR 28	68749	Private	No	Unknown	Stock watering
Kane Springs Canyon	No	ADWR 29	17437	BLM	No	Unknown	Wildlife
Kane Springs Canyon	No	ADWR 30	68740	Private	No	Unknown	Stock watering
Kane Springs Canyon	No	ADWR 31	17448-68756	BLM	No	Unknown	Wildlife

Notes:

1. Based on field work by WestLand (WestLand 2014b).
2. Spring or seep found in the field, but with no corresponding ADWR water right.

3.4.2 Environmental Consequences

3.4.2.1 Effects of the No Action Alternative

Under the no action alternative, neither the Ripsey Wash nor the Hackberry Gulch TSF would be constructed. The surface water systems of these sites would remain as they currently exist and would not be covered with tailings material. Ranch management activities (livestock grazing) and dispersed recreation would continue in the area of the proposed TSF sites, but these activities would not have any significant effects on the surface water hydrologic systems of the area. Current patterns of water use would continue for the Ray Mine under the no action alternative until the Ray Concentrator is shut down when the Elder Gulch TSF reaches its capacity. At that time, water use for the Ray Mine would decrease but would still be used for dust control and leaching operations. The Hayden Concentrator and Smelter would continue to use water under the no action alternative.

3.4.2.2 Effects of the Ripsey Wash TSF Alternative

The Ripsey Wash TSF Alternative will impact Ripsey Wash and its tributaries, Zelleweger Wash, and the East drainage as shown on **Figure 26, Surface Water Features**, Ripsey Wash TSF, and **Figure 2, Site Plan Layout, Ripsey Wash TSF**.

The construction and operation of the Ripsey Wash TSF would remove runoff potential from approximately 16% of the Ripsey Wash drainage basin and approximately 20% of the East Wash drainage basin during the operation of the Ripsey Wash TSF. See **Table 3-26, Ripsey Wash TSF Affected Drainage Areas**.

Table 3-26, Ripsey Wash TSF Affected Drainage Areas

	Total Drainage Area (sq. miles)	Drainage Area within TSF (sq. miles)	Percentage of Watershed covered by TSF
Ripsey Wash	18.1	2.90	16%
East Wash (unnamed tributary)	2.2	0.43	20%
Gila River at Zelleweger Wash	18,040	3.33	0.018%

The possible runoff loss to the Gila River hydrologic system with the construction and operation of the Ripsey Wash TSF would be negligible. At the confluence of Zelleweger Wash and the Gila River (immediately downstream of the TSF), the TSF footprint would amount to about 0.018% of the of the Gila River watershed.

Development of the TSF facilities and related construction activities are potential sources of soil erosion and increased sediment loading in the area washes.

The Arizona Mining MSGP (Multi-Sector General Permit) Stormwater Pollution Prevention Plan (SWPPP) (EEC 2016) describes the comprehensive program used to implement Individual Best Available Demonstrated Control Technology (BADCT) for the tailings and surface impoundments.

Major facilities included in the Ripsey Wash TSF alternative are listed below. For a detailed discussion of the Ripsey Wash facilities, see Section 2.3, Ripsey Wash TSF: Proposed Action.

- **Two rock-fill starter dams**. Colluvium material under the dams would be constructed with underdrains that would channel any seepage to the down-gradient seepage control trenches, from where collected seepage would be pumped to one of the two reclaim ponds that would be down-gradient of the starter dams. During centerline construction, lined underdrains would be installed to channel any water from the tailings to the reclaim ponds.

- **Main and East Reclaim Ponds**. The reclaim ponds are located below the TSF and would collect water from the alluvial cutoff walls and seepage collection systems, and stormwater runoff from the down-gradient tailings. These reclaim ponds would be equipped with pumping capacity to return (recycle) water for reuse at the Ray Concentrator or to route water back to the tailings impoundment. The reclaim pond located in Ripsey Wash would be over 1,500 feet from the Gila River; see **Figure 2, Site Plan Layout – Ripsey Wash TSF, and Figure 26, Site Drainages – Ripsey Wash**.
- **Draindown Pond**. This lined facility would be located north of the Gila River and would be used, in the event of an emergency or pipeline leak to collect tailings and reclaim water present in the tailings and reclaim water pipelines that connect to the Ripsey Wash TSF.
- **Ripsey Wash Detention Dam**. A detention dam would be constructed across Ripsey Wash up-gradient of the ultimate projected footprint of the Ripsey Wash TSF impoundment. This detention dam would be initially sized to contain flows from a 500-year, 24-hour storm event, with an emergency spillway to direct any water overflow into the tailings impoundment. During operations (prior to the initiation of up-stream tailings construction), the detention dam would be raised approximately 60 feet to detain stormwater volumes from the probable maximum precipitation (PMP) storm event.
- **Stormwater Diversion Channels**. Stormwater runoff from the up-gradient watersheds to the east of the Ripsey Wash TSF would be routed around the tailings facility through a stormwater diversion channel. Stormwater runoff in Ripsey Wash (captured in the above-mentioned Detention Dam) and other stormwater from the up-gradient watersheds on the west side of the Ripsey Wash TSF would be routed to Zelleweger Wash through a series of detention ponds, pump stations, and pipelines (AMEC 2014a).

The potential for erosion and sediment loading downstream from disturbed areas would be the greatest during the initial construction period. During actual TSF operations, the potential for erosion would decrease due to reduced construction activity at the site and the completion of the protection facilities described above. The detention dam and reservoir, the main and east reclaim ponds, draindown pond and other collection structures would have additional capacity for expected sediment.

The tailings slurry pipeline and a bridge across the Gila River, and other supporting infrastructure would be needed to transport tailings from the existing thickener to the Ripsey Wash TSF. The proposed pipeline crosses the Gila River within the sediment impaired segment of the Gila River. No fill would be placed in the river as part of that construction.

Erosion rates above background conditions would be expected even with the implementation of Arizona BADCT sediment control measures; especially in the upland areas.

Intense rainfall (which implies heavy runoff) would increase the potential for sediment loading during severe thunderstorms common in the region. The reduction of infiltration and concentration of flows from roads or other compacted areas could result in localized erosion and deposition, especially during the initial construction period.

For the most part, sediment would be stored in the upland areas and in ephemeral channels, but a portion of this sediment could be transported to the Gila River during intense storm events. The amount of sediment would depend largely on the effectiveness of the erosion control practices.

The Ripsey Wash TSF alternative would cover portions of ephemeral watersheds where the TSF would be constructed and would cause a reduction in down-drainage flow in those ephemeral washes during construction, operations and post-closure.

Under the terms and conditions of the Arizona MSGP, and APP permits, a TSF would be operated as a zero surface water discharge facility, with any direct precipitation and runoff captured in the tailings impoundment being pumped back to the Ray Concentrator for reuse. Seepage through the tailings themselves and the underlying alluvium material beneath the TSF would be captured by down-drainage seepage trenches and routed to lined reclaim ponds, where the water would be pumped back to the tailings impoundment or to the Ray Concentrator for reuse. As tailings consolidate over time during operations, the permeability of the tailings materials themselves are expected to decrease and lessen the amount of infiltration through the tailings. See Section 3.6, Groundwater Hydrology.

With proper design construction and operation of the Ripsey Wash TSF, there should be no surface water quality impacts to the down-gradient drainages, including the Gila River. As discussed in Section 3.3.1.4, Geochemistry, the kinetic testing of tailings materials revealed a low potential for any acid generation from tailings materials and confirmed that the alluvium material to be used for construction activities are not acid-generating. The meteoric water mobility testing on both tailings and alluvium material also revealed that there is a low probability for dissolution and mobilization of leaching minerals from these materials. Monitoring wells down-gradient of the TSF would serve as points of compliance for the Ripsey Wash TSF APP. See Section 3.6, Groundwater.

None of the runoff from precipitation on the tailings impoundment would report to the down-drainage Ripsey Wash or the the Gila River. The SWPPP would address pollution prevention of surface water by capturing runoff from the disturbed areas during construction of the TSF and from the tailings embankments during operations.

A system of diversion channels would be constructed to divert up-gradient flows resulting from precipitation events away from the tailings impoundment area and into existing drainages down-gradient of the TSF. The diversion of these flows through diversion channels could result in bank erosion and lateral channel migration in undisturbed ephemeral drainages down-drainage of the outlets of these diversion channels. This could lead to increased sediment loading in these washes and the Gila River.

The upgradient detention dam would also be constructed to prevent up-gradient stormwater runoff from entering the tailings impoundment area, and these up-gradient structures would delay the release of stormwater runoff to downstream ephemeral washes, which would reduce the down-drainage peak discharge and limit down-drainage erosion potential with reduced flow velocities at the outfalls. With the reduction of up-gradient stormwater runoff and sediment load, the existing sediment transport regime for the Ripsey TSF site would essentially remain in balance. Because of the time lag between detention and release, it is anticipated that much of the suspended sediment in the runoff would settle out, so stormwater released from detention facilities would yield lower sediment concentrations than natural uncontrolled runoff. To maintain the integrity of Zelleweger Gulch, stormwater releases to this drainage would have a decreased amount of sediment (resulting from settlement in the detention facilities) and would be at a controlled flow level that would limit or prevent sediment generation down-gradient of the release point, and to maintain the down-drainage geomorphology of the Gila River.

Upon permanent TSF closure, water remaining within the tailings impoundment would evaporate, allowing the surface layers of the tailings to dry and be graded for post-project drainage. Rock material would be placed onto the regraded surface of the tailings impoundment. The resulting topography would allow post-closure drainage off the impoundment through an engineered outfall, but post-closure runoff is expected to be limited for most typical precipitation events given relatively flat surface of the regraded tailings impoundment surface and high evaporation rates.

If accidental spills of diesel fuel or tailings were to occur, there could be impacts to surface water. If such a release occurred, impacts to the ephemeral washes in the area would likely be minor and short-term because of the lack of perennial surface flow and the prompt control and countermeasures that would occur per the SPCC plan (for fuel or oil spills) or per the APP Contingency Plan (for tailings spill). Additional discussion of accidental spills and possible impacts are discussed in Section 3.16, Design Considerations, Accidents and Spills.

The Ripsey Wash TSF would not impact any springs, as there are no known springs within the TSF footprint or within 0.5 miles up-gradient of the facility, to the Gila River. This TSF would affect five stock water tanks registered to the ASLD. Asarco is in the process of acquiring the land and water rights where these tanks are located. Regardless of ownership, the potential impact from removal or relocation of the stock watering tanks would be negligible.

Some erosion and sediment could result, especially during intense storms, during the re-route construction of the Florence-Kelvin highway, the SCIP 69 kV electric transmission line and the new re-routed segment of the Arizona Trail, as well as from various access roads at the TSF site. The potential for erosion would be greatest during construction and could create minor impact to surface water drainages.

No adverse effects to surface water are expected with the relocation of the Arizona Trail, as re-route work on the Arizona Trail would be predominantly hand construction, except in limited areas where benching or removal of heavy vegetation would be required or in segments where there would be trail switchback construction. In these cases, light or small equipment would be employed for vegetation removal, benching and switchback construction. Trail construction would end at the ordinary high water mark of the drainages encountered along the trail re-alignment. Trail users would walk across the ephemeral drainages and reconnect to constructed trail on the other side of the drainage. This method of construction (or lack of construction) would create negligible impact from erosion and sedimentation to existing drainages.

No effects are expected to the Gila River as a result of Arizona Trail relocation, or to the Gila River or the San Pedro River as a result of the work in the areas proposed for waters of the U.S. mitigation (see **Appendix J, Compensatory Mitigation**). If it rains or floods during the clearing and grubbing of the burned tamarisk trees from Mitigation Site E, or after the various lands under Mitigation Sites A through E have been cultivated and newly seeded, there could be some minor short-term and localized soil erosion, but the potential for sedimentation reaching either the Gila River or the San Pedro River would be low, and any associated effects would be limited. As part of the mitigation work, stormwater management and erosion control measures found in the MSGP would be implemented and would limit any adverse effects. With the completion of the 404 mitigation work, there would be a beneficial effect to the mitigation areas that would result in a decrease in the potential for soil erosion, coupled with an improvement in vegetative cover.

3.4.2.3 Effects of the Hackberry Gulch TSF Alternative

The Hackberry Gulch TSF alternative would impact seven drainages as shown on **Figure 28, Site Drainages – Hackberry Gulch TSF**, and **Figure 14, Site Plan Layout, Hackberry Gulch**.

Major facilities included in the Hackberry Gulch TSF Alternative are listed and summarized below. For additional discussion on these facilities, see Section 2.4, Hackberry Gulch TSF Alternative.

- **Starter Dam**. The Hackberry Gulch TSF would require a major elongated starter dam that would cross the seven major drainages that dissect the Hackberry Gulch TSF. Where this starter dam intersects those drainages, underdrains would be constructed (during centeriline construction) to channel down-gradient seepage to one of the seven reclaim ponds that would be constructed in the drainages down-gradient of the starter dam.
- **Seven Reclaim Ponds**. The seven reclaim ponds would be located below the TSF and would collect water from the alluvial cutoff walls and seepage collection systems, and stormwater runoff from the down-gradient tailings embankment. These reclaim ponds would be equipped with pumping capacity to return (recycle) water for reuse at the Ray Concentrator or to route water back to the tailings impoundment. Reclaim Pond #2 would be located within approximately 500 feet of the Gila River; see **Figure 14, Site Plan Layout – Hackberry Gulch TSF, and Figure 28, Site Drainage – Hackberry Gulch**.
- **Draindown Pond**. This lined facility would be located northeast of the Hackberry Gulch TSF and would be used in the event of an emergency or pipeline leak to collect tailings and reclaim water present in the tailings and reclaim water pipelines that connect to the Hackberry Gulch TSF.
- **Box Culverts**. Box culverts would be constructed under State Route 177 to allow the passage of stormwater and reclaim water. Multiple box culverts would be required at each of four drainages to segregate stormwater runoff from the seepage that would be routed to the reclaim ponds in lined channels. ee **Figure 14, Site Plan Layout – Hackberry Gulch TSF**, and **Figure 17, Conceptual Box Culverts for State Route 177**.
- **Overpass Bridge**. An overpass bridge would be constructed for State Route 177 to allow seepage water and stormwater runoff to be channeled under State Route 177, as well as to segregate highway traffic from the construction and operational traffic for the Hackberry Gulch TSF. See **Figure 16, Typical Overpass Bridge for State Route 177**.
- **Upgradient Detention Dams**. A series of detention dams would be constructed up-gradient of the ultimate projected footprint of the Hackberry Gulch TSF impoundment. These detention dams would be initially sized to contain flows from a 500-year, 24-hour storm event, with emergency spillways to direct any water overflow into the tailings impoundment. As part of closure, these detention dams would be raised to detain stormwater volumes from the probable maximum precipitation (PMP) storm event.
- **Stormwater Diversion Channels**. Stormwater runoff from the up-gradient watersheds located east and upgradient of the Hackberry Gulch TSF would be routed around the tailings facility through stormwater diversion channels. Stormwater runoff in captured in the above-mentioned detention dams other stormwater runoff from the up-gradient watersheds would be routed to either Belgravia Wash on the northwest side of the Hackberry Gulch TSF or to an unnamed drainage to the south of the Hackberry Gulch TSF. A diversion channel planned for construction at closure of the Elder Gulch TSF would be modified and be routed between the Elder Gulch TSF and the Hackberry Gulch TSF. The current alignment would have traversed the Hackberry Gulch TSF.

The Hackberry Gulch TSF and supporting infrastructure would remove varying runoff potential from up to nine ephemeral watersheds. See **Table 3-27, Hackberry Gulch TSF Affected Drainage Areas**. Approximately 30% of the runoff potential would be lost from these watersheds; however, the possible runoff loss to the Gila River hydrologic system with the construction and operation of the Hackberry Gulch TSF would be negligible. At the USGS Kelvin gaging station (immediately downstream of the TSF), the TSF footprint would amount to about 0.018% of the of the Gila River watershed.

Table 3-27, Hackberry Gulch TSF Affected Drainage Areas

	Drainage Area (sq. miles)	Drainage Area within TSF (sq. miles)	Percentage of Watershed covered by TSF
Hackberry Gulch	2.9	0.70	24.1%
Kane Springs Canyon	3.0	0.45	15.0%
Belgravia Wash	0.5	0.23	46.0%
B Wash	1.0	0.81	81.0%
C Wash	0.5	0.37	74.0%
E Wash	1.1	0.52	47.3%
F Wash	0.7	0.07	10.0%
G Wash	0.6	0.01	1.7%
H Wash	0.3	0.01	3.3%
Total Hackberry TSF Site	10.6	3.17	29.9%
Gila River at Kelvin	18,011	3.17	0.018%

Development and construction activities for the Hackberry Gulch TSF would be similar to the Ripsey Wash TSF Alternative and would have the same effect on sediment and erosion as described in Section 3.4.2.2, Effects of the Ripsey Wash TSF Alternative. As with the Ripsey Wash TSF alternative, a Mining MSGP and SWPPP must be obtained for the Hackberry Gulch TSF and followed to implement Arizona BADCT sediment control measures,Nonetheless, some erosion above background conditions would still be expected.

Alteration of the surface water regime of ephemeral channels in the vicinity of the TSF would cause a reduction in down-drainage flow during construction and operation of the TSF.

Similar to the Ripsey Wash TSF, the Hackberry Gulch TSF would also be operated as a zero surface water discharge facility. Precipitation and stormwater runoff captured in the tailings impoundment would be pumped back to the Ray Concentrator for reuse.

The Hackberry Gulch TSF must be designed, constructed and operated to capture any seepage through the alluvium material beneath the tailings facility through the aforementioned down-drainage seepage trenches and cut-off structures and routed to lined reclaim ponds, where the water would be pumped back to the Ray Concentrator and/or back to the tailings impoundment. Nonetheless, the Hackberry Gulch TSF site has severe engineering challenges for the effective control of seepage from the tailings impoundment; and, in order for the Hackberry Gulch TSF alternative to be permitted under an APP by the Arizona DEQ, extensive engineering and design studies would be required to ensure that tailings seepage from the TSF would not reach the Gila River during operation and post-closure. Additional discussion on potential tailings seepage is set forth in Section 3.6.2.3, Effects of the Hackberry Gulch TSF Alternative. The Hackberry Gulch TSF would cover two springs, eleven seeps, two wetland areas, and one stock watering tank. The potential impact from the removal of the stock watering tank would be negligible, as it could be relocated, but the impact to the springs, seeps and wetland areas within the footprint of the TSF would be both adverse and irreversible.

Similar to the discussion in Section 3.4.2.2, Effects of Ripsey Wash TSF Alternative, there should be no adverse effects to either the Gila River or the San Pedro River as a result of the work in the areas proposed for waters of the U.S. mitigation (see **Appendix J, Compensatory Mitigation**). If it rains or floods during the clearing and grubbing of the burned tamarisk trees from Mitigation Site E, or after the various lands under Mitigation Sites A through E has been cultivated and newly seeded, there could be some minor short-term and localized soil erosion, but the potential for sedimentation reaching either the Gila River or the San Pedro River would be low, and any associated effects would be limited. As part of the mitigation work, stormwater management BMPs would be implemented as required under a SWPPP for the areas, and these BMPs would limit any adverse effects. With the completion of the 404 compensatory mitigation work, there would be a beneficial effect to the mitigation areas that would result in a decrease in the potential for soil erosion, coupled with an improvement in vegetative cover.

3.5 WATERS OF THE U.S.

Address project-related impacts to waters of the U.S. *Areas of concern include: (1) the impacts to waters of the U.S.; and (2) changes in the functions and values of on-site jurisdictional waters of the U.S. from tailings disposal operations.*

3.5.1 Affected Environment

3.5.1.1 Jurisdictional Determination – Ripsey Wash TSF Site

A jurisdictional determination (delineation) was completed for the Ripsey Wash TSF site. The delineation work was completed by WestLand (a consultant retained by Asarco). The delineation work followed guidelines promulgated by the U. S. Army Corps of Engineers. The Corps found the WestLand report to be accurate and complete and approved the jurisdictional determination in February 2013.

Ordinary High Water Mark (OHWM) determinations were made based on direct measurement, a hydrologic analysis completed for Ripsey Wash (JE Fuller 2012), and aerial photo interpretation. Drainages less than 1,000 feet long and having an average width of less than or equal to four feet were classified as erosional features and non-jurisdictional. Drainages exhibiting an OHWM were found to have a significant nexus to the Gila River and are classed as jurisdictional. At the Corps' request, WestLand broadened the area of analysis for the delineation to include the portion of the Gila River downstream from the proposed TSF site. Also, per Corps direction, WestLand employed a wetland determination methodology along the Gila River corridor using on-site and off-site quantitative and qualitative data. Only a very small part of the project footprint (the proposed pipeline bridge over the Gila River) intersects the Gila River, which would not be disturbed under this alternative.

WestLand prepared an additional report presenting the results of a surface water features survey to support the permitting process (WestLand 2014d) that included more specific information with regard to wetlands within the Ripsey Wash TFS footprint and associated facilities.

3.5.1.1.1 Perennial and Intermittent Waters

No perennial or intermittent waters were found to occur within the footprint for the Ripsey Wash TSF site. The Gila River is a perennial stream that occurs immediately adjacent to some components of the project, but fill associated with the project footprint does not extend into the stream corridor. The pipeline bridge spans the Gila River but does not require fill within perennial or intermittent waters. The four mitigation sites are located along the San Pedro River, a perennial stream.

3.5.1.1.2 Ephemeral Waters

With the exception of the Gila River, all surface water drainages at the Ripsey Wash TSF site are ephemeral and known locally as "dry washes". They are typically braided, sand-bottom systems interspersed with upland vegetation, cacti and can carry heavy sediment loads to the Gila River. They flow only in response to significant precipitation events. The major washes are Ripsey Wash and Zelleweger Wash, which are both tributary to the Gila River. Smaller tributaries to Ripsey Wash and Zelleweger Wash exhibit moderate to high gradients, are bedrock-dominated, and of limited length. No waters of the U.S. were found along the proposed realigned Arizona Trail.

A functional assessment was prepared for the Ripsey Wash area that is included with **Appendix J, Compensatory Mitigation**. This report contains an assessment of the ephemeral washes. Ephemeral drainages were sorted into three classes of ephemeral water features based on the frequency of flow and the size of the drainage. A qualitative functional assessment was performed for these waters based on eleven functions (four hydrologic functions, two chemical functions, and five biotic functions. A qualitative approach was used because there are no approved quantitative methods available for use in this region.

The three classifications used for assessing ephemeral waters are:

Ephemeral Class 1 – This class consists of very large, wide, ephemeral drainages which, within the Project footprint, are limited to the main channel of Ripsey Wash. Drainages within this class have a median width of 180 ft and an average width of 167 ft.

Ephemeral Class 2 – This class consists of relatively smaller drainages in comparison to Ephemeral Class 1. Ephemeral Class 2 drainages within the Ripsey Wash site include the larger tributaries of Ripsey Wash and another unnamed ephemeral channel that drains toward the Gila River. Drainages within this class have a median width of 35 ft and an average width of 60 ft.

Ephemeral Class 3 – This class consists of headwaters and relatively smaller drainages in comparison to Ephemeral Class 2 drainages. Ephemeral Class 3 drainages within Ripsey Wash are in the upper parts of the watershed and may drain into Class 2 or Class 1 ephemeral drainages. Drainages within this class have a median width of 6 ft and an average width of 10 ft.

Table 3-28, Waters of the U.S. - Ripsey Wash TSF Footprint, provides a summary of the classes of ephemeral waters located within the Ripsey Wash TSF footprint. In addition, the total score for each class is provided as determined by the functional assessment.

Table 3-28, Waters of the U.S. - Ripsey Wash TSF Footprint

Classification	Acres	Functional Score[1]
Ephemeral Class 1	68.03	28
Ephemeral Class 2	45.89	24
Ephemeral Class 3	20.73	17

Note:

1. Total functional scores ranges from 0 to 55 points (5 points maximum per function).

3.5.1.1.3 Wetlands

No seeps or springs were found at the Ripsey Wash TSF site. No isolated open water or vegetated wetlands occur within Ripsey Wash where the TSF is proposed. The only wetlands in the vicinity of the project consist of adjacent wetlands along the Gila River outside of the Ripsey Wash TSF footprint.

3.5.1.1.4 Compensatory Mitigation Sites

Four mitigation sites have been identified for potential use for compensatory mitigation. In addition, Asarco has proposed to purchase credits at the Lower San Pedro River Wildlife Area (LSPRWA) In-Lieu Fee Project site. These sites and the activities planned for each site are discussed in **Appendix J, Compensatory Mitigation**. A functional assessment was conducted at each of these sites as part of the process for calculating mitigation for the loss of waters of the U.S. See **Table 3-29, Summary of Functional Values for Each Mitigation Site**.

Table 3-29, Summary of Functional Values for Each Mitigation Site

Mitigation Site	Functional Score(1)
PZ Ranch Site A	36
PZ Ranch Site B	28
PZ Ranch Site C	32
PZ Ranch Site D	34
LSPRWA In Lieu Fee Project Wetland Establishment	41
LSPRWA In Lieu Fee Project Riparian Restoration	44

Note:

1. Total functional scores ranges from 0 to 55 points (5 points maximum per function).

3.5.1.2 Potential Waters of the U. S. - Hackberry Gulch TSF Site

No formal jurisdictional determination report has been made by the Corps for the Hackberry Gulch TSF site. Existing information and data along with some field verification were used to assess this site and estimate the extent of jurisdictional waters for the purpose of comparison with the Applicant's proposal (WestLand 2014e).

The field wetland delineations completed by WestLand followed approved Corps procedures (U. S. Army Corps of Engineers 1987, 2008). Other sources of information including data gathered during previous on-site surveys, U.S. Geological Survey topographic maps, and aerial photos were accessed to aid in the development of this analysis.

3.5.1.2.1 Perennial and Intermittent Waters

Field surveys indicate the presence of smaller drainages that have perennial or intermittent flows on the Hackberry Gulch TSF site. These areas are not part of a delineated wetland. **Table 3-30, Potential Waters of the U.S. - Hackberry Gulch TSF Footprint**, summarizes potential waters of the U.S. for the Hackberry Gulch TSF Alternative site.

Table 3-30, Potential Waters of the U.S. - Hackberry Gulch TSF Footprint

Classification	Acres	Functional Score[1]
Ephemeral Class 1	0	NA
Ephemeral Class 2	49.86	22
Ephemeral Class 3	21.64	15
Perennial/Intermittent Class	1.65	17
Wetland Class	0.62	41

Note:
1. Total functional scores ranges from 0 to 55 points (5 points maximum per function)

3.5.1.2.2 Ephemeral Waters

Within the alternative footprint, there are ephemeral drainages that would likely be considered waters of the U.S. These drainages were classified into the same three categories used for the Ripsey Wash TSF Alternative. Wetlands

Five wetland areas (including one or more seeps at each wetland), two springs, and six small seeps that did support wetland vegetation were evaluated within the boundaries of the Hackberry Gulch TSF site. The five wetland areas exist at the Hackberry Gulch TSF site and exhibit seasonal or perennial surface water saturation and support wetland vegetation. See **Figure 43, Vegetation Map**.

Wetland A is located in an eastern tributary of Hackberry Gulch and exhibits wetland conditions approximately 300 feet down channel that support the wetland species velvet ash and netleaf hackberry (*Celtis reticulata*).

Wetland B exhibits wetland conditions for approximately 3,800 feet in tributaries and the main channel of Belgravia Wash. Wetland B includes four identified seeps and supports narrow strands of riparian vegetation including Fremont cottonwood, Goodding's willow, southern cattail (*Typha domingensis*) and spikerush (*Eleocharis* sp.).

Wetlands C, D, and E are located near SR 177 west of the Hackberry Gulch TSF site in unnamed tributaries to Belgravia Wash. These smaller wetlands support variable stands of Fremont cottonwood, Goodding's willow, tamarisk and seepwillow.

Of the two springs found, one is located on the main channel of Hackberry Gulch and one is found in a tributary of Hackberry Gulch. Both springs support stands of Fremont cottonwood and tamarisk, but are not considered wetlands.

The wetland areas were delineated using the Corps's wetlands delineation methodology. In addition to the delineated wetlands, other intermittent flow areas were found within the alternative footprint that did not comprise wetlands.

3.5.1.2.3 Compensatory Mitigation Sites

Potential mitigation sites for this alternative would be the same as described above for the Ripsey Wash TSF Alternative. See Section 3.5.1.1.4, Compensatory Mitigation Sites.

3.5.2 Environmental Consequences

3.5.2.1 Effects of the No Action Alternative

Under the no action alternative, neither the Ripsey Wash nor the Hackberry Gulch TSF would be constructed. Wetlands and other waters of the U.S. on site would retain their current form, functions, and values into the foreseeable future.

3.5.2.2 Effects of the Ripsey Wash TSF Alternative

The Ripsey Wash TSF alternative would result in the direct disturbance of approximately 134.36 acres of jurisdictional ephemeral drainages that would be filled, excavated, dewatered, or subject to surficial disturbances resulting in the loss or significant modification of their form, functions and values. The functions and values of these resources, as described in **Appendix J, Compensatory Mitigation**, would be completely lost as a result of the implementation of this alternative, while washes subject to dewatering effects would lose a portion of their functions and values. Some value would be retained as these washes would not be directly impacted by ground disturbing activities but would still provide smaller scale ecological functions.

These impacts would be mitigated through the implementation of the compensatory mitigation plan, See **Appendix J, Compensatory Mitigation**. In this plan, the applicant has identified four mitigation sites that would provide compensatory mitigation for the loss of functions and values associated with the impacted ephemeral washes. Preservation and restoration of aquatic resources at these sites have been proposed to address mitigation. In addition, credits will be purchased from the Lower San Pedro River Wildlife Area (LSPRWA) In-Lieu Fee project. The mitigation requirements for this project were calculated using the Corps' South Pacific Division procedures for determining mitigation ratios for compensatory mitigation. Qualitative methods were used to assess the functions and values of the impacted ephemeral drainages and the compensatory mitigation sites. After mitigation ratios were applied to the proposed impacts, compensatory requirements were calculated. The proposed mitigation plan is expected to fully compensate for the loss of aquatic resources under this alternative based on a preliminary review by the Corps.

No effects are expected to waters of the U.S. as a result of the relocation of the Arizona Trail or from work in the areas proposed for waters of the U.S. mitigation because there is no work proposed in waters of the U.S. (see **Appendix J, Compensatory Mitigation**). With the completion of the 404 mitigation work, there would be improvement to the waters of the U.S. in the mitigation areas.

3.5.2.3 Effects of the Hackberry Gulch TSF Alternative

Implementation of Hackberry Gulch TSF alternative would result in the direct disturbance through filling, excavation, or various construction activities of approximately 71.50 acres of waters of the U.S. The waters of the U.S. within the disturbance footprint for this alternative include ephemeral drainages, intermittent drainages, and wetlands for which their form, functions and values would be lost or significantly modified. The wetlands that would be impacted under this alternative are classified as "special aquatic sites" under the 404(b)(1) guidelines (40 CFR Part 230).

Per these guidelines (40 CFR 230.10[a][3]), there is a rebuttable presumption that practicable alternatives are presumed to have a less adverse impact on the aquatic ecosystem than alternatives that do impact special aquatic sites. This presumption is part of the consideration for determining the Least Environmentally Damaging Practicable Alterative (LEDPA), which the Corps must select for a permit. See **Appendix B, Alternative Screening and Clean Water Act Section 404(b)(1) Alternative Analysis.**

Impacts to aquatic resources under this alternative would be mitigated in a similar fashion as the Ripsey Wash TSF Alternative. Using the functions and values calculated for the aquatic resources that would be lost and the mitigation ratio-setting checklist required by the South Pacific Division, the Applicant would provide sufficient compensatory mitigation to fully mitigate for the loss of aquatic resources and the "special aquatic sites" under this alternative. Potentially, the same mitigation sites could be used to provide for mitigation under this Alternative, but a separate plan would have to be developed by the Applicant in consultation with the Corps. Lost functions associated with intermittent drainages and wetlands under this alternative would have to be assessed and accounted for as part of the compensatory mitigation plan.

No effects are expected to waters of the U.S. as a result of the work in the areas proposed for waters of the U.S. mitigation (see **Appendix J, Compensatory Mitigation**). With the completion of the 404 mitigation work, there would be improvement to the waters of the U.S. in the mitigation areas.

3.6 GROUNDWATER HYDROLOGY

Identify any impacts to groundwater flow and quality within and surrounding the proposed TSF area. *The areas of concern include: (1) the potential to alter existing groundwater hydrologic systems by tailings disposal; (2) changes in alluvial and bedrock groundwater chemistry as a result of tailings disposal; and (3) any impacts on existing groundwater wells.*

3.6.1 Affected Environment

Groundwater within the Ripsey Wash and Hackberry Gulch TSF sites occurs in both bedrock and in Quaternary sediments. The geology of these alternatives is discussed in Section 3.3, Geology and Geochemistry.

The regional bedrock has varying degrees of groundwater and its flow direction generally mirrors topography, from the mountains to the valley floors and then down-drainage. There can be preferential flow locally along fracture and fault systems in the bedrock. Fracture systems are influenced by structural episodes of faulting and folding, which have sheared, foliated or lineated the bedrock.

Quaternary sediments are found along the Gila River and many of its tributary watersheds. The unconsolidated Quaternary sediments are a mixture of clays, silts, sands and gravels. These alluvial sediments are recharged by infiltration of precipitation, by flow losses from drainages, and by discharge from the bedrock groundwater systems. The regional surface and groundwater systems are interdependent; groundwater contributes in some areas to the Gila River baseflow (gaining reach), while surface flow in the Gila River contributes to groundwater recharge (losing reach) in other areas. Seasonal variation in this interrelationship is common.

The Ripsey Wash and Hackberry Gulch TSF sites are located in the western portion of the Southeastern Arizona Groundwater Planning Area (Anderson, Greethy and Tucci 1992). This Planning Area has fourteen groundwater basins, which are characterized by alluvial basins in gently sloping valleys separated by mountain ranges. The various basin locations are illustrated on **Figure 29, Groundwater Basins of the Southeastern Arizona Planning Area**.

Groundwater accounts for approximately 84% of the water supply demand in the Southeastern Arizona Groundwater Planning Area (ADWR, 2009).

3.6.1.1 Ripsey Wash TSF Site

The Ripsey Wash TSF site is located in the Donnelly Wash Groundwater Basin, which is a small 293 square mile basin in the northwestern portion of the Southeastern Arizona Groundwater Planning Area. See **Figure 29, Groundwater Basins of the Southeastern Arizona Planning Area**. There have been exceedances of drinking water standards in this basin for arsenic, fluoride and nitrates (ADWR, 2009).

The Gila River flows east to west through this basin; numerous drainages, including Ripsey and Zelleweger washes are tributaries to the Gila River. See Section 3.4, Surface Water. In general, groundwater flow follows surface water drainage patterns, flowing toward the Gila River. At the Ripsey Wash TSF site, the direction of groundwater movement is northward toward the Gila River, at a gradient of approximately 3.5 feet per 100 feet (or about 0.035 ft/ft). See **Figure 30, Groundwater Hydrology - Ripsey Wash TSF**.

Eleven monitoring wells and nineteen piezometers were used at the Ripsey Wash TSF site to evaluate the hydrogeological characteristics of the site and to monitor groundwater quantity and quality. See **Figure 30, Groundwater Hydrology - Ripsey Wash TSF.**

Monitoring well information, including depth to groundwater, is summarized in **Table 3-31, Monitoring Well Information – Ripsey Wash TSF Site** (1)(2).

Table 3-31, Monitoring Well Information – Ripsey Wash TSF Site (1)(2)

Well ID	MW-1	MW-1A	MW-1B	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9
Total Well Depth (ft)	200	80	172	72	265	141	161	250	345	180	70
Depth to Bedrock (ft)	18	71	71	0	85	8.5	8	90	20	30	64
Static Water Level (ft)(2)	89	56	62	44	154	32	65	96	97	80	Dry
Completion of Well	bedrock	alluvial	bedrock	bedrock	bedrock	bedrock	bedrock	bedrock	bedrock	bedrock	alluvial

Notes:
1. See Figure 30, Groundwater Hydrology - Ripsey Wash TSF, for monitoring well locations.
2. Static water levels measured in February 2014.

Information about the piezometers, including their specific purposes and depths to groundwater, is set forth in **Table 3-32, Piezometer Information – Ripsey Wash TSF Site** (1)(2).

3.6.1.1.1 Bedrock Hydrogeology and Groundwater Quality at Ripsey Wash TSF Site

Groundwater was encountered in all of the bedrock monitoring wells and most of the piezometer wells at the Ripsey Wash TSF site (AMEC, 2014).

Pump tests[35] were conducted in bedrock wells (except MW-1B and MW-2), and these tests revealed low groundwater yields, at rates averaging 0.25 to 3.6 gallons per minute (gpm). See **Table 3-33, Pump Test Results - Ripsey Wash TSF** (1). MW-1B and MW-2 were not tested because of extremely low yields from

[35] Step-discharge and/or constant-rate discharge, single well pumping tests were performed (AMEC 2014).

these wells (<0.005 gpm). Due to the limited yields from the tested wells, the pumping portion of the tests ranged from one to four hours, at which time the wells were pumped dry.

Table 3-32, Piezometer Information – Ripsey Wash TSF Site (1)(2)

Piezometer ID	Total Depth (ft)	Depth to Bedrock (ft)	Static Water Level (ft)	Purpose of Piezometer
P-1	127	50	Dry	Investigate the hydrogeological conditions along the alignment of the proposed seepage collection trench in Ripsey Wash.
P-2	136	44	49	Same as P-1.
P-3	122	27	N/A	Same as P-1.
P-4	142	104	Dry	Same as P-1.
P-5	142	93	Dry	Same as P-1.
P-6	127	54	Dry	Same as P-1.
P-7	81	12	44	Same as P-1.
P-8	100	97	90	Same as P-1.
P-9	178	2	140	Investigate the thickness of the Tertiary deposits along the west side of the proposed Ripsey Wash TSF and to characterize conditions along the Hackberry Fault.
P-10	168	37	113	Same as P-9.
P-11	79	14	18	Investigate the hydrogeological conditions at the proposed cut off wall in the East Wash drainage.
P-12	79	21	24	Same as P-11.
P-13	180	14	139	Same as P-9.
P-14	94	19	66	Same as P-9.
P-15	179	35	69	Same as P-9.
P-16	199	5	NM	Characterize subsurface conditions along the Ripsey Fault trend.
P-17	99	5	NO	Same as P-16.
P-18	64	16	NO	Same as P-11.
P-19	80	10	NM	Same as P-11.

Notes:

1. See **Figure 30, Groundwater Hydrology - Ripsey Wash TSF**, for piezometer locations.
2. Static water levels measured in February 2014 for all piezometers except P-14 and P-15, which were measured in March 2014.
3. Abbreviations:
4. N/A = not applicable
5. NM = not measured
6. NO = not observed

Table 3-33, Pump Test Results - Ripsey Wash TSF (1)

Well ID(2)	Bedrock Unit	Average Pump Rate (gpm)	Hydraulic Conductivity(3) (cm/s)	Transmissivity(4) (gpd/ft)
MW-1	Ruin Granite	1.5	1.37×10^{-5}	12.6
MW-3	Lower Member of San Manuel and Ruin Granite	3.6	1.33×10^{-4}	138.5
MW-4	Upper Member of San Manuel	0.25	6.72×10^{-7}	1.7
MW-5	Ruin Granite	1.2	3.02×10^{-6}	5.7
MW-6	Upper Member of San Manuel	1.8	1.19×10^{-6}	6.4
MW-7	Ruin Granite	1.5	1.98×10^{-6}	6.7
MW-8	Lower Member of San Manuel	1.4	3.50×10^{-6}	7.2

Notes:

1. Source: AMEC 2014a
2. See **Figure 30, Groundwater Hydrology - Ripsey Wash TSF**, for monitoring well locations.
3. Hydraulic conductivity is the ease with which water can move through rock pore spaces and fractures, and depends on the permeability of the material and the amount of saturation.
4. Transmissivity is the rate at which water is transmitted through rock under a unit hydraulic gradient, which is approximately 3.5 ft per 100 ft (or 0.035 ft/ft) for the Ripsey Wash TSF site.
5. **Abbreviations: gpm** = gallons per minute, **cm/s** = centimeters per second, **gpd/ft** = gallons per day per foot

The pumping test results for the bedrock wells were relatively consistent, with the exception of the results for MW-3, which was advanced through the Hackberry Fault zone. As explained in Section 3.3, Geology, Geotechnical and Geochemistry, this fault zone underlies the western portion of the Ripsey Wash TSF and occurs along the contact between the Lower Member of the San Manuel Formation and the Ruin Granite.

Two hundred thirty six packer tests were conducted in borings within and surrounding the Ripsey Wash TSF site to obtain hydraulic conductivity values for the bedrock. The tests revealed relatively low hydraulic conductivity values in the overall (non-fractured) bedrock. See **Table 3-34, Hydraulic Conductivities of Bedrock Units - Ripsey Wash TSF Site** (1)(2).

Table 3-34, Hydraulic Conductivities of Bedrock Units - Ripsey Wash TSF Site (1)(2)

Bedrock Unit	Hydraulic Conductivity (cm/sec)		
	Maximum	Minimum	Average
Ruin granite	8.49×10^{-5}	5.06×10^{-7}	1.10×10^{-5}
Diabase	3.02×10^{-47}	1.01×10^{-7}	3.45×10^{-5}
Lower Member San Manuel	3.87×10^{-4}	2.20×10^{-7}	3.60×10^{-5}
Upper Member San Manuel	1.06×10^{-6}	1.21×10^{-7}	6.06×10^{-7}

Notes:
Source: AMEC 2014a.
These hydraulic conductivity values represent (non-fractured) bedrock and do not include values for Hackberry Fault zone.
Abbreviation: cm/s = centimeters per second

Based on packer tests in piezometers P-9, P-13, P-14 and P-15, the Hackberry Fault zone has greater permeability values than the overall bedrock. See **Table 3-35, Hydraulic Conductivities of the**

Hackberry Fault Zone - Ripsey Wash TSF Site. This fault zone provides a preferential pathway for groundwater movement through bedrock.

Table 3-35, Hydraulic Conductivities of the Hackberry Fault Zone - Ripsey Wash TSF Site

Bedrock Unit	Hackberry Fault Hydraulic Conductivity (cm/sec)		
	Maximum	Minimum	Average
Ruin Granite	1.60×10^{-4}	9.67×10^{-6}	4.77×10^{-5}
Lower Member San Manuel	4.23×10^{-4}	5.83×10^{-6}	1.94×10^{-4}
Notes: Source: AMEC 2014a			

Based on packer tests in piezometers P-16 and P-17, the Ripsey Fault zone, which underlies the northern portion of the Ripsey Wash TSF site, has hydraulic conductivity values similar to those of the overall non-fractured bedrock. See **Table 3-36, Hydraulic Conductivities of the Ripsey Fault Zone - Ripsey Wash TSF Site**. These values indicate that the Ripsey Fault zone does not act as a preferential pathway for groundwater movement.

Table 3-36, Hydraulic Conductivities of the Ripsey Fault Zone - Ripsey Wash TSF Site

Bedrock Unit	Ripsey Fault Hydraulic Conductivity (cm/sec)		
	Maximum	Minimum	Average
Ruin Granite	8.5×10^{-5}	1.9×10^{-6}	1.2×10^{-5}

The bedrock underlying the Ripsey Wash TSF site is recharged by infiltration of precipitation, which based on case studies of mine sites in semi-arid environments, is estimated to be 5 to 15% of annual precipitation (Hutchinson and Ellison, 1992). Infiltration from local washes contributes to recharge, but all washes in the Ripsey Wash TSF site are ephemeral, so infiltration is seasonal. Bedrock water is mostly under unconfined conditions and, as explained previously, can be affected by fault zones, in particular the Hackberry Fault zone.

Baseline groundwater quality data from 2014 and 2015 (eight quarterly sampling events) from proposed compliance wells MW-1A, 1B, 2, and 3 are summarized in in **Table 3-37, Summary of Baseline Groundwater Quality - Ripsey Wash TSF Site**.

Table 3-37, Summary of Baseline Groundwater Quality - Ripsey Wash TSF Site

Monitoring Well 1-A

Analyte	Units	MW-1A	Period of Record 2-2014 through 2-2015			AAWQS[1]
General Inorganics		**Min**	**Median**	**Mean**	**Max**	
Alkalinity as CaCO3	mg/L[2]	260	280	279	290	---
Bicarbonate Alkalinity as CaCO3	mg/L	260	280	278	290	---
Carbonate Alkalinity as CaCO3	mg/L	3.0	3.0	3.0	3.0	---
Hydroxide Alkalinity as CaCO3	mg/L	3.0	3.0	3.0	3.0	---
Calcium	mg/L	260	280	280	300	---
Chloride	mg/L	260	275	275	300	---
Fluoride	mg/L	1.4	1.6	1.6	1.7	4
Magnesium	mg/L	36.0	40.0	39.5	42.0	---
Nitrate as N	mg/L	0.2	0.3	0.3	0.6	10
Nitrite as N	mg/L	0.1	0.1	0.1	0.1	1
Nitrate-Nitrite as N	mg/L	0.2	0.3	0.3	0.6	10
Potassium	mg/L	2.6	2.8	2.8	3.0	---
Sodium	mg/L	280	310	315	350	---
Sulfate	mg/L	850	870	880	930	---
Total Dissolved Solids	mg/L	1500	2050	2000	2200	---
pH	s.u.[3]	7.1	7.2	7.2	7.4	---
Dissolved Metals		**Min**	**Median**	**Mean**	**Max**	
Antimony	mg/L	0.0015	0.0015	0.0017	0.003	0.006
Arsenic	mg/L	0.0015	0.0015	0.0017	0.003	0.05
Barium	mg/L	0.024	0.0250	0.0246	0.025	2
Beryllium	mg/L	0.0005	0.0005	0.0005	0.0005	0.004
Cadmium	mg/L	0.0005	0.0005	0.0006	0.001	0.005
Chromium	mg/L	0.005	0.0050	0.0050	0.005	0.1
Cobalt	mg/L	0.005	0.0050	0.0069	0.02	---
Copper	mg/L	0.0031	0.0050	0.0048	0.006	---
Lead	mg/L	0.0075	0.0075	0.0075	0.0075	0.05
Manganese	mg/L	0.005	0.0050	0.0066	0.012	---
Mercury	mg/L	0.0001	0.0001	0.0001	0.0001	0.002

Table 3-37, Summary of Baseline Groundwater Quality - Ripsey Wash TSF Site (continued)

Analyte	Units	MW-1A	Period of Record 2-2014 through 2-2015			AAWQS[1]
Nickel	mg/L	0.005	0.0072	0.0076	0.011	0.1
Selenium	mg/L	0.001	0.0010	0.0011	0.002	0.05
Thallium	mg/L	0.0005	0.0005	0.0005	0.0005	0.002
Zinc	mg/L	0.005	0.0250	0.0225	0.025	---
Field Measurments		**Min**	**Median**	**Mean**	**Max**	
Field pH	s.u.	6.8	7.1	7.1	7.2	---
Field Conductivity	us/cm[4]	2480	2745	2718	2920	---
Field Temperature	^{o}C[5]	24.4	24.7	24.7	25.2	---

Monitoring Well 1-B

Analyte	Units	MW-1B	Period of Record 2-2014 through 2-2015			AAWQS[1]
General Inorganics		**Min**	**Median**	**Mean**	**Max**	
Alkalinity as CaCO3	mg/L[2]	35	40	42	50	---
Bicarbonate Alkalinity as CaCO3	mg/L	35	40	42	50	---
Carbonate Alkalinity as CaCO3	mg/L	3.0	3.0	3.0	3.0	---
Hydroxide Alkalinity as CaCO3	mg/L	3.0	3.0	3.0	3.0	---
Calcium	mg/L	74	80	80	83	---
Chloride	mg/L	110	120	120	130	---
Fluoride	mg/L	2.2	2.3	2.3	2.6	4
Magnesium	mg/L	8.5	9.2	9.1	9.6	---
Nitrate as N	mg/L	0.1	0.3	0.3	0.4	10
Nitrite as N	mg/L	0.1	0.1	0.1	0.5	1
Nitrate-Nitrite as N	mg/L	0.1	0.3	0.3	0.4	10
Potassium	mg/L	3.3	3.4	3.5	3.9	---
Sodium	mg/L	290	300	302	310	---
Sulfate	mg/L	600	680	665	700	---
Total Dissolved Solids	mg/L	1200	1200	1233	1300	---
pH	s.u.[3]	7.7	7.8	7.8	8.0	---

Table 3-37, Summary of Baseline Groundwater Quality - Ripsey Wash TSF Site (continued)

Monitoring Well 1-B (continued)

Analyte	Units	MW-1B	Period of Record 2-2014 through 2-2015			AAWQS[1]
Dissolved Metals		**Min**	**Median**	**Mean**	**Max**	
Antimony	mg/L	0.0015	0.0015	0.0018	0.003	0.006
Arsenic	mg/L	0.0015	0.0015	0.0018	0.003	0.05
Barium	mg/L	0.012	0.0150	0.0212	0.044	2
Beryllium	mg/L	0.0005	0.0005	0.0005	0.0005	0.004
Cadmium	mg/L	0.0005	0.0005	0.0007	0.001	0.005
Chromium	mg/L	0.005	0.0050	0.0050	0.005	0.1
Cobalt	mg/L	0.005	0.0050	0.0050	0.005	---
Copper	mg/L	0.0015	0.0042	0.0041	0.006	---
Lead	mg/L	0.0075	0.0075	0.0075	0.0075	0.05
Manganese	mg/L	0.005	0.0210	0.2748	1.3	---
Mercury	mg/L	0.0001	0.0001	0.0001	0.0001	0.002
Nickel	mg/L	0.0025	0.0032	0.0038	0.0063	0.1
Selenium	mg/L	0.001	0.0010	0.0012	0.002	0.05
Thallium	mg/L	0.0005	0.0005	0.0005	0.0005	0.002
Zinc	mg/L	0.005	0.0250	0.0217	0.025	---
Field Measurments		**Min**	**Median**	**Mean**	**Max**	
Field pH	s.u.	7.7	7.8	7.8	8.1	---
Field Conductivity	us/cm[4]	1430	1645	1599	1690	---
Field Temperature	^{o}C[5]	24.9	25.1	25.2	25.5	---

Monitoring Well 2

Analyte	Units	MW-2	Period of Record 2-2014 through 2-2015			AAWQS[1]
General Inorganics		**Min**	**Median**	**Mean**	**Max**	
Alkalinity as CaCO3	mg/L[2]	200	200	207	230	---
Bicarbonate Alkalinity as CaCO3	mg/L	200	200	207	230	---
Carbonate Alkalinity as CaCO3	mg/L	3.0	3.0	3.0	3.0	---
Hydroxide Alkalinity as CaCO3	mg/L	3.0	3.0	3.0	3.0	---
Calcium	mg/L	64	72	73	80	---

Table 3-37, Summary of Baseline Groundwater Quality - Ripsey Wash TSF Site (continued)

Monitoring Well 2 (continued)

Analyte	Units	MW-2	Period of Record 2-2014 through 2-2015			AAWQS[1]
General Inorganics		**Min**	**Median**	**Mean**	**Max**	
Chloride	mg/L	120	125	127	140	---
Fluoride	mg/L	4.6	5.2	5.1	5.7	4
Magnesium	mg/L	9.7	12.0	11.8	14.0	---
Nitrate as N	mg/L	0.1	0.1	0.1	0.3	10
Nitrite as N	mg/L	0.1	0.1	0.1	0.1	1
Nitrate-Nitrite as N	mg/L	0.1	0.1	0.1	0.2	10
Potassium	mg/L	5.0	6.9	7.2	11.0	---
Sodium	mg/L	500	555	548	570	---
Sulfate	mg/L	920	1050	1037	1100	---
Total Dissolved Solids	mg/L	1900	2000	2000	2100	---
pH	s.u.[3]	7.5	7.5	7.5	7.6	---
Dissolved Metals		**Min**	**Median**	**Mean**	**Max**	
Antimony	mg/L	0.0015	0.0015	0.0021	0.006	0.006
Arsenic	mg/L	0.0015	0.0015	0.0023	0.006	0.05
Barium	mg/L	0.03	0.0390	0.0426	0.06	2
Beryllium	mg/L	0.0005	0.0005	0.0005	0.0005	0.004
Cadmium	mg/L	0.0005	0.0005	0.0007	0.002	0.005
Chromium	mg/L	0.005	0.0050	0.0050	0.005	0.1
Cobalt	mg/L	0.005	0.0050	0.0069	0.02	---
Copper	mg/L	0.005	0.0081	0.0088	0.018	---
Lead	mg/L	0.0075	0.0075	0.0075	0.0075	0.05
Manganese	mg/L	0.005	0.0090	0.0195	0.058	---
Mercury	mg/L	0.0001	0.0001	0.0001	0.0001	0.002
Nickel	mg/L	0.0038	0.0050	0.0131	0.045	0.1
Selenium	mg/L	0.001	0.0015	0.0022	0.0053	0.05
Thallium	mg/L	0.0005	0.0005	0.0007	0.002	0.002
Zinc	mg/L	0.012	0.0250	0.0234	0.025	---

Table 3-37, Summary of Baseline Groundwater Quality - Ripsey Wash TSF Site (continued)

Monitoring Well 2 (continued)

Analyte	Units	MW-2	Period of Record 2-2014 through 2-2015			AAWQS[1]
Field Measurments		**Min**	**Median**	**Mean**	**Max**	
Field pH	s.u.	7.3	7.6	7.5	7.7	---
Field Conductivity	us/cm[4]	1999	2746	2621	2940	---
Field Temperature	^{o}C[5]	24.6	24.7	24.7	25.2	---

Monitoring Well 3

Analyte	Units	MW-3	Period of Record 2-2014 through 2-2015			AAWQS[1]
General Inorganics		**Min**	**Median**	**Mean**	**Max**	
Alkalinity as CaCO3	mg/L[2]	180	190	186	190	---
Bicarbonate Alkalinity as CaCO3	mg/L	180	190	186	190	---
Carbonate Alkalinity as CaCO3	mg/L	3.0	3.0	3.0	3.0	---
Hydroxide Alkalinity as CaCO3	mg/L	3.0	3.0	3.0	3.0	---
Calcium	mg/L	180	190	187	200	---
Chloride	mg/L	140	150	149	150	---
Fluoride	mg/L	1.2	1.4	1.4	1.6	4
Magnesium	mg/L	29.0	29.0	29.9	32.0	---
Nitrate as N	mg/L	9.9	10.0	10.0	10.0	10
Nitrite as N	mg/L	0.1	0.1	0.1	0.1	1
Nitrate-Nitrite as N	mg/L	9.9	10.0	10.0	10.0	10
Potassium	mg/L	3.0	3.1	3.1	3.2	---
Sodium	mg/L	64	66	67	71	---
Sulfate	mg/L	260	290	288	300	---
Total Dissolved Solids	mg/L	970	1000	1009	1100	---
pH	s.u.[3]	7.0	7.2	7.2	7.3	---
Dissolved Metals		**Min**	**Median**	**Mean**	**Max**	
Antimony	mg/L	0.0015	0.0015	0.0015	0.0015	0.006
Arsenic	mg/L	0.0015	0.0015	0.0015	0.0015	0.05
Barium	mg/L	0.005	0.0115	0.0106	0.017	2
Beryllium	mg/L	0.0005	0.0005	0.0006	0.001	0.004

Table 3-37, Summary of Baseline Groundwater Quality - Ripsey Wash TSF Site (continued)

Monitoring Well 3 (continued)

Analyte	Units	MW-3	Period of Record 2-2014 through 2-2015			AAWQS[1]
Dissolved Metals		**Min**	**Median**	**Mean**	**Max**	
Cadmium	mg/L	0.0005	0.0005	0.0005	0.0005	0.005
Chromium	mg/L	0.005	0.0050	0.0050	0.005	0.1
Cobalt	mg/L	0.005	0.0050	0.0069	0.02	---
Copper	mg/L	0.0015	0.0015	0.0024	0.005	---
Lead	mg/L	0.0075	0.0075	0.0075	0.0075	0.05
Manganese	mg/L	0.005	0.0050	0.0070	0.014	---
Mercury	mg/L	0.0001	0.0001	0.0001	0.0001	0.002
Nickel	mg/L	0.005	0.0280	0.0295	0.059	0.1
Selenium	mg/L	0.0064	0.0075	0.0075	0.0084	0.05
Thallium	mg/L	0.0005	0.0005	0.0005	0.0005	0.002
Zinc	mg/L	0.005	0.0250	0.0225	0.025	---
Field Measurments		**Min**	**Median**	**Mean**	**Max**	
Field pH	s.u.	6.8	7.1	7.0	7.2	---
Field Conductivity	us/cm[4]	1277	1331	1351	1488	---
Field Temperature	ºC[5]	25.6	25.9	25.9	26.3	---

Note: Non-detected values were set at 1/2 the analytical reporting limit for computational purposes

1. AAWQS - Arizona Aquifer Water Quality Standard
2. mg/L - milligrams per liter
3. s. u. - standard units
4. µs/cm - microsiemens per centimeter
5. ºC - degrees Centigrade

Compared to Arizona Aquifer Water Quality Standards, the only general inorganic parameter that exceeded a standard was fluoride in bedrock well MW-2 (up to 5.7 mg/L versus a standard of 4 mg/L). None of the monitored metals exceeded a standard; and, although radionuclides are not shown in the table, none of the monitored radionuclides (radium 226; radium 228; radium 226+228; total uranium; and gross alpha) exceeded a standard.

Field measurements indicate that groundwater sampled from the compliance wells are near neutral pHand electrical conductivities range from 1277 to 2940 microsiemens per centimeter (µs/com). Groundwater temperatures in these wells were warm and ranged from 24.4ºC to 26.3ºC.

3.6.1.1.2 Alluvial Hydrogeology and Groundwater Quality at Ripsey Wash TSF

Alluvial groundwater is found in the Quaternary sediments along the Gila River and in the alluvial sediments in Ripsey Wash, near the contact between the alluvial material and the underlying bedrock.

No groundwater was found in the alluvial sediments in either the East Wash or Zelleweger Wash (AMEC, 2014a).

Based on geotechnical and hydrogeological drilling at the site, the thickness of the alluvial deposits in Ripsey Wash reach approximately 100 feet, while the thickness of alluvial deposits in the East Wash reach approximately 21 feet.

Depths to groundwater in MW-1A and P-8, which are located in Ripsey Wash, are set forth in **Table 3-31, Monitoring Well Information – Ripsey Wash TSF Site** (1)(2)**,** and **Table 3-32, Piezometer Information – Ripsey Wash TSF Site** (1)(2)**.** Saturated thicknesses in these wells were less than 20 feet. Monitoring well MW-9, located in Zelleweger Wash, is dry. The pump test on MW-1A revealed high average hydraulic conductivity for the alluvial sediments in Ripsey Wash at 4.6 x 10^{-2} cm/sec, with an estimated transmissivity of 14,744 gpd/ft (AMEC, 2014a).

The alluvial sediments in the Gila River and tributary washes are recharged by precipitation, direct infiltration from flows in the drainages, and inflow from bedrock groundwater. Groundwater flow in the alluvial sediments follows the local topography.

Groundwater quality data for alluvial well MW-1A are presented in **Table 3-37, Summary of Baseline Groundwater Quality - Ripsey Wash TSF Site**. No parameters exceeded AWQS in the analyses of water from MW-1A, and groundwater analyses for water from this well are similar to those analyses for bedrock groundwater.

3.6.1.1.3 Existing Groundwater Wells at Ripsey Wash TSF Site

Based on ADWR data, there are 39 registered wells located within 0.5 miles of the Ripsey Wash TSF and supporting infrastructure (site roads, diversion structures, pipelines, drain-down pond, seepage trenches, reclaim ponds, etc.). **See Table 3-38, Registered Wells within 0.5 Miles of Ripsey Wash TSF Site**.

Table 3-38, Registered Wells within 0.5 Miles of Ripsey Wash TSF Site

Well Number	ADWR Registry ID	Well Owner	Well Type	Well Depth	Well Location
RW-1	220883	Asarco	Monitor	NR	Down-gradient of TSF
RW-2	220887	Asarco	Monitor	NR	TSF Footprint
RW-3	220891	Asarco	Monitor	NR	Down-gradient of TSF
RW-4	902827	Asarco	Geotechnical	NR	TSF Footprint
RW-5	914144	Asarco	Exploration	1000	Down-gradient of TSF
RW-6	914632	Asarco	Monitor	NR	Down-gradient of TSF
RW-7	914664	Asarco	Monitor	NR	TSF Footprint
RW-8	914665	Asarco	Monitor	NR	TSF Footprint
FW-9	914474	Asarco	Monitor	127	Down-gradient of TSF
RW-10	914475	Asarco	Monitor	138	Down-gradient of TSF
RW-11	914476	Asarco	Monitor	122	Down-gradient of TSF
RW-12	914479	Asarco	Monitor	127	Down-gradient of TSF
RW-13	914481	Asarco	Monitor	70	Down-gradient of TSF

Table 3-38, Registered Wells within 0.5 Miles of Ripsey Wash TSF Site (continued)

Well Number	ADWR Registry ID	Well Owner	Well Type	Well Depth	Well Location
RW-14	220884	Asarco	Monitor	NR	Down-gradient of TSF
RW-15	220885	Asarco	Monitor	NR	TSF Footprint
RW-16	220886	Asarco	Monitor	NR	TSF Footprint
RW-17	220888	Asarco	Monitor	NR	TSF Footprint
RW-18	220889	Asarco	Monitor	NR	TSF Footprint
RW-19	220890	Asarco	Monitor	NR	Up-gradient of TSF
RW-20	220892	Asarco	Monitor	NR	TSF Footprint
RW-21	615335	ASLD	Exempt	37	TSF Footprint
RW-22	807260	ASLD	Exempt	NR	Down-gradient of TSF
RW-23	807261	ASLD	Exempt	NR	Down-gradient of TSF
RW-24	914663	Asarco	Monitor	NR	TSF Footprint
RW-25	914666	Asarco	Monitor	NR	Down-gradient of TSF
RW-26	914667	Asarco	Monitor	NR	Down-gradient of TSF
RW-27	914696	Asarco	Monitor	NR	TSF Footprint
RW-28	914447	Asarco	Monitor	122	TSF Footprint
RW-29	914478	Asarco	Monitor	142	Down-gradient of TSF
RW-30	914480	Asarco	Monitor	100	Down-gradient of TSF
RW-31	500041	Asarco	Exempt	250	Near tailings pipeline
RW-32	518060	Asarco	Exploration	675	Near tailings pipeline
RW-33	521218	Asarco	Exploration	20	Near tailings pipeline
RW-34	524869	Asarco	Exploration	NR	Near tailings pipeline
RW-35	617421	Asarco	Exempt	NR	Near tailings pipeline
RW-36	807138	Asarco	Exploration	102	Near tailings pipeline
RW-37	645330	Hunt	Exempt	32	Near drain-down pond
RW-38	645887	Morrow	Exempt	65	Down-gradient of TSF (A-Diamond Ranch)
RW-39	593519	Bradford	Exempt	57	Down-gradient of TSF (A-Diamond Ranch)

Notes:
1. Source: Arizona Department of Water Resources (ADWR) (2014).
2. Abbreviations: NR= not reported.

Thirty three of these wells have been installed and are owned by ASARCO; these wells were installed as part of Asarco's geological, geotechnical, and hydrogeological work for the Ripsey Wash TSF. The remaining six (non-Asarco) wells are classified as "exempt" by ADWR, which allows for domestic and/or livestock use of the groundwater.[36]

The six (non-Asarco) wells are as follows:

- Well RW-21 (ADWR Registration No. 615335) – located within the footprint of the Ripsey Wash TSF. The well is owned by the ASLD and is 37 feet deep.
- Well RW-22 (ADWR Registration No. 807260) – located down-gradient of the Ripsey Wash TSF on the north side of the Florence-Kelvin highway. The well is also owned by the ASLD, was drilled in 1976, but its depth is not reported. A field survey revealed the well is abandoned (WestLand, 2014a).
- Well RW-23 (ADWR Registration No. 807261) – located down-gradient from the Ripsey Wash TSF on the south side of Florence-Kelvin highway. The well is also owned by ASLD, was drilled in 1976, but its depth is not reported. The well is active, supplying water to a holding tank and watering trough (WestLand, 2014a).
- Well RW-37 (AWDR Registration No. 645330) – located north of the Gila River and east of the proposed drain-down pond. The well is privately-owned, was drilled in 1971, and is 32 feet deep.
- Well RW-38 (ADWR Registration No. 645887) – located on the A-Diamond Ranch. It is privately-owned, was drilled in the early 1980s, and is 65 feet deep.
- Well RW-39 (ADWR Registration No. 593519) – located on the A-Diamond Ranch. It is privately-owned, was drilled in 2002, and is 57 feet deep.

If the State lands in and around the Ripsey Wash TSF site are sold by auction to Asarco, the above-listed ASLD wells would be transferred to Asarco. Similarly, Asarco has a purchase option on the A-Diamond Ranch, and these wells would be transferred to Asarco, if the option is exercised. The remaining non-Asarco well is located on the north side of the Gila River, approximately 0.4 miles upstream and up-gradient from the proposed drain-down pond.

3.6.1.2 Hackberry Gulch TSF Site

The Hackberry Gulch TSF site is located in the northern portion of the Lower San Pedro Groundwater Basin, which is a 1,624-square mile basin on the western side of the Southeastern Arizona Groundwater Planning Area. See **Figure 29, Groundwater Basins of the Southeastern Arizona Planning Area**.

The San Pedro River flows northward in this basin and joins the Gila River in the vicinity of the community of Winkleman. From that confluence, the Gila River flows northward. In general, similar to the Donnelly Wash Basin (and other basins in the Southeastern Groundwater Planning Area), groundwater flow follows surface water drainage patterns, flowing toward the San Pedro River, and then to the Gila River. There have been some exceedances of drinking water standards in this basin for arsenic, antimony, beryllium, cadmium, lead, nitrates, radionuclides, and total dissolved solids (ADWR, 2009).

3.6.1.2.1 Bedrock Hydrogeology and Groundwater Quality at Hackberry Gulch TSF Site

Groundwater occurs in the conglomerate and tuff members of the Big Dome Formation at depths ranging from a few feet in incised gulches to several hundred feet in upland areas.

[36] The "exempt" category allows for a maximum pumping rate of 35 gpm.

The conglomerate units appear to be hydraulically confined, with artesian heads approximately 40 feet above the top of the water bearing units (SHB, 1989). The artesian pressures signify that the conglomerate or tuff units are recharged from higher elevations of the Dripping Spring Formation and that their vertical hydraulic conductivities are lower than their horizontal hydraulic conductivities.

Similar to the Ripsey Wash TSF site, groundwater in the bedrock at the Hackberry Gulch TSF site is recharged by infiltration. Although bedrock groundwater movement is influenced by localized fault and fracture systems that are perpendicular to the topography at the Hackberry Gulch TSF site, the overall regional groundwater flow direction is toward the Gila River.

The hydraulic gradient for the Hackberry Gulch TSF site is projected to be 8 feet per 100 feet (or 0.08 ft/ft), which is the pre-construction hydraulic gradient estimated for the adjacent (and existing) Elder Gulch TSF that has similar geology to the Hackberry Gulch TSF site.

Hydraulic conductivities of the Big Dome Formation conglomerates were determined from past packer testing in the vicinity of the Elder Gulch TSF (SHB, 1989). They range from 4.6×10^{-4} cm/sec to 5.5×10^{-6} cm/sec, and average approximately 2.5×10^{-5} cm/sec. These values are similar to the bedrock hydraulic conductivities at the Ripsey Wash TSF site. However, using Elder Gulch as a hydrogeologic analog to the Hackberry Gulch TSF site, hydraulic conductivities may increase with depth (see Appendix E to the Section 404(b)(1)) between 75 feet and over 300 feet bgs), as opposed to decrease with depth, which is the case at the Ripsey Wash TSF site.

Background water quality data were obtained from five USGS wells located down-gradient from the Hackberry Gulch TSF site, as shown on **Figure 31, Groundwater Hydrology - Hackberry Gulch TSF**. Groundwater quality data for these are presented in **Table 3-39, Groundwater Quality - Hackberry TSF Site**.

Table 3-39, Groundwater Quality - Hackberry TSF Site

Analyte	USGS-AZ D-04-1416CBB 1985(2)	USGS-AZ D-04-1416CBC 1990(2)	USGS-AZ D-04-1407ABC 1952-65(2)	USGS-AZ D-04-1407BBB 1990(2)	USGS-AZ D-04-1406CDC 1985(2)	AAWQS(3)
Field Measurements(4)						
pH	7.5	8.8	7.4	7.2	7.2	---
Electric Conductivity	516	950	4017	4330	3310	---
Temperature	81.5	84.2	77.7	73.4	69.8	---
General Inorganics(5)						
Alkalinity as $CaCO_3$	205	210	349	312	295	---
Total Hardness	158	14.9	901	1360	890	---
Calcium	35	4.1	204	330	240	---
Chloride	20	82	879	900	560	---
Fluoride	0.4	0.3	1.9	0.6	1.2	4

Table 3-39, Groundwater Quality - Hackberry TSF Site (continued)

Analyte	USGS-AZ D-04-1416CBB 1985(2)	USGS-AZ D-04-1416CBC 1990(2)	USGS-AZ D-04-1407ABC 1952-65(2)	USGS-AZ D-04-1407BBB 1990(2)	USGS-AZ D-04-1406CDC 1985(2)	AAWQS(3)
General Inorganics(5)						
Magnesium	17	1.1	71	130	70	---
Nitrate as N	NA	NA	1.7	NA	NA	10
Potassium	5.6	2.1	NA	5.5	7.4	---
Sodium	42	190	453	460	340	---
Sulfate	17	130	386	830	610	---
Total Dissolved Solids	154	283	1137	1462	1051	---
Dissolved Metals(5)						
Arsenic	0.001	0.002	NA	0.001	0.004	0.05
Barium	0.22	0.021	NA	ND	0.071	2
Beryllium	ND	ND	NA	ND	ND	0.004
Cadmium	ND	ND	NA	ND	ND	0.005
Cobalt	ND	ND	NA	0.001	ND	---
Copper	0.01	0.001	NA	0.001	0.02	---
Lead	ND	0.001	NA	ND	ND	0.05
Manganese	0.013	0.002	NA	0.01	0.031	---
Molybdenum	ND	0.006	NA	0.007	0.01	---
Zinc	190	7	NA	10	20	---

Notes:

1. Source: National Water Quality Monitoring Council, Water Quality Portal. This is a cooperative service sponsored by the USGS, EPA and the National Water Quality Monitoring Council (NWQMC). www.waterqualitydata.us. The database did not identify well depths or completion details. See Figure 31, Groundwater Hydrology - Hackberry Gulch TSF.
2. Year(s) sampled.
3. AAWQS are Arizona Aquifer Water Quality Standards set by Arizona DEQ.
4. The pH, electrical conductivity (EC) and temperature were measured at the time of collection. The pH in standard units (s.u.); EC in microsiemens per centimeter (us/cm); and temperature in degrees Fahrenheit (°F).
5. General inorganics and dissolved metals reported in milligrams per liter (mg/l).
6. Abbreviations:
7. NA = not analyzed
8. ND = not detected. Detection limit not reported in database.

3.6.1.2.2 Alluvial Hydrogeology and Groundwater Quality at Hackberry Gulch TSF

Similar to the Ripsey Wash TSF site, alluvial groundwater is found in the Quaternary sediments along the Gila River. Given the small areal extent and limited thicknesses of alluvial sediments within the Hackberry Gulch TSF site, it is expected that the volume of water contained in these sediments is low.

The direction of flow in these deposits follows surface topography. Hydraulic conductivities of the Quaternary deposits typically range between 1 x 10^{-3} and 1 x 10^{-5} cm/sec (Freeze and Cherry, 1979).

3.6.1.2.3 Existing Groundwater Wells at Hackberry Gulch TSF Site

Based on ADWR data, there are 42 registered wells located within 0.5 miles of the Hackberry Gulch TSF and supporting infrastructure (site roads, diversion structures, pipelines, seepage trenches, reclaim ponds, etc.). See **Table 3-40, Registered Wells within 0.5 Miles of Hackberry Gulch TSF Site**.

Table 3-40, Registered Wells within 0.5 Miles of Hackberry Gulch TSF Site

Well Number	ADWR Registry ID	Well Owner	Well Type	Well Depth	Well Location
HW-1	529319	Southwest Gas Corp	Exploration	105	Down-gradient of TSF
HW-2	627462	Sanchez	Exempt	60	Down-gradient of TSF
HW-3	641992	Guilliams	Exempt	54	Down-gradient of TSF
HW-4	642519	Wixom	Exempt	65	Down-gradient of TSF
HW-5	645205	Taylor	Exempt	52	Down-gradient of TSF
HW-6	803149	McNees	Exempt	60	Down-gradient of TSF
HW-7	647746	Hoyt	Exempt	35	Down-gradient of TSF
HW-8	646209	Henley	Exempt	55	Down-gradient of TSF
HW-9	646210	Payton	Exempt	56	Down-gradient of TSF
HW-10	649441	London	Exempt	52	Down-gradient of TSF
HW-11	646286	Leyba	Exempt	40	Down-gradient of TSF
HW-12	648733	Hatfield	Exempt	32	Down-gradient of TSF
HW-13	646769	Fraley	Exempt	35	Down-gradient of TSF
HW-14	646770	Baca	Exempt	47	Down-gradient of TSF
HW-15	649234	Hayes	Exempt	32	Down-gradient of TSF
HW-16	646462	Sisemore	Exempt	230	Down-gradient of TSF
HW-17	809560	Pfahl	Exempt	420	Down-gradient of TSF
HW-18	809596	Stein	Exempt	85	Down-gradient of TSF
HW-19	526274	Asarco	Exploration	NR	Down-gradient of TSF
HW-20	527945	Asarco	Exploration	NR	Down-gradient of TSF
HW-21	529600	Asarco	Monitor	NR	Down-gradient of TSF
HW-22	529601	Asarco	Monitor	NR	Down-gradient of TSF
HW-23	529602	Asarco	Monitor	NR	TSF Footprint
HW-24	531832	Asarco	Monitor	300	Down-gradient of TSF
HW-25	533677	Asarco	Monitor	160	Down-gradient of TSF
HW-26	533678	Asarco	Monitor	200	TSF Footprint
HW-27	535160	Asarco	Monitor	NR	Down-gradient of TSF
HW-28	534346	Asarco	Monitor	205	TSF Footprint

Table 3-40, Registered Wells within 0.5 Miles of Hackberry Gulch TSF Site (continued)

Well Number	ADWR Registry ID	Well Owner	Well Type	Well Depth	Well Location
HW-29	549782	Asarco	Monitor	83	TSF Footprint
HW-30	549783	Asarco	Monitor	23	TSF Footprint
HW-31	915124	Asarco	Monitor	300	Down-gradient of TSF
HW-32	915125	Asarco	Monitor	258	Down-gradient of TSF
HW-33	915126	Asarco	Monitor	40	TSF Footprint
HW-34	915365	Asarco	Monitor	NR	TSF Footprint
HW-35	915366	Asarco	Monitor	NR	TSF Footprint
HW-36	915367	Asarco	Monitor	NR	TSF Footprint
HW-37	915368	Asarco	Monitor	NR	TSF Footprint
HW-38	219671	Asarco under lease to Morris Land & Cattle *	Exempt	500	Up-gradient of TSF Footprint
HW-39	540818	Tucker	Exempt	320	Down-gradient of TSF
HW-40	543984	Weeks	Exempt	365	Down-gradient of TSF
HW-41	549930	O'Hara	Exempt	360	Down-gradient of TSF
HW-42	637740	Santos Ranch	Exempt	565	Down-gradient of TSF

Notes:

1. Source: Arizona Department of Water Resources (ADWR) (2014).
2. Abbreviations: NR= not reported.

* Well is on land owned by Asarco and leased to Morris Land & Cattle.

Twenty of these wells are owned by ASARCO, 19 of which were installed for geological and monitoring. Twenty-two wells are classified as "exempt" by ADWR, which allows for domestic and/or livestock use of the groundwater and allows for pumpage of less than 35 gpm. One well is registered to Southwest Gas Company and registered for exploration.

Of the twenty two wells not owned by Asarco, all are located down-gradient of the Hackberry Gulch TSF. Based on well depth, , most of these downgradient wells are probably completed in Gila River Quaternary deposits.

3.6.2 Environmental Consequences

3.6.2.1 Effects of the No Action Alternative

Under the no action alternative, neither the Ripsey Wash nor the Hackberry Gulch TSF would be constructed. Ranch management activities (livestock grazing) and dispersed recreation would continue in the area of the proposed TSF sites, but these activities would not have any significant effect on groundwater.

3.6.2.2 Effects of the Ripsey Wash TSF Alternative

3.6.2.2.1 Potential Impacts to Groundwater Hydrology

The Ripsey Wash TSF is essentially a "valley-fill" facility where most of the tailings would be contained in the basin (or valley) that is the lower watershed of Ripsey Wash. For this type of facility, the controls and containment for groundwater (predominantly alluvial groundwater) can be concentrated in the seepage trench within Ripsey Wash immediately down-gradient of the tailings impoundment. This "valley-fill" nature of the Ripsey Wash lessens the number of control and containment points for groundwater seepage from the tailings facility.

Construction and operation of the Ripsey Wash TSF would temporarily increase recharge to the Quaternary deposits beneath the TSF. The down-gradient seepage trenches in Ripsey Wash and the East Wash would be designed and constructed to capture groundwater movement through the Quaternary deposits beneath the TSF, and this water would be returned to the Ray Concentrator for reuse. This activity would eliminate recharge to the Gila River alluvium from the two aforementioned washes. The loss of recharge would be proportional to the surface area covered by the TSF as compared to the watershed area of the Gila River up-drainage of its confluence with Zelleweger Wash. At this location, the loss of potential recharge to the Gila River Quaternary deposits would be less than 0.02% of Gila River basin recharge.

Shallow groundwater flows in the Quaternary alluvium from undisturbed areas up-gradient of the TSFs are limited but would be intercepted by detention dams that would be excavated through Quaternary deposits and keyed into bedrock. Intercepted shallow groundwater would comingle with stormwater runoff, which would be routed around the TSF and released into ephemeral washes adjacent to the tailings facilities. Much of this diverted water would probably re-infiltrate into the alluvial deposits in the wash where it is released.

Bedrock groundwater recharge from the TSF would be limited, given the relatively low hydraulic conductivities of bedrock.

At and following closure, infiltration into the underlying alluvium and bedrock would decrease because tailings slurry would no longer be applied to the top of the TSF; the tailings themselves have low permeability and over time would consolidate, further decreasing permeability; and some water would be entrapped within the tailings (Hutchison and Ellison, 1992). Asarco will continue to operate its seepage collection and pump-back systems at and following closure to prevent seepage from entering the Gila River.

A water balance and drain-down assessment was performed to estimate the volume and rate of seepage that would occur from the bottom of the TSF following closure of the TSF, and how long the TSF would take to drain (AFW, 2016a and 2017). Material types and properties applied to the studies were representative of Ripsey Wash TSF site conditions (alluvium and bedrock), and tailings that are currently stored in the Elder Gulch TSF. Results indicated that for a reasonable drain-down scenario of one hundred to two hundred years, average flow rates will likely be in the 200 to 400 gpm range.

No effects are expected to the groundwater hydrology of the area as a result of the relocation of the Arizona Trail or from work in the areas proposed for waters of the U.S. mitigation (see **Appendix J, Compensatory Mitigation**). The trail construction and mitigation activities do not require any well construction or direct groundwater use and will not result in any discharges that would affect groundwater resources.

3.6.2.2.2 Potential Impacts to Groundwater Quality

The potential for degradation of groundwater quality from tailings leachate or tailings dam construction materials would be low, for two reasons.

First, the meteoric water mobility testing on both tailings and alluvium material revealed that the probability for dissolution and mobilization of leaching minerals from these materials is low. Test results were compared to the tailings decant water quality and it was determined that the results are similar. See **Table 3-13, Tailings Water Analyses**, and **Table 3-15, Meteoric Water Mobility Procedure Results for Tailings**. Moreover, analytical results show that the existing tailings water quality and simulated leachate water quality comply with the Arizona Aquifer Water Quality Standards (AAWQS). In addition, no acid generation from tailings or alluvium materials is expected based on kinetic testing discussed in Section 3.3.4, Geochemistry. See **Table 3-17, Weekly Humidity Cell Test (HCT) Results for Tailings and Alluvium Materials**, and **Table 3-18, Dissolved Metals Humidity Cell Test (HCT) Results for Tailings and Alluvium Materials**.

Second, groundwater modeling (AMEC 2014a) showed alluvial groundwater movement through Quaternary deposits beneath the footprint of the Ripsey Wash TSF, but this seepage would be intercepted and captured by down-drainage seepage trenches in Ripsey Wash and East Wash and routed to a lined reclaim pond, where the water would be pumped back to the tailings impoundment or to the Ray Concentrator for reuse. These controls would prevent any water quality impacts to the Gila River. Similarly, with safeguards in place as described in Section 2.3.2.7, Hackberry Fault Seepage Mitigation, there should be negligible groundwater seepage through or along the Hackberry Fault, and into Zelleweger Wash (AMEC 2014a).

Under the terms and conditions of an APP permit and Surface Water Pollution Prevention Plan (SWPPP) developed under the AZPDES permit, a TSF would be operated as zero surface water discharge facility, with any direct precipitation and runoff captured in the tailings impoundment being pumped back to the Ray Concentrator for reuse. Although some of the direct precipitation falling within the tailings impoundment footprint, along with some water in the tailings decant ponds, would infiltrate into underlying alluvium material, seepage through the tailings embankment would be captured by down-drainage seepage trenches and routed to lined reclaim ponds, where the water would be pumped back to the tailings impoundment or to the Ray Concentrator for reuse. These controls would prevent any water quality impacts to the Gila River.

An accidental spill from a tailings pipeline rupture or from a fueling accident involving diesel fuel is unlikely, but they could cause temporary and local groundwater contamination at the site of the spill. The impacts would likely be minor and short-term given the control and countermeasures that would be implemented as per the site's SPCC plan and contingency plans required by the Arizona DEQ as part of the APP permit. Additional discussion of accidental spills and possible impacts are discussed in Section 3.16, Accidents and Spills.

The APP permit for the Ripsey Wash TSF Site would require compliance monitoring along the groundwater compliance boundary down-gradient of the TSF. As shown on **Figure 30, Groundwater Hydrology - Ripsey Wash TSF**, compliance wells MW-1A, MW-1B, MW-2, and MW-3 would be monitored for water levels and groundwater quality in accordance with the APP permit. Should a performance standard be exceeded, mitigation measures prescribed in the APP permit would be implemented.

3.6.2.2.3 Potential Impacts to Groundwater Wells

Existing groundwater wells located within the disturbance footprint of the proposed TSF footprint would be directly impacted. Existing shallow groundwater wells located in the Quaternary deposits immediately down-gradient of the TSF sites might be impacted by construction and operation of the tailings facilities due to potential loss of yield. Down-gradient bedrock wells are not expected to be impacted.

As set forth in Section 3.6.1.1.3, Existing Groundwater Wells at Ripsey Wash TSF, there are 39 wells within 0.5 miles of the Ripsey Wash TSF (see **Table 3-38, Registered Wells within 0.5 Miles of Ripsey Wash TSF Site**) and these wells are segregated as follows:

- Within Ripsey Wash TSF Footprint: 13
- Up-Gradient of Ripsey Wash TSF Footprint: 1
- Down-Gradient of Ripsey Wash TSF: 18
- Near Tailings Pipeline: 7

Thirty three of the 39 wells were installed by Asarco for exploration (condemnation drilling), geotechnical or hydrologic monitoring purposes. With the exception of one well, Asarco would control these wells once the State lands are purchased from ASDL and Asarco exercises its options for the private property (A-Diamond Ranch). The only well not in the process of being acquired by Asarco is located north of the Gila River and approximately 0.4 miles upstream and up-gradient from the proposed drain-down pond. This well would not be impacted by Ripsey Wash TSF activities.

The 13 wells within the footprint of the Ripsey Wash TSF would be abandoned prior to tailings disposal; this would include several ASDL wells used for livestock watering, but these wells would be transferred to Asarco as part of the expected land package purchase.

The capture of alluvial groundwater by the seepage trench in Ripsey Wash down-gradient of the TSF (coupled with the closed-circuit operation of the TSF where tailings decant water would be returned to the Ray Concentrator) would cause a loss of groundwater recharge to the alluvium material down-gradient of the facility. The diminished recharge could cause a reduction in yields from down-gradient wells, but this effect should be negligible to the wells on the A-Diamond Ranch which are completed in Quaternary deposits along the Gila River.

3.6.2.3 Effects of the Hackberry Gulch TSF Alternative

3.6.2.3.1 Potential Impacts to Groundwater Hydrology

The Hackberry Gulch TSF is essentially a “side-hill” facility where the tailings would be contained on a “hillside” which is dissected by multiple drainages. For this type of facility, controls and containment for groundwater (predominantly alluvial groundwater) must be placed in the seven main drainages that are intersected by the tailings embankment. The “side-hill” nature of the Hackberry Gulch TSF would complicate the overall construction of the TSF and necessitates the installation of seepage trenches and reclaim water ponds in major down-gradient drainages, plus expanded monitoring. Although the primary fracture pattern in the Big Dome conglomerate formation occurs generally parallel to the axis of the Hackberry Gulch TSF tailings embankment, there could be leakage along secondary fracturing perpendicular to the primary fracturing or along sand-pebble lenses in the conglomerate that express themselves as uncontrolled seepage in areas external to the seepage trenches that are located in the seven drainages. In this situation, any seeps would have to be captured and routed to the down-gradient reclaim water ponds, where the water would be allowed to evaporate and/or returned to the tailings facility itself.

Like the Ripsey Wash TSF, construction and operation of the Hackberry Gulch TSF would temporarily increase recharge during construction and operations, but following closure, would decrease because tailings slurry would no longer be applied to the top of the TSF; the tailings themselves have low permeability and over time would consolidate, further decreasing permeability; and some water would be entrapped within the tailings. The down-gradient seepage trenches would be designed and constructed capture groundwater movement through the Quaternary deposits beneath the TSF, and this water would be returned to the Ray Concentrator for reuse. This activity would eliminate recharge to the Gila River alluvium from the seven washes that dissect the site.

The potential impacts to shallow and bedrock groundwater recharge and flow direction would be similar to those described for the Ripsey Wash TSF site, as would post-closure drain-down timeframes and flow rates.

No effects are expected to the groundwater hydrology in the areas proposed for waters of the U.S. mitigation (see **Appendix J, Compensatory Mitigation**). The mitigation activities do not require any well construction or direct groundwater use and will not result in any discharges that would affect groundwater resources.

3.6.2.3.2 Potential Impacts to Groundwater Quality

The potential impacts to groundwater quality would be the same as those described for the Ripsey Wash TSF.

Similar to the Ripsey Wash TSF, should the Hackberry Gulch TSF be selected for tailings disposal, an APP permit for the TSF would be required. Such a permit would require groundwater monitoring along a compliance boundary, as well as requisite mitigation measures should a performance standard be exceeded as part of monitoring of compliance wells.

3.6.2.3.3 Potential Impacts to Groundwater Wells

As set forth in Section 3.6.1.2.3, Existing Groundwater Wells at Hackberry Gulch Wash TSF, there are 42 wells within 0.5 miles of the Hackberry Gulch TSF. See **Table 3-40, Registered Wells within 0.5 Miles of Hackberry Gulch TSF Site.** These wells are segregated as follows:

- Within Hackberry Gulch TSF Footprint: 19
- Up-Gradient of Hackberry Gulch TSF Footprint: 0
- Down-Gradient of Hackberry Gulch TSF: 23

Nineteen of the 42 wells were installed by Asarco for exploration (condemnation drilling), geotechnical or hydrologic monitoring purposes. The remaining 23 wells are mainly owned by individuals or commercial (non-Asarco) entities.

Of the wells not owned by ASARCO, nine are located within the footprint of the proposed Hackberry Gulch TSF. These would be abandoned, so the water yield from these wells would be permanently lost. Seven of the non-Asarco wells are located immediately down-gradient of the TSF. Although these wells are probably completed in the Quaternary deposits along the Gila River, the yield from these wells could be compromised by a reduction of recharge to Gila River Quaternary deposits from the construction and operation of the Hackberry Gulch TSF.

The likelihood of private well yields down-gradient from the TSF being compromised is primarily a function of whether the down-gradient wells are, or are not, completed in Quaternary deposits that are in direct hydraulic communication with the Gila River. If they are, the significance would likely be low, because the loss of recharge to the Gila River Quaternary deposits from removal of recharge from the TSF footprint area would be small relative to the recharge from the entire Gila River drainage basin. Specifically, at the USGS Kelvin gaging station (immediately downstream of the TSF), the loss of potential recharge to the Gila River Quaternary deposits would be less than 0.02% of Gila River basin recharge. Conversely, if the wells down-gradient from the TSF are not completed in Quaternary deposits that are in direct hydraulic communication with the Gila River, the likelihood of yield loss would be high.

3.7 LAND USE

Identify land disturbance. *Areas of concern include: (1) the acreage of disturbance on federal, state and private lands; (2) the effects on livestock grazing in the area; (3) the effects on the recreational setting of the area; and (4) changes in future (post-project) land use.*

3.7.1 Affected Environment

The dominant land use in the vicinity of the Ripsey Wash and Hackberry Gulch TSF sites is mining. Other land uses within the region, including the areas that would be disturbed by either the Ripsey Wash or the Hackberry Gulch TSF sites, are dispersed recreation, open space, residential use, agriculture (cattle grazing) and wildlife habitiat. Specifics about land uses in the area are set forth in **Appendix D, Regional Activity**.

3.7.1.1 Land and Mineral Ownership

A mixture of federal, state and private lands occurs in this area. Private lands, as well as those lands administered by the BLM and the ASLD, are shown on **Figure 32, Surface Ownership**. Asarco owns and controls much of the private lands within and adjacent to the existing Ray Mine. The BLM has indicated their intent to conduct a physical on-the-ground survey to accurately locate the boundary between Asarco's private lands and lands and minerals administered by the BLM.

Surface ownership at the Ripsey Wash TSF site may change to Asarco with the proposed forthcoming sale (auction) of state lands at the Ripsey Wash site by the ASLD and to Asarco from federal ownership at the Hackberry Gulch TSF site with pending Asarco-BLM land exchange. See **Appendix D, Regional Activity**.

Similar to surface ownership, there is a mixture of federal, state and private mineral ownership in this area. See **Figure 33, Ripsey Wash Alternative Mineral Estate**, and **Figure 33, Hackberry Gulch Alternative Mineral Estate**. Asarco owns or controls the mineral estate within the areas being considered for both the Ripsey Wash and Hackberry Gulch TSFs.

3.7.1.2 Mining

Copper mining has occurred in this area since the 1880s, a period extending for over 130 years. Early mining in this area was completed by underground techniques; however, by 1955 all major underground mining had ceased in the area around the current Ray Mine. The Ray Mine, which is an existing open-pit copper mine, began operations in 1952 and has been the prominent mine in the area since that time.

The areas within and adjacent to the Ray Mine have been explored since the late 1880s and early 1900s, and numerous old test pits, mine adits (tunnels), and shallow shafts are found scattered throughout the region. Most of the public lands in this area are open to mineral entry, mineral leasing and mineral sales, except for the White Canyon Wilderness Area.

3.7.1.3 Agricultural Activities

Cattle grazing is an established and long-term land use in the area. Portions of several BLM grazing allotments are found within the area of the Ray Mine and the proposed Ripsey Wash and Hackberry TSFs. See **Figure 35, Grazing Allotments**, and **Table 3-41, Grazing Allotment Summary**.

Table 3-41, Grazing Allotment Summary

BLM Grazing Allotment Number	Allotment Name	Current Public Land (acres)	Other Areas (acres)	Total Area (acres)	Total AUMs (1) on Public Land	Acres per AUM	AUMs per Arce	Current Grazing System
6067	Rafter Six	15,962	10,999	26,961	1,668	16.16	0.062	DR (2)
6016	Troy	5,319						
6120	A Diamond	6,566	14,213	20,779	696	29.85	0.034	DR (2)

Notes:
1. AUM: (Animal Unit Month - a cow and a calf foraging for one month).
2. DR stands for Deferred Rotation.

Some range improvements, such as fencing and livestock watering facilities (wells, tanks, pipelines, cross, impoundments or stock tanks), salt licks, corals and gathering areas, have been made to the grazing allotments in this region.

With the exception for water access at designated locations to the Gila River, livestock grazing is subject to seasonal restrictions from most of the riparian zones along the Gila River on BLM administered lands in accordance with a 2003 USFWS Biological Opinion (US Fish and Wildlife Service 2003).

3.7.1.4 Residential Use

Residential use in the immediate vicinity of the Ray Mine is concentrated in the communities of Kearny, Kelvin, and Riverside, with scattered development along the Gila River south of the operation. The A Diamond Ranch is located north of Florence-Kelvin highway, near the confluence of Ripsey Wash with the Gila River. There are no existing or planned residences or houses within the areas to be directly physically disturbed by the Ripsey Wash or the Hackberry Gulch TSFs.

3.7.1.5 Recreation

Recreation is another land use in the area and is discussed in more detail in Section 3.9, Recreation.

A segment of the Arizona Trail traverses the area proposed for development and operation of the Ripsey Wash TSF. Background on the discussions and the proposed plan to relocate a section of Arizona Trail are set forth in **Appendix G, Arizona Trail Relocation Analysis**.

Other than the Arizona Trail, there are no developed recreational facilities operated by the BLM, Forest Service, ASLD, or Pinal County within the areas to be used for either the Ripsey Wash or Hackberry Gulch TSFs. However, there are dispersed outdoor recreational activities that occur in this area that include hunting, four-wheeling, mountain biking, hiking, picnicking, camping, horseback riding, rock-hounding, fishing, river floating and water play in the Gila River, and general sightseeing. There is an existing network of primitive roads that provide access for dispersed recreational activities.

The White Canyon Wilderness area (approximately 5,773 acres) was designated by Congress in 1990. This wilderness area is located approximately two miles west of the Ray Mine, four miles north of the proposed Ripsey Wash TSF, and six miles northwest of the proposed Hackberry Gulch TSF.

The White Canyon Area of Critical Environmental Concern (ACEC) is adjacent to the White Canyon Wilderness area and was established because of its scenic, wildlife, and cultural values. The White Canyon ACEC is addressed in the BLM's Phoenix Resource Management Plan (RMP), dated September 1989, and includes approximately 1,920 acres of BLM administered lands and 480 acres of State lands.

3.7.1.6 Utilities and Transportation

SCIP owns and operates a 69-kV electric transmission line that crosses the area proposed for use by the Ripsey Wash TSF. The transmission line structures are wooden H-poles.

The Copper Basin Railroad is a 54-mile long Arizona short-line railroad that is owned by Asarco and operates from a connection with the Union Pacific Railroad at Magma Junction to an interchange connection with the San Manuel Railroad near the town of Hayden. The railroad principally parallels the Gila River but has an approximate seven-mile branch line that connects to the Ray Mine. The railroad serves the Ray Mine, transporting ore material to the Hayden Concentrator and copper concentrates to the Hayden Smelter and returning sulfuric acid from the Hayden Smelter to the Ray Mine.

State Route 177 (SR 177) is a two-lane, asphalt state highway that connects the towns of Superior on the north and the communities of Hayden/Winkelman on the south. SR 177 passes adjacent the communities of Kelvin, Riverside and Kearny. A 15-mile long stretch of SR 177 (between mileposts 149 and 164) is designated as the Copper Corridor Scenic Road West, which is an Arizona scenic road. This scenic corridor was established in October 2008, offers views of high desert ecology and the Ray Mine operations, and traverses the Hackberry Gulch TSF project area and the proposed Ripsey Wash TSF tailings and return water pipeline corridor.

The Florence-Kelvin highway is a 32-mile long, two-lane road that connects State Highway 79 south of the town of Florence to State Route 177 near the community of Kelvin and near the entrance to the Ray Mine. Approximately 16 miles of this highway is paved with asphalt from its junction with State Route 79 (near Florence) but the remaining portion is a graveled surface roadway. This road is maintained by Pinal County. As explained in Section 2.3.2.1, Florence-Kelvin highway, a segment of this highway would be permanently re-routed and re-constructed to the north and northeast of the proposed Ripsey Wash TSF to allow for construction and operation of the proposed tailings facility.

3.7.1.7 Land Use Plans and Policies

Asarco is currently working with the BLM on a land exchange that would involve the BLM-administered lands, including portions of the site proposed for the Hackberry Gulch TSF. The work on this land exchange has been underway for nearly 25 years, since 1994. See **Appendix D, Regional Activity**. Under this pending land exchange, transfer of BLM-administered land to Asarco would mean that the federal land would become private ownership. The BLM would benefit from this land exchange by receiving other acreages in the state of Arizona deemed valuable for scenic, wildlife, and recreation purposes. However, even if the land exchange is consummated, development of the Hackberry Gulch TSF would still impact an estimated 105 acres of BLM-administered lands in the southeast corner of the TSF. In addition, a portion of the stormwater diversion infrastructure would also occur on BLM-administered lands outside the land exchange parcels.

Pinal County has a Comprehensive Plan, which outlines a vision on how and where the County should grow and develop over time (Pinal County 2009). The Comprehensive Plan is not a regulatory documentand does not grant entitlements. However, it is a plan and a vision for future growth to assist and guide the Pinal County Planning and Zoning Commission and the Board of Supervisors in the pursuit of "coordinated, adjusted and harmonious development of unincorporated areas of Pinal County".

The proposed Ripsey Wash and Hackberry Gulch TSF sites (and the Ray Mine itself) are located in an area designated in the Pinal County Comprehensive Plan as "Open Space". This designation reflects the Pinal County Open Space and Trails Master Plan that was adopted by Pinal County in 2007 (Pinal County 2007). The Open Space vision in this plan is stated as follows:

> *Residents value large connected open spaces and unique plans of Pinal County, not only as part of their quality of life, but as an important resource to sustain the region's immense wildlife habitat and corridors. From majestic mountains rising from the desert floor in the west to the high desert and rugged mountain terrain to the east, enjoyment of and respect for natural surroundings is a part of why people choose to live and visit Pinal County.*

The Arizona Trail is located within this area and has been recognized in the Pinal County Open Space and Trails Master Plan as one of the regional trail corridors in the County. See Section 3.9, Recreation. As such, the Corps coordinated with Pinal County as to the relocation of a segment of the Arizona Trail should the Ripsey Wash TSF site be selected as the preferred alternative. The BLM administers the Arizona Trail north of the Florence-Kelvin highway, including sections across ASLD, under a right of entry, whereupon the Arizona Trail right-of-way is 15 feet wide and would be held by the United States. The area that encompasses the Arizona Trail in the vicinity of the Ray Mine is part of the White Canyon Resource Conservation Area (RCA)[37] and the Middle Gila Cultural Resource Management Area under the BLM Phoenix Resource Management Plan (RMP), dated September 1989 (Bureau of Land Management 1989). This RMP is a BLM land management guide.

Most of the Ripsey Wash TSF site is currently land owned by the state of Arizona and is managed by the ASLD. This land status is expected to change to Asarco with the proposed forthcoming sale (auction) of state lands at the Ripsey Wash site by the ASLD.

The Hackberry Gulch site is located on BLM-administered lands that was addressed in the amendment to the BLM RMP for the Asarco-BLM Ray Land Exchange.. Use of public lands administered by the BLM requires authorization by the BLM. The BLM uses guidance in the RMP to make land use planning decisions.

Portions of the Ripsey Wash TSF site are located within the BLM Middle Gila Canyons Area Travel and Transportation Management Plan area. Travel route designations include existing primitive roads and the Arizona Trail. See Section 3.9, Recreation.

3.7.2 Environmental Consequences

3.7.2.1 Effects of the No Action Alternative

Under the no action alternative, neither the Ripsey Wash nor the Hackberry Gulch TSF would be constructed. The land use at the Ripsey Wash or Hackberry Gulch TSF sites would not change. Current land use trends in the region would continue, including mineral exploration, mining, livestock grazing activities and recreational use.

3.7.2.2 Effects of the Ripsey Wash TSF Alternative

Although mining has historically occurred in this region, the construction and operation of the Ripsey Wash TSF facility would introduce a noticeable land use change within the immediate area. On a more regional basis, a new TSF at the Ray Mine would not change other land uses in Pinal County.

Acreage disturbance for the Ripsey Wash TSF are set forth in **Table 2-1, Summary of Ripsey Wash TSF Alternative**.

[37] The general long-term goal for the BLM White Canyon RCA is to retain federal lands for sustained use and to consolidate ownership for management efficiency of multiple resources and uses.

The construction and operation of TSF sites would cause permanent impacts to rangeland, wildlife habitat, and dispersed recreation on land uses within the footprint of the Ripsey Wash TSF. Available livestock forage would be lost in the grazing allotment areas that would be affected by the construction and operation of the TSF. Site access restrictions (e.g., the loss of the use of primitive roads in the area of construction and operation) would occur during this time frame, primarily because of physical disturbance land ownership patterns; it is expected that only sparse vegetation would reemerge on the area where tailings are placed, and not to the conditions that currently exist. The closed tailings site would likely never have the species composition or density of vegetation that exists today.

The proposed post-project land use of the area where tailings are placed is slated for possible solar power generation, would be quite different from pre-project land uses, and the area, being covered with rock material, would lack long-term value for wildlife habitat, dispersed recreation and livestock grazing. Placement of rock material over the tailings facility would be employed for site stability, and it is possible that a photovoltaic array (solar panels) would be placed atop the rocked TSF.

Approximately 2.3 miles of the existing SCIP 69 kV electric transmission line that crosses through the area of the Ripsey Wash TSF would be eliminated as part of the TSF construction work and replaced by an approximate 3.2-mile long transmission line would be re-constructed around the north side of the Ripsey Wash TSF. This relocation would not create any noticeable land use change in the area, and this line would have post-closure value for transmission of electricity from the solar power generation facility proposed for the post-closure tailings area.

A 6.8-mile segment of the existing Arizona Trail would be lost, but plans have been made to replace this segment of trail with a 6.4-mile segment to the east of the proposed Ripsey Wash TSF site. The existing trailhead on the Florence-Kelvin Highway would also be replaced with a new trailhead near the intersection of Riverside Road and the Florence-Kelvin highway. See **Figure 41, Proposed Trailhead & Parking**.

Two BLM grazing allotments (the A Diamond and Rafter Six allotments) would be affected by the Ripsey Wash TSF. See **Table 3-42, Grazing Allotment Impact - Ripsey Wash TSF.**

Table 3-42, Grazing Allotment Impact - Ripsey Wash TSF

Allotment Name and BLM Designation Number	Estimated Allotment Area (acres)	Allotment Areas Physically Disturbed by Ripsey Wash TSF (acres)	Percentage of Allotment Directly Disturbed
A Diamond (06120)	20,779	2,426	11.5%
Rafter Six (06067)	26,961	149	0.06%

Asarco plans to purchase acreage for the Ripsey Wash TSF from the ASLD, which would transfer the land from state of Arizona ownership to private. If the property is purchased from the ASLD, a portion of the property would be used for the Ripsey Wash TSF, thus changing the pre-project land use from livestock grazing, dispersed recreation use and wildlife habitat to the industrial use of tailings placement. Post-project land use is proposed as the development of a solar electric power-generating facility. Land within the purchased area not used by Asarco for the Rispey Wash TSF would continue under present land uses. With the sale of the land to Asarco, Pinal County would benefit financially through the collection of property taxes.

The relocation of the Arizona Trail and the fencing and general upgrade (seeding and removal of tamarisk) of the riparian habitat within the proposed Waters of the U.S. mitigation areas would not create any noticeable land use change in the areas of the relocated trail and the Waters of the U.S. mitigation sites (see **Appendix J, Compensatory Mitigation**).

Indirect effects are expected to be minor, but certain recreationists may decide to avoid the area around the Ripsey Wash TSF during construction, operation and post-closure. Others may be curious and want to see the facility during construction, operation and post-closure. See Section 3.9.2.2, (Recreation) Effects of Ripsey Wash Alternative.

3.7.2.3 Effects of the Hackberry Gulch TSF Alternative

The land-use effects of the Hackberry Gulch TSF would essentially be the same as described in Section 3.7.2.2, Effects of the Ripsey Wash TSF Alternative. Acreage disturbance for the Hackberry Gulch TSF are set forth in **Table 2-2, Summary of Hackberry Gulch TSF Alternative**.

Two BLM grazing allotments (the Rafter Six and Troy allotments) would be affected by this alternative. See **Table 3-43, Grazing Allotment Impact - Hackberry Gulch TSF.**

Table 3-43, Grazing Allotment Impact - Hackberry Gulch TSF

Allotment Name and BLM Designation Number	Estimated Allotment Area (acres)	Allotment Areas Physically Disturbed by Ripsey Wash TSF (acres)	Percentage of Allotment Directly Disturbed
Rafter Six (06067)	26,961	2,267	8.4%
Troy (06016)	5,319	23	0. 4%

The fencing and general upgrade (seeding and removal of tamarisk) of the riparian habitat within the proposed mitigation areas would not create any noticeable land use change in the areas of the mitigation sites (see **Appendix J, Compensatory Mitigation**).

Indirect effects are expected to be minor, but certain recreationists may decide to avoid the area around the Hackberry Gulch TSF during construction, operation and post-closure. Others may be curious and want to see the facility during construction, operation and post-closure. See Section 3.9.2.3, (Recreation) Effects of Hackberry Gulch Alternative.

3.8 NOISE

Identify noise impacts. *Areas of concern include: (1) level of noise from construction traffic and development activities; (2) level of noise during operations; (3) compliance with federal, state and local noise standards; (4) disruptions caused by noise to recreational users and wildlife.*

3.8.1 Affected Environment

3.8.1.1 General Overview

Noise is defined as an unwanted, disturbing sound. The impact of a noise source depends on the levels and characteristics of background sounds, as well of the characteristics of the actual sound. Sound is transmitted through the atmosphere as low-intensity pressure waves. People can detect sounds differently and can respond to a wide range of sound intensities and frequencies.

The logarithmic decibel (dB) scale is used to indicate the intensity of sound. To measure sound on a scale that approximates the way people hear, more emphasis must be placed on those sound frequencies (or pitch) that people hear. EPA recommends the use of "A-weighted" sound pressure levels, expressed as A-weighted decibels of dBA, for analyzing community noise issues.

The threshold of human hearing is set at 0 dBA. Quiet whispers and birdcalls produce about 25 to 40 dBA. Emergency vehicles can reach as high as 100 dBA, while if standing close to a jet airplane the sound may reach 140 dBA.

The range of everyday sounds is shown on **Table 3-44, Typical Range of Common Sounds**.

Table 3-44, Typical Range of Common Sounds

Noise Source	A-Weighted Sound Level (dBA)
Holitzer or explosion	120-170
Military Jet airplane (at 50 feet)	140
Commercial jet Airplane (at 200 feet)	120
Emergency Vehicle (at 100 feet)	110
Power (gas) Lawn Mower	100
Motorcycle (at 25 feet)	90
Diesel truck, 40 mph (at 50 feet)	90
Garbage Disposal (3 feet)	80
Passenger Car, 65 mph (25 feet)	70
Vacuum Cleaner (at 3 feet)	70
Normal Conversation (at 5 feet)	60
Traffic (at 100 feet)	50
Bird Calls (at 50 feet)	40
Soft Whisper (at 5 feet)	30
Library (at 25 feet)	20
Hearing threshold	0

Source: Occupational Safety and Health Administration (2016)

The noise level of sound is measured in decibels on a logarithmic scale. A doubling of sound pressure corresponds to a noise increase of 3 dBA. For example, a single bulldozer typically produces about 85 dBA of noise at a distance of 50 feet from the dozer. Therefore, two identical dozers operating side-by-side (with each producing 85 dBA) produces a theoretical noise level of 88 dBA.

Many factors determine whether an increase in the noise level above the existing background is "audible". The most important factor is the nature of the new noise source as compared to the nature of the background noise. In the case of proposed Ripsey Wash TSF, the noise caused by construction activities would be different from the rural, open-space sounds, so relatively small increases in noise levels caused by mechanical equipment would be noticeable. This would be slightly different at the proposed Hackberry Gulch TSF site, which is located adjacent to State Route 177 and the Ray Mine (Elder Gulch TSF), where there is industrial noise and highway traffic noise.

3.8.1.2 Background Conditions

The proposed Ripsey Wash TSF site is located in an unpopulated and relatively remote area. Background noise levels range from near 30 dBA to approximately 80 dBA, depending on road traffic, wind, and wildlife activity (birds singing). See **Table 3-45, Background Noise Levels** (1).

The closest residence to the Ripsey Wash TSF site is the A-Diamond Ranch, for which Asarco has an option to purchase. The Tortilla Mountain range separates the Ripsey Wash TSF site from the residences of Riverside and Kelvin. In general, the Ripsey Wash TSF site is relatively quiet, with wind and/or thunderstorm activity being the principal sound sources. Traffic along the Florence-Kelvin highway would generate noise, although traffic volume on this highway is relatively low (See Section 3.12, Transportation). There could also be localized noise from off-highway vehicles (OHVs) using the two-track roads in the area, as well as the occasional over flight by jet aircraft and train noise from the Copper Basin Railroad that operates north of the site.

Table 3-45, Background Noise Levels (1)

Location (2)	A-Weighed Sound Level (dBA)
State Route 177 at Proposed Hackberry Gulch TSF	33 – 35 (at approximately 60 feet from highway – no traffic)
	60 -70 (passing car at approximately 60 feet from highway)
State Route 177 near Elder Gulch TSF	32 – 26 (at approximately 25 feet from highway – no traffic)
	80 (semi-truck passing at approximately 25 feet from highway)
	70 (passing car at approximately 25 feet from highway)
State Route 177 at junction with Florence-Kelvin highway	40 – 43 (at approximately 100 feet from highway – no traffic)
	75 (semi-truck passing at approximately 100 feet from highway)
	70 (passing car at approximately 100 feet from highway)
Florence-Kelvin highway in community of Kelvin	50-54 (at edge of highway: birds singing in nearby trees)
	80 (passing car at edge of highway)
Florence-Kelvin highway at Ripsey Wash	30-50 (in middle of road - no traffic but wind gusts and sporadic bird singing)
Florence-Kelvin highway west of bridge over Gila River and Arizona Trail	38-50 (in middle of road - no traffic but wind gusts and sporadic bird singing)
Florence-Kelvin highway on bridge over Gila River	43-45 (in middle of bridge – Gila River flowing; some sporadic bird singing)

Note:

1. Noise readings made on February 25, 2015 using a handheld NM102 noise meter.
2. At the locations where noise readings were made, no apparent noise from ongoing Ray Mine operations were audible.

The proposed Hackberry Gulch TSF site is located adjacent to the existing Ray Mine and the Elder Gulch TSF, as well as being directly adjacent to State Route 177. Portions of the proposed Hackberry Gulch TSF would be located on either side of this highway. There are permanently occupied residences and human receptors in the communities of Riverside and Kelvin, which are within approximately 0.3 miles of the proposed Hackberry Gulch TSF site. Current noise at the site is principally associated with traffic on State Route 177, as operations at the Elder Gulch TSF principally involve electric pump stations and minor construction equipment. Other noise would include train noise from the Copper Basin Railroad that operates to the west of the proposed Hackberry Gulch TSF. This site, like the proposed Ripsey Wash TSF site, would also be subjected to wind and thunderstorm activity.

3.8.1.3 Noise Ordinances or Regulations

Pinal County has noise regulations, but these are principally focused on projects and activities in urban areas, not at mine operations that are located in remote, low-populated areas.

In 1974, EPA established a 24-hour average level of 55 dBA as a guideline threshold for acceptable environmental noise. This level is used as a general basis for evaluating effects from noise when no other local, county or state standards have been established. Typically, this guideline level would be directed at areas where people live and work, not the remote region found for the Ripsey Wash and Hackberry Gulch TSF sites; however, this 55-dBA threshold level would serve as a general target level by which to assess noise levels for the TSF construction and operation.

TSF construction, operation and closure/reclamation would be under the jurisdiction of the Mine Safety and Health Administration (MSHA). This federal agency requires worker hearing protection for continuous noise levels that exceed 90 dBA. See **Table 3-46, Permissible Occupational Noise Exposures**.

Table 3-46, Permissible Occupational Noise Exposures

SOUND LEVEL (dBA)	DURATION (HR/DAY)
90	8
92	6
95	4
97	3
100	2
102	1.5
105	1
110	0.5
115	<0.25

Source: U.S. Department of Labor, “Occupational Noise Exposure”, Code of Federal Regulations, Title 29, Part 1926.

3.8.2 Environmental Consequences

3.8.2.1 Effects of the No Action Alternative

Under the no action alternative, neither the Ripsey Wash nor the Hackberry Gulch TSF would be constructed. However, mining would continue at the Ray Mine for many years. Noise levels in the area would continue at background levels, affected by time of day, topography, wind speed and direction, nearby mining activities, traffic from State Route 177 and the Florence-Kelvin highway, railroad traffic, recreational activities (such as OHV travel), and general rangeland management. Over the next 20 to 30 years, noise would reduce slightly as mining related activity at the Ray Mine decreases. Subsequently, Ray Mine related traffic on State Route 177 would also lessen.

3.8.2.2 Effects of the Ripsey Wash TSF Alternative

Noise impacts associated with the Ripsey Wash TSF site would be short-term and primarily occur during early site development and construction activities, an estimated three-year period that would include road building, starter dam construction, seepage trench installation, detention dam and diversion ditch construction, and miscellaneous pipeline and utility installation.

Sources of operational noise would include periodic trips to the site by Asarco personnel, tailings slurry and reclaim water pumps, and a small number of earthmoving equipment associated with centerline tailings construction or raising of the lifts for upstream tailings construction.

Expected noise levels for construction is expected to peak at approximately 85 dBA at 50 feet; this noise level corresponds to the type of equipment to be used for this activity. See **Table 3-47, Equipment Noise Levels**.

Table 3-47, Equipment Noise Levels

Equipment	Decibels (dBA) (1)
Drills	80-85
Loaders	75-85
Bulldozers	75-85
Graders	80-85
Haul Trucks	75-85
Electric Pumps	40-50
Crew and Supply Trucks	45-65

Notes:

1. As projected at 50 feet from the source.

The inverse square law of noise states that noise decreases (attenuates) by 6 dBA for every doubling of distance. Because not all construction equipment operates continuously or at full load, it is assumed that the approximate average equipment noise level would range from 75 to 85 dBA at 50 feet. Using the propagation formulation, average noise levels at 85 dBA would be expected to drop to 79 dBA at 100 feet, 73 dBA at 200 feet, 67 dBA at 400 feet, 61 dBA at 800 feet, 55 dBA at 1,600 feet, 49 dBA at 3,200 feet, and 43 dBA at 6,400 feet. Similar noise estimates could be made for lower noise levels.

Noise levels should attenuate to near background noise levels within a mile of the project work; this would depend on the topography, time of day, wind conditions, and the level of ambient noise at the location of the listener. It should be noted that mechanical noise is noticeable even when it is slightly above the natural background or ambient noise levels.

Some blasting may be necessary during construction work, and this would only occur during daylight hours. It is assumed that typical surface-delay blasting methods would be used. Blasting would generate a single noise, estimated at approximately 120 dBA at 50 feet, which would probably be heard several miles from the blast site. Noise associated with blasting would be blocked by the Tortilla Mountains, and most residents in in Riverside and Kelvin would hear only an elevated sound for 1 or 2 seconds. Many people associate blast noise with that of thunder or a sonic boom.

Most of the residences in the community of Riverside and Kelvin are located more than a mile from the proposed Ripsey Wash TSF site (see **Figure 51, Nearby Residents – Ripsey Wash TSF**) and are separated from the proposed Ripsey Wash TSF site and the new constructed section of the Florence-Kelvin highway by the north-south trending Tortilla Mountains. The ridge of mountains (coupled with the distance) would effectively screen Riverside and Kelvin residents from noise associated with the Ripsey Wash TSF, although blasting noise may be audible during construction.

The communities of Riverside and Kelvin are separated from the proposed Ripsey Wash TSF site and the new constructed section of the Florence-Kelvin highway by the north-south trending Tortilla Mountains. The ridge of mountains (coupled with the distance) would effectively screen Riverside and Kelvin residents from noise associated with the Ripsey Wash TSF, although blasting noise may be audible during construction.

Residents of Kelvin and Riverside, along with recreationists and travelers, would be exposed to increased traffic noise along the Florence-Kelvin highway, mainly during the Three-year construction work. See Section 3.12, Transportation. Truck traffic would be sporadic during daylight hours and would cause a noise level of approximately 80 dBA at about 50 feet from the road. Upon completion of construction, small vehicle traffic noise levels would return to near current levels; however, there would be occasional large truck traffic associated with supply delivery that would travel from State Route 177 to the TSF site.

The residents of Riverside and Kelvin would also be exposed to noise from the installation of the tailings slurry and reclaim water pipelines that would be installed near, but not adjacent to the Florence-Kelvin highway (see Figure2, Site Plan Layout- Ripsey Wash TSF), the construction of the pipeline bridge across the Gila River, the relocation of and the asphalt-paving work on the Florence-Kelvin highway, and the construction of the tailings pumping station on the north side of the Gila River (directly south of the community of Kelvin). These noise impacts would be temporary, moderate and short term. During operations, noise levels from the electric pumping facilities on the north side of the Gila River would be negligible to the residents of Riverside and Kelvin since the pumps would be enclosed in a building. Closure and reclamation noise would also be negligible (mainly traffic) to Riverside and Kelvin residents.

The headquarter buildings and structures for the A Diamond Ranch are located near the confluence of Ripsey Wash and the Gila River, and they are the nearest residential property to the Ripsey Wash TSF site. At present, Asarco has an option to purchase this property and would exercise that option if the Ripsey Wash TSF is selected for construction. The A Diamond Ranch is approximately 0.6 miles from the proposed starter dam in Ripsey Wash and about a mile from any blasting activities. At this distance, it is expected that noise levels would be negligible as normal equipment and facility construction noise would attenuate to background levels before reaching these buildings, although it is expected that blasting noise would be audible at this site (similar to noise created by thunder).

Recreationists and hikers using the re-aligned Arizona Trail would be exposed to some increase in noise levels, in particular during the construction of the detention dam up-drainage of the Ripsey Wash TSF, and the construction of the diversion channel structure on the east side of the proposed TSF. Hikers might also experience some blasting noise during the initial TSF construction period. Blasting noise would be of a short duration lasting only a few seconds.

Recreationists using the re-aligned Arizona Trail would be exposed to increased sporadic noise levels, in particular during the construction of the main and east starter dams and reclaim pondsand the construction of the diversion channel structure on the east side of the proposed TSF. The noise associated with this construction is expected to occur during daylight hours.

The estimated noise levels at points along the Arizona Trail is shown on **Table 3-48, Noise Estimates along Arizona Trail**. There would be periods of time during construction when noise levels would be above background and noticeable. Measured background noise in this area ranged from as low as 30 dBA, when the wind was calm, to noise measurements exceeding 50 dBA with the wind blowing and birds chirping. The estimated noise shown on Table 3-47a, Noise Estimates along Arizona Trail, indicates receptor noise at any given time (could be calm or wind blowing). Once highway construction is completed, construction-related noise would cease; however, a hiker along the Arizona Trail (near Jacob's Point) could hear vehicles passing on the Florence/Kelvin highway (near the Starter Dam).

With the new Florence-Kelvin highway segment constructed on the south side of the Tortilla Mountains, there would be very little noise impacts to hikers using the Arizona Trail, except where the hikers at KOP 4 (Gila River access) could see the highway construction cut slope. The noise impacts associated with the cut slope would be minor and only last a couple of months during highway construction. There would also be minor noise impacts at the new trail head from traffic crossing over the newly constructed Gila River bridge. However, it is expected that there would be no noise impacts associated with the operation of the TSF at the new trail head or the Gila River access. Hikers using the Arizona Trail east of the trail head would be able to hear truck noise on the newly-paved Florence Kelvin highway until that traffic passes over the Tortilla Mountains.

With construction is completed, noise from on-going operations would be minimal as shown on **Table 3-48, Noise Estimates along Arizona Trail**.

The effect of noise on wildlife is generally avoidance and accommodation. Experience at active mining sites shows that certain wildlife become accustom to equipment noise in a short time and wildlife are often seen close to construction. Once the Ripsey Wash TSF construction is complete, most operation noise would be limited to the north end of the TSF. See Section 3.15, Wildlife.

No adverse noise effects are expected as a result of the relocation of the Arizona Trail or the riparian habitat improvement work in the areas proposed for waters of the U.S. mitigation (see **Appendix J, Compensatory Mitigation**).

Some stretches of the proposed Arizona Trail realignment could be constructed or cleared using manual labor, although there would be the short-term need for small equipment such as a skid-steer or compact track loader and a compact excavator to assist in constructing switchbacks or moving large rocks for the relocated trail. This equipment and the work to construct the new trail alignment would create minor amounts of noise, but the noise levels would be temporary and localized, and there are no sensitive receptors in close proximity to the proposed new routing of the Arizona Trail.

As explained in **Appendix J, Compensatory Mitigation**, all or portions of Mitigation Sites A, B, C and D would require active management to enhance the riparian habitat values; this action would be primarily fencing and seeding. A mechanical posthole digger mounted on an off-road vehicle would be used for fence construction, and a farm tractor with a cultivator and a drill seed would be used for seeding, although hand seeding could also be used. For Mitigation Site E and where needed on other sites to remove tamarisk, a bulldozer (Caterpillar D6 or equivalent) would be used to clear and grub burned trees and stumps. The equipment used for riparian habitat improvements would produce noise, but the noise levels would be temporary and localized, and there are no sensitive receptors in close proximity to the proposed mitigation sites.

Indirect noise effects are expected to be negligible and would result from additional non-work related travel by new construction workers that might reside in the area. This increase in activity is expected to be minor and dispersed throughout communities of Apache Junction, Gold Canyon, Superior, Kearny, Hayden and Winkelman.

Table 3-48, Noise Estimates along Arizona Trail

Location Along Arizona Trail	Construction or Operation Activity	Distance to Activity (feet)	Background Decibels (dBA)	Noise Source[2]	Estimated Decibels on Trail (dBA)	Estimated Distance to Background Noise Levels[6] (feet)
KOP 2	Construction -Starter Dam Reclaim Pond, Seepage Trench Blasting [3] (during TSF Construction)	4,000 2,500 4,000	38-50 38-50 38-50	Large Construction Equip, Dozers, Excavators, Trucks Small Equipment	53 58 40	6,400 4,800 4,000
KOP 4[4]	F/K Highway construction and operation	500-1000	30-50	Large Equipment/possible shear-line blasting Vehicle traffic during operation	40-55	3,200
New TrailHead at Gila River Bridge[5]	Traffic flow across bridge	100-300	30-50	Passing cars, tractor-trailer rigs	50-54	1,600
Re-located Trail KOP 7 Segment	Ripsey Wash TSF Operation East Diversion - Construction	5,000 1,700	30-50 30-50	Small Equip. Dozers Large dozers, Excavators	43 50	5,000 2,400

Notes:

1. Noise receptor locations shown on **Figure 44, KOP Locations**.
2. See Table 3-47, Equipment Noise Levels; used 85 dBA for main starter dam construction site; used 80-85 dBA for large construction equipment. The analysis used 75-80 dBA for small equipment and 70 dBA for passing cars and pickup trucks. Decibel levels are estimated for a distance of 50 feet from the source.
3. Blasting will occur infrequently and could exceed 120 dBA at 50 feet, but would be a distinct momentary event.
4. The Arizona Trail would be relocated prior to construction of the East Starter Dam, East Reclaim Pond and Florence-Kelvin highway and East Seepage Control trench.
5. Noise would occur only when traffic crosses the bridge.
6. The background noise levels used for this estimation is 40 dBA.

3.8.2.3 Effects of the Hackberry Gulch TSF Alternative

Similar to the discussion in Section 3.8.2.2, Effects of the Ripsey Wash TSF Alternative, noise impacts associated with the Hackberry Gulch TSF site would be short-term and primarily occur during early site development and construction activities, an estimated three-year period that would include starter dam construction, seepage trench installation, detention dam and diversion ditch construction, and miscellaneous pipeline and utility installation.

Sources of operational noise would include periodic trips to the site by Asarco personnel, tailings slurry and reclaim water pumps, and a small number of earthmoving equipment associated with centerline tailings construction or raising of the lifts for upstream tailings construction. Expected noise levels for construction is expected to peak at approximately 85 to 90 dBA at 50 feet.

There are numerous residences within 1,000 feet of the Hackberry Gulch TSF. See Figure 52, Nearby Residents – Hackberry Gulch TSF. Because there is no natural or artificial barrier between the proposed construction and nearby houses, these residences would likely be impacted by noise from the Hackberry Gulch TSF throughout its life. During construction, noise would be a major direct impact to these residences. During operations the noise would subside and be buffered, somewhat by the traffic on State Route 177. Blasting would also be a major, direct, although very brief, impact to these residences. See **Figure 52, Nearby Residents – Hackberry Gulch TSF**.

The main community of Riverside is approximately a half mile from the lower portions of the proposed Hackberry Gulch TSF site (in particular, the areas to be used for collection ponds), and the community of Kelvin is approximately three quarters of a mile from the proposed Hackberry Gulch TSF site. Residents of Riverside and Kelvin would be subject, during daylight hours, to construction noise that could reach 30 dBA over background levels. The level of the noise would depend on the weather, wind direction, time of day, and line of site to the activity. Construction-related blasting noise would be clearly audible at residences in both Riverside and Kelvin; such noise would last a few seconds and would be similar to the noise from thunder or a sonic boom.

During operations and closure reclamation, noise levels would be negligible to Riverside and Kelvin residents as such noise levels would attenuate to near background noise levels.

Recreationists and hikers using the Arizona Trail would not be exposed to noise levels from the construction, operation and closure/reclamation of the Hackberry Gulch TSF, although recreationalists would hear any blasting noise for a few seconds. The effect of noise on wildlife is generally avoidance and accommodation. See Section 3.15, Wildlife.

Similar to the discussion in Section 3.8.2.2, Effects of the Ripsey Wash Alternative, any noise effects associated with the equipment used for fencing, seeding and clearing tamarisk as part of the waters of the U.S. mitigation work would be short-term and localized, and there are no sensitive receptors in close proximity to the currently proposed mitigation sites.

Indirect noise effects are expected to be negligible, similar to the discussion in Section 3.8.2.2, Effects of the Ripsey Wash TSF Alternative.

3.9 RECREATION

Identify impacts to recreational activities and opportunities. *Areas of concern include: (1) changes to the character of the recreational setting in the project area; (2) disruption to recreational opportunities along the Arizona Trail (the only developed recreation site within the project area) and (3) disruption to dispersed recreation activities such as off-road recreation and hunting.*

3.9.1 Affected Environment

The recreation opportunities within and immediately adjacent to the Ripsey Wash and Hackberry Gulch TSF sites are dispersed in nature. The one exception is the Arizona Trail, a portion of which is located within the eastern section of the proposed Ripsey Wash TSF site.

Recreational information included in this section is based on discussions with federal, state, regional, and local government agencies and organizations, as well as recreation data compiled by WestLand for the region within and surrounding the RIpsey Wash and Hackberry Gulch TSF sites (WestLand 2014c).

Field investigations were also conducted within the area, principally site visits to the Arizona Trail and associated trailheads.

3.9.1.1 Recreation Management

Most of the land proposed for use as the Ripsey Wash TSF is currently owned by the state of Arizona and managed by ASLD. Asarco is working with ASLD to purchase this land. Although ASLD is not mandated or funded to provide outdoor recreation facilities on state trust lands, they sell use permits to those interested in recreating on trust land. Camping, hiking, horseback riding, and other non-consumptive recreational activities are allowed by permit on publicly accessible ASLD rangeland. Permits are also available to allow OHV's to cross State Trust Lands temporarily on open, existing routes. Permits are not required for hunters or anglers in possession of a valid hunting or fishing license (AORCC 2012, p. 48).

Lands at the Hackberry Gulch TSF site are presently a combination of private and public ownership, with the public lands being managed by the BLM. Asarco is working with the BLM on a land exchange that would include the public lands located within the Hackberry Gulch TSF site; this land exchange is separate from this EIS. BLM management of recreation on BLM-administered lands in this area is guided by the 1989 Phoenix Regional Management Plan (RMP) (BLM 1989). Because there are no Recreation Management Areas designated by the 1989 RMP for either TSF site, the BLM manages their lands in this area to meet basic recreation and resource stewardship needs. Although recreation is not emphasized, recreation activities, except those in conflict with the primary land uses, may occur unless the land is closed to public use (BLM 2011).

The 1989 RMP also limited OHV use on BLM-administered lands to existing roads and trails, except for areas identified as closed or where travel would be limited to specifically designated roads and trails. In 2012, the BLM adopted The Middle Gila Canyons Transportation and Travel Management Plan, which contains an inventory of roads, primitive roads, and trails in the Middle Gila Canyons region and establishes designations for their use and maintenance. This 2012 plan covers BLM-administered lands north and west of the Florence-Kelvin highway, designating the OHV routes in this area as primitive routes. Primitive routes are open to motorized vehicles on a year-round basis (BLM 2010).

Pinal County plans for and maintains recreation facilities throughout the county, including OHV routes and portions of the Arizona Trail. The 2007 Pinal County Open Spaces and Trails Master Plan identifies goals and objectives for the attainment of open space, trails, and regional parks. The plan identifies 399,300 acres of existing or planned open space, 802,400 acres of proposed open space, 25,900 acres of restricted use open space, and 168,700 acres of regional parks.

Congress assigned administration of the Arizona Trail to the Secretary of Agriculture, which delegated overall administration to the Forest Service. The Forest Service is responsible for establishment of an advisory council for trail management and the development of a trail-wide comprehensive plan (CP). The nature and purposes of the trail are established through the CP, which is developed in coordination with the national trail managing agencies and includes goals designed to safeguard the trail's nature and purposes. The CP designates the trail planning corridor, which extends ½ mile on both sides of the trail. A public engagement process conducted in 2012 provided preliminary input towards the development of the CP. (White, 2014) An interdisciplinary team is collecting current conditions and trail use information, conducting visual analyses, and developing CP components which include the identification of significant scenic, natural, historical, and cultural resources to be preserved (White, 2016). The plan focuses on land use activities within the one-mile wide planning corridor, which may affect the nature and purpose of the trail, as well as the resources found within the corridor.

The trail managing agency consists of the public agency or landowner with the authority and /or responsibility for decision making for lands through which the trail passes. The BLM and Pinal County are the designated trail managers for the section of trail located within and immediately adjacent to the Ripsey Wash TSF site. A 3.6-mile portion of the Arizona Trail within the vicinity of the Ripsey Wash TSF site is located on a trail easement held by Pinal County through ASLD land, while the remaining portions of the trail within the vicinity are managed by the BLM. The Arizona Trail Association, a non-profit private organization, assists the public agencies in managing the trail by coordinating volunteers, developing public awareness and support for the trail, encouraging and coordinating management of the trail project, and raising funds on behalf of the trail (ATA 2014).

3.9.1.2 Regional Recreation Settings and Facilities

The majority of public land in this region is open to recreational use that includes hunting, hiking, camping, mountain biking, scenic driving, wildlife-viewing, OHV use, fishing, and rock collecting. Areas that support recreation in the region range from very primitive backcountry lands to developed facilities, including BLM designated wilderness areas, AGFD Game Management Units, Forest Service designated campgrounds and picnic areas, hiking trails, and OHV routes. Many of the larger communities in the region provide more formal recreation opportunities, such as parks, ball fields, golf courses, rodeo arenas, and fairgrounds. See **Figure 36, Regional Recreation Resources**.

3.9.1.2.1 Wilderness Areas

There are several wilderness areas in this region. See **Appendix D, Regional Activity**.

The closest wilderness is the White Canyon Wilderness Area, which is located approximately four miles from the Ripsey Wash TSF site and about six miles from the Hackberry Gulch TSF site. Two prominent topographical features characterize this wilderness area, White Canyon, with its eroded formations and numerous side canyons, and the Rincon, a large escarpment located near the area's southern boundary. Due to its steep terrain, the White Canyon Wilderness Area has only one developed hiking trail.Non-Motorized Trails

The region provides opportunities for non-motorized activities, including hiking, biking, and horseback riding. Trails include a hiking trail in the White Canyon Wilderness, a trail at Devils Canyon, a network of trails near the Pinal Mountain campgrounds, and the Arizona Trail. Shorter recreational trails are found in the region at Cross Canyon, Apache Leap, and the Boyce Thompson Arboretum.

The Arizona Trail is located on the eastern side of the proposed Ripsey Wash TSF site and provides a recreation opportunity for overnight trips and day use. Designated in 2009 and completed in 2011, the Arizona Trail is over 800 miles long and stretches from Mexico to Utah, showcasing the state's mountain ranges, canyons, forests, wilderness areas, historic sites, copper mining operations, communities, and people (ATA 2014).

The Ripsey Wash segment of the trail forms part of the trail's 24-mile Tortilla Mountains Passage, one of four passages that make up the 93-mile Pickett Post to Tiger Mine section of trail.

The Ripsey Wash segment provides a transition between the open desert landscape to the south of Ripsey Wash and the mountainous terrain north of the Gila River (Redfield 2014). The trail traverses the bottomland of Ripsey Wash, followed by a climb into the Tortilla Mountains and across the Gila River via the historic Florence-Kelvin highway bridge. This trail section has varied topography, including views over the Tortilla Mountains towards the east and views down into Ripsey Wash. Much of the northern four miles of this section has views of the existing Ray Mine.

Two trailheads, both managed by Pinal County, provide access to the Tortilla Mountains passage of the Arizona Trail:

- The Freeman Trailhead, located southwest of the town of Dudleyville; and,
- The Florence-Kelvin highway Trailhead, located within the Ripsey Wash TSF site.

In addition, the BLM maintains the Kelvin Trail Access, located just north of the Tortilla Mountains Passage on the north side of the Gila River, about one-third mile west of the Florence-Kelvin highway. This site provides access for higher clearance vehicles. The only developed water sources within the Ripsey Wash section of the Arizona Trail are several water tanks permitted for stock and wildlife use. Long-distance hikers are known to treat and use these water sources.

3.9.1.2.2 Off-Highway Vehicle Trails

The region's rugged terrain and network of primitive roads makes it popular for recreational OHV use. See **Figure 36, Regional Recreation Resources**.

Within the Ripsey Wash TSF site, the Ripsey Wash OHV trail connects the Florence-Kelvin highway to the town of Kearny and a network of trails near the Old Ripsey Mine to the south. Pinal County's Open Space and Trails Master Plan indicates several trails within the area. The county's intent is to work with the managing agencies to preserve these corridors and improve existing trails in order to provide a connected system of county-wide trails. The plan shows an OHV trail traversing the Ripsey Wash TSF site along the Florence-Kelvin highway, designed to provide a connection between the trails north and south of the Gila River. See **Figure 37, Existing Recreation Resources, Ripsey Wash Project Area**, and **Figure 38, Existing Recreation Resources, Hackberry Gulch Project Area**.

The project area is also listed as a potential route for the Great Western Trail (GWT). The GWT is an OHV trail crossing through five states between the Mexican and Canadian borders. The trail is currently in the planning stages.

3.9.1.2.3 Hunting

The region provides a broad base of hunting opportunities due to its large extent of public lands and diversity in elevation, terrain, and vegetation.

The Ripsey Wash TSF site is located within Game Management Unit (GMU) 37B, most of which is BLM or ASLD-managed land. Principal game species likely to be found are javelina, mule deer, and Gambel's quail. Secondary game species likely to occur are desert cottontail and dove.

The Hackberry Gulch TSF site is located within GMU 37B and 24A. Game species in these GMUs include javelina, mule deer, white-tailed deer, mountain lion, desert cottontail, dove, and Gambel's quail. Only public lands at this site are available to the general public for hunting.

3.9.1.2.4 Fishing and Boating

The region provides several resources for fishing. Sunfish, catfish, and largemouth bass can be caught in the Gila and San Pedro rivers (AGFD 2014a). The AGFD regulates Kearny Lake for bass, trout, and catfish (AGFD 2014b). The BLM maintains two developed recreation sites (the Christmas and Shores Recreation Areas) that support fishing activities in the Gila River north of Winkelman along SR 77 (BLM 2013). The Town of Winkelman also manages a river park along the Gila River. The Town of Kearny is developing a small river access park along the Gila River. Recreational boating and floating activity is relatively light, but does occur in the Gila River during the higher flow seasons, which provides Class 1 and 2 whitewater. Undeveloped access points are found near the Florence-Kelvin highway bridge, at Cochran, and at Whitlow Ranch (BLM 2010).

3.9.1.2.5 Campgrounds and Picnic Areas

There are no developed campsites found within or adjacent to the Ripsey Wash or Hackberry Gulch TSF sites; however, these areas do have several dispersed campsites and fire-rings.

The Forest Service manages several developed campgrounds in the Pinal Mountains within the Tonto National Forest, north and northeast of the TSF sites; these include the Kellner Campground, Cherry Flat, Sulfide del Rey, Pioneer Pass, and Upper Pinal and Pinal Recreation Areas. The Tonto National Forest also maintains camping facilities along the Gila-Pinal Scenic Route (east of the town of Superior), at Devils Canyon and Oak Flat campgrounds. The closest federally-managed developed campground to the Ripsey and Hackberry TSF sites is 13 miles away. The Town of Winkelman also maintains a developed campground along the Gila River. The Forest Service manages several day-use areas, including Capitan Pass and Icehouse CCC picnic areas. The closest day-use area to either of the TSF sites is Capitan Pass, which is 13 miles northeast of the Hackberry TSF site.

3.9.1.2.6 Scenic Highways

SR 177 is a designated state scenic highway, known as the Copper Corridor West. The Copper Corridor West spans 32 miles from Superior to Hayden/Winkelman. Natural landforms visible along SR 177 include Picketpost Mountain, Dripping Springs Mountains, Mineral Mountains, the Tortilla Mountains, and the Gila River. The Ray Mine and Hayden Smelter complexes are considered part of the corridor’s scenic attractions (ADOT Undated). Asarco has established a public overlook off SR 177 for viewing of the Ray Mine.

Other state designated scenic roads in the region include the Copper Corridor East, a 38-mile segment of SR 77, and the Gila-Pinal Scenic Road, a 26-mile segment of US Highway 60. SR 177, SR 77, SR 79, and US Highway 60 make up a 148-mile scenic loop (ADOT Undated and ADOT 1989).

3.9.1.2.7 Other Regional Recreation Facilities

Founded in 1920, the Boyce Thompson Arboretum is a 323-acre Arizona State Park, known as Arizona’s oldest and largest botanical garden. The Arboretum is located west of the town of Superior, approximately 15 miles from the Ripsey Wash TSF site and 16 miles from the Hackberry Gulch TSF site.

Kearny Lake and two BLM-developed recreation sites located along the Gila River (Christmas and Shores Recreation Areas) attract visitors for kayaking, picnicking, camping, and bird watching (BLM 2013; Town of Kearny Undated).

The Kearny Golf Course is a popular recreation site located west of Kearny Lake.

The A Diamond Ranch headquarters operates as a guest lodge, offering eco-tourism activities to visitors interested in southwestern ranching experiences.

Rock collecting is another recreational activity in the region. Rock collecting areas closest to the two TSF sites include the abandoned Finch Mine, located north of Hayden, and the abandoned Gray Horse Mine located immediately east of the Hackberry Gulch TSF site. Access to this historic mine is gained through the Hackberry Gulch TSF site via an OHV trail leading from Old Ray Road (Bearce 2006).

OHV trails provide access to several other popular features, including a water source known as the Artesian Well and the Coke Ovens, located south of the White Canyon Wilderness. People also travel through the Ripsey Wash TSF site to access the abandoned Old Ripsey Mine (BLM 1999).

3.9.1.3 Recreation Use Levels and Trends

Demographic data indicates a growing demand for recreational facilities in Arizona. The Ripsey Wash and Hackberry Gulch TSF sites are located within a two-hour drive from the Phoenix and Tucson metropolitan areas, both contributing to demand for recreation opportunities within the project area.

The 2013 Draft Statewide Comprehensive Outdoor Recreation Plan (SCORP) reported Arizona as having the eighth fastest rate of population growth in the country. Pinal County has experienced a doubling of population between 2000 and 2012, making it the second fastest growing county in the U.S. Although most growth has occurred west of Interstate 10, the Pinal County cities of Florence and Oracle Junction are also experiencing growth. Arizona is a major annual destination for millions of visitors, with 2011 tourism expenditures near $18 billion (AORCC 2012).

The 2010 National Survey on Recreation and the Environment indicates overall growth in both the number of people participating in outdoor recreation and in the number of participation days. The survey shows that 69% of residents in the western states are visiting recreation and historic sites on public lands. Arizona data show state park visitation has declined overall from 2007 to 2011, but the five state parks in Pinal County have all experienced increased visitation (AORCC 2012).

Approximately 60% of the households in Pinal County report visiting a park or recreation area an average of four times in the past three months, which equates to around 430,000 visits, with 37% reporting that they traveled more than 50 miles to visit a park (Pinal County 2007).

Since recreation in the Ripsey Wash and Hackberry Gulch TSF sites is dispersed in nature, visitation data for these areas is limited. The Ripsey Wash TSF project area occupies about 8% of the Middle Gila Canyons study area, which had an estimated 65,000 to 70,000 recreational visits annually during 2003-2006. Much of this use, however, occurs closer to the urban areas west and north of Ripsey Wash (BLM 2010).

Field observations indicate that the Arizona Trail is being used for hiking, biking, and horseback riding. Observers reported seeing three groups of five to ten bikers on the trail or trailhead and a truck/horse trailer parked in the trailhead during eight days in the field (Purcell 2014, ECA 2014). Observers during the peak season noted the Florence-Kelvin highway (Arizona Trail) Trailhead as fully occupied, with many vehicles from other states or Canada (Nelson 2014, Redfield 2014). The trail attracts international attention, as evidenced by international orders for the Arizona Trail Guidebook (Nelson 2014).

Ripsey Wash is used for camping, hunting, and OHV use. Hunting pressure is relatively light within the Tortilla Mountains, used primarily by local residents (AGFD 2014c). OHV riding is very popular in this region (as well as throughout Arizona), with an estimated 22 percent of the state population participating. The number of registered OHV vehicles in Arizona more than doubled between 2006 and 2011 and is forecasted to continue to grow (AORCC 2012).

The BLM Middle Gila Canyons Transportation Management Plan study area is one of several destinations in Arizona that provides opportunities for OHV use. Traffic sampling in 2007 indicated an annual average of 17.6 vehicles per day and peak daily traffic of 41 vehicles on the Cochran Road, located about three miles west of the Ripsey Wash TSF site. More recent sampling indicated increases in volume (BLM 2010). OHV riding in Ripsey Wash is popular with Kearny residents via the Hackberry

Wash trail west of town. OHV use also occurs within the Hackberry Gulch TSF site along several routes, one of which leads to the abandoned Gray Horse Mine.

3.9.1.4 Recreational Opportunity Spectrum Classification

The BLM uses the recreation opportunity spectrum (ROS) system to incorporate recreation planning into their land use management process. The ROS continuum describes the existing conditions that define a land area's capability and suitability for providing a particular range of recreation experience opportunities. Once ROS classes are established, any proposed alterations to the landscape can be evaluated based on their potential to change the ROS class. The 1989 RMP did not establish ROS classes for the BLM-administered areas within or adjacent to the TSF sites, so this document uses the ROS system to describe the exsting recreational setting for the two TSF sites based on collected data. See **Table 3-49, Recreational Opportunity Spectrum Classes**.

Table 3-49, Recreational Opportunity Spectrum Classes

ROS	Class Description
Primitive	Opportunity for isolation from man-made sights, sounds, and management controls in an unmodified natural environment. Only facilities essential for resource protection are available. A high degree of challenge and risk are present. Visitors use outdoor skills and have minimal contact with other users or groups. Motorized use is prohibited.
Semi-Primitive Non-Motorized	Some opportunity for isolation from man-made sights, sounds, and management controls in a predominantly unmodified environment. Opportunity to have a high degree of interaction with the natural environment, to have moderate challenge and risk and to use outdoor skills. Concentration of visitors is low, but evidence of users is often present. On-site managerial controls are subtle. Facilities are provided for resource protection and the safety of users. Motorized use is prohibited.
Semi-Primitive Motorized	Some opportunity for isolation from man-made sights, sounds, and management controls in a predominantly unmodified environment. Opportunity to have a high degree of interaction with the natural environment, to have moderate challenge and risk and to use outdoor skills. Concentration of visitors is low, but evidence of other area users is present. On-site managerial controls are subtle. Facilities are provided for resource protection and the safety of users. Motorized use is permitted.
Roaded Natural	Mostly equal opportunities to affiliate with other groups or be isolated from sights and sounds of man. The landscape is generally natural with modifications moderately evident. Concentration of users is low to moderate, but facilities for group activities may be present. Challenge and risk opportunities are generally not important in this class. Opportunities for both motorized and non-motorized activities are present. Construction standards and facility design incorporate conventional motorized uses.
Roaded Modified	Similar to the Roaded Natural setting, except this area has been heavily modified (roads or recreation facilities). This class still offers opportunity to have a high degree of interaction with the natural environment and to have moderate challenge and risk and to use outdoor skills.
Rural	Area is characterized by a substantially modified natural environment. Opportunities to affiliate with others are prevalent. The convenience of recreation sites and opportunities are more important than a natural landscape or setting. Sights and sounds of man are readily evident, and the concentration of users is often moderate to high. Developed sites, roads, and trails are designed for moderate to high uses.
Urban	Area is characterized by a substantially urbanized environment, although the background may have natural-appealing elements. High levels of human activity and concentrated development, including recreation opportunities are prevalent. Developed sites, roads and other recreation opportunities are designed for high use.

Although much of the land within the two TSF sites is either ASLD-managed land or privately owned and thus not subject to BLM management prescriptions, the ROS system was used to characterize the recreational setting for the entire study area to provide a consistent means to analyze project-related impacts on recreation resources.

Based on the above analysis of existing recreation facilities and use patterns, the ROS for the majority of the Ripsey Wash TSF project area would be considered Semi-Primitive Motorized due to its natural setting, combined with the extensive OHV activity in the area. Semi-Primitive Motorized settings are landscapes that are generally natural in appearance, but which are easily accessible, experience motorized use, and may be within sight or sound of human improvements.

The western portion of the Arizona Trail corridor north of the Gila River would be considered Semi-Primitive Non-Motorized due to the relative lack of OHV trails and human improvements. The eastern portion of the trail corridor north of the river would be considered Roaded Modified due to its proximity to the existing Ray Mine.

The portion of the Ripsey Wash TSF site within one-half mile of the Florence-Kelvin highway would be considered a Roaded Natural setting, since most of the road corridor is relatively natural except for several livestock improvements and several electric transmission lines (including the 69kV SCIP electric transmission line) that are visible from the Florence-Kelvin highway. The only Roaded Modified setting is in the northeast corner of the project area where the existing Ray Mine dominates the view (defined as the portions of the mine viewshed within two miles of the mine). The northern portion of the proposed Arizona Trail realignment route is within the Roaded Modified setting due to its potential for views of the Ray Mine, with the remainder designated as Semi-Primitive Motorized. See **Figure 37, Existing Recreation Resources, Ripsey Wash Project Area**.

Within the Hackberry Gulch TSF project area, the landscape is generally natural with a relatively low concentration of users. The Semi-Primitive Motorized ROS setting includes areas outside the existing Ray Mine Viewshed or where the mine may be visible but does not dominate the area's visual character. Roaded Modified ROS settings include areas in which views of the existing Ray Mine dominate or lie within one-half mile of State Route 177. See **Figure 38, Existing Recreation Resources, Hackberry Gulch Project Area**.

3.9.2 Environmental Consequences

3.9.2.1 Effects of the No Action Alternative

Under the no action alternative, neither the Ripsey Wash nor the Hackberry Gulch TSF would be constructed. The current recreation setting would remain in its present condition, unless changed by other causes. Current dispersed recreation uses of the TSF sites would continue, including hunting, camping, OHV travel, hiking, etc. The Arizona Trail would remain in its current location.

After the Ray concentrator shuts down due to lack of tailings storage room at the Elder Gulch TSF and the lack of any new TSF site at the Ray Mine (which is projected to occur at year 2023 or 2024), direct mine employment would be reduced by an estimated 280 people, with indirect employment decreasing by about 678 to 1,196 jobs, which could reduce demand for recreational resources in the region. The ultimate mine footprint would be approximately 1,377 acres less than the average footprint under the two action alternatives, potentially leaving more land available for dispersed recreation activities depending on the ultimate land disposition and access.

3.9.2.2 Effects of the Ripsey Wash TSF Alternative

Construction and operational activities associated with the Ripsey Wash TSF would have direct effects on recreational activities in the project area. Development of the TSF would change the recreational setting from primarily semi-primitive motorized and semi-primitive non-motorized to a roaded modified setting with an industrial character. Portions of the Arizona Trail and dispersed recreational opportunities, such as OHV routes, campsites, and hunting resources, located within and immediately adjacent to the TSF footprint would be lost. Effects on game populations and habitat fragmentation are discussed in Section 3.15.2.2.

Approximately 10.2 miles of OHV trails (i.e, primitive roads) would be eliminated with this alternative, including the northern portion of the Ripsey Wash Trail and the OHV trail along the section of Florence-Kelvin highway to be paved. Connectivity from Kearny to the Florence-Kelvin highway, as well as access to upper Ripsey Wash and the Old Ripsey Mine, would continue via the Red Cloud Trail, located south of the project boundaries. The loss of the Ripsey Wash trail combined with the paving of the highway, however, would interrupt Pinal County's planned OHV connections between the north and south sides of the Gila River. See **Figure 39, Recreation Resources, Ripsey Wash Alternative**.Eight informal, dispersed campsites within the Ripsey Wash TSF footprint would also be eliminated. Other lands beyond 500 feet of project facilities would remain open to the public. ASARCO plans to fence the reclaim and drain down ponds with chain link fencing and all active operations with four-strand barbed wire.

The TSF would displace dispersed recreational use to other areas, especially during construction when new workers and their families might create an increase in local recreation activity. Recreation from the project areas is most likely to be displaced to lands north of the Gila River, to OHV routes south and west of the TSF site, or to the Dripping Springs Mountains. Because of the limited additional work force needed for TSF operation, decommissioning and final closure, this effort would not create any noticeable additional demand on recreation opportunities in this area.

Increased construction traffic on SR 177 or the Florence-Kelvin highway could have a minor effect on scenic driving. Night sky effects would be minimal and localized as most construction activities would be conducted during daylight hours. Night sky effects during TSF operations would be negligible given the limited need for lighting at the site.

Noise generated during the construction phase would also affect recreational users in the immediate vicinity of the activity. Relocation of the Florence-Kelvin highway would generate intermittent noise over a period of six to 12 months, which would be noticeable above background levels from portions of the Arizona Trail north of the Gila River. Construction of the main and east starter dams and reclaim ponds and the east diversion channel structure would extend over a three-year period, but would be less noticeable from the Arizona Trail due to the greater distance. These activities would be audible from the trail north of the Gila River as well as the realigned segment of the trail, primarily from the sections with views of the TSF. The remaining sections of the realigned trail would be east of the ridgeline, which would buffer the noise. Noise from construction-related blasting would be highly noticeable, but infrequent and short in duration (1-2 seconds).

Traffic and noise generated by TSF operations are expected to have a negligible effect on recreational users in the area. Traffic along the realigned Florence-Kelvin highway, however, would be noticeable from the Arizona Trail north of the Gila River, primarily from the 5.7 miles of trail with views of the highway. See Section 3.8, Noise, for noise estimates expected from the construction and operation of the Ripsey Wash TSF.

Travelers who use the Florence-Kelvin highway for scenic driving or to access dispersed recreation areas could have a diminished recreation experience due to views of the TSF.

Some of the higher elevations within the White Canyon Wilderness Area are within the TSF viewshed, but recreational use of these areas is minimal due to the steep terrain and difficult access. Portions of the Forest Service trails and campgrounds in the Pinal Mountains are also within the project viewshed, but the TSF would be over 15 miles away and thus would not impact the recreational experience of those using these facilities.

Development of the Ripsey Wash TSF would require relocation of a portion of the Arizona Trail, as well as the trailhead maintained by Pinal County on the Florence-Kelvin highway. Pinal County, the BLM, the Forest Service, the Arizona Trail Association, and Asarco worked together to identify trail selection criteria and possible new routes for the portion of the Arizona Trail, along with the existing trailhead, that would be eliminated by the construction and operation of the Ripsey Wash TSF. This group agreed on a recommendation to the Corps for preferred route relocation on the south and east side of the TSF and for the need to construct the new trail as part of the initial Ripsey Wash TSF construction. See **Appendix G, Arizona Trail Relocation Analysis**.

Relocation of the Arizona Trail would require replacing approximately 6.8 miles of existing trail with about 6.4 miles of new trail construction, primarily along the eastern slopes of the Tortilla Mountains, and about 0.2 miles of shared use along Riverside Drive. Of the 6.8 miles of trail to be replaced, 5.1 miles are on state land. Pinal County holds the ROW for the 3.6 miles of state-owned trail located south of the Florence-Kelvin highway. The BLM is in the process of acquiring the ROW on the 1.5 miles of state-owned trail north of the highway. The remaining 1.7 miles of trail to be replaced are on the BLM portions of trail east of the state land boundary. The relocated trail would be located almost entirely within BLM-managed land (79%), compared to the existing trail which is almost entirely within ASLD land (75%). See **Table 3-50, Arizona Trail Land Ownership** and **Figure 37 Existing Recreation Resources, Ripsey Wash Project Area**.

Table 3-50, Arizona Trail Land Ownership

Landowner (Easement Holder)	Existing Trail Alignment (miles)	Proposed Trail Alignment (miles)
BLM	1.7	5.2
ASLD (Pinal County)	5.1	0
Private		1.2
Pinal County: Riverside Drive ROW		.2
Total	**6.8**	**6.6**

After construction and operation of the TSF, a total of 3.3 miles of trail located within the footprint or within 500 feet of project facilities would be fenced and closed to public use (1.0 miles on BLM ROW and 2.2 miles on County ROW). Portions of the remaining 3.5 miles of trail may be available for continued public use as spur trails if the BLM or County decide to continue to hold their easements on and maintain their sections of trail during TSF construction and operation. Much of the trail's new route is located on the east side of the Tortilla Mountains, at a higher elevation than the existing trail, and thus provides additional views of the Gila River Valley and the Dripping Springs Mountains relative to the existing trail. The Ripsey Wash TSF, however, would be visible from approximately 1.2-miles of the new route, affecting its visual quality. The route's steep topography would also likely require a wider trail width than the existing trail and bench-cut construction techniques, which would affect the trail's scenic quality compared to the existing trail. The new trail route crosses a federally patented mining claim owned by Asarco; however, the likelihood of mining such a small parcel of land is remote. It should be noted that the U.S. Department of the Interior currently maintains a moratorium on the acceptance of new mineral patent applications.

Construction and operation of the realigned Florence-Kelvin highway and the Ripsey Wash TSF facility would adversely affect the scenic value of portions of the trail north of the Gila River. Visual effects on the Arizona Trail are discussed in more detail in Section 3-14.

The existing trailhead would be relocated to a location near the new Florence-Kelvin highway bridge. Trail users would be able to cross the Gila River via the existing historic bridge, which would remain open for pedestrian/equestrian use after completion of the new bridge[38]. See **Figure 41, Proposed Trailhead & Parking**.

The Ripsey Wash TSF would alter the ROS setting in portions of the project area. Portions of the Roaded Natural setting along the Florence-Kelvin highway and the existing Semi-Primitive Motorized setting would change to a Roaded Modified setting, because the TSF would dominate the view. Those portions of the Semi-Primitive Non-Motorized setting north of the Gila River with views of the TSF would also change to a Roaded Modified setting. Section 3.14, Visual Resources, provides more detailed description of visual impacts from the Arizona Trail and other recreation facilities.

The sites proposed for waters of the U.S. mitigation (see **Appendix J, Compensatory Mitigation**) have no or limited present recreation value due to their condition and location on private property. The fencing of the proposed mitigation areas to preclude livestock grazing, wood harvesting and off-vehicle access would produce no impact to local or regional recreation activities because of the relatively small area involved with the proposed mitigation sites, their location on private property, and the adjacent public lands in this region that are available for outdoor recreation activities.

3.9.2.3 Effects of the Hackberry Gulch TSF Alternative

Development of the Hackberry Gulch TSF would alter the recreational setting of portions of the existing project area from a semi-primitive motorized setting to a roaded modified setting. As with the Ripsey Wash TSF, dispersed recreational opportunities such as OHV riding, camping and hunting would be affected by the construction and operation of the Hackberry Gulch TSF. Effects on wildlife populations and habitat fragmentation are discussed in Section 3.15.2.3.

The Hackberry Gulch TSF would cause the loss of approximately 4.9 miles of primitive roads within the TSF footprint, primarily the Old Kelvin road (Kane Springs Canyon road), but a re-route of this primitive road around the TSF would allow continued access to Kane Spring Canyon.Loss of these roads would affect dispersed recreation opportunities, resulting in displacement of recreation users to other areas, most likely to other primitive roads or OHV routes accessed from SR 177, such as the trails east of Kearny. Several informal, dispersed campsites within the project footprint would also be lost. Other lands located over 500 feet from project facilities would remain open to the public.

[38] Construction of the new Florence-Kelvin highway bridge across the Gila River is a joint project of Pinal County and ADOT. It is not part of the Ray Mine TSF project.

Construction traffic on SR 177 and noise generated during construction and operation would have similar effects on dispersed recreation activities as the Ripsey Wash TSF. Night sky effects during construction and operations are also expected to be similar to those for the Ripsey Wash TSF.

The Hackberry Gulch TSF would also affect the scenic views from recreation resources, including the Arizona Trail, and SR 177. See Section 3.14, Visual Resources.

The Hackberry Gulch TSF would expand the portion of the project area designated as Roaded Modified ROS, since opportunities to interact with the natural environment (outside the TSF) would continue, but the industrialized character of the TSF would dominate the view. With construction and operation of the Hackberry Gulch TSF, the Semi-Primitive Motorized setting would be reduced to areas outside the TSF viewshed or within the viewshed, but where the view would be relatively intermittent or where the TSF would not dominate the view (defined as areas over two miles from the TSF). See **Figure 40, Recreation Resources, Hackberry Gulch Alternative,** and Section 3.14, Visual Resources, for viewshed discussion.

Similar to the discussion in Section 3.9.2.2, Effects of the Ripsey Wash Alternative, recreation effects associated with the waters of the U.S. mitigation work set forth in **Appendix J, Compensatory Mitigation**, would be negligible.

3.10 CULTURAL RESOURCES

Identify cultural resources and conduct Native American consultation. *The areas of concern include: (1) the effects to pre-historic and historic cultural resources listed or eligible for listing on the National Register of Historic Places; and, (2) the potential to affect traditional cultural properties.*

3.10.1 Affected Environment

This section provides an analysis of cultural resources, including historical and archeological resources, for the proposed Ripsey Wash and Hackberry Gulch TSF alternatives. Historical resources are buildings, structures, sites, places, or objects generally associated with the time period from the beginning of the written recording of history to the present time. Archaeological resources may include both prehistoric remains and remains dating to the historical period. Prehistoric (or Native American) archaeological resources are physical properties resulting from human activities that predate written records.

This section provides a description of the regulatory context with respect to cultural resources, background information related to this project, a summary of the cultural resources investigations that have been conducted for this project, and an overview of the consultation activities between the Corps and relevant Native American tribes. A summary of the prehistoric and historic context for the project area is provided in **Appendix H, Cultural History**.

3.10.1.1 Background

3.10.1.1.1 Regulatory Context

Section 106 of the National Historic Preservation Act (NHPA) of 1966 (36 CFR 800, Section 106), as amended, requires that the lead federal agency with jurisdiction over a project must consider effects to historic properties. The Corps has established procedures for complying with this requirement for 404 permit applications through 33 CFR Part 325, Appendix C: Procedures for the Protection of Historic Properties.

Compliance with Section 106 requires a sequence of steps, often referred to as the "Section 106 process." The steps include:

- Identify the "area of potential effects" (APE) for the project;
- Identify historical or archaeological resources within the affected area;
- Evaluate the eligibility of resources for listing on the National Register of Historic Places (NRHP);
- Determine the level of effect of the undertaking on eligible properties; and,
- Consult with concerned parties and develop a memorandum of agreement (MOA) on avoidance, minimization, or mitigation of adverse effects on eligible properties.

As defined in the NHPA (36 CFR 800.16(d)), an APE "is the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if such properties exist. The area of potential effects is influenced by the scale and nature of the undertaking and may be different for different kinds of effects caused by the undertaking."

Federal agencies define the APE for cultural resources in consultation with the SHPO. The Corps uses the term "permit area" See (33 CFR Part 325, Appendix C) instead of APE, which is defined as "those areas comprising the waters of the U.S. that will be directly affected by the proposed work or structures and uplands directly affected as a result of authorizing the work or structures."

Cultural resources are evaluated for their eligibility for inclusion on the NRHP based on a set of criteria detailed in the National Historic Preservation Act (NHPA) to serve as "an authoritative guide to be used by federal, state, and local governments, private groups and citizens to identify the Nation's cultural resources and to indicate what properties should be considered for protection from destruction or impairment" (36 CFR 60.2). The eligibility criteria are as follows:

- Criterion A: Are associated with events that have made a significant contribution to the broad patterns of our history; or,
- Criterion B: Are associated with the lives of persons significant in our past; or,
- Criterion C: Embody the distinctive characteristics of a type, period, or method of construction, or that possess high artistic values, or that represent a significant distinguishable entity whose components may lack individual distinction; or,
- Criterion D: Have yielded or may be likely to yield, information important to history or prehistory.

The criteria for eligibility to the NRHP provide the basis for evaluation and subsequent management of cultural resources in the permit area. The term "historic property" is used in this EIS to identify a property that is listed in the NRHP or which has been determined to be eligible for listing in the National Register. The eligibility of a property is determined by the Corps in consultation between the Corps and other federal agencies and the SHPO.

Effects of the proposed undertaking on eligible properties are determined by the federal lead agency, in this case, the Corps. The lead federal agency will consult with the SHPO and request concurrence. In addition, the federal lead agency will consult with other federal agencies with land management responsibilities within the APE. Consultation with the SHPO is requested for evaluations and recommendations with respect to NRHP eligibility and adverse effects.

In situations where a federal undertaking will have an adverse effect on historic properties, a Historic Properties Treatment Plan (HPTP) is developed that describes how a project proponent will avoid, minimize, or mitigate adverse effects. A MOA is also developed that makes reference to the HPTP and spells out the responsibilities of all the parties who are signatories to the agreement and identifies concurring parties. Concurring parties may include other stakeholders that do not have a financial or regulatory role in the project and they are not signatories to the MOA.

3.10.1.1.2 Related Projects

The Ripsey Wash TSF, which is the alternative proposed and preferred by Asarco, is contingent on the purchase of state-owned land by Asarco from the ASLD. The lengthy land auction/purchase process with ASLD has a number of required preliminary steps involving pre-sale activities such as inventories of biological and cultural resources, condemnation drilling, etc.

Prior to the submittal of a 404 permit application to the Corps in 2013, Asarco had conducted cultural resources surveys and was in the process of performing data recovery activities for known sites located within the prospective sale parcel, consistent with state cultural resources laws. The ASLD requires complete data recovery of cultural resources prior to the auction and sale of state-owned land. These activities have been performed, in part, in coordination and consultation with both the ASLD and the Arizona SHPO.

Data recovery activities had not been completed when Asarco submitted their 404 permit application, and they were suspended at the Corps' request once the application was submitted and Section 106 requirements were triggered within the permit area.

3.10.1.2 Permit Area

As described above, the Corps established a permit area for the proposed Ripsey Wash TSF alternative that identifies a physical area for evaluation of direct and indirect effects to historic properties. See **Figure 53, Ripsey Wash Area of Potential Effect**. The SHPO was also consulted regarding the permit area established by the Corps. The permit area has been determined to consist of the entire physical footprint associated with the Ripsey Wash TSF and associated infrastructure and facilities. The APE includes approximately a 100-foot-wide buffer from the edges of the project footprint, and extends along affected washes downstream of this TSF to their confluence with the Gila River. In addition, the Corps has included the realigned segment of the ANST and compensatory mitigation sites within the permit area because of their direct connection to the project.

A permit area was not established for the Hackberry Gulch TSF Alternative; however, an analysis area was developed that included the alternative footprint for this TSF and its supporting infrastructure. The compensatory mitigation sites would also be included in the permit area for this alternative.

3.10.1.3 Cultural Resource Investigations

3.10.1.3.1 Ripsey Wash TSF Site

WestLand (Asarco's consultant) has conducted cultural resource surveys both in support of Asarco's acquisition of State lands for the proposed project and for the larger permit area associated with the 404 permit application. WestLand prepared a summary document that details the previous investigations that have occurred within the permit area and provides a summary of the status of each archaeological site (Jerla 2018). This summary has been updated several times to address small changes to the Corps's permit area as minor project revisions have occurred. Thirty-two investigations have been previously conducted within the permit area.

Table 3-51, Previous Cultural Resource Survey Projects within the Ripsey Wash TSF Permit Area, summarizes the previous cultural resources survey projects within the permit area.

Table 3-51, Previous Cultural Resource Survey Projects within the Ripsey Wash TSF Permit Area

Agency No.		Company	Project Name	Project Type
1963-8.ASM	1	ASM Cultural Resources Management Division	Buttes Dam Site Survey	Class III Survey
1973-2.ASM	2	ASM Cultural Resources Management Division	Buttes Reservoir Survey	Class III Survey
1975-5.ASM	3	ASM Cultural Resources Management Division	Buttes Reservoir Phase II	Phase II Data Recovery
1990-178.ASM	4	SWCA Inc.	ASARCO Tailings Pipeline	Class III Survey
1993-369.ASM	5	Unknown	Unknown	Class III Survey
1995-127.ASM	6	Archaeological Research Services, Inc.	State Route 177/Kearny-Ray	Class III Survey
1997-59.ASM	7	AZTLAN	Arizona Trail Survey	Class III Survey
1997-416.ASM	8	SWCA Inc.	Mineral Creek Survey	Class III Survey
1998-213.ASM	9	Dames and Moore	Arizona Trail Archaeological Survey	Class III Survey
2003-1172.ASM	10	Gila River Indian Community, CRMP	SCIP Survey of Power Line near Riverside	Class III Survey
2003-1178.ASM	11	Gila River Indian Community, CRMP	SCIP Survey of Coolidge-Hayden 69-kV Power Line	Class III Survey
2003-1201.ASM	12	Gila River Indian Community, CRMP	SCIP Historical Assessment of Power Line in Vicinity of Riverside	Class III Survey
2066-250.ASM	13	Desert Archaeology	BHP San Manuel Survey	Class III Survey
2007-19.ASM	14	Logan Simpson Design, Inc.	AZ Trail White Canyon Passage	Class III Survey
2008-762.ASM/2009-432.ASM	15	Archaeology Southwest	San Pedro Survey	Class III Survey
ASM ACC 1111	16	Donald Tuohy	Archaeological Survey and Excavation in the Gila River Channel between Earven Dam Site and Buttes Reservoir Site, Arizona	Phase II Date Recovery
SWCA 6369-076	17	SWCA Inc.	A Cultural Resources Survey of Approximately 8 acres along Kelvin Bridge	Class III Survey

Table 3-51, Previous Cultural Resource Survey Projects within the Ripsey Wash TSF Permit Area (continued)

Agency No.		Company	Project Name	Project Type
SWCA 6369-187	18	SWCA Inc.	Phase I and II Data Recovery Plan for Portion of AZ V:13:33 (ASM)	Phased Data Recovery Plan
SWCA 6369-187	19	SWCA Inc.	Living along the Gila River: Results of Archaeological Investigations at AZ V:13:33(ASM)	Phases I and II Data Recovery
WRI 203.20/2010-475.ASM	20	WestLand	ASARCO Tailings Dam Class	Class III Survey
WRI 203.25	21	WestLand	Archaeological Data Recovery and NRHPEligibility Evaluation Plan for 28 Sites on Arizona State Trust Land in the Northern Tortilla Mountains	Phased Data Recovery and Eligibility Evaluation Plan
WRI 203.23/2010-475.ASM	22	WestLand	Ripsey Wash Drill Pads	Class III Survey
WRI 203.252014-378.ASM	23	WestLand	Ripsey Wash Pipeline Survey	Class III Survey
WRI 203.25	24	WestLand	Cultural Resources Inventory of 84.7 acres in Support of Projects for the Ray Mine near Kelvin, Pinal County, Arizona	Class III Survey
WRI 203.33/ 2014-380.ASM	25	WestLand	2.16 Acre Water Line	Class III Survey
2014-570.ASM	26	WestLand	Belgravia Waterline Survey II	Class III Survey
WRI 203.25/ WRI 203.43/ 2014-113.ASM	27	WestLand	Arizona Trail Relocation Survey	Class III Survey
WRI 203.30/ 2012-108ps.ASM	28	WestLand	Ripsey Data Recovery & Eligibility Testing	Phased Data Recovery and Eligibility Testing
WRI 203.43/ 2016-58.ASM	29	WestLand	Arizona Trails II	Class III Survey
WRI 203.43	30	WestLand	Ripsey 404 Mitigation Sites	Class III Survey
WRI 203.51/ 2017-256.ASM	31	WestLand	Ripsey 2017 CWA 404 Support Services	Class III Survey
WRI 203.51/ 2017-362.ASM	32	WestLand	ASARCO Ripsey Slurry Pipeline	Class III Survey
Source: Jerla 2018				

WestLand has conducted pre-404 application data recovery and eligibility evaluation activities within the APE in accordance with the Data Recovery Plan coordinated with/approved by the SHPO and ASLD. The fieldwork obligations defined in the Data Recovery Plan have been fully implemented except for Phase II data recovery work at four sites (AZ U:16:21[ASM], AZ U:16:350[ASM], AZ U:16:351[ASM], and AZ U:16:394[ASM]), which cannot occur until consultation under the NHPA has been completed. Subsequent to Asarco's submittal of the 404 permit application for the TSF project, the Corps requested that Asarco stop performing data recovery actions until the Corps could define the project permit area and conduct NHPA Section 106 and tribal consultation, as appropriate.

3.10.1.3.2 Hackberry Gulch TSF Site

WestLand conducted an assessment of known cultural resources projects, located within the proposed Hackberry Gulch TSF site (King 2014). Thirty investigations have been previously conducted in this area though most of these studies are greater than 10 years old and only examined about 57% of the analysis area. See **Table 3-52, Cultural Resource Survey Projects within the Hackberry Gulch Analysis Area**.

Table 3-52, Cultural Resource Survey Projects within the Hackberry Gulch Analysis Area

Project No.		Project Name	Company
1963-8.ASM	**1**	Buttes Dam Site Survey	Arizona State Museum
1973-2.ASM	**2**	Buttes Reservoir	Arizona State Museum
1975-5.ASM	**3**	Buttes Reservoir Phase II	Arizona State Museum
1990-178.ASM	**4**	Asarco Pipeline Project	SWCA, Inc.
1990-179.ASM	**5**	Asarco Survey	SWCA, Inc.
1990-200.ASM	**6**	Asarco Alternatives	SWCA, Inc.
1991-224.ASM	**7**	Kearny Survey	Cultural and Environmental Systems, Inc.
1992-291.ASM	**8**	Route 177 Winkelman to Kearny	Archaeological Research Services
1993-369.ASM	**9**	EMA Survey	SWCA, Inc.
1995-127.ASM	**10**	State Route 177 Kearny and Ray	Archaeological Research Services
1997-258.ASM	**11**	Asarco Surveys	SWCA, Inc.
1997-416.ASM	**12**	Mineral Creek Survey	SWCA, Inc.
2003-1172.ASM	**13**	SCIP Survey of Powerline near Riverside	Gila River Indian Community
2003-1178.ASM	**14**	SCIP Survey of Coolidge-Hayden 69-kV Powerline	Gila River Indian Community
2003-1201.ASM	**15**	SCIP Historical Assessment and Documentation of Powerline in the Vicinity of Riverside	Gila River Indian Community
AZ-000114	**16**	BLM Grazing Lease Site Assessment, Middle Gila River	BLM Tucson Field Office
BLM-020-98-01	**17**	San Carlos Irrigation Project, Powerline	BLM Phoenix Field Office
BLM-024-95-20	**18**	Kearny Waterline Right-of-way	BLM Phoenix Field Office
BLM-060-MG-00-9	**19**	BLM Fence Line Survey (A-H Dam to 2 Mi. East of Cochran)	BLM Tucson Field Office
BLM-060-MG-00-10	**20**	Battle Ax Segment Fence Line Survey	BLM Tucson Field Office

Table 3-52, Cultural Resource Survey Projects within the Hackberry Gulch Analysis Area (continued)

Project No.		Project Name	Company
BLM-060-MG-00-11	**21**	BLM Fence Line Survey: LEN Segment	BLM Tucson Field Office
BLM-17-85	**22**	Asarco Alternatives	SWCA, Inc.
BLM-17-32	**23**	Mining Plan	BLM Phoenix Field Office
BLM-17-50	**24**	Unknown	Not recorded
BLM-17-77	**25**	Asarco Survey	BLM Phoenix Field Office
BLM-95-19	**26**	Unknown	Not recorded
WRI 203.25	**27**	Ripsey Wash Pipeline Survey	WestLand
WRI 203.29	**28**	Belgravia Pipeline Survey	WestLand
WRI 203.33	**29**	Belgravia Block Survey	WestLand
WRI 203.33	**30**	Belgravia Additional Class III Survey	WestLand

Source: King 2014

3.10.1.4 Archaeological Sites

3.10.1.4.1 Ripsey Wash TSF Permit Area

Thirty-eight archaeological sites were originally recorded within the portion of the permit area directly associated with the TSF facilities. Two of these sites (AZ V:13:6 (ASM) and AZ V:13:33 (ASM)) were originally recorded as separate sites and have since been incorporated into one site (under AZ V:13:33 (ASM)); therefore, there are 37 total sites within the TSF permit area. Of these 37 sites, one site, the Kelvin Bridge, is listed on the NRHP. Twenty-two of the sites are considered eligible for listing on the NRHP, and 14 sites are not considered eligible. Of the remaining 22 eligible sites, data recovery activities were fully completed at 12 sites and partially completed at four sites prior to the 404 permit application submission as part of the ASLD land sale process. In addition, data recovery was conducted within portions of one site, AZ V:13:33, as part of the Florence-Kelvin Highway Bridge project.

The potential east and west bypass routes for the Arizona Trail were surveyed for the presence of cultural resources. For the eastern by-pass route that has been selected, the survey indicated the presence of three total sites. The survey also found 11 isolated occurrences. Of the three sites, two were determined to be not NRHP-eligible by the SHPO. One site was determined to be NRHP-eligible but was previously mitigated under a separate project. The isolated occurrences are recommended as ineligible.

The existing SCIP powerline to be relocated is an NRHP-historic property (AZ V:13:211[ASM]). Two other NRHP-eligible sites, AZ V:13:220(ASM) and AZ U:16394(ASM) are located within the powerline relocation corridor.

The compensatory mitigation sites were each surveyed for cultural resources, and no such resources were found.

3.10.1.4.2 Hackberry Gulch TSF Site.

As noted previously, approximately 57% of the analysis area has been previously surveyed and most of the previous surveys conducted in this area are more than 10 years old. Within the area surveyed, 85 sites were previously recorded. Six of those sites were determined to be NRHP-eligible by the SHPO, and an additional 25 were recommended as eligible. The SHPO determined two sites to be not eligible, and an additional 14 sites were recommended as ineligible. Seven sites were not evaluated for eligibility, and 31 of these sites did not have their eligibility status recorded. There are two NRHP-listed sites located within five miles of the analysis area (Florence-Kelvin highway bridge over the Gila River and the SR 177 bridge over Mineral Creek).

In addition to these sites, the WestLand study noted that a review of General Land Office (GLO) plats and USGS quadrangle maps indicated 63 discrete historical features that meet the minimum threshold for being considered archaeological sites. Six of these features have already been recorded and are accounted for above.

Based on the number of sites previously recorded for just over half of the analysis area and the number of probable unrecorded features, it is likely that substantially more sites exist within the unsurveyed portion of the Hackberry Gulch analysis area.

In the event the Hackberry Gulch TSF is chosen as the preferred alternative, the mitigation sites picked for the Ripsey Wash TSF would be a part of the mitigation for the Hackberry Gulch TSF. There are no cultural resources sites located within the mitigation parcels.

3.10.1.5 Consultation and Coordination with SHPO

Asarco has previously conducted cultural resources surveys within the portion of the proposed Ripsey TSF site to be purchased from ASLD. In addition, a substantial amount of testing and data recovery has occurred within the sale parcel prior to Asarco submitting their 404 permit application. Up until the time the 404 permit application was submitted, these activities had all been conducted in consultation with ASLD staff and the Arizona SHPO in accordance with state law. Once the application was submitted to the Corps, these activities were ceased within the permit area at the Corps' request pending completion of Section 106 consultation.

The Corps initiated Section 106 consultation with the SHPO on September 23, 2013. The consultation letter to the SHPO indicated the Corps' determination that historic properties will be adversely affected if the proposed action is implemented. In addition, the consultation letter requested concurrence on NRHP eligibility recommendations for five sites that had not yet been reviewed by the SHPO.

The SHPO replied to the Corps on October 7, 2014 concurring with the Corps' determination of adverse effect to historic properties. The SHPO also concurred with the eligibility determinations provided for the five sites in question. The SHPO deferred concurrence on future treatment recommendations for sites with previous Phase I testing work until such time the Phase I results are reviewed by the SHPO. Consultation with the SHPO will continue as the project progresses through the 404 permit review process.

Three consultation updates have been conducted with the SHPO since the initial consultation to address small project changes that affected the extent of the permit area and to consider NRHP eligibility for any new sites located within the revised permit area. The results of the consultation updates have been incorporated herein.

3.10.1.6 Native American Consultation

The Corps also initiated tribal consultation with 14 Native American tribes on September 23, 2013, requesting their participation in the Section 106 consultation process. The tribes were provided the opportunity to review and comment on cultural resources documentation that had been completed to date for the proposed action. In addition, the Corps asked the tribes to identify any Traditional Cultural Properties (TCPs) that may exist in the project vicinity.

The Corps received replies from four tribes expressing an interest in participating with the consultation process: Gila River Indian Community, Tohono O'odham Nation, Hopi Tribe, and White Mountain Apache Tribe. Tribal consultation will be ongoing as the project progresses through the 404 permit review process.

These Tribes were also provided with similar consultation updates as described above for the SHPO.

3.10.2 Environmental Consequences

3.10.2.1 Effects of the No Action Alternative

Under the no action alternative, neither the Ripsey Wash nor the Hackberry Gulch TSF would be constructed. Cultural resources would continue to be exposed to natural geomorphic processes or other disturbances associated with current and expected future recreation and ranch management activities in this area.

3.10.2.2 Effects of the Ripsey Wash Alternative

There are 22 NRHP-eligible sites located within the permit area associated with the proposed action and one site that is already on the NRHP (Kelvin Bridge, NR #88001646: MPAEXP-17236). Implementation of the Ripsey Wash TSF would adversely affect all of these NRHP-eligible sites except two because the sites are either located within the footprint for the TSF or would be affected indirectly by the project. The Florence-Kelvin highway bridge (known locally as the Kelvin bridge) over the Gila River and the historic Mesa to Winkelman spur of the Southern Pacific Railroad (currently called the Copper Basin Railway) are located within the permit area for the proposed action but would not be affected by the project.

Archaeological sites that were originally located on the ASLD sale parcel were either fully or partially mitigated prior to submission of the 404 permit application through performing eligibility determinations, performing Phase I and II data recovery activities, and consulting with SHPO throughout this process. Therefore, some of the impacted sites have already been mitigated. **Table 3-53, Summary of Cultural Impacts and Mitigation Status for Ripsey Wash TSF Permit Area**.

Construction and operation of the proposed Ripsey Wash TSF would have an adverse direct effect on the 22 historic properties that are eligible for listing on the NRHP. See **Table 3-53, Summary of Cultural Impacts and Mitigation Status for Ripsey Wash TSF Permit Area**. The adverse effects to these sites would result because of their location within the construction footprint for the TSF and related facilities. This is an unavoidable effect of implementation for this alternative. Although some of these impacted properties have been previously mitigated through data recovery, the proposed action would result in either capping of the sites (permanent burial) or complete removal from excavation, which is considered an adverse impact. Mitigation would be required to minimize this adverse effect for those sites that were not previously mitigated under separate circumstances. An HPTP will be developed to provide a research and methodological framework for mitigating the adverse effects of the project on cultural resources. The HPTP will also provide methods to monitor and mitigate adverse effects for new sites discovered during construction.

Table 3-53, Summary of Cultural Impacts and Mitigation Status for Ripsey Wash TSF Permit Area

NRHP-Eligible Sites (ASM)	Location	Mitigation Status	Type of Impact
AZ U:16:21	Within ASLD sale parcel	Partially mitigated previously (Phase I completed)	Directly impacted
AZ U:16:23	Within ASLD sale parcel	Fully mitigated previously	Directly impacted
AZ U:16:299	Privately owned	Not previously mitigated	Not impacted
AZ U:16:345	Within ASLD sale parcel	Fully mitigated previously	Directly impacted
AZ U:16:346	Within ASLD sale parcel	Fully mitigated previously	Directly impacted
AZ U:16:347	Within ASLD sale parcel	Fully mitigated previously	Directly impacted
AZ U:16:348	Within ASLD sale parcel	Fully mitigated previously	Directly impacted
AZ U:16:349	Within ASLD sale parcel	Fully mitigated previously	Directly impacted
AZ U:16:350	Within ASLD sale parcel	Partially mitigated previously (Phase I started but incomplete)	Directly impacted
AZ U:16:351	Within ASLD sale parcel	Partially mitigated previously (Phase I completed)	Directly impacted
AZ U:16:390	Within ASLD sale parcel	Fully mitigated previously	Directly impacted
AZ U:16:392	Within ASLD sale parcel	Fully mitigated previously	Directly impacted
AZ U:16:394	Within ASLD sale parcel	Partially mitigated (Phase 1 started but incomplete)	Directly impacted
AZ U:16:395	Within ASLD sale parcel	Fully mitigated previously	Indirect impacted
AZ U:16:428	BLM-managed	Not previously mitigated	Indirect impacted
AZ V:13:7	Privately owned	Not previously mitigated	Directly impacted
AZ V:13:33	Privately owned	Portions partially mitigated previously	Directly impacted
AZ V:13:211	Within ASLD sale parcel	Fully mitigated previously	Directly impacted
AZ V:13:220	Within ASLD sale parcel	Fully mitigated previously	Directly impacted
AZ V:13:221	Within ASLD sale parcel	Fully mitigated previously	Directly impacted
AZ V:13:291	Privately-owned	Not previously mitigated	Directly impacted
AZ V:13:292	Privately-owned	Not previously mitigated	Directly impacted
NR #88001646: MPAEXP-17236	Privately owned, BLM-managed	Not previously mitigated	Not impacted
*Note: Jerla (2018) also identified two sites that were not relocated or identified within the APE, AZ BB:2:102 and AZ U:16:26, and 14 sites that were determined to be not eligible.			

The permit area for the Ripsey Wash TSF includes a pipeline corridor extending from the proposed TSF site northward across the Gila River to the thickener, which is part of the concentrator facilities at Ray Mine. A pipeline bridge, separate from both the existing Kelvin Bridge National Register Property would be constructed over the Gila River in the future by Asarco to accommodate the required pipelines. This pipeline bridge would not use or require modification to any of the structural components associated with Kelvin Bridge and would be built as a separate structure. Impacts on the Kelvin Bridge would be limited to a change in the visual context for the existing bridge that would likely not be noticeable when compared to the much larger roadway bridge that is being constructed under a separate project. The proposed roadway bridge will be constructed between the historic bridge and the proposed pipeline bridge. For these reasons, impacts are expected to be minimal. No mitigation is required.

The east Arizona Trail alignment contains three archaeological sites, one NRHP-eligible site and two ineligible sites. Although relocation of a segment of the Arizona Trail would occur in an area where these sites exist, construction of the new alignment can be accomplished without disturbing known archaeological sites. The one eligible site along this alignment ((the Coolidge-Hayden 69-kV Transmission Line administered by the SCIP, AZ V:13:211[ASM]) was mitigated previously under a separate unrelated project.

Construction and operation of the Ripsey Wash TSF has the potential to indirectly effect two historic properties that are eligible for listing on the NRHP. See **Table 3-53, Summary of Cultural Impacts and Mitigation Status for Ripsey Wash TSF Permit Area**. The indirect effects to these sites would potentially result because of their location along Zelleweger Wash, which would receive additional redirected stormwater flow from above the TSF. As documented in the APP for this project, the stormwater detention impoundments will collect stormwater runoff above the TSF and direct it via pumps and piping to Zelleweger Wash. However, the pumping rates/timing that are proposed for conveying this water will be conducted such that pumping does not coincide with peak flows in Zelleweger Wash. Thus, any potential for higher flow rates and associated erosion rates would be minimized.

No adverse effects are expected to occur to cultural resources in the waters of the U.S. mitigation areas (**Appendix J, Compensatory Mitigation**). The four sites proposed for waters of the U.S mitigation were surveyed for the presence of cultural resources, and none were found.

Even with implementation of mitigation in the form of an HPTP, the potential would exist for the discovery of previously unknown resources during construction and operation. The HPTP will include procedures to be followed in the event of unexpected discoveries, to include human burial remains and associated artifacts. Per typical procedure, the Corps will require a special condition to any 404 permit issued for this project containing instructions for the permittee to follow in this situation.

3.10.2.3 Effects of the Hackberry Gulch TSF Alternative

Only about 57% of the Hackberry Gulch TSF alternative footprint has been surveyed to date. Within the area previously surveyed, there are 31 sites that are either NRHP-eligible or recommended as NRHP eligible. Based on the number of resources previously recorded in this area, it is reasonable to expect that additional sites would be potentially impacted by the construction and operation of the Hackberry Gulch TSF. A substantial amount of additional surveys, eligibility determinations, testing, data recovery, and consultation with the SHPO and tribes would be required if this alternative were implemented.

Construction and operation of the Hackberry Gulch TSF alternative would have an adverse direct effect on an unknown number of NRHP-eligible properties. The adverse effects to these sites would result because of their location within the construction footprint for the TSF and related facilities. This is an unavoidable effect of implementation for this alternative because it would result in the capping of the sites from complete permanent burial or excavation during construction of the facility. Mitigation is required to minimize this adverse effect.

Even after the footprint of the Hackberry Gulch TSF site is fully surveyed and historic properties documented, the potential would exist for the discovery of previously unknown resources during construction and operation. To address this contingency, mitigation is required. An HPTP will be developed to provide a research and methodological framework for mitigating the adverse effects of the project on cultural resources. The HPTP will also provide methods to monitor and mitigate adverse effects for inadvertent discoveries during construction.

There are no known traditional cultural properties within the project footprint for this alternative.

No adverse effects are expected to occur to cultural resources in the areas proposed for waters of the U.S. mitigation (see **Appendix J, Compensatory Mitigation**). The four sites proposed for waters of the U.S mitigation were surveyed for the presence of cultural resources, and none were found.

No indirect effects to cultural resources are expected to occur under the Hackberry Gulch TSF alternative.

3.11 SOCIOECONOMICS

Address the social, economic and lifestyle effects on residents in the local communities surrounding the Ray Mine. *Areas of concern include project-related construction and operational impacts to the demographics of local communities surrounding the Ray Mine, include impacts to employment, income, housing, utilities, public service, tax and governmental revenues, and present lifestyles.*

3.11.1 Affected Environment

The proposed Ripsey Wash and Hackberry Gulch TSF sites are located in Pinal County. The County seat is Florence. Pinal County covers an estimated 5,374 square miles.

This section provides an overview of the socioeconomic conditions of Pinal County, with particular focus on the communities of Kearny, Superior, Gold Canyon, Hayden, and Winkelman. Other communities in the vicinity of the TSF sites are Kelvin and Riverside, although little to no data are available for these small communities. To aid comparison of the nearby communities, statistics from both the state of Arizona and Pinal County are included.

3.11.1.1 Population and Demographics

As of 2010 census, the population of Pinal County was 375,770 people, making it the third most populous county in Arizona. At the 2000 census, the population of Pinal County was 179,727 people. Census populations for 1990 through 2010 for Arizona, Pinal County, Kearny and other nearby communities are set forth in the **Table 3-54, Historic Population**.

For the period between 2000 and 2016, Pinal County population increased by nearly 120%. The majority of this population increase is located in the western portion of the county and results from suburban growth from the greater Phoenix area and northward from the Tucson area.

However, over that same year period, the populations of the communities of Superior, Hayden and Winkelman have decreased. These changes tend to parallel changes in employment activity, individuals leaving the smaller towns to relocate in other areas, and new employees (particularly at Ray Mine) deciding to live closer to the Phoenix metropolitan area.

Arizona and Pinal County expect population growth into the future, with projected population growth in Pinal County predicted to be more than double the overall statewide rate. See **Table 3-55, Population Trends**.

Table 3-54, Historic Population

Place	1990	2000	% Change 1990-2000	2010	% Change 2000-2010	2016 (est)	% Change 2010-2016
Arizona	3,665,228	5,130,632	40%	6,392,017	25%	6,931.071	8%
Pinal County	116,379	179,727	54%	375,770	109%	416,540	11%
Kearny	2,262	2,249	(-1%)	1,950	(-13%)	2,306	18%
Superior	3,501	3,254	(-7%)	2,837	(-13%)	2,895	2%
Gold Canyon	NA	6,029	NA	10,159	(67%)	NA	NA
Hayden	909	892	(-2%)	662	(-26%)	519	(-22%)
Winkelman	676	443	(-34%)	353	(-20%)	282	(-20%)
Source: U.S. Department of Commerce, Bureau of the Census							

Table 3-55, Population Trends

Place	2010 (x 1000)	2020 (x 1000)	2030 (x 1000)	2040 (x 1000)	2050 (x 1000)	Total Projected Growth (2010-2050)	Average Annual Growth (2010-2050)
Arizona	6,392	7,225 – 7,698	8,156 – 9,419	8,997 -11,236	9,708 – 13,164	206%	5.2%
Pinal County	376	465 - 517	596 - 752	767 – 1,076	962 - 1,480	439%	11.0%

Notes:
1. U.S. Department of Commerce, Bureau of the Census
2. Arizona Department of Administration, Office of Employment and Population Statistics: Arizona State and County Population Projections, 2012-2050: Methodology Report, December 7, 2012.

The demographic characteristics for the area are set forth in **Table 3-56, General Demographic Characteristics: 2010**.

The data reports a considerably older population living in the community of Gold Canyon than the rest of Pinal County or Arizona. This reflects the migration of retirees to this area.

The populations of Superior, Kearny, Hayden and Winkelman are also somewhat older than state and county averages, pointing to the general economic stagnation and an overall population decline in these communities over the past 20 years. Simply, many younger people are migrating from these towns in search of other employment or educational opportunities.

Hispanic residents represent the largest minority/ethic group in Arizona and Pinal County at slightly less than 30%. The communities of Kearny, Superior, Hayden and Winkelman have Hispanic populations greater than the statewide and Pinal County averages, while the Hispanic population in the Gold Canyon is considerably less than those averages.

Table 3-56, General Demographic Characteristics: 2010

Subject	Arizona	Pinal County	Kearny	Superior	Gold Canyon	Hayden	Winkelman
Population	6,392,017	375,770	1,950	2,837	10,159	662	353
Veterans	530,693	NR[3]	NR	NR	NR	NR	NR
Sex							
Female (%)	50.3%	47.5%	50.7%	50.5%	51.9%	51.1%	49.6%
Male (%)	49.7%	52.5%	49.3%	49.5%	48.1%	48.9%	50.4%
Age							
Under 5 years (%)	7.1%	8.0%	6.0%	6.0%	2.5%	6.9%	5.4%
Under 20 years (%)	28.4%	28.7%	29.0%	26%	11.3%	29.7%	24.3%
65 years & over (%)	13.8%	13.9%	19.8%	19.6%	38.6%	18.4%	27.0%
Median Age (years)	35.9	35.3	41.8	45.0	60.9	40.0	46.5
Population by Race							
White (%)[1]	73.0%	72.4%	83.2%	70.5%	94.6%	63.9%	60.6%
Black or African American (%)[1]	4.1%	4.6%	0.5%	0.6%	1.0%	0.0%	0.6%
American Indian (%)[1]	4.6%	5.6%	0.8%	2.0%	0.4%	0.2%	3.7%
Asian (%)[1]	2.8%	1.7%	0.4%	0.6%	0.8%	0.3%	0.6%
Native Hawaiian and other Pacific Islander (%)[1]	0.2%	0.4%	0.1%	0.0%	0.1%	0.0%	0.0%
Some Other Race (%)	11.9%	11.5%	11.6%	22.5%	1.4%	34.0%	31.4%
Two or More Races (%)	3.4%	3.8%	3.4%	3.8%	1.6%	1.7%	3.1%
Population by Ethnicity							
Hispanic or Latino (%)[2]	29.6%	28.5%	41.6%	68.5%	5.5%	84.4%	82.4%
Not Hispanic or Latino (%)	70.4%	71.5%	58.4%	31.5%	94.5%	15.6%	17.6%

Source: U.S. Department of Commerce, Bureau of the Census

Notes:

1. Includes persons reporting only one race.
2. Hispanics may be of any race, so also are included in applicable race categories.
3. NR means Not Reported.

3.11.1.2 Housing

Current household size in this area ranges from 2.20 persons per household in Gold Canyon to 2.71 persons per household in Hayden. See **Table 3-57, Housing Status: 2010**. Only Hayden has a higher average household size than reported for Arizona and Pinal County.

Kearny has a higher occupancy percentage than Arizona and Pinal County, but the towns of Superior and Gold Canyon report lower occupancy percentages than the state or county.

Average rental vacancy rates are higher in Kearny, Superior, Gold Canyon and Winkelman than the Arizona and Pinal County averages, but the average rental vacancy rate in Hayden is less than half of the statewide and county averages.

Table 3-57, Housing Status: 2010

Housing Status	Arizona	Pinal County	Kearny	Superior	Gold Canyon	Hayden	Winkelman
Total Housing Units	2,844,526	159,222	878	1,465	6,874	301	163
Occupied	2,380,990	125,590	756	1,103	4,888	236	136
Percent Occupied	83.7%	78.9%	86.1%	75.3%	71.1%	78.4%	83.4%
Owner Occupied	1,571,687	95,629	616	797	4,358	190	99
Population in Owner-Occupied	4,134,117	254,864	1,589	2,079	8.807	514	250
Average Household Size of Owner-Occupied	2.63	2.67	2.58	2.61	2.02	2.71	2.53
Renter-Occupied	809,303	29,961	140	306	530	46	37
Population in Renter-Occupied	2,118,516	94,661	361	758	1,352	148	103
Average Household Size of Renter- Occupied	2.62	3.16	2.58	2.48	2.55	3.22	2.78
Vacant	463,536	33,632	122	362	1,986	65	27
Vacant for Rent	120,490	4,887	23	79	123	3	8
Vacant for Sale	64,407	5,660	23	37	202	1	2
Vacant for Seasonal or recreational use	184,327	15,499	26	53	1,487	6	3
Homeowner Vacancy Rate (%)	3.9%	5.5%	3.6%	4.4%	4.4%	0.5%	2.0%
Rental Vacancy Rate (%)	12.9%	13.9%	14.1%	20.3%	18.3%	6.1%	17.8%

3.11.1.3 Employment

The percentage of the population over 16 not in the labor force is higher in Kearny, Superior, Gold Canyon, Hayden and Winkelman than that for the state of Arizona (38.6% not in the labor force). Statewide unemployment rate is 6%. Kearny has the lowest unemployment rate at 2.7%. See **Table 3-58, Employment (2008-2012)** [(1)]**.**

Table 3-58, Employment (2008-2012) [1]

Subject	Arizona	Pinal County	Kearny	Superior	Gold Canyon	Hayden	Winkelman
EMPLOYMENT							
Population 16 Years and Older							
Total	4,967,615	281,615	1,878	2,364	9,430	601	361
Percentage	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Employed Civilian Labor Force							
Total	2,733,537	1131.512	907	999	3,754	287	126
Percentage	55.0%	46.7%	48.3%	42.3%	39.8%	47.8%	34.9%
Armed Forces							
Total	19,750	348	0	0	0	0	0
Percentage	0.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Unemployed							
Total	296,132	17,028	51	106	358	32	28
Percentage	6.0%	6.0%	2.7%	4.5%	3.8%	5.3%	7.8%
Not in Labor Force							
Total	1,918,196	132,727	920	1,259	5,138	282	207
Percentage	38.6%	47.1%	49.0%	53.3%	54.5%	46.9%	57.3%
INDUSTRY							
Agriculture, Forestry and Mining							
Percentage	1.4%	3.9%	32.9%	16.8%	1.0%	36.2%	40.5%
Construction							
Percentage	7.2%	7.5%	2.9%	6.1%	8.2%	4.2%	11.9%
Manufacturing							
Percentage	7.5%	10.1%	4.1%	1.2%	6.7%	12.2%	4.0%
Wholesale Trade							
Percentage	2.5%	2.2%	2.0%	0.3%	4.2%	0.0%	0.0%
Retail Trade							
Percentage	12.3%	11.5%	6.2%	9.8%	11.0%	3.1%	0.0%
Transportation and Warehousing, and Utilities							
Percentage	4.9%	5.0%	2.6%	4.4%	2.8%	0.0%	0.0%
Information							
Percentage	1.9%	2.0%	2.2%	3.2%	3.4%	0.0%	0.0%
Finance , Insurance and Real Estate							
Percentage	8.0%	6.6%	3.2%	2.6%	11.3%	0.0%	2.4%

Table 3-58, Employment (2008-2012) [1] (continued)

Subject	Arizona	Pinal County	Kearny	Superior	Gold Canyon	Hayden	Winkelman
INDUSTRY							
Professional, Scientific, Management and Administrative							
Percentage	11.4%	8.7%	4.9%	7.7%	13.1%	9.1%	3.2%
Educational Services and Health Care							
Percentage	21.8%	20.4%	16.1%	18.9%	20.2%	13.6%	24.6%
Arts, Entertainment, Recreation, Accommodation and Food Services							
Percentage	10.5%	8.8%	8.9%	6.9%	5.8%	0.0%	0.0%
Other Services, Except Public Administration							
Percentage	4.9%	4.1%	2.0%	5.9%	6.0%	4.9%	0.0%
Public Administration							
Percentage	5.7%	9.2%	12.1%	16.1%	6.2%	16.7%	13.5%
CLASS OF WORKERS							
Private Wage and Salary Workers							
Percentage	78.4%	73.8%	73.6%	59.6%	73.2%	68.6%	64.3%
Government Workers							
Percentage	15.4%	20.9%	24.5%	34.1%	12.4%	30.3%	33.3%
Self-Employed in Own Not Incorporated Business Workers							
Percentage	6.1%	5.1%	1.9%	4.3%	14.2%	1.0%	2.4%
Unpaid Family Workers							
Percentage	0.1%	0.2%	0.0%	2.0%	0.2%	0.0%	0.0%

Source: U.S. Department of Commerce, Bureau of the Census, 2008-2012 American Community Service
Notes:
1. Employment rates are averaged over a 5-year period from 2008-2012.

3.11.1.4 Income

Overall average per capita income in Pinal County is lower that the statewide average per capita income, and Hayden is considerably lower than the statewide average. See **Table 3-59, Income (in 2012 Inflation-Adjusted Dollars)**.

Table 3-59, Income (in 2012 Inflation-Adjusted Dollars)

Subject	Arizona	Pinal County	Kearny	Superior	Gold Canyon	Hayden	Winkelman
Per Capita Income	$25,571	$20,901	$22,506	$19,962	$40,042	$12,927	$18,155
Household Income and Benefits							
Total Households	2,357,158	122,746	804	1,066	4,828	210	120
Less than $10,000	7.4%	7.2%	6.0%	16.3%	3.4%	6.7%	10.0%
$10 - $14,999	5.2%	4.1%	4.5%	3.9%	2.5%	4.3%	6.7%
$15 - $24,999	11.0%	10.6%	12.3%	13.0%	6.4%	30.0%	7.5%
$25 - $34,999	11.2%	11.3%	13.1%	11.7%	9.8%	8.1%	14.2%
$35 - $49,999	15.0%	16.7%	13.4%	14.5%	10.8%	23.3%	16.7%
$50 - $74,999	18.9%	22.6%	19.9%	15.2%	26.1%	11.0%	20.8%
$75 - $99,999	12.0%	12.8%	9.3%	12.9%	11.7%	16.7%	10.0%
$100 - $149,999	12.0%	10.6%	9.3%	8.8%	19.1%	0.0%	14.2%
$150 - $199,999	3.9%	2.6%	1.4%	2.7%	5.1%	0.0%	0.0%
$200,000 or More	3.5%	1.6%	1.6%	0.8%	5.0%	0.0%	0.0%
Median Household Income	$50,256	$50,164	$50,556	$38,722	64,927	37,778	$38,846
Source: U.S. Department of Commerce, Bureau of the Census, 2008-2012 American Community Survey							

Median household income is similar for the entire state, Pinal County and Kearny, with a higher reported median household income for Gold Canyon and lower median household incomes for Superior, Hayden and Winkelman. See **Table 3-59, Income (in 2012 Inflation-Adjusted Dollars)**.

Median earnings for individuals employed in mining (with the exception of Hayden) have the highest for any reported earnings category. See **Table 3-60, Median Earnings by Industries for Individuals**.

Table 3-60, Median Earnings by Industries for Individuals

Subject	Arizona	Pinal County	Kearny	Superior	Gold Canyon	Hayden	Winkelman
Median Earnings for Civilian Employed Population 16 Years and Over							
	$32,270	$34,036	$32,391	$29,214	$39,207	$25,243	$28,333
Agriculture, Forestry, Fishing and Hunting							
	$23,105	$25,817	-	-	-	-	-
Mining							
	$58,202	$52,555	$53,802	$51,667	$85,694	$30,192	$49,125
Construction							
	$32,846	$40,228	$33,182	$27,596	$46,250	-	$80,156
Manufacturing							
	$47,642	$44,782	$50,865	-	$71,974	$25,865	-
Wholesale Trade							
	$40,755	$40,483	$39,000	-	$17,167	-	-
Retail Trade							
	$22,437	$21,287	$7,500	$12,500	$29,958		-
Transportation and Warehousing, and Utilities							
	$42,494	$42,500	$53,750	$55,357	$38,984	-	-
Information							
	$41,398	$41,407	$25,714	$14,615	$108,315	-	-
Finance and Insurance							
	$43,402	$40,870	$22,500	-	$105,552	-	-
Real Estate and Rental & Leasing							
	$33,052	$31,689	-	-	$4,417	-	$2,500
Professional, Scientific, Management and Administrative							
	$34,519	$35,647	$31,111	$19,620	$27,188	$13,833	-
Educational Services							
	$34,331	$33,248	$32,566	$29,934	$29,471	$20,208	$6,932
Health Care and Social Assistance							
	$33,435	$32,045	$31,146	$40,625	$44,655	-	$6,750
Arts, Entertainment, Recreation, Accommodation and Food Services							
	$16,203	$16,201	$20,451	$6,494	$28,516	-	-
Other Services, Except Public Administration							
	$21,916	$24,735	$12,500	$10,938	$33,542	$20,909	-
Public Administration							
	$47,157	$45,308	$38,472	$44,271	$32,411	-	$27,639

Source: U.S. Department of Commerce, Bureau of the Census, 2008-2012 American Community Survey

3.11.1.5 Environmental Justice

In 1994, the President of the United States issued Executive Order 12898, Federal Actions to Address Environmental Justice in Minority and Low-Income Populations. The objectives of the Executive Order include developing federal agency implementation strategies, identifying minority and low-income populations where proposed federal actions could have disproportionately high and adverse human health and environmental effects, and encouraging the participation of minority and low-income populations in the NEPA process.

There are two types of data that must be reviewed to evaluate environmental justice effects: minority populations and poverty levels. Minority and income data for census tracts located within the project area were obtained from the most recent 2010 census. Countywide statistics for Pinal County were reviewed to determine the percentage of the population not classified as Caucasian and the percentage classified as Hispanic. Using the county average for comparison, each of the census tracts in the area was evaluated to determine whether the minority and/or Hispanic population percentages were greater than the county average. If a census tract percentage exceeded the county average, the tract was evaluated for environmental justice effects based on its minority population. In addition, the percentage of the population living below the poverty line was determined both for Pinal County and the census tracts/block groups near the project site.

Table 3-61, Minority and Low Income Populations for Pinal County and the Project Area, provides a summary of relevant data for Pinal County and for the project area (Census Tracts 23 (Block Groups 1, 2, and 3). The percentage of Hispanic and low income populations in the project area is higher than Pinal County levels and is subject to review under Executive Order 12898. Although the affected area Hispanic population (Census Tract 23) is greater than the Pinal County Hispanic population, there appears to no disproportionate impacts.

Table 3-61, Minority and Low Income Populations for Pinal County and the Project Area

Population	Geographic Area	
	Comparison Population Pinal County (% of Total Population)	Affected Area Census Tract 23 Block Groups 1, 2, and 3 (% of Total Population)
Ethnic Groups		
Total Population	375,770	2,420
White	72.4%	59.4%
Black/African American	4.6%	0.6%
Native American	5.6%	1.0%
Asian	1.7%	0.3%
Pacific Islander	0.4%	0.0%
Hispanic (any race)	28.5%	**38.7%**
Low Income		
Population below poverty level	15.2%	**16.1%**
Source: http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml; accessed October 14, 2014		

3.11.1.6 Social Values

The eastern part of Pinal County has a long history with copper mining, milling and smelting. The town of Kearny was developed by Kennecott in the 1950s when the company decided that underground mining had to give way to surface mining, and the old mining towns of Ray and Sonora had to be abandoned to advance the development and operation of the Ray Mine. The towns of Hayden and Winkelman developed around the copper smelting business.

Most households in eastern Pinal County identify with making a living from the copper industry, and these communities continue to obtain economic benefits from the high wage jobs associated with the copper mining, milling and smelting business. Most residents in these communities tend to value economic opportunity as represented by mining and related activities, but some raise concerns about the impacts of such activity on land use and recreation.

As explained in Section 3.10.2, Population and Demographics, the towns of Kearny, Hayden and Winkelman have experienced a decline in population over the past decade. Even with this decline in population, based on the public comments received during scoping, most residents of this area still view mining and smelting activities as having a positive effect on the quality of life because of economic stimulus and job opportunities.

3.11.2 Environmental Consequences

3.11.2.1 Effects of the No Action Alternative

Under the no action alternative, neither the Ripsey Wash nor the Hackberry Gulch TSF would be constructed. Selection of the no action alternative would forgo an opportunity for construction employment and income, as well as long-term economic activity from the Ray Mine and the Hayden Smelter. There would be a reduction in property taxes to Pinal County, should the Ripsey Wash TSF not be permitted. The land is not taxed at all under federal and state ownership, but, if permitted, substantial tax revenues would be paid as part of the operating mine.

3.11.2.2 Effects of the Ripsey Wash TSF Alternative

3.11.2.2.1 Employment

The construction of the Ripsey Wash TSF would result in increased employment in Pinal County during the three years of construction activity. Employment levels would return to approximate current levels once TSF operations commence. The Ripsey Wash TSF is simply designed to replace the current Elder Gulch TSF and would be operated with the current on-site workforce.

Given the relative short-term nature of the construction activity, there would be negligible adjustments to the current indirect employment opportunities available in Kearny or other local communities.

3.11.2.2.2 Income

The three years of construction work for the Ripsey Wash TSF would add to Pinal County income. Actual wages would vary for the workers depending on job skills and job assignments, but construction workers for mine related activities in Arizona are generally some of the highest paid construction workers in Arizona.

The Ripsey Wash TSF construction is projected to provide an estimated 200 additional jobs to the Pinal County workforce, although most of these jobs would be short-term (less than three years). Asarco states that the company is committed to hiring as many local people as possible, and most of the construction workforce are expected to come from Pinal County.

The transition from the existing Elder Gulch TSF to a new TSF would allow existing TSF-related operational jobs to remain consistent with current levels. Thus, there would be no increase in overall income as a result of operation of the Ripsey Wash TSF site.

Closure activities, similar to construction, would have a minor effect on income because it is assumed that most of the closure workers would already live in Pinal County.

If ASLD lands are sold to Asarco, there would be property taxes paid to Pinal County. The ASLD managed lands in the Ripsey Wash area are currently not taxed under state of Arizona ownership.

3.11.2.2.3 Population

Construction jobs would have a negligible effect on the population of Kearny and other local communities because of the temporary duration of construction and because most of the expected construction workers are assumed to already live in Pinal County. Given the temporary nature of the construction work, any individuals who are presently living outside of the region would probably not uproot themselves or their families to move to Kearny for the short duration of the construction activity.

The transition from the existing Elder Gulch TSF to a new TSF would allow existing TSF-related operational jobs to remain consistent with current levels. Thus, there would be no long-term increase in population in Kearny or other local communities as a result of the operation of the Ripsey Wash TSF site.

Closure activities, similar to construction, would have a negligible effect on the population of Kearny and other local communities because of the temporary nature of closure activities and because most of the expected workers are assumed to already live in Pinal County.

3.11.2.2.4 Housing

The construction and operation of the Ripsey Wash TSF would have a negligible effect on permanent housing in Kearny and other local communities. Most of the expected construction workers are assumed to already live in Pinal County. There would be ample hotel and rental accommodations for any of the “outside" construction workers in Kearny, Gold Canyon, or Apache Junction.

3.11.2.2.5 Community and Public Service

The construction and operation of the Ripsey Wash TSF would not have a measurable effect on the community and public services of Kearny and other Pinal County communities. With no permanent increase in local population as a result of the proposed TSF, there would be no influx of families, thus no increase in students for the local school systems. The existing law enforcement and fire protection personnel would continue to handle situations that arise. There is potential for accidents with construction workers, but the local and regional medical and hospital facilities should be adequate if there was a need for their services. The water supply and wastewater facilities of Kearny and other local communities would have capacity to handle any increase of construction workers in the community.

3.11.2.2.6 Social Values

The area around the communities of Kearny, Hayden and Winkelman has a long history of copper mining and smelting. The combination of familiarity and knowledge of economic benefit create a climate of general community acceptance and support for continued operation of this industry in the area. Combined with this general climate of acceptance are resident attitudes and values that may diminish support or create opposition for a particular development proposal, especially if residents perceive that such development might impact water quality or degrade the quality of recreation. These attitudes and values are evident in the NEPA scoping comments submitted to the Corps.

Objections to the Asarco TSF project would typically be related to concern over unknown changes, loss of personal or local control, concern for long-term well-being of the environment, and protection of life style. Those who opposed the TSF express concern that water quality and quantity could be negatively impacted within and adjacent to the project. This is coupled with concerns about aesthetic qualities of the environment (such as air pollution, noise, and impact to recreation).

Those who support the Asarco TSF project related to continued or expanded employment opportunities and economic benefit to the region. Also identified are interests in providing jobs for area youth and maintaining an ongoing tradition of copper mining in the area.

3.11.2.2.7 Environmental Justice

Although there are disproportionately minority and low-income populations identified within the general vicinity of the Ray Mine, there are some differences with respect to potentially disproportionate environmental justice effects. The Ripsey Wash TSF site is much less visible to communities with low-income and minority populations compared to the Hackberry Gulch site, which is readily visible and physically closer to such communities. Thus, comparatively, there is a potentially disproportionate effect on low-income and minority communities under the Hackberry Gulch Alternative.

3.11.2.3 Effects of the Hackberry Gulch TSF Alternative

The socioeconomic effects of the Hackberry Gulch TSF alternative would be essentially the same as addressed in Section 3.11.2.2, Effects of the Ripsey Wash TSF Alternative. There would be little variation in the socioeconomic effects between Hackberry Gulch TSF and the Ripsey Wash TSF. The primary differences would be in physical design and the amount of construction activity required, with Hackberry Gulch having a more complex design and construction undertaking.

In addition, if the Asarco-BLM Ray Land Exchange is approved, the selected lands would be owned by Asarco, and there would be property taxes paid to Pinal County. The selected lands are currently public lands administered and managed by the BLM, and these lands are not taxed under federal ownership.

3.12 TRANSPORTATION

Address project construction and operations traffic impacts*. Areas of concern include: (1) the amount of road use and traffic on the Florence-Kelvin Highway and State Route 177; (2) amount of project-related traffic impacts during construction and operations; and (3) potential for accidents with any increased road use.*

3.12.1 Affected Environment

The transportation analysis includes US Highway 60, State Route 177, the Florence-Kelvin highway, and local unpaved and two-track roads within or adjacent to the areas to be disturbed by either the proposed Ripsey Wash or Hackberry Gulch TSF sites. The main highways within the region are used by Asarco employees, contractors and suppliers, and are shown on **Figure 42, Highways & Roads**.

Traffic loads/traffic counts are identified by average daily traffic (ADT). ADT is defined as the measure of traffic over a 24-hour period and is determined by counting the number of vehicles passing a specific point on a particular road from either direction.

The Arizona Department of Transportation (DOT) estimates ADT values based on actual traffic counts made at various locations. See **Table 3-62, Traffic Counts**.

Table 3-62, Traffic Counts

Location of Traffic Counts	Year	Average Daily Traffic (All Vehicles)	Average Daily Traffic (Commercial Vehicles)	
			Single Truck	Combo Truck
U.S. 60 in Apache Junction	2015	73,655	2,919	1,163
U.S. 60 at junction with State Route 177	2015	7,059	426	327
State Route 177 at junction with US 60	2015	2,481	129	201
State Route 177 at junction with Florence-Kelvin Hwy (near Ray Mine)	2015	1,912	92	106
State Route 177 in Winkleman	2015	2,312	123	140

Source: ADOT traffic logs, 2017 (www.azdot.gov)
Note: No recent traffic counts are available for the Florence-Kelvin highway near the TSF site. In a Gila River Bridge Design report, ADOT estimates ADT in 1989 was less than 200 vehicles per day.Pinal County estimated 126 vehicles per day near Florence in 2014. Pinal County, Public works, 2017.

3.12.1.1 U.S. Highway 60

U.S. Highway 60 is the main artery that connects the Apache Junction and Phoenix metro area with points east, including the towns of Superior and Globe. From Apache Junction eastward toward Superior (approximately 29 miles), U.S. Highway 60 is an asphalt, four-lane divided highway. About seven miles west of Superior, U.S. Highway 60 narrows to an asphalt two-lane road. For Ray Mine employees and suppliers who are located in the Phoenix metro area, U.S. Highway 60 is the main road used to access Arizona State Route 177, whose junction is located in Superior.

3.12.1.2 Arizona State Route 177

Arizona State Route 177 is a two-lane asphalt highway that connects Superior and Winkleman (about 32 miles). The Ray Mine complex is accessed from State Route 177. In 2008, Arizona designated a 15-mile portion of the highway (from mile post 149 to mile post 164) as the “Copper Canyon Scenic Route.

3.12.1.3 Florence-Kelvin Highway

The Florence-Kelvin highway is a 32-mile two-lane Pinal County road that connects State Route 179 (about three miles south of the town of Florence) with State Route 177 near the Ray Mine. For approximately 16 miles east of State Route 179, the Florence-Kelvin highway is paved with asphalt, but the remaining 16 miles is unpaved, including the portion that crosses Ripsey Wash.

The Florence-Kelvin highway crosses the Gila River near the community of Kelvin. Current ADT levels for this road at Kelvin are estimated to range from approximately 200 to 500 (personal communication with Chris Pfahl of Asarco). The existing bridge is a one-lane, weight-limited structure built in 1928. Beginning in April 2018, Pinal County and the ADOT are planning to construct a new two-lane bridge adjacent to the existing bridge (personal communication J. Ortiz. Pinal County on May 18, 2017). As of February 2018, the bridge was partially complete. This planned bridge construction is independent of the work associated with Asarco’s proposed Ripsey Wash TSF.

3.12.1.4 Project Site Roads

Unpaved roads connect the community of Riverside with State Route 177 and the Florence-Kelvin highway. There are also numerous two-track and dirt roads throughout this region. The two-track roads are mainly used for OHV recreation, although they are also used to access grazing allotments and mining claims in the region.

3.12.2 Environmental Consequences

3.12.2.1 Effects of the No Action Alternative

Under the no action alternative, neither the Ripsey Wash nor the Hackberry Gulch TSF would be constructed. However, mining would continue at the Ray Mine complex for 30 more years. See Section 2.2, No Action Alternative. Current traffic patterns and volumes on State Route 177 and the Florence-Kelvin highway would be expected to continue at current levels until about 2024 when the Ray Mine concentrator shuts down and employment at the Ray Mine complex is reduced. A second reduction in employment (and corresponding reduction in employee and commercial traffic) would occur in 2030 when oxide leaching activities at the Ray Mine ceases. During this time period, traffic could fluctuate (increase or decrease) depending on the level of mining and recreation activity in the area.

Reductions in employment (employment opportunities) could correspond to reductions in residents living in the area, who might leave looking for work. This would also result in reductions in traffic in the State Route 177 corridor from Riverside/Kelvin to Hayden and the Florence-Kelvin highway from Kelvin to Florence. The Copper Basin Railroad could operate for 30 plus years, depending on the economics of transporting sulfide ore from the Ray Mine to Hayden.

3.12.2.2 Effects of the Ripsey Wash TSF Alternative

Under the Ripsey Wash TSF alternatives, traffic levels on State Route 177 would increase during early development and construction activity, which is slated to last an estimated three years. This work would involve the transport of construction employees, equipment and supplies.

Construction employment would vary, but peak at about 200 workers. It is assumed that many of the construction employees would either carpool or van pool; this would be analogous to that of the existing Ray Mine workforce. To assess the traffic load increase on State Route 177 during peak construction, the following assumptions were made:

- 50% of peak 200 workforce in van pools with 10 people per van: 10 vehicles;
- 25% of peak 200 workforce to car pool with 2 people per vehicle: 25 vehicles;
- 25% of peak 200 workforce with only one person per vehicle: 50 vehicles; and,
- Supply trucks per day (piping, fuel, liner material, etc.): 30 vehicles.

With these assumptions, there would be an additional 115 vehicles per day using State Route 177 at peak construction. Current State Route 177 traffic load at its intersection with the Florence-Kelvin highway is approximately 2,300 ADT, which includes about 200 trucks. Therefore, the overall increase in traffic volume would be about 5% during peak construction. There would be an estimated 15% ADT increase in truck volume on State Route 177 at peak construction.

As one of the first aspects of Ripsey Wash TSF construction, Asarco would construct a new routing (approximately 1.7-miles in length) of the Florence-Kelvin highway to the north and northeast of the tailings facility. This new road segment would be paved with asphalt, meet required Pinal County road standards, and replace an approximate 1.8-mile long segment of the current Florence-Kelvin highway.

The new segment of highway would be located on the south side of the Tortilla mountains. Persons travelling on the new road segment would see the construction and operation of the Ripsey Wash TSF. The Ray Mine plans to construct a visitor view point on the southeast side of the Ripsey Wash TSF, along the Florence-Kelvin highway. The portions of the Florence-Kelvin highway to be relocated and the portions that would be paved are shown on Figure 2, Site Plan Layout-Ripsey Wash TSF.

Due to the close proximity of the new road segment with the existing Florence-Kelvin highway, there could be delays on the existing route during construction; this would include users of Riverside Road and Centurion Lane that are accessed from the Florence-Kelvin highway. Flag persons would be necessary during delays for safety and facilitate traffic flow. These delays could occur sporadically during the construction of the new road segment. The impacts caused by the new road construction would occur sporadically for the construction period (6 months - one year).

The construction of the new segment of the Florence-Kelvin highway would greatly improve the condition of the highway. In addition, three miles of the existing Florence-Kelvin would be paved (under agreement with Pinal County).[39] This paving would improve highway conditions and reduce fugitive dust generation.

During construction of the Ripsey Wash TSF, traffic levels on the Florence-Kelvin highway (from its junction with State Route 177 to the TSF work site – about three miles) would increase about 50%. At peak construction (lasting approximately 6-12 months), there would be an estimated increase of 115 vehicles on this road leading to the Ripsey Wash TSF site. No ADT levels for the Florence-Kelvin highway are available from Pinal County or ADOT, but it is estimated that current ADT levels for this section of the Florence-Kelvin highway range from approximately 200 to 500 (personal communication with Chris Pfahl at Asarco). Pinal County estimated traffic on the Florence-Kelvin highway to be 126 vehicles per day in 2014; however, this estimate was recorded near Florence. The project increase in construction traffic would be short-term.

During construction, the tailings slurry and reclaim water pipelines would be installed under the road or in the shoulder for a portion of the Florence-Kelvin highway. Traffic delays would be likely during this installation phase, but such delays would be short-term and only occur during the expected one to three months of pipeline installation work. Flag persons would be used during this installation work for safety and to facilitate traffic flow. It is expected that traffic would be confined to one lane during this work.

The current Arizona Trail trailhead parking lot located off the Florence Kelvin highway would be eliminated with Ripsey Wash TSF construction, but Asarco would construct a new parking lot for the Arizona Trail near the intersection of the Florence-Kelvin highway and Riverside Drive, adjacent to the Florence-Kelvin highway bridge over the Gila River. See Section 3.9, Recreation. The new segment of the Arizona trail would be constructed prior to construction of the Florence Kelvin highway and the Ripsey Wash TSF.

Following construction, and throughout operation of the Ripsey Wash TSF, State Route 177 and Florence-Kelvin highway traffic volume would return to near pre-construction ADT. Even with a few additional personnel required for the operation of the Ripsey Wash TSF, there would be no noticeable effect on the traffic load of the Florence-Kelvin highway. With Pinal County/ADOT's construction of a new bridge across the Gila River and Asarco's plans to upgrade and asphalt approximately three miles of the Florence-Kelvin highway, traffic flow and safety would be improved over the existing road. Since the

[39] The BLM would be responsible to issue a right-of-way grant to Asarco before the company could make any improvements to the Florence-Kelvin highway where this road crosses BLM administered land.

new Gila River bridge would have a higher weight limit, higher weight vehicles such as tractor trailer rigs would be permitted to use the Florence-Kelvin highway from the intersection of SR 177 to the Ripsey Wash TSF. Asarco's Ray Mine would use this bridge and new highway segment to transport supplies and equipment to the Ripsey Wash TSF.

Under TSF closure, additional traffic load would be expected for State Route 177 (approximately 1 to 2% over pre-construction levels) and the Florence Kelvin highway (approximately 10-15% over pre-construction levels), but this load would be of less duration and less volume than projected for the construction period.

An increase in traffic during the three-year construction phase of the project could result in an increase in accidents on State Route 177 and the Florence-Kelvin highway, although it is difficult to predict the number of accidents. A new modern bridge constructed across the Gila River on the Flounce-Kelvin highway and the re-routed section of highway paved and constructed to Pinal County standards should serve to mitigate accident potential. The new bridge is planned for completion in April 2018. (per, com., J. Ortiz, Pinal County, 2016). Once the construction phase of the project is completed, traffic would probably return to near present levels.

Primitive roads located within the proposed TSF footprint, including the road in Ripsey Wash itself, would be closed to public access and would eventually be covered with tailings. There would continue to be public access on various primitive roads to the upper reaches of Ripsey Wash during construction and operation, as well as during closure/reclamation and post closure of the Ripsey Wash TSF. See Section 3.9, Recreation, for discussion on access road locations. There are no federal, state or Pinal County transportation routes or facilities that would be affected by the construction of the new section (relocated portion) of the Arizona Trail. Similarly, there are no transportation routes or facilities that would be affected by the fencing and general upgrade (seeding and removal of tamarisk) of the riparian habitat within the proposed waters of the U.S. mitigation areas (see **Appendix J, Compensatory Mitigation**). No adverse effects are expected to transportation due to these proposed activities.

Indirect effects on State Route 177 would be negligible. The Florence-Kelvin highway would be upgraded from the Gila River bridge to the west side of the Ripsey Wash TSF entrance; this upgrade could be seen as a positive effect because of a better driving surface and reduced dust emissions from traffic.

3.12.2.3 Effects of the Hackberry Gulch TSF Alternative

Under the Hackberry Gulch TSF alternative, traffic levels on State Route 177 would be the same as discussed in Section 3.12.2.2, Effects of the Ripsey Wash TSF Alternative.

As with the Ripsey Wash TSF alternative, an increase in traffic during the construction phase of the Hackberry Gulch TSF could correspond to an increase in accidents, although this is difficult to assess. During construction involving State Route 177, traffic flow would experience delays, but once the construction phase is completed, traffic on State Route177 is expected to return to near current levels.

Under the construction of the Hackberry Gulch TSF, traffic on State Route 177 would be impacted for an estimated 9 to 12 months with the installation of box culverts, installation of a maintenance vehicle underpass and a large box culvert or tunnel associated with up-gradient storm water diversions. This construction work would necessitate speed limit reductions and traffic detours on State Route 177. Flag persons would be required during these State Route 177 construction activities. By-pass routes may be required to allow tractor-trailer rigs to safely pass the construction area.

The ADOT would need to be consulted concerning these construction activities, and the associated detour requirements. This agency would need to review and approve the plans associated with bridge construction and box culvert installation on State Route 177.

Given the proximity of State Route 177 to the proposed Hackberry Gulch TSF work, traffic would be periodically stopped for certain construction activities, including blasting. These traffic delays could impact employees and contractors who commute on State Route 177 from Kearny, Hayden and Winkelman, as well as non-Ray Mine traffic on State Route 177, which includes local residents.

For approximately three miles, State Route 177 would straddle the Hackberry Gulch TSF on the east and related-support facilities (seepage trenches and seepage collection ponds) on the west. Travelers on State Route 177 could be distracted by maintenance vehicle underpass and culvert construction work for State Route 177 associated with the construction activities of the Hackberry Gulch TSF.

Primitive roads located within the Hackberry Gulch TSF footprint would be closed to public access and would eventually be covered with tailings. Alternative access on a re-aligned primitive road would allow continued access to the Kane Springs Canyon. In addition, other primitive roads would be available in areas east of the Hackberry Gulch TSF to the public.

There would be no adverse effects to transportation from the mitigation work at the proposed for waters of the U.S. mitigation areas for the same reasons set forth in Section 3.12.2.2, Effects of Ripsey Wash TSF Alternative. There would be no adverse effects on the Arizona Trail with the construction and operation of the Hackberry Gulch TSF.

Indirect effects to State Route 177 would be negligible with the construction and operation of the Hackberry Gulch TSF.

3.13 VEGETATION

Address project-related impacts to vegetation. *Areas of concern include: (1) the impacts to vegetation communities by the project; (2) the impacts to any threatened, endangered, and candidate plant species as identified by the U.S. Fish and Wildlife Service; (3) the impacts to any BLM sensitive plant species; (4) the control of noxious weeds.*

3.13.1 Affected Environment

Vegetation baseline studies were conducted to provide a description of the existing vegetation community conditions of the Ripsey Wash and Hackberry Gulch TSF sites. The baseline reports were designed to provide data on plant community structure and composition characteristics.

The vegetation communities were determined based on aerial and satellite imagery, data from existing vegetation surveys, and field visits. Plant association (vegetation community) names were based on the U. S. National Vegetation Classification System (USNVC 2013).

Table 3-63, Pertinent Characteristics of Vegetation Communities, presents descriptive information for the vegetation communities mapped at the Ripsey Wash and Hackberry Gulch TSF sites. Vegetation communities are shown on **Figure 43, Vegetation Map**.

Table 3-63, Pertinent Characteristics of Vegetation Communities

Vegetation Community Name	Location Across Project Site	Dominant Species/Features	Comments
Ripsey Wash TSF Alternative			
Saguaro/Paloverde-Jojoba/Mixed Cacti Shrubland	Ubiquitous across various topographies and geologic parent materials; the dominant community	Saguaro, foothills paloverde, jojoba	A wide variety of cacti are present; southern aspects support a greater diversity of species.
Saguaro/Ocotillo/Jojoba/Triangle-leaf Bursage Shrubland	Limited to central portion of TSF site immediately east of Ripsey Wash	Saguaro, foothills paloverde, jojoba, triangleleaf bursage	Limited acreage; includes old river channels overlain with soils and gravel.
Tuffaceous Sandstone Outcrop	Limited acreage along western side of Ripsey Wash	Rock outcrop, various species including perennial grasses	Sparse to moderately vegetated; vegetation typically found in rock fractures and soil accumulations.
Paloverde/Catclaw-Burrowbush-Desert Broom Xeroriparian Washes	Dry washes including Ripsey Wash, Zelleweger Wash and tributaries	Foothills paloverde, catclaw acacia, netleaf hackberry	Vegetation fairly homogenous; typical of dry desert washes.
Riparian Vegetation	Near Mouth of Mineral Creek and along the Gila River	Fremont cottonwood, Gooding's willow, tamarisk, mesquite	Additional shrub species present include catclaw acacia, seepwillow and desert hackberry.
Hackberry Gulch TSF Alternative			
Saguaro/Paloverde-Jojoba/Mixed Cacti/Shrubland	Ubiquitous across various topographies and geologic parent materials; the dominant community	Saguaro, foothills paloverde, jojoba	A wide variety of cacti are present; southern aspects support a greater diversity of species.
Saguaro/ Ocotillo/Paloverde-Jojoba Shrubland	A significant, continuous acreage northeast of TSF site at higher elevations	Saguaro, ocotillo	At elevations ranging from approximately 2,300 to 2700 ft.
Saguaro/Paloverde-Jojoba/Triangleleaf Bursage Shrubland	Broad, nearly level ridge tops southeast of Hackberry Gulch	Foothills paloverde, triangle-leaf bursage	Saguaros more dense in this community than other areas, cactus species vary widely depending upon locale.
Saguaro/Paloverde/Teddybear Cholla Shrubland	Northeast of TSF site	Foothills paloverde, teddybear cholla	At highest elevation of Analysis Area; from 2,600 to 2,800 ft.
Ocotillo/Paloverde-Mixed Shrubland	Limited acreage and distribution; isolated locations in eastern portion of TSF site	Ocotillo	Most common on north-facing slopes; near absence of saguaro and cacti species.
Sonoran Riparian Deciduous Woodlands	Associated with riparian zones along Gila River and limited reaches of Gila River tributaries	Gooding's willow, Fremont cottonwood, seepwillow, tamarisk	Uncommon with a restricted distribution associated with springs, seeps, mesic sites, and wetlands.
Gila River Riparian Vegetation (Riparian Zone)	Along both banks of the Gila River	Freemont cottonwood, Goddin's willow, tamarisk, mesquite	Hydroriparian and mesoriparian vegetation characteristic; grass-like wetland species locally present.

Table 63, Pertinent Characteristics of Vegetation Communities (continued)

Vegetation Community Name	Location Across Project Site	Dominant Species/Features	Comments
Hackberry Gulch TSF Alternative			
Paloverde/Catclaw-Burrobush-Desert Broom Xeroriparian Washes	Along dry washes and drainages including Hackberry Gulch and Kane Spring Canyon	Highly variable depending upon locale and site characteristics	Vegetation typical of dry, desert washes; upper drainages show evidence of scouring by water.
Conglomerate Outcrop	Minor acreage in northwest portion of TSF site	Barren conglomerate outcrops	Vegetation sparse; when present, vegetation typically limited to foothills paloverde.
Arizona National Scenic Trail Reroute – Eastern Alignment			
Saguaro/Paloverde-Jojoba/Mixed Cacti Shrub-land (SPJM)	Ubiquitous along this trail reroute alternative	Saguaro, foothills paloverde, jojoba, creosote bush	A wide variety of cacti are present.
Source: WestLand 2014d and 2014e.			

3.13.1.1 Data Collection Methodologies

Vegetation field surveys were conducted for the Ripsey Wash TSF site in 2011, 2012, 2013 and 2014 (WestLand 2014d). Vegetation density, vegetation composition and noxious weed data were initially compiled in 2011 (WestLand 2011a). Information and data regarding total vegetation volume (TVV)[40] of woody species were collected and compiled in 2013 to support the assessment of functions and values associated with jurisdictional Waters of the U. S. at the Ripsey Wash TSF site (WestLand 2013a).

Vegetation field surveys were completed for the Hackberry Gulch TSF site in 2013 and 2014 (WestLand 2014e). Vegetation data for this area was collected in 1990 (SWCA 1991). This information was supplemented by additional fieldwork in 2013 (WestLand 2014f). WestLand visited SWCA evaluation areas at the Hackberry Gulch TSF site in 2013 and confirmed that the species composition extant was similar to that observed in 1990 and remained applicable to the Hackberry Gulch TSF site.

3.13.1.2 Upland and Riparian Vegetation – Ripsey Wash TSF Site

The upland vegetation at the Ripsey Wash TSF site is characteristic of the Paloverde-Cacti-Mixed Shrub series of the Arizona Upland Subdivision of the Sonoran Desertscrub. The riparian vegetation communities are characteristic of the Sonoran Interior Strands classification. Four vegetation communities and one geologic formation were identified at the site. See **Table 3-63, Pertinent Characteristics of Vegetation Communities**, and **Figure 43, Vegetation Map**.

The Saguaro/Paloverde-Jojoba/Mixed Cacti Shrubland community is the dominant upland community established across the majority of the site and supports a variety of woody and cacti species. The Paloverde/Catclaw-Burrowbush-Desert Broom Xeroriparian Washes unit represents the dry washes characteristic of the drainages within Ripsey Wash, Zelleweger Wash and their tributaries. Wetlands and riparian vegetation is mapped as the Riparian Vegetation Unit and is present along the banks of the Gila River (WestLand 2014d).

[40] TVV is reported as “cubic meters of vegetation per square meter of surface area” (m^3/m^2) and measures vegetation density.

The average upland total (woody) vegetation volume (TVV) calculated across upland vegetation community types equaled 0.55 m^3/m^2. Upland woody species richness, or the total number of upland species encountered in the analysis plots during the field surveys equaled 30 species. The dominant plant species in the uplands, and the percent of the total TVV each species accounted for, were foothill paloverde (*Parkinsonia microphylla*) at 26.5%, jojoba (*Simmondsia chinensis*) at 19.3%, and catclaw acacia (*Senegalia greggii*) at 11.1%. These species plus desert hackberry (*Celtis ehrenbergiana*) and whitethorn acacia (*Vachellia constricta*) accounted for 76% of the TVV of the evaluated uplands. Based on the evaluation of three representative sample plots, it was estimated that an average of approximately 19 saguaro (*Carnegia gigantia)* plants per acre exist in the uplands of the Ripsey Wash TSF site.

The average TVV measured for the riparian vegetation community was 0.48 m^3/m^2. Species richness equaled 27 species. The Paloverde/Catclaw-Burrobush-Desert Broom Xeroriparian Washes vegetation community was divided into three classes for field evaluation based on watershed size. The "small" category (watersheds less than 50 acres in size) exhibited a mean TVV value of 0.42m^3/m^2 and a woody species richness of 19 species in the sample plots. "Medium" watersheds (ranging in size from 50-200 acres) posted a mean TVV value of 0.48m^3/m^2. A total of 18 species were tallied in all plots examined. For "large" riparian watersheds (watersheds greater than 200 acres in size), a mean TVV of 0.52 m^3/m^2 was recorded with a total of 21 species found in the sample plots. Dominant woody species across all watersheds included foothills paloverde, catclaw acacia, whitethorn acacia, and desert hackberry. The TVV volumes for these dominant species, in terms of the percent of total TVV in each watershed type, ranged from 22.7% to 29.6%, 8.1% to 15.6%, 9.4% to 18.2% and 9.2% to16.9%, respectively. These four species, along with jojoba and velvet mesquite (*Prosopsis velutina*), comprised approximately 72% to 80% of the total TVV of the three watershed size classifications.

There are no vegetated wetlands within the Ripsey Wash TSF Site. Vegetated wetlands exist near the footprint for this alternative adjacent to the Gila River.

3.13.1.3 Upland and Riparian Vegetation – Hackberry Gulch TSF Site

Vegetation communities at the Hackberry Gulch TSF site are mapped within the Arizona Upland Subdivision of the Sonoran Desertscrub biotic community. A narrow riparian zone (including small wetland areas) with inclusions of the Sonoran Riparian Deciduous Woodland is also present. Sonoran Interior Strands of Xeroriparian vegetation are present along the ephemeral drainages. Seven distinct vegetation communities and one geologic formation were identified at the Hackberry Gulch TSF site. See **Table 3-63, Pertinent Characteristics of Vegetation Communities**, and **Figure 43, Vegetation Map**. Wetland vegetation present at the Hackberry gulch TSF site is discussed in Section 3.5, Waters of the U.S.

As for the Ripsey Wash TSF site, the Saguaro/Paloverde-Jojoba/Mixed Cacti/Shrubland vegetation type is dominant and occurs across a variety of elevations and topographic features with similar biotic characteristics. Dry washes were mapped as the Paloverde/Catclaw-Burrobush-Desert Broom Washes unit while the riparian zone was mapped as the Sonoran Riparian Deciduous Woodlands map Unit

The average upland TVV was calculated as 0.35 m^3/m^2. A total of 55 woody species were found in the upland plots evaluated. The dominant species, and the percent of TVV each species accounted for, were foothills paloverde at 34.1%, creosote bush (*Larrea tridentata*) at 16.9% jojoba at 12.3% and brittlebush (*Encelia farinosa*) at 6.0%. These four species comprise approximately 70% of the vegetation volume of the upland vegetation types mapped. Saguaro densities were evaluated across selected areas and plots.

A density of 7.5 saguaros per acre was calculated for the large sample areas and 67.5 saguaros per acre for smaller plots established in flatter areas underlain by pediment sediments.

The average TVV measured for the riparian vegetation community as a whole was 0.49 m^3/m^2; similar to that for the Ripsey Wash TSF site. Species richness equaled 40 species. The Paloverde/Catclaw-Burrobush-Desert Broom Xeroriparian Washes vegetation community was divided into three classes for field evaluation based on watershed size as for the Ripsey Wash TSF site. The small watersheds exhibited a mean TVV value of 0.57m^3/m^2. Woody species richness was 26 species across the sample plots. Medium watersheds exhibited a mean TVV value of 0.48m^3/m^2, identical to that found for the Ripsey Wash TSF site. A total of 21 species were tallied in all plots evaluated. For large riparian watersheds, a mean TVV of 0.47 m^3/m^2 was calculated with a total of 33 species found in the sample plots.

Species dominance across the three watershed types was more variable than for the Ripsey Wash TSF site. Foothills paloverde was the sole dominant species occurring in all watershed types at the Hackberry Gulch TSF site accounting for 12.6% to 24.9 % of the TVV values. Velvet mesquite (7.4% and 10.0%), whitethorn acacia (5.8% and 6.7%), and tamarisk (*Tamarix* sp.) (7.2% and 9.9%) are dominant in two of the three watershed types. With respect to other dominant species, seepwillow (*Baccharis salicifolia*) at 14.7% and Goodding's willow (*Salix gooddingii*) at 13.0% are dominants in small watersheds. Fremont cottonwood (*Populus fremontii*) at 39.6% is a major contributor to TVV values in medium watersheds and velvet ash (*Fraxinus velutina*) is a notable dominant in larger watersheds at 18.5%.

Pinal County uses TVV values to classify Xeroriparian habitat quality to implement the county's riparian protection ordinance. The values calculated for both the Ripsey Wash and Hackberry Gulch TSF sites fall into *Xeroriparian Class D* (least dense, spare density).

3.13.1.4 Upland Vegetation – Arizona National Scenic Trail Reroute – Eastern Alignment

The dominant vegetation community occurring along this alignment option is the Saguaro/Paloverde-Jojoba/Mixed Cacti Shrubland. Specific vegetation analyses were not conducted for this proposed disturbance. However, the vegetative characteristics of this community parallel those described for the Ripsey Wash and Hackberry Gulch TSF sites.

3.13.1.5 Upland Vegetation of the Compensatory Wetland Mitigation Sites

A total of four compensatory wetland mitigation sites are proposed to mitigate for the waters of the U. S. that would be impacted under either project alternative. All four are located adjacent to or within close proximity to the San Pedro River and, in some cases, previously developed wetland mitigation sites. Shrub and tree species, including mesquite, tamarisk, and cottonwoods (*Populus* sp.) typically dominate the existing vegetation communities of these sites (see **Appendix J, Compensatory Mitigation**).

3.13.1.6 Threatened, Endangered and Sensitive Vegetation Species

A screening analyses was conducted to determine the potential for any USFWS-listed threatened and endangered species and BLM-listed sensitive species to be present on the Ripsey Wash and Hackberry Gulch TSF sites and surrounding areas including a reach of the Gila River and a portion of Belgravia Wash (WestLand 2014g and 2014h; WestLand 2014i and 2014j).

A variety of data sources were reviewed for these screening analyses including various USFWS, BLM and AGFD species lists, documents, species abstracts, previous pertinent biological surveys, and other pertinent literature (WestLand 2014g, 2014h, 2014i and 2014j). The determination of the potential for a species to be present at either the Ripsey Wash or Hackberry TSF site was based on:

- an evaluation of the known distribution and elevation ranges for a listed species;
- a review of the known habitat requirements of each species;
- field observations and pertinent habitat descriptions;
- a review of previous occurrence records; and,
- a comparison of these data with the conditions present on site.

As a result of these analyses, the potential presence of each listed species was determined to fall into one of four categories including “present”, “possible”, “unlikely”, or “none”. These classifications are defined with respect to the screening analyses for the Endangered Species Act and the BLM in the documents WestLand 2014g and WestLand 2014h, respectively.

3.13.1.7 USFWS-Listed Vegetation Threatened and Endangered Species.

The screening analyses identified three endangered plant species that are listed as occurring in Pinal County in the vicinity of the Ripsey and Hackberry TSF sites as listed below. The Acuna cactus is the only species that might potentially occur across the proposed Ripsey Wash (WestLand 2014f) and Hackberry Gulch (WestLand 2014h) TSF sites though its presence is highly unlikely. These species are:

- Arizona hedghog cactus (Echinocereus triglochidiatus var. arizonicus),
- Nichol Turk’s head cactus (Echinocactus horizonthalonius var. nocholii), and,
- Acuna cactus (Echinomastus [Sclerocactus] erectocentrus var. acunensis).

3.13.1.7.1 Arizona hedghog cactus (*Echinocereus triglochidiatus* var. *arizonicus*)

No suitable habitat conditions were found for this species at either the Ripsey Wash or Hackberry Gulch TSF sites, which are outside the known geographic range of this species and below its recognized elevational range of 3,300 to 6,300 feet. There is no designated or proposed critical habitat for this species.

3.13.1.7.2 Nichol Turk’s head cactus (*Echinocactus horizonthalonius* var. *nocholii*)

No suitable habitat conditions were found for this species at either the Ripsey Wash or Hackberry Gulch TSF sites, as these species typically grows on limestone bedrock and limestone-derived soils at elevations from 2,000 to 3,600 feet. There is no suitable limestone substrate in the Ripsey Wash TSF site. Limestone bedrock and limestone-derived soils do exist in the northeast edge of the Hackberry Gulch TSF site, but the proposed TSF disturbed area is approximately 55 miles from the closest known populations of this species. There is no designated or proposed critical habitat for this species.

3.13.1.7.3 Acuna cactus (*Echinomastus* [*Sclerocactus*] *erectocentrus* var. *acunensis*)

The potential for this species to occur at the TSF sites is considered to be “unlikely”. Although this species grows on a wide variety of bedrock substrates ranging from granite and diorite to ryolite and tuff at elevations ranging from 1,300 to 2,000 feet, specific habitat requirements incorporating these geologic units are not well defined. WestLand did not detect the presence this species during the company’s survey work on either alternative TSF site or the Arizona Trail. The nearest known populations of this species are over two miles to the southwest and twelve miles to the west-northwest of the Ripsey Wash TSF site and approximately ten to fifteen miles southwest and west of the Hackberry Gulch TSF site.

3.13.1.8 BLM-Listed Vegetation Sensitive Species

The screening analyses conducted for sensitive species listed by the BLM Gila District determined that there is one plant species potentially occurring within limited habitat of both the Ripsey Wash and Hackberry Gulch TSF sites, and an additional three species potentially occur across the Hackberry Gulch TSF site (WestLand 2014h and 2014j). Species presence classifications included “none”, “unlikely” or “possible” given site characteristics.

The sensitive species potentially present are discussed below.

3.13.1.8.1 Pima Indian mallow (*Abutilon parishii*)

This species is classed as “possibly” present at both TSF sites, which are within the species’ known geographic and elevation ranges and where suitable Sonoran desertscrub habitat is present. It is known to be present in Mineral Hills about 14 miles from the Ripsey Wash TSF site and in the Dripping Spring Mountains about 10 miles east of the Hackberry Gulch TSF site. The acreage of habitat suitable for supporting this species is notably small at both sites and any impact would not result in a trend to federal listing or a loss of viability.

3.13.1.8.2 Aravaipa sage (*Salvia amissa*)

The potential for this species to occur at the Hackberry Gulch TSF site is considered “unlikely”. Small areas of suitable habitat, in the form of isolated springs supporting velvet ash, are present near the northeast edge of the proposed Hackberry Gulch TSF site. However, the closest known existing population of this species is located about 29 miles southeast of this site.

3.13.1.8.3 Aravaipa woodfern (*Thelypteris puberula* var. *sonorensis*)

Suitable habitat for this species may be present at isolated springs associated with moist soil in the shade of boulders northeast of the Hackberry Gulch TSF site, but the closest known population of this species is east of the town of Superior about 11 miles north of the Hackberry Gulch TSF site. Therefore, the presence of this species is considered to be “unlikely”.

3.13.1.8.4 Giant sedge (*Carex ultra* var. *spissa*)

The potential for this species to occur within the Hackberry Gulch TSF site is classed as “unlikely”, although the Hackberry Gulch TSF site is within the known geographic range for this species. Suitable habitat may be present in the form of moist soil near isolated perennially wet springs and undulating rocky-gravelly terrain. However, the closest known population of this species is located about 30 miles southeast of the Hackberry Gulch TSF site.

3.13.2 Environmental Consequences

3.13.2.1 Effects of the No Action Alternative

Under the no action alternative, neither the Ripsey Wash nor the Hackberry Gulch TSF would be constructed. Endemic vegetation communities would continue to mature at natural rates, subject to climatic variations. Vegetation communities, including those associated with the proposed compensatory wetland mitigation areas, would continue to be subject to existing grazing, wood cutting, off-road vehicle access and current dispersed recreation use.

3.13.2.2 Effects of the Ripsey Wash TSF Alternative

3.13.2.2.1 Upland and Riparian Vegetation

This alternative would impact a total of 2,636 acres. Direct impacts to the upland vegetation resource (including Xeroriparian communities) include the immediate removal of all vegetation at the base of the impoundment dam and adjunct facilities (access roads, pump stations, etc.), and the incremental burial of vegetation communities overlaying the TSF footprint. The contribution of these communities to the surrounding ecosystem would be lost. Portions of the vegetation communities subject to eventual burial may remain viable for variable time periods until the entire TSF floor is covered with tailings.

The realignment and paving of the Florence-Kelvin Highway and the realignment of the Arizona Trail also contribute to the acreage of vegetation removed. To a lesser extent, the SCIP 69-kV transmission line realignment would have a small foot print of vegetation removal at support structure sites. See **Table 2-1, Summary of Ripsey Wash TSF Alternative.**

Approximately four acres of vegetation would be eliminated through construction of the Arizona Trail. The trail reroute is designed to avoid the removal of any saguaro cactus. Dust deposition on nearby desert vegetation from construction and operations activities may result in the loss of adjacent plant vigor due to reduced capability of photosynthesis from reduced light availability. These effects would be minor and would be minimized by proposed dust control measures during construction. Blowing dust in the desert is a common phenomenon during windy days because of the sparse vegetative cover.

Loss of vegetation translates into loss of wildlife habitat, and some species may be dislocated due to the change in habitat availability with vegetation community loss. See Section 3.15, Wildlife. Increased erosion potential of exposed soils is discussed in Section 3.2, Soils.

No adverse effects are expected to wetland vegetation as a result of the work in the areas proposed for waters of the U.S. mitigation (see **Appendix J, Compensatory Mitigation**). The proposed fencing and general upgrade (seeding and removal of tamarisk) of the riparian habitat within the proposed mitigation sites would improve the vegetation resources in the mitigation areas.

3.13.2.2.2 Threatened, Endangered, Candidate, and BLM Sensitive Plant Species

One , endangered species, Acuna cactus, listed by the USFWS, was determined to be present west of the Ripsey Wash TSF but unlikely to occur on site due to its limited distribution (WestLand 2014g and 2014i). See **Table 3-64, Plant Species of Special Concern.**

The nearest surveyed occurrences of the Acuna cactus are over seven miles from the Ripsey Wash TSF site. Field surveys did not record any plants in the project area. No impact to this species is anticipated under the Ripsey Wash TSF alternative.

BLM Sensitive Species in the Gila District with a potential to occur in the vicinity of the project area are summarized in **Table 3-64, Plant Species of Special Concern**.

Pima Indian Mallow (*Abutilon parishii)* could potentially be affected by the Ripsey Wash TSF alternative, however the nearest surveyed occurrences is 14 miles from the Ripsey Wash area. Impacts would be limited to a notably small fraction of the total potential habitat available for this species. Any potential impacts would be to individual plants but such impacts are not likely to trend toward a federal listing or loss of viability (WestLand 2014 h and 2014j).

Table 3-64, Plant Species of Special Concern

Common Name	Scientific Name	Category	Potential to Occur	Range
Acuna cactus	*Echinomastus erectocentrus* var. *acunensis*	USFWS Endangered	Unlikely	Gravel ridges; small knolls up 30% slope
Aravaipa sage	*Salvia amissa*	BLM Sensitive Gila District	Possible but unlikely	Narrow range, floodplain terraces in shady canyons
Aravaipa woodfern	*Thelypteris puberula* var. *sonorensis*	BLM Sensitive CO River District	Possible	Few scattered springs
Giant sedge	*Carex spissa* var. *ultra*	BLM Sensitive Phoenix & Gila Districts	Possible but unlikely	Springs
Pima Indian mallow	*Abutilon parishii*	BLM Sensitive Gila District	Possible	Rocky slopes, good condition desert mountains.

3.13.2.2.3 Noxious Weeds

Weed infestations could occur in areas disturbed by project operations, given their aggressive nature. No noxious weeds were found during fieldwork (WestLand a); however, the BLM has noted that Malta Starthistle has been identified as occurring at the new Florence-Kelving highway bridge over the Gila River, as well as along the Arizona Trail between Kelvin and Cochran. **Appendix I, Applicant Project Mitigation**, includes information about weed control proposed by Asarco.

3.13.2.3 Effects of the Hackberry Gulch TSF Alternative

This alternative would result in approximately 2,290 acres of surface disturbance, the vast majority of which currently supports vegetation communities. See **Table 2-1, Summary of Ripsey Wash TSF Alternative**. As a result, the effects of this alternative in terms of direct and indirect impacts such as vegetation productivity/habitat loss, blowing dust, noxious weeds, etc. are the same as for the Ripsey Wash TSF. The Arizona Trail would not be disturbed under this alternative.

The nearest surveyed occurrences for Acuna cactus (USFWS endangered species) is over 13 miles from Hackberry Gulch area. BLM Sensitive Species in the Gila District with a potential to occur in the vicinity of the project area are summarized in **Table 3-64, Plant Species of Special Concern**.

Pima Indian Mallow (*Abutilon parishii)* could potentially be affected by the Hackberry Gulch TSF alternative, however the nearest surveyed occurrence is over nine miles from the Hackberry Gulch area. Impacts would be limited to a notably small fraction of the total potential habitat available for this species. Any potential impacts would be to individual plants but such impacts are not likely to trend toward a federal listing or loss of viability (WestLand 2014j).

No adverse effects are expected to vegetation as a result of the work in the areas proposed for waters of the U.S. mitigation (see **Appendix J, Compensatory Mitigation**). The proposed fencing and general upgrade (seeding and removal of tamarisk) of the riparian habitat within the proposed mitigation sites would improve the vegetation resources in the mitigation areas and serve as compensatory mitigation.

3.14 VISUAL RESOURCES

Identify project-related impacts to visual resources. *The area of concern includes how the proposed new tailings storage facility might affect the view for: (1) residents of Kearny, Kelvin and Riverside; (2) travelers on State Route 177 and the Florence-Kelvin highway; and, (3) recreational users in the area, particularly those on the Arizona Trail.*

3.14.1 Affected Environment

This section focuses on the inventory and characterization of the visual resources potentially affected by the construction and operation of the proposed Ripsey Wash and Hackberry Gulch TSF sites and the proposed corridor for the relocated Arizona Trail.

3.14.1.1 Management Framework and Methodology

Most of the land at the proposed Ripsey Wash TSF site is owned by the state of Arizona and managed by ASLD; Asarco is working with ASLD to purchase this land. The proposed route for the relocated Arizona Trail traverses a combination of private lands and public lands managed by the BLM. Lands at the Hackberry Gulch TSF site are a combination of private and public ownership, with the public lands being managed by the BLM. Asarco is working with the BLM on a land exchange involving public lands that would include a portion of the Hackberry Gulch TSF. The land exchange is not a part of the proposed TSF project and thus is only being considered in the cumulative effects analysis of this EIS.

The BLM has established procedures for managing visual resources (BLM 1984), consisting of its visual resource management (VRM) system. The BLM VRM system was used to assess existing visual conditions of the BLM lands within the two project areas. The VRM system consists of a Visual Resource Inventory (VRI) analysis, designation of VRM objectives, and analysis of the compatibility of proposed development with VRM objectives.

The VRI analysis is based on scenic quality, viewer sensitivity, and viewing distance as follows:

- Scenic quality is defined by the BLM as the aesthetic appeal of each Scenic Quality Rating Unit (SQRU), which are delineated based on similar visual characteristics, such as topography, color, and vegetation. Scenic Quality is expressed as Class A, B, or C Scenic Quality Rating (SQR). BLM criteria for evaluating scenic quality consist of the relative variety created by the study area's landform, vegetation patterns, water, and colors, as well as the relative scarcity of the landscape and the contribution of adjacent scenery, such as mountain backdrops. Cultural modifications are also considered, which can detract from the scenery in the form of a negative intrusion or improve the scenic quality. Class A scenery typically has the highest degree of scenic quality, which harmoniously combines and results in a high level of aesthetic appeal. Level C scenery has the lowest degree of scenic quality (BLM 1986a).
- Viewer sensitivity, ranked as high, medium or low, is a measure of public concern for scenic quality, based on the type of users, amount of use, level of public interest, adjacent land uses, and special area designation. A high sensitivity rating would occur in places where scenic quality is a major concern for most users and/or where use levels are relatively high.
- Distance of view is considered through the delineation of three distance zones: foreground-middleground (less than three to five miles away from sensitive viewing locations), background (between five and 15 miles away), and seldom seen zones (over 15 miles away or not visible) (BLM 1986a).

Once visual values are inventoried, landscapes are assigned to one of four VRI classes, which represent the relative value of visual resources. Class I VRI is only assigned to areas where a management decision has been made previously to maintain a natural landscape, such as national wilderness areas. Classes II, III, and IV are assigned based on a combination of scenic quality, sensitivity level, and distance zones. VRI classes are informational in nature, providing the basis for considering visual values in the RMP process, but do not establish management direction.

On BLM-administered lands, the VRI classes are considered with other resource values in the Resource Management Plan (RMP) process, which designates visual resource management (VRM) objectives for each area. The VRM objectives provide standards for evaluating proposed projects' effects on visual resources. In cases where the RMP has not established VRM classes, as in the case of the Ripsey Wash and Hackberry Gulch project areas, the BLM uses the Class III VRM as an interim VRM class. **Table 3-65, BLM Visual Resource Management Classes**, provides the definitions of the VRM classes. The nearest Class I area is the White Canyon Wilderness Area, located approximately four miles north of the proposed Ripsey Wash TSF site.

Table 3-65, BLM Visual Resource Management Classes

Class I Objective	The objective of this class is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.
Class II Objective	Class II Objective. The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
Class III Objective	The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention, but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
Class IV Objective	The objective of this class is to provide for management activities which require major modifications of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.

For this visual resource analysis, the BLM visual inventory process (VRI) was used to describe existing conditions on BLM lands. The Class III VRM objective was then used to compare the effects of the two action alternatives and the no-action alternative within BLM-managed lands. **Appendix F, Visual Resource Inventory and Scenic Quality Analysis,** provides the detailed VRI analyses and associated maps. On non-BLM-administered lands, the visual resources were described in terms of scenic quality, viewer sensitivity, and distance zones. The alternatives' effects on visual resources within these lands were evaluated in terms of their visibility from sensitive resources, duration of impact, distance from sensitive viewing areas, and degree of contrast with the existing landscape generated by the alternative.

The degree of contrast with the existing landscape is evaluated based on the BLM contrast rating system. The degree to which a project feature affects the visual quality of a landscape depends in part on the visual contrast created between a project and the existing landscape. The basic design elements of form, line, color, and texture are used to make this comparison and to describe the visual contrast and thereby the visual impact created by the project (BLM 1986b). **Appendix F, Visual Resource Inventory and Scenic Quality Analysis**, provides the contrast rating forms completed for the two TSF sites.

3.14.1.2 Regional Landscape Character

The Ripsey Wash and Hackberry Gulch TSF project areas are located on the eastern edge of the Sonoran Desert subdivision of the Basin and Range Physiographic Province (AORCC 2012). The Basin and Range Province is characterized by its elongated, roughly parallel mountain ranges alternating with flat, closed (undrained) desert basins. The mountain ranges generally trend north-south and can be up to 100 miles in length. Typical landforms include creosote flats, bajada slopes, rugged mountains, and steep walled canyons. Prominent landscape features in the region include the Pinal Mountains, Mineral Mountains, Dripping Springs Mountains, Tortilla Mountains, White Canyon, the Rincon, and Copper Butte. The predominant vegetation communities consist of the Lower Colorado River Valley and the Arizona Upland subdivisions of the Sonoran Desertscrub biotic community. A riparian community follows the Gila and San Pedro River floodplains.

Scenic quality is considered important to those who visit the region's many recreation resources, including the Tonto National Forest Service, BLM lands, the Arizona Trail, and two wilderness areas. The closest wilderness area to the project site is the White Canyon Wilderness.

The region is primarily rural in character, with a generally natural, intact landscape. Residential communities include Superior, Kearny, Kelvin, Riverside, Hayden, and Winkelman. The Ray Mine and its associated infrastructure are visible for about five miles along SR 177. The Hayden mill and smelter complex, and its associated tailings facilities, are also visible from SR 177.

Transportation corridors include U.S. 60, SR 177, also known as the Copper Corridor West, the Florence-Kelvin highway, and the Copper Basin Railroad. See **Figure 42, Highways and Roads**. Other cultural modifications to the landscape include transmission lines, microwave towers, irrigation canals, historic town sites and mines, isolated ranch houses, and range improvements, such as tanks, pipelines, fences, and windmills.

3.14.1.3 Local Area Visual Character

3.14.1.3.1 Landscape Description

The landscape within and adjacent to the Ripsey Wash TSF site is dominated by the Tortilla Mountains to the east, rising 1700 feet from elevation 1800 feet amsl to over 3500 feet amsl. To the north, the Gila River Canyon creates a curvilinear form, marked by its riparian vegetation. Ripsey Wash runs north-south along the base of the Tortilla Mountains, punctuated by small peaks and bajadas. Compared to the more open desert landscape to the west, the terrain is relatively rugged, dissected by deeply incised finger ridges separated by steep-walled gullies. The area is located in the Arizona Upland subdivision of the Sonoran Desert scrub, characterized by the paloverde-cacti-mixed shrub vegetation in the uplands and semi-riparian vegetation in Ripsey Wash and some of the ephemeral washes (WestLand 2014k).

The Ripsey Wash TSF site is relatively natural in appearance. Cultural modifications include the A-Diamond Ranch near the mouth of Ripsey Wash, the Copper Basin Railroad, and the arched span of the railroad bridge over the Gila River. Near the Ripsey Wash TSF site, the Florence-Kelvin highway is an unpaved road that crosses the Gila River on an historic, one-lane bridge. The Arizona Trail traverses the area, following the eastern side of Ripsey Wash and the north side of the Gila River. A county-maintained trailhead for the Arizona Trail is located adjacent to the Florence-Kelvin highway, south of the Gila River near Ripsey Wash. The BLM manages a trail access on the north side of the Gila River at the end of Centurion Lane, about one-third mile west of the Florence-Kelvin highway. The first several miles of the Arizona Trail west of the BLM-managed trail access follow a reclaimed Asarco exploration road.

OHV trails and dispersed campsites are found throughout the area, primarily south of the Gila River, as are occasional livestock improvements. Other human modifications include the 500 kV transmission line visible in the background and the 69kV SCIP transmission line. Views of the Ray Mine are visible in the distance from the Florence-Kelvin highway looking east-northeast. Hikers on the Arizona Trail also have foreground/middleground views of the Ray mine for a total of 5 miles and background views of the mine for 0.6 miles, most of which occur along the Tortilla Mountains Passage south of the Gila River.

The Hackberry Gulch TSF site is dominated by the gentle bajada slopes at the lower elevations, transitioning to the steeper ridges of the Dripping Springs Mountains. The mountains provide a bold background skyline, while the Gila River floodplain creates a sinuous curve in the valley below. This site is more open than the Ripsey Wash TSF site, allowing more distant views across the Gila River valley.

Cultural modifications in the Hackberry Gulch TSF area are dominated by the Ray Mine and the existing Elder Gulch TSF. Other cultural modifications include the community of Riverside, the SR 177 corridor, and several electric distribution structures and lines. A network of OHV trails parallels the Gila River west of SR 177 and, on the east side of SR 177, provides access to the Dripping Springs Mountains. Dispersed campsites and occasional livestock improvements are also found east of SR 177.

3.14.1.3.2 Scenic Quality Evaluation

The scenic quality evaluation for the Ripsey Wash TSF Alternative is set forth in **Appendix F, Visual Resource Inventory and Scenic Quality Analysis**.

The rolling character of the Ripsey Wash landform, although not highly distinctive, represents a visual relief from the flatter, desert landscape to the south and the open range east of the Gila River. The Tortilla Mountains to the east and ridgelines to the west provide a sense of containment to the Ripsey Wash area. Ripsey Wash has a Class C SQR, whereas the Tortilla Mountains are a Class B due to its topographic variety. The vegetation pattern in the area is fairly uniform, with relatively little variation; but, as with the landform, the ephemeral riparian and upland vegetation provide variation from the semi-desert grassland community to the south and west. The Gila River Floodplain is classified as a Level A SQR due to its relative scarcity in the region in terms of vegetation, color, and water.

Most of the cultural modifications that exist in the Ripsey project area are located within the Gila River riparian vegetation and thus not highly visible from much of the project area. The Florence-Kelvin highway is the most visible cultural modification in the area, visible against the hillsides from primitive roads and the Arizona Trail. Being an unpaved road, the color and texture of the road are similar to some of colors/textures seen in the adjacent lands, while the curvilinear line and form are also compatible with the adjacent landscape, and thus the road does not detract significantly from the visual quality.

The Hackberry Gulch TSF project area would be a Class C SQR since it is typical of the basin and range region. The vegetation pattern and colors are relatively uniform throughout the project area. The Dripping Springs Mountains create the greatest visual variety within the Hackberry Gulch project area and are thus designated as a Class B SQR. The mountains offer relatively steep slopes dissected with numerous drainages rising above the valley floor, as well as some unique topographic features and red and purple rock formations. The cultural modifications within the Ray Mine scenic quality rating unit present a visual detraction, primarily because of the large scale and geometric form of the existing Elder Gulch TSF.

3.14.1.3.3 Sensitivity Levels

Sensitivity levels of the Ripsey Wash TSF site are considered moderate to high. Views from the Arizona Trail are of high sensitivity due to the trail's national significance, its potential for increased use in the future, and the type of users, which are generally sensitive to visual quality. Views from the Florence-Kelvin highway would be rated a moderate concern level. Although traffic volumes on this route are relatively low, some traffic is generated by recreationists using the highway to access public lands. The OHV trails in the area would have a moderate level of sensitivity, since many of the users are concerned about scenery, but these OHV trails do not have the national recognition of the Arizona Trail.

The sensitivity level of the Hackberry Gulch TSF site is considered moderate. The status of SR 177 as a state-designated Scenic Highway, its relatively high traffic volume, and nearby OHV trails contribute to its sensitivity, but the project area is not as widely used for recreation as Ripsey Wash and has extensive cultural modifications (such as the adjacent existing Elder Gulch TSF), which contribute to its moderate sensitivity rating.Viewing Distance

The Ripsey Wash and Hackberry TSF sites are both located within the foreground-middleground distance zone of two transportation corridors (SR 177 and Florence-Kelvin highway), the Arizona Trail, and local OHV routes. The Hackberry TSF would also lie within the foreground-middleground distance zone from the communities of Riverside, Kelvin, and Kearny.

3.14.1.3.4 Visual Resource Inventory (VRI) Class

Using BLM methodology for delineating VRI classes, the VRI class for the 196 acres of BLM-managed land within the Ripsey Wash SQRU is Class III. Most (56 percent) of the 18,031 acres of BLM-managed lands in the SQRU's adjacent to the Ripsey Wash project area would also be Class III due either to their Class C SQR or their location outside the foreground- middleground views from the Arizona Trail. See **Table 3-66, VRI Classes by SQRU**. For example, the areas south and west of Ripsey Wash are classified Class C SQR and thus would be a Class III VRI where located within the Arizona Trail foreground-middleground or Level IV within the background view from the trail or from the foreground-middleground view from the medium sensitivity viewing areas. The exception would be the Gila River floodplain and the lands north of the river, which both have a Class B SQR and thus are primarily Class II VRI lands. See **Appendix F, Visual Resource Inventory and Scenic Quality Analysis.**

Most (81 percent) of the 2,917 acres of BLM-managed lands within the SQRU containing the Hackberry Gulch TSF site would be classified as VRI III, due to its Class C SQR and visibility within the foreground-middleground view from the Arizona Trail. The remaining 543 acres of BLM-managed lands within the Hackberry SQRU are a Class III VRI due to their location within the background view from the Arizona Trail. Most (67 percent) of the 10,624 acres of BLM-managed lands in SQRU's adjacent to the Hackberry Gulch SQRU would be a Class III since much of this area is a Class C SQR or is Class B SQR but located outside the foreground-middleground view from the Arizona Trail. See **Table 3-66, VRI Classes by SQRU**.

Table 3-66, VRI Classes by SQRU

SQRU	VRI II	VRI III	VRI IV	Unit Total
1: North of Gila River	2,957	1,882	0	4,839
2: Gila River Floodplain	710	17	0	727
3: Golden Bell Mine Area	0	3,545	2,111	5,656
4: Southwest of Ripsey Wash	5	192	281	478
5: Ripsey Wash	0	196	0	196
6: Tortilla Mountains	1,863	4,468	0	6,330
7: Dripping Springs Mountains	2,889	6,647	0	9,535
8: Hackberry Gulch	1	2,373	543	2,917
9: Kearny Bajada	0	491	524	1,015
10: Ray Mine	10	28	36	74
TOTAL ACRES	**8,435**	**19,839**	**3,494**	**31,769**

3.14.1.4 Key Observation Points

Key Observation Points (KOPs) are publicly accessible locations from which a project would be visible and where there could be public concern for visual quality. KOPs are typically located within recreation resources, community facilities, key travel routes, or residential areas and are used to describe existing visual conditions and evaluate project-related visual effects. The criteria used in selecting KOPs were:

- Number of viewers;
- Duration of the view (e.g. miles of trail with view of project);
- Angle of view;
- Clear, unobstructed view of project features; and,
- Distance from project.

Seven KOPs were selected based on viewshed analyses, field visits, and agency input, four of which were presented in the Draft EIS to evaluate contrasts generated by the Ripsey TSF alternative and two for the Hackberry alternative. KOP 7 was added to the final EIS in response to comments requesting a simulation from the new alignment of the Arizona Trail. **See Figure 44, Key Observation Point (KOP) Locations**. All of the KOPs are located on travel corridors. Five are located on the Arizona Trail, one on the Florence-Kelvin highway, and one on SR 177. Photos of the existing conditions as seen from each KOP are set forth in **Appendix E, Visual Simulations**.

3.14.1.4.1 KOP 1 – Florence-Kelvin Highway

KOP 1 is located within State Trust Land along the Florence-Kelvin highway, approximately one mile southwest of the Ripsey Wash TSF site and two miles southwest of the Ripsey Wash crossing. KOP 1 was selected for use in evaluating visual effects of the Ripsey Wash TSF.

The Florence-Kelvin highway would be considered of moderate viewer sensitivity. Although traffic volumes on this route are relatively low (estimated to be less than 500 vehicles per day), it provides access to dispersed recreation, including numerous OHV trails, as well as the Arizona Trail. KOP 1 has an extended, relatively unobstructed view of the Ripsey Wash TSF site to the northeast.

The predominant forms within the foreground-middleground views from KOP 1 are characterized by the rolling terrain typical of the upper Sonoran Desert region. The forms are dominated by the undulating, horizontal bands of the Tortilla and Dripping Springs Mountains. The dominant lines are generally curvilinear, with diagonal lines formed by the mountain drainages. The highway forms a curving line, and the Saguaros add occasional vertical elements. The foreground-middleground color is predominantly a combination of the dark and light greens of the vegetation and light, pink tans of the exposed earth and highway. The colors of the mountains in the background become more blue-grey and a lighter value with distance. The texture of the exposed earth is fine to medium, interspersed with the coarser texture of the vegetation.

The only structures within the foreground/middleground view are the SCIP electric transmission structures and lines, which add vertical and horizontal lines to the landscape. Their dark, red-brown poles contrast with the lighter-value colors in the adjacent landscape. The existing Ray Mine is visible in the background as a lighter color. The pale green color of the dust control treatment accentuates the horizontal line of the Elder Gulch TSF, and the unpaved roads visible above the TSF create a strong color contrast.

3.14.1.4.2 KOP 2 - Arizona Trail (at Mile 4.3)

KOP 2 is located on the Arizona Trail within BLM-managed lands, about 4.3 miles west of the Kelvin Trail Access and about one mile north of the A-Diamond Ranch. See **Figure 44, Key Observation Point (KOP) Locations**.

This KOP was selected to represent views of the proposed Ripsey Wash TSF as seen from the Arizona Trail. The Ripsey TSF project site is to the south-southeast from KOP 2. This KOP would have a high viewer sensitivity rating, due to its national importance. Although relatively small in number, trail users generally have a high concern for visual quality. Trail use is expected to increase over time as it becomes more well-known, particularly by people from outside Arizona and the U.S. (Nelson 2014). This section of trail represents the most prominent view of the Ripsey Wash TSF site from the north side of the Gila River due to its north-south orientation and close proximity to the proposed TSF site (slightly over one mile away).

The existing landscape as seen from KOP 2 is characterized by rolling terrain and the rounded forms and horizontal bands created by the overlapping ridges. Vegetation creates irregularly shaped forms in the immediate foreground, transitioning to rounded clumps on the ridgeline. Dominant lines include the sinuous curves of unpaved roads visible in the foreground-middleground, the undulating line of the ridgelines and horizon, and the occasional strong verticals of the saguaro. Colors include a mix of dark and light greens, grays, and orange/yellow hues of the vegetation and the light pink/tan color of the exposed earth and road. Textures range from coarse in the immediate foreground to medium fine/patchy in the middleground and fine in the background. The only visible, cultural modifications are the Florence/Kelvin Highway and other unpaved roads.

3.14.1.4.3 KOP 3 – Arizona Trail (Jake’s Overlook)

Located within State Trust land, approximately 2.5 trail miles west of the Kelvin Trail Access, KOP 3 was selected due to its relatively high viewer sensitivity and to evaluate visual effects of the realignment of the Florence-Kelvin highway and SCIP electric transmission line as originally proposed as part of the DEIS. This KOP reveals existing views towards the south and southwest from Jake’s Overlook.

KOP 3 is situated within an open, relatively flat area at the end of a former mine exploration road reclaimed to form part of the trail. The BLM is considering plans to develop this location into an overlook because of its panoramic view of the surrounding mountains and Gila River floodplain..

The view from KOP 3 is dominated by the undulating, horizontal ridgelines of the background and middleground mountains silhouetted against the sky, contrasted by the diagonal lines and triangular shapes of the drainages. Floodplain vegetation creates sinuous curves along the Gila River and the lower reach of Ripsey Wash. Colors include the pale red/tan earth and the dark and light greens of the upland vegetation. The riparian vegetation has more variation in color, with pale orange, blue, and grey colors. Textures are coarse in the foreground, trending to the patchy, medium texture created by the vegetation against the exposed earth on the ridgeline. The A-Diamond Ranch and Kelvin/Riverside communities are visible in the distance, adding rectilinear forms and lines and light grey colors to the view. The historic railroad bridge visible in the foreground creates a rounded form and hard-edged line, with a medium value, blue-grey color and coarse texture created by the ironwork.

3.14.1.4.4 KOP 4 - Kelvin Trail Access

KOP 4 is located at the Kelvin Trail Access, managed by the BLM and located west of the Florence-Kelvin highway. This KOP illustrates the view to the southwest from KOP 4.

This site is not considered a full trailhead, since it is not accessible for large trailers, but is an important departure point for the scenic Gila Canyons Passage of the Arizona Trail. The KOP was requested by the BLM as a means to evaluate the effects of the relocated Florence-Kelvin highway and SCIP electric transmission structures and lines as originally proposed in the DEIS. This KOP would also be considered of high viewer sensitivity. Use levels are generally highest within or near the trailheads since they are used by individuals doing short hikes as well as thru-travelers, and the view duration is typically longer than on the trail.

The view is dominated by the triangular form of the ridgeline rising over the Gila River floodplain. The predominant lines include the undulating ridgeline sloping toward the river, the horizontal line of the valley floor, curvilinear lines of the vegetation, and the vertical saguaro. Colors are dominated by the green vegetation interspersed with the light red-tan of the earth. The floodplain vegetation is more varied in color than on the hillside, with muted yellows, ochre, orange, and the grey/lavender of the deciduous shrubs' branches. The texture is irregular and coarse in the foreground, transitioning to a medium texture as the landscape recedes.

The only cultural modifications at this KOP are the gravel surfaces and signage visible within the access area and the trail. The trail is a light tan color relative to its surroundings and is also visible on the opposite ridge, with its fill slopes creating a lighter color and finer texture than the surrounding vegetated hillside.

3.14.1.4.5 KOP 5 – State Route 177

KOP 5 is one of two KOP's selected for evaluation of the Hackberry Gulch TSF site. Located on SR 177 and within State Trust Lands, KOP 5 is about 1.5 miles north of the town of Kearny and about one mile south of the proposed TSF. KOP 4 would have an expansive view of the Hackberry Gulch TSF from SR 177 looking to the north.

SR 177 has a moderate sensitivity level. Its relatively large traffic volume (typically more than 2,500 vehicles per day) and designation by the state as the Copper Corridor West Scenic Highway is moderated by the highly modified surroundings. The bajada, or alluvial plain, transitioning to the Dripping Springs

Mountains represents the view's dominant landscape character. The dominant forms are the horizontal masses formed by the middleground mountains, with steeper triangular forms of the background mountains. The dominant lines are the curvilinear hillsides in the foreground and the jagged background mountains. Colors are characterized by the light and medium-value greens and browns of the vegetation, interspersed with light red earth colors. The colors of the foreground earth are light pink/tan.

Cultural modifications consist of SR 177, electric transmission and distribution structures and lines, and the Elder Gulch TSF. These combine to create strong horizontal and vertical forms and line. The highway and guardrails create a strong triangular shape and diagonal lines. The highway adds a contrasting light grey and finer texture than its surroundings, while the power pole structures add a darker red-brown color. While the color of the Elder Gulch TSF is compatible with the adjacent landscape, it's more uniform texture and geometric form contrasts with the surroundings.

3.14.1.4.6 KOP 6 - Arizona Trail (Mile 2)

Located on the Arizona Trail within State Trust land and approximately two trail miles west of the Kelvin Trail Access, KOP 6 was selected because of its panoramic view of the existing Ray Mine and Elder Gulch TSF and the proposed Hackberry Gulch TSF site to the east.

This view is similar to the view from the community of Riverside and thus is also intended to be used to evaluate visual effects on Riverside. The number of users and viewer sensitivity level of KOP 6 would be similar to that for KOP's 2, 3 and 4. The Hackberry Gulch TSF would be in the foreground-middleground and background views from KOP 6.

The dominant forms as seen from KOP 6 are the horizontal bands formed by the overlapping ridgelines and the Elder Gulch TSF. Other forms include the triangular shapes of the drainages below the ridgelines and the rounded clumps of vegetation, interrupted by the occasional vertical saguaro. The ridgelines create soft, undulating lines, except for the skyline which has a harder edge. The green vegetation creates the dominant color in the foreground, interspersed with the light red-tan color of the exposed earth. The colors become more muted and blue-grey as the landscape recedes. Textures are primarily coarse in the foreground, transitioning to the patchy texture in the middleground created by the clumps of shrubs against the exposed earth and then to a finer texture in the background.

Cultural modifications are highly visible from KOP 6. The horizontal form of the Elder Gulch TSF is compatible with the horizontal mountains, but the top edge creates a strong line against the curvilinear lines of the mountains. The colors seen on the embankment are compatible with the adjacent earth colors, but the geometric patterns formed by the different rock colors and the lack of vegetation contrast with the vegetation colors and the forms and textures of the surroundings. The light green color of the dust control treatment along the top of the existing Elder Gulch TSF accentuates its contrasting horizontal line. Unpaved roads and SR 177 also create color contrasts. Structures within the Riverside community are visible primarily as rectangular forms and lighter colors, with coniferous trees creating dark contrasts.

3.14.1.4.7 KOP 7 – Arizona Trail (Proposed Trail Alignment)

KOP 7 is located in the Tortilla Mountains, selected to represent views of the Ripsey TSF alternative from the proposed realigned section of Arizona Trail. The KOP is within BLM-managed lands about two miles south of Riverside Road.

The view from KOP 7 is dominated by the expansive view down towards Ripsey Wash and across to Grayback Mountain and the surrounding highlands. The Gila River floodplain is visible to the right. The dominant forms as seen from KOP 7 are mostly horizontal in nature, with the distant mountains creating an undulating skyline. The smaller knolls in the foreground represent more triangular shapes and rounded lines. The colors are dominated by the light red-tan of the earth, interspersed with the light green color of the vegetation. The river creates a darker green horizontal line in the distance. Small areas of light tan color emerge in the distance from exposed slopes. Textures range from coarse in the immediate foreground to medium fine/patchy in the middleground and fine in the background.

Cultural modifications visible from KOP 7 include the Diamond A Ranch, the 500 kV transmission and 69kV SCIP power lines visible in the background, and the Florence Kelvin Highway, which creates a thin, slightly sloping, light tan colored line in the background.

3.14.2 Environmental Consequences

The severity of a visual effect is dependent upon a number of factors including:

- Degree of contrast with the existing landscape;
- Visibility of project features from sensitive viewing areas;
- The distance from sensitive viewing areas (i.e., transportation corridors, residential communities, and Arizona Trail) in terms of the TSF's location within the foreground/middleground or background;
- The level of disturbance visible from the visual resource;
- The duration of views from transportation or recreation corridors (length of view);
- Duration of the impact (short vs. long term);
- Potential for project features to alter the VRI Classification within BLM-managed lands; and,
- Potential for project features to conflict with VRM objectives within BLM-managed lands.

Computer-generated visual simulations were prepared from seven KOPs surrounding the TSF sites to represent the visual character of the TSF at the end of the centerline construction (approximately 20 years from project initiation) and at the end of the project operation, prior to closure (approximately 50 years from project initiation). KOPs locations are shown on **Figure 44, Key Observation Point (KOP) Locations.** Photographs of the existing visual conditions from each KOP and simulations of the expected appearance of the proposed TSF are set forth in **Appendix E, Visual Simulations**. Appendix E also includes simulations prepared for the DEIS showing the Florence-Kelvin highway realignment as originally proposed, to facilitate comparison to visual effects of the new highway realignment as proposed in the modified proposed action.

3.14.2.1 Effects of the No Action Alternative

The existing Ray Mine creates high degree of visual contrast with the surrounding landscape, and, due to its large scale, dominates the foreground/middleground views from much of the surrounding area. Under the no action alternative, neither the Ripsey Wash nor the Hackberry Gulch TSF would be constructed. The existing visual contrasts created by the Ray Mine would remain essentially in their current state, with operation of the Ray Mine and the Elder Gulch TSF being visible to those passing through the immediate area on SR 177 or the Florence-Kelvin highway, as well as those using the Arizona Trail, OHV trails or dispersed campsites in the vicinity of the Ray Mine. The existing Ray mine is visible from approximately 5.6 miles of the Arizona Trail. Five of these miles are within the middleground/foreground distance zone, with the remaining within the background zone. The area's visual character would continue to be affected by other features and structures, such as SR 177, the

Florence-Kelvin highway, the SCIP 69 kV electric transmission line, and the houses and structures in the communities of Kelvin, Riverside and Kearny.

The Ray Mine Concentrator is estimated to continue operation until year 2023 or 2024 under the no action alternative. Mining would continue after this time, with sulfide ore being transported by rail to the Hayden Concentrator. This would result in continued visual effects of mining equipment and activities visible from State Route 177, the Arizona Trail, and dispersed recreation areas for a potential additional 30 years. The rail transport of ore to Hayden would result in continued visual effects along the Gila River corridor, through which Pinal County is planning a multi-use trail. The no action alternative would also reduce the mine's disturbance footprint by approximately 1,377 acres (including less waste rock) compared to the two action alternatives, allowing more acres to remain in a relatively natural state.

3.14.2.2 Effects of the Ripsey Wash TSF Alternative

The Ripsey Wash TSF would introduce a permanent change to the project area, creating a high level of visual contrast in an area currently characterized by a largely natural landscape. Due to its large scale, the TSF would dominate the natural landscape and attract attention in the foreground/middle ground views from key viewing areas. The Ripsey Wash TSF alternative would be visible from portions of the Florence-Kelvin highway, State Route 177, the Arizona Trail, and OHV routes in the vicinity of the TSF site (WestLand 2014l). See **Figure 45, Visibility Study - Ripsey Wash Alternative.**

Travelers on the Florence-Kelvin highway would have intermittent views of the Ripsey Wash TSF for a total distance of about 5.4 miles, all of which would be foreground-middleground views. The Florence-Kelvin highway would run along the northern edge of the TSF for approximately 0.5 miles, in some places just several hundred feet from the embankment.

The Ripsey Wash TSF would be visible within the foreground-middleground view from SR 177 for a distance of about 1.7 miles and within the background view for about 1.0 miles. Some of the high-elevation OHV trails east of SR 177 in the Dripping Springs Mountains would have foreground-middleground or background views of the Ripsey Wash TSF. Some of the lower elevation OHV trails along the Florence-Kelvin highway and south of the TSF site would also have foreground-middleground views.

Users of the realigned Arizona Trail would have intermittent foreground-middleground views of the Ripsey Wash TSF for a distance of about 7.6 miles and background views for about 0.2 miles. See **Table 3-67, Miles of Arizona Trail with Views of TSF Alternatives**. Most of the foreground/middleground views (5.4 miles) would occur along the segment of trail north of the Gila River, known as the Gila River Canyons Passage. Most of these TSF views would be over one mile away, and all would be over .5 miles away from the TSF. TSF views from the Gila River Canyons Passage would all be partial views, with 0 to 10 percent of the TSF visible, except for a short section of trail, located over three miles away, with 10 to 20 percent visible. **See Figure 45 Visibility Study - Ripsey Wash Alternative.**

The remaining 2.2 miles of trail with foreground/middleground views of the TSF would be located south of the river within the trail's Tortilla Mountains Passage. Most of these trail miles would have partial views of the TSF (from 0 to 35 percent of the TSF). There are several short sections with more extensive views of the tailings, ranging from 35 to 70 percent of the TSF. These views are also the closest to the TSF, approximately .4 to .8 miles away. KOP 7 was selected in one of these locations to illustrate the most extensive and close-up view of the TSF from the trail.

Table 3-67, Miles of Arizona Trail with Views of TSF Alternatives

		Views from Existing Trail Alignment Under the Hackberry Alternative		Views from Re-Aligned Trail under the Ripsey Wash Alternative	
Trail Miles	**Trail Passage**	**Foreground/ Middleground**	**Background**	**Foreground/ Middleground**	**Background**
Miles of Trail with Views of Ray Mine	Gila River Passage	0.7	0.1	0.7	0.1
	Tortilla Mountain Passage	4.3	0.5	4.7	0.5
	Total	**5.0**	**0.6**	**5.4**	**0.6**
Miles of Trail with Views of TSF	Gila River Passage	1.3	0.0	5.4	0.2
	Tortilla Mountain Passage	3.3	0.0	2.2	0.0
	Total	**4.6**	**0.0**	**7.6**	**0.2**
Miles of Trail with View of Realigned Florence-Kelvin Highway Only (1)	Gila River Passage			5.7	0.0
	Tortilla Mountain Passage	N/A	N/A	2.4	0.0
	Total			**8.1**	**0.0**
Total Miles of Trail with View of Ray Mine, TSF or Realigned Highway	Gila River Passage	1.5	0.1	6.4	0.3
	Tortilla Mountain Passage	5.2	0.5	6.6	0.5
	Total	**6.7**	**0.6**	**13.0**	**0.8**
New Miles of Trail Affected by TSF or Realigned Highway (In addition to Ray Mine Views)	Gila River Passage	0.8	0.0	5.7	0.2
	Tortilla Mountain Passage	0.9	0.0	1.9	0.0
	Total	**1.7**	**0.0**	**7.6**	**0.2**

Notes:

1. Includes views of the new alignment of the Florence-Kelvin highway, as well as portions of the existing alignment that will remain in place but be paved.

The realigned Florence-Kelvin highway and paving of portions (approximately three miles) of the existing highway would also be visible from portions of the Arizona Trail. Approximately 2.4 miles of the Tortilla Mountains Passage would have views of the new highway, most of which would be seen as a cut slope above the impoundment. Approximately 5.7 miles of the Gila River Canyons Passage would also have views of the realigned highway and/or paving of the existing highway. About 2.5 of these miles, between the Kelvin Trail Access (KOP 4) to Jakes Overlook (KOP 3), would have views of the highway's cut slopes, with smaller areas of fill slopes in the lower elevations. West of this section, in the vicinity of KOP 2, about 3.2 miles of the trail would have views of the highway modification, primarily a small section of cut and fill slope. Most of the visual impacts in this area would result from paving of the existing highway, resulting in an increase in color contrast from tan to grey. See **Appendix E, Visual Simulations**.

The existing Ray Mine would be visible from 6.0 miles of the realigned Arizona Trail route as part of the Ripsey Wash TSF alternative. Constructing the Ripsy Wash TSF alternative would result in a total of 7.8 new miles of trail affected either by views of the TSF or relocated highway, in addition to the 6.0 miles of trail already affected by views of the existing Ray Mine.

Certain TSF support facilities (pumping station, tailings pipeline, pipeline bridge, electric switchgear and drain-down pond) located primarily north of the Gila River would be visible from the Florence-Kelvin highway and the portion of Arizona Trail in the vicinity of the Gila River crossing. These facilities would not generate extensive visual contrasts since they would be located near other similar cultural modifications, including the existing Florence-Kelvin highway, the Copper Basin Railway, the SCIP 69 kV electric transmission line and other utility lines, a Pinal County maintenance facility, and the proposed new Pinal County/ADOT Florence-Kelvin highway bridge over the Gila River.

The east reclaim pond may be visible from the higher elevation sections of trail just west of the Kelvin Trail Access (KOP 4). The pond and associated disturbance would contrast with the surroundings, but would be adjacent to the disturbances created by the realigned Florence-Kelvin highway.

The Ripsey Wash TSF would be visible in the background view from the White Canyon Wilderness Area, but views of the TSF site from the wilderness are from relatively inaccessible areas with rugged and steep terrain that are expected to have limited public visitation. The Pinal Mountains and portions of the Forest Service Pinal Mountain recreation facilities are located within the seldom-seen/unseen distance zone from the TSF site. Visual effects on these facilities would be minimal due to existing vegetative screening and the viewing distance of over 15 miles.

The Ripsey Wash TSF would generate contrasts with the form, line, texture, and colors found in the adjacent landscape, visible from sensitive viewing areas. See **Appendix E, Visual Simulations.** The horizontal form of the TSF embankment would be compatible with the horizontal mass of the surrounding mountains, but its geometric shape and the unbroken, straight lines of the top and side surfaces would contrast with the mountains' curvilinear form.

The outer surface of the tailings embankment during the centerline construction phase would appear as a light, warm grey color with a uniform texture, contrasting with the surrounding green vegetation, light pink-tan earth colors, and rough, irregular textures created by the patches of vegetation against exposed earth.

After initiation of upstream tailings construction, concurrent reclamation would be initiated on the embankment slope created by centerline tailings construction. The embankment would be covered with rock quarried from an onsite source. This rock would be similar to the natural light pink-tan color of existing rock surfaces in the area, but its uniform texture would contrast with the irregular texture and combination of green vegetation and earth colors of the surrounding natural landscape.

During the upstream construction phase, dust-control treatment would be applied to the top lifts of the embankment. This would create a contrasting, light green color, accentuating the horizontal line of the TSF. Rock would be applied to the outer embankment after every third 10-foot lift; thus, the maximum height of the exposed tailings with dust control treatment would be about 30 feet.

Effects of TSF construction and operation on night sky resources would be minimal, as most construction would occur during daylight and operations would require little lighting. Construction activities would generate some fugitive dust, and high winds during operations could also lead to blowing dust that would be visible.

Upon permanent closure, TSF support facilities (i.e., drain-down pond, seepage ponds and power lines) would be removed, and those areas would be graded to blend with the surrounding undisturbed topography. Stormwater control features would remain in perpetuity, visible as a horizontal line along the ridge.

The remaining outer surface of the tailings embankment would be covered with rock, thus eliminating the color contrast created by the dust-control treatment, as would the impoundment area, which would allow it to blend with the surrounding colors. But the TSF would continue to contrast with the adjacent landscape colors due to its flat surfaces and lack of vegetation. The natural revegetation process would gradually soften this contrast, but would take many years after closure. Asarco is considering the placement of solar panels on the tailings impoundment area after closure. The solar panels, combined with the impoundment's flat surface and relative lack of vegetation, would introduce contrasts in color, texture, form, and line with the surrounding natural landscape.

The Ripsey Wash TSF would require relocation of a 6.8-mile section of the Arizona Trail with a 6.4-proposed route located east of the existing trail within the Tortilla Mountains. The VRI classifies the existing landscape of the new trail route as Class B SQR due primarily to the interesting topographic features visible from the trail and the views of the Gila River valley and Dripping Springs Mountains.

The new trail would result in only minor visual effects on travel routes in the vicinity and thus would not alter the SQR rating of the surrounding area. The trail route currently traverses areas of Class II and Class III VRI, but after trail construction would be entirely within a Class II VRI since it would fall entirely within the trail's foreground-middleground distance zone.

The trail bench width would average from 4 to 5 feet, but the trail construction disturbance width would vary from 15 to 20 feet, due to bench cuts, switchbacks, and retaining walls or fill slopes resulting from the steep terrain. Onsite materials would be used to construct rock walls or rip/rap. These features would be visible in the immediate vicinity of the trail route. The trail plans include transplanting vegetation along areas of numerous switchbacks, which would minimize visual effects.

The proposed trail route is located primarily on the eastern side of the Tortilla Mountains and thus would not be highly visible from the Florence-Kelvin highway. The trail may be visible from intermittent locations along SR 177, within the foreground-middleground view, as a line of lighter color and relatively smooth texture against the hillside. Its form and line would be relatively compatible with the curvilinear character of the surrounding landscape. The proposed new trailhead site near the junction of Riverside Road with the Florence-Kelvin highway is currently disturbed, and thus development of the trailhead would likely improve visual conditions at this location.

The Class III VRM objective would only apply to the BLM-managed lands to be used for the 0.3 mile tailings/reclaim water pipelines route. This objective would be met since the TSF would not be highly visible from most of the route and the above-ground portions of pipeline would not be highly noticeable in the context of other proposed cultural modifications in the area (Florence-Kelvin highway, the proposed Kelvin bridge over the Gila River, county maintenance buildings and electric transmission lines). The relocated Arizona Trail, as seen from this area, would also meet the Class III VRM objectives, since the trail would not dominate the view.

Using BLM criteria, the 196 acres of BLM-managed lands within the Ripsey Wash SQRU would remain as a Class III VRI, since the SQR would remain as a Class C and the area would continue to be within the foreground-middleground view from the Arizona Trail. The Class II portions of the Tortilla Mountains SQRU would remain a Class II VRI under the Ripsey Wash TSF. The relocated Arizona Trail and the tailings pipeline are the only project features located within this unit, which would not be highly visible, and thus are not expected to change the SQR. Much of the VRI III portions of this SQRU would change from III to II because they would fall within the foreground-middleground view from the new Arizona Trail. The VRI Classes in the other SQRU's are not expected to change substantially as a result of the Ripsey Wash TSF.

No adverse effects are expected to visual resources as a result of the work in the areas proposed for waters of the U.S. mitigation (see **Appendix J, Compensatory Mitigation**). The general upgrade (seeding and removal of tamarisk) of the riparian habitat within the proposed mitigation sites would enhance the visual appearance of the sites to a more natural landscape. The proposed mitigation work would soften the cultivated appearance of Mitigation Sites A, B and D, as well as remove stands of burned tamarisk in Mitigation Site E that are now visible from State Route 177.

3.14.2.2.1 KOP 1: Florence-Kelvin Highway

The tailings embankment and impoundment would be highly visible in the foreground-middleground from this KOP (approximately 0.8 miles away). See **Appendix E, Visual Simulations**. As seen from KOP 1, the TSF would generate contrasts in form, line, color, and texture.

The east diversion channel and associated cut slopes would also be visible across the impoundment from this KOP as a thin, horizontal, grey line against the backdrop of the Tortilla Mountains, creating a contrast in line, color, and texture. The realigned Florence-Kelvin highway and associated cut slopes would be visible on the ridge above the tailings impoundment, to the right of the embankment. As the TSF approaches completion, the highway cut slopes would be increasingly screened by the impoundment. The highway would also be slightly visible to the left of the impoundment as a sloping grey line. The realigned highway and cut slopes would not be as noticeable as the TSF, but would create contrasts with the surrounding landscape's texture and mixture of green and tan colors, particularly during the early stages of the facility when more of the road cut would be visible.

One of the borrow areas would also be visible above the impoundment, seen as a horizontal band of light tan color. After project completion, it would continue to be visible above the surface of the impoundment, to be used for post-closure cover materials. Excavation activities in this area would thus be visible during reclamation. The final configuration of the borrow areas after reclamation would match the form of the adjacent tailings. If ASARCO decides to install solar panels on the tailings impoundment area after project closure, they would be relatively visible from this KOP due to the angle of view.

3.14.2.2.2 KOP 2: Arizona Trail, Mile 4.3

KOP2 is situated within the Gila River Canyons Passage of the Arizona Trail, approximately 1.3 miles north of the Ripsey Wash TSF site. See **Appendix E, Visual Simulations**. The trail is oriented north to south in the vicinity of KOP 2, and thus the TSF would be backlit during much of the day, making color and texture contrasts less visible than if they were in direct sunlight. This orientation also results in southbound hikers having a direct view of the TSF for about one mile. Since KOP 2 is 543 feet lower than the ultimate height of the TSF, the tailings embankment would be the most visible feature to hikers. The tailings impoundment area would not be visible once it reaches a height above the KOP. The tailings embankment would block views of most of the background mountains, generating contrasts in form, line, color, and texture.

Borrow area A and possibly borrow area B may be visible approximately two miles away from KOP 2 during the initial construction of the starter dam until the embankment reaches sufficient elevation to provide screening. The relocated Florence-Kelvin highway would be visible from this KOP as a grey line below the impoundment, approximately 0.9 mile south of the KOP. A small portion of the highway's cut and fill slopes would be visible as the highway rises towards the ridge. The paving planned for the existing highway would also be visible to the southwest of Ripsey Wash as a change in color from tan to grey. The realigned SCIP electric transmission line would be slightly visible as vertical dark brown poles along the highway.

3.14.2.2.3 KOP 3: Arizona Trail, Jake's Overlook

KOP 3 is located north of the Gila River and was selected to portray views of the relocated Florence-Kelvin highway and SCIP electric transmission line as originally proposed in the DEIS. To reduce impacts on the Arizona Trail, the highway route has been moved to the south side of the ridge across from KOP 3, substantially reducing the highway's visual effects along the section of trail north of the river.

With the currently proposed highway alignment, a very small portion of the cut slope required for the highway would be visible from KOP 3, seen on the simulation as a thin, tan-colored line left of the main ridge in the center of the view. The cut would be approximately 0.6 miles away, compared to the originally proposed alignment at 0.3 miles away. An additional area of road cut and fill would be visible further to the left of the ridge, about 0.7 miles away, similar in size and color to that shown on the simulation. See **Appendix E, Visual Simulations**.

The SCIP electric transmission line structures (power poles) would not be visible from KOP 3 under the current alignment. The TSF would also not be visible from KOP 3 due to the screening provided by the ridge across the river.

3.14.2.2.4 KOP 4: Kelvin Trail Access

KOP 4, located at the Kelvin Trail Access, was selected to portray views of the relocated Florence-Kelvin highway and SCIP electric transmission line as originally proposed in the DEIS. The visual effects of the realigned Florence-Kelvin highway have been substantially reduced by revising the alignment. See **Appendix E, Visual Simulations**. The SCIP transmission line would not be visible from this KOP.

The cut slopes for the highway would be visible to the left of the large ridge in the center, appearing as horizontal bands of tan and grey color and thus creating a contrast in color from adjacent vegetated slopes. The visible disturbance would be approximately one mile from KOP 4, compared to 0.7 miles under the original proposal. The surface of the highway would not be visible.

As the trail turns to the north and west from KOP 4 and increases in elevation, the extent of visible highway increases. The view expands to include more of the cuts and fills required for the new highway, as well as some of the highway surface (and associated traffic). Portions of the existing Florence-Kelvin highway to be paved would also be visible from some of this trail segment. As the trail approaches Jake's Overlook (KOP 3), the view of the highway alignment diminishes in extent.

3.14.2.2.5 KOP 7: Arizona Trail, (Proposed Trail Alignment)

KOP 7 is located approximately 0.4 miles east of the proposed stormwater diversion channel and thus represents the trail's closest point to the TSF. Since KOP 7 is at a higher elevation than the TSF site, trail users would have an expansive view of the top surface of the tailings impoundment and one of the borrow areas. See **Appendix E, Visual Simulations.**

The impoundment would create a relatively horizontal form, consistent with the existing landscape, but the relatively straight line along the top of the embankment would contrast with the more undulating lines of the surrounding landscape. The tailings' light grey color and smooth texture would create the most contrast, differing from the surroundings' fine to coarse textures and red-tan colors mixed with the green vegetation. After project completion and reclamation, the flat topography created by the tailings would result in a permanent contrast with the surroundings. The rock surface would reduce the contrast in texture and color to some extent, but lack the variegated color and texture of the surrounding landscape. The natural revegetation process would gradually, over the very long term, introduce more variety in color and texture. Installation of solar panels on the impoundment after closure, if determined to be feasible, would generate contrasts in color, form, line, and texture.

3.14.2.3 Effects of the Hackberry Gulch TSF Alternative

As with the Ripsey Wash TSF alternative, the Hackberry Gulch TSF alternative would generate permanent visual contrasts, expanding the relatively high level of contrast generated by the existing Ray Mine onto an adjacent area characterized by a largely natural landscape. Due to its large scale, the TSF would be highly noticeable and attract attention in the foreground/middle ground as seen from areas with views of the TSF. The landscape in this area is already highly modified, however, by the existing mine disturbance, and the expanded visual impact would would blend in with the predominantly modified landsape.

The Hackberry Gulch TSF would be visible from portions of the Florence-Kelvin highway, SR 177, the Arizona Trail, and OHV routes in the project area (WestLand 2014m). The contrasts in form, line, texture and color resulting from the embankment and tailings impoundment during the centerline and upstream tailings construction phases would be the same as for the Ripsey Wash TSF. The installation of solar panels after project closure, if determined to be feasible, would not be highly visible from the Arizona Trail or SR 177 KOP's due to the height of the completed TSF relative to the KOP's. Effects of TSF construction and operation on night sky resources and fugitive dust would also be similar to those under the Ripsey Wash TSF, as well as the visual effects occurring after permanent closure.

The visual effects of the Hackberry Gulch TSF would differ from the Ripsey Wash TSF primarily in terms of its visibility from sensitive viewing locations. See **Figure 46, Visibility Study - Hackberry Gulch Alternative**. Surface disturbance for the construction and operation of the Hackberry Gulch TSF would be highly visible within the foreground-middleground view from SR 177, as well as the community of Riverside, both of which have panoramic views of the Hackberry Gulch TSF site. The Hackberry Gulch TSF would be less noticeable from the town of Kearny and the Florence-Kelvin highway since most of the views from these areas are either relatively distant or screened by vegetation or topography.

Travelers on SR 177 would have foreground-middleground views of the Hackberry Gulch TSF for a total distance of 7.8 miles and background views for a distance of 0.6 miles. From the Florence-Kelvin highway, the Hackberry Gulch TSF would be visible for a total distance of 3.1 miles within the foreground/middleground and about two miles within the background. Hikers on the Arizona Trail would have foreground/middleground views of the Hackberry Gulch TSF for 4.6 miles and no background views. The alternative would result in an additional 1.7 miles of trail affected by views of mine facilities in addition to the 5.6 miles of Ray Mine views under current conditions. See **Table 3-67, Miles of Arizona Trail with Views of TSF Alternatives.**

Using BLM criteria, the VRI classification of the 2,917 acres of BLM-managed land within the Hackberry Gulch TSF area would not be altered by the project, thus remaining primarily (81 percent) Class III, with the remaining lands (19 percent) as Class IV, since the SQR would remain a Class C.

The Hackberry Gulch TSF site would not meet the interim Class III VRM assigned to the area because the change to the landscape would be considered major and the TSF would dominate the view, especially as seen from SR 177. Asarco is currently working with the BLM on a land exchange that would involve the BLM-administered lands, including the site proposed for the Hackberry Gulch TSF. Once the BLM-administered land is transferred to private ownership the VRM protocol would not apply .

No adverse effects are expected to visual resources as a result of the work in the areas proposed for waters of the U.S. mitigation (see **Appendix J, Compensatory Mitigation**). The general upgrade (seeding and removal of tamarisk) of the riparian habitat within the proposed mitigation sites would enhance the visual appearance of the sites to a more natural landscape. The proposed mitigation work would soften the cultivated appearance of Mitigation Sites A, B and D, as well as remove stands of burned tamarisk in Mitigation Site E that are now visible from SR 177.

3.14.2.3.1 KOP 5: State Route 177

The Hackberry Gulch TSF would have a major visual impact to travelers on SR 177 and residents of Riverside because of its location and proximity, along with the contrast generated by its form, line, color, and texture. The Hackberry Gulch TSF embankment would be highly visible within the foreground/middleground view from KOP 5, which is located on SR 177 approximately one mile south of the TSF. See **Appendix E, Visual Simulations**. The actual tailings impoundment area would not be visible from KOP 5 because its elevation is below the ultimate tailings embankment height.

From KOP 5, the Hackberry Gulch TSF would screen views of most of the existing Elder Gulch TS. The Hackberry Gulch TSF would be compatible with the straight lines and geometric shapes of the visible portion of the Elder Gulch TSF. The continuous, straight line created by the crest of the Hackberry Gulch TSF embankment, however, would contrast with the curvilinear character of the form and lines of the adjacent undisturbed landscape. Visual contrasts would diminish along SR 177 south of KOP 5 towards Kearny as the TSF becomes lighter and greyer with distance and occupies a smaller portion of the overall view. Borrow areas are not likely to be visible from KOP 177 due to intervening topography.

3.14.2.3.2 KOP 6: Arizona Trail, Mile 2

The Hackberry Gulch TSF would be located about 1.9 miles east of KOP 6, which is located on the Arizona Trail. The TSF would be highly visible within the foreground/middleground view from this KOP. See **Appendix E, Visual Simulations**. The TSF would be most visible in the afternoon given the east-facing orientation of KOP 6. The view from Riverside would be much closer than from KOP 6, slightly over one mile away; thus, the TSF embankment would occupy most of the view. Since KOP 6 is lower in elevation than the ultimate height of the TSF embankment, the tailings surface would be visible during the early operational period, but over time the embankment would gradually become the dominant project feature. Some of the borrow areas could potentially be within the viewshed of KOP 6, but the three to four-mile sight distance to the borrow areas would make them less noticeable than the embankment structure.

3.15 WILDLIFE

Identify impacts to wildlife and wildlife habitats. *Areas of concern include (1) the impacts to wildlife habitat, such as the physical loss of habitat and a reduction in diversity and habitat effectiveness; (2) the impacts to wildlife species found in the area, including those species listed in the Arizona Game and Fish Species of Greatest Conservation Need (SGCN) and Species of Economic and Recreational Importance (SERI); (3) the impacts on any threatened, endangered, and candidate wildlife species as identified by the U.S. Fish and Wildlife Service; and, (4) the impacts to any Bureau of Land Management sensitive wildlife species.*

3.15.1 Affected Environment

Information used to describe and characterize wildlife resources for the Ripsey Wash and Hackberry Gulch TSF sites was obtained from:

- Published literature;

- AGFD's State Wildlife Action Plan (SWAP), HabiMap graphics information system (GIS), and Heritage Data Management System (HDMS);
- BLM;
- Pinal County; and,
- WestLand field surveys and reports.

In addition, Cedar Creek Associates, Inc. completed reconnaissance level surveys of the Ripsey Wash and Hackberry Gulch TSF sites in early March of 2014.

The Ripsey Wash analysis area consists of approximately 9,500 acres and was defined to include all three Ripsey Wash Alternative TSF footprints and tailings embankments, surface water diversion features, seepage collection infrastructure, tailings delivery and reclaim water pipelines and project power line, the relocation of a segment of the Florence-Kelvin Highway, the realignment of a segment of the SCIP power line, and the realignment of the Arizona Trail. The analysis area consists of lands owned primarily by the ASLD, including lands that Asarco is seeking to acquire, and privately owned lands and lands administered by the BLM. Approximately 2,636 acres would be disturbed by the Ripsey Wash alternative within the 9,500-acre analysis area. **Figure 47, Wildlife Analysis Area - Ripsey Wash and Hackberry Gulch TSF**, displays the extent of the Ripsey Wash TSF Alternative analysis area.

The Hackberry Gulch analysis area consists of approximately 6,900 acres and was defined to include both Hackberry Gulch Alternative TSF and tailings embankments, surface water diversion features, tailings delivery and reclaim water pipelines, project power line, seepage collection infrastructure, lining of Belgravia Wash above its confluence with the Gila River, and a buffer area around all potential project activities including a reach of the Gila River downslope from Project activities. The analysis area consists primarily of privately-owned lands, lands administered by the BLM, and lands owned by the ASLD. Approximately 2,290 acres would be disturbed by the Hackberry Gulch TSF alternative within the 6,900-acre analysis area. **Figure 47, Wildlife Analysis Area – Ripsey Wash and Hackberry Gulch TSF**, displays the extent of the Hackberry Gulch analysis area.

3.15.1.1 Habitat Overview

The topography, vegetation, and water sources within the Ripsey Wash and Hackberry Gulch analysis areas create a diversity of habitats and habitat features that support a variety of wildlife species. The Ripsey Wash and Hackberry Gulch analysis areas are characterized by rugged terrain, which varies from sandy wash bottoms to ridges and terraces with relatively steep side slopes and areas of rock outcrop. Elevations at the Ripsey Wash TSF site range from 1,800 to 3,000 feet above mean sea level and from 1,770 feet to 3,600 feet at the Hackberry Gulch TSF site. Both sites are mapped within the Arizona Upland subdivision of the Sonoran Desertscrub biotic community and possess the characteristic slopes, broken ground, and multi-dissected sloping plains typical of this subdivision (Brown and Lowe 1980).

Vegetation baseline surveys and analysis have confirmed the majority of both analysis areas are in Arizona Upland (WestLand 2014d, 2014e, and 2014f). There is a narrow riparian zone with patches of Sonoran Riparian Deciduous Woodland and Sonoran Riparian Scrubland along the Gila River and patches of Sonoran Riparian Scrubland on the lower reach of Mineral Creek. Small patches of Sonoran Interior Strands are also present in the xeroriparian vegetation along the major ephemeral drainages. Aquatic habitat near the two TSF sites is limited to lower Mineral Creek, the Gila River and seeps and springs that create relatively small perennial surface water sources within the Hackberry Gulch TSF site.

Seven upland plant associations were identified and mapped within the Arizona Upland subdivision and three categories of riparian vegetation in the Ripsey Wash TSF (WestLand 2014d). Six upland plant associations and three categories of riparian vegetation were also identified and mapped for the Hackberry Gulch TSF (WestLand 2014e). The saguaro/paloverde-jojoba/mixed cacti shrubland plant association dominates both sites and the entire Arizona Trail realignment is in this plant association. Summary descriptions of the upland, xeroriparian, mesoriparian, and hydroriparian plant associations for the two TSF sites are provided in Section 3.5, Waters of the U.S. and Section 3.13, Vegetation.

Habitat characteristics of the five compensatory mitigation sites are summarized in **Table 3-67, Wildlife**, in Section 3.15.2.2.15, Threatened, Endangered, Proposed and Candidate Species.

3.15.1.1.1 Special Habitat Features

Seeps and springs provide water sources for wildlife and abandoned mine features create special habitat features important to some wildlife species groups (WestLand 2014a and 2014b). Surface water sources are discussed in Section 3.4, Surface Water, and associated wetlands are discussed in Section 3.5, Waters of the U.S. Locations of surface water features are depicted for the Ripsey Wash TSF and Hackberry Gulch TSF, respectively, on **Figures 26, Surface Water Features – Ripsey Wash TSF**, and **Figure 28, Site Drainages – Hackberry Gulch TSF**.

There are no seeps or springs within the Ripsey Wash TSF, and the only wetlands near this TSF site are along the Gila River. There are two water wells and associated stock watering structures present within the Ripsey Wash TSF footprint (WestLand 2014a). Additionally there is a spring in a higher tributary, outside of the Ripsey Wash TSF footprint, that provides water to two stock watering structures within the TSF. All drainages within the Ripsey Wash TSF are ephemeral. There were only two of the survey located surface water features that contained water available to wildlife. These were Stock Watering Feature #2 and Well 2 (WestLand 2014a).

Within the Hackberry Gulch TSF, thirty-eight surface water features have been identified. These include five wetland areas (including one or more seeps at each wetland), two springs, six small seeps with no associated wetland vegetation, and two wells (WestLand 2014b). Seeps and springs supported within the Hackberry Gulch TSF provide water sources important to almost all wildlife species in the TSF and nearby areas as well as supporting small pockets of riparian vegetation, including Fremont cottonwood (*Populus fremontii*), velvet ash (*Fraxinus velutina*), net-leaf hackberry (*Celtis reticulata*), Goodding's willow (*Salix gooddingii*), seepwillow (*Baccharis salicifolia*), and tamarisk (*Tamarix* sp.). Cattails (*Typha* sp.), arrowweed (*Pluchea sericea*), and spikerush (*Eleocharis* sp.) are also present at some of the more mesic seep and spring locations (WestLand 2014b). Pockets of riparian and wetland habitats within an area, otherwise dominated by dry upland habitats, serve to increase habitat diversity and support a wider diversity of resident and migratory wildlife species.

The Gila River and associated riparian vegetation create an important habitat feature near the Ripsey Wash and Hackberry Gulch TSF sites, although riparian habitat value is somewhat reduced by the dominating presence of a non-native species, salt cedar. The riparian zone along the river also provides enhanced conditions to increase the diversity of bird and mammal species in the TSF analysis areas. The Gila River is the only aquatic habitat within both analysis areas that supports fish populations. The lower reach of Mineral Creek, near its confluence with Gila River also supports fish populations within the Ripsey Wash TSF analysis area. The riparian woodlands along the Gila River are of relatively limited occurrence in central Arizona. These woodlands, dominated by tamarisk, Fremont cottonwood, and Goodding's willow, are important to many types of wildlife life, but especially to songbirds and some raptor species. Gila River riparian woodlands are known to support many migratory and resident songbirds, including breeding populations of the federally listed endangered southwestern willow flycatcher (*Empidonax traillii extimus*) and the threatened western distinct population segment (DPS) of yellow-billed cuckoo (*Coccyzus americanus*).

Saguaro cactus density is generally low in the in the two TSF sites, although there are areas with fairly dense saguaro stands. Saguaros are important to many species of wildlife in that they provide forage in the form of pollen, nectar, and fruit in the late spring and early summer. Saguaros are also used by Gila woodpeckers (*Melanerpes uropygialis*) and gilded flickers (*Colaptes chrysoides*) to excavate cavity nest sites, which are subsequently used by a number of other cavity-nesting bird species, including elf owl.

Sonoran desert tortoise special habitat features include caliche banks along washes, shelter sites under shrubs, and caves and burrows in wash banks and on slopes.

3.15.1.1.2 AGFD Habitat Ratings

The AGFD uses the Species and Habitat Conservation Guide (SHCG) for non-tribal lands across Arizona to evaluate wildlife conservation potential. The SHCG model is intended to identify areas of wildlife conservation potential at a landscape/statewide scale to guide the AGFD's strategic wildlife goals and objectives. The five model indicators upon which SHCG mapping values are based (AGFD 2013a) are:

- The importance of the landscape in maintaining biodiversity - represented by the Species of Greatest Conservation Need (SGCN);
- The economic importance of the landscape to the Department and the community – represented by the Species of Economic and Recreational Importance (SERI);
- The economic importance of the water bodies and aquatic systems to the Department and the community - represented by sport fish;
- Large areas of relatively intact habitats - represented by unfragmented areas; and,
- The importance of riparian habitat to wildlife – represented by riparian habitat.

These indicators are ranked and mapped as separate layers within the AGFD's HabiMap system (AGFD 2013a), and all five layers are combined to rank conservation potential. AGFD's HabiMap was queried to obtain rankings for the five indicators and SHCG for the Ripsey Wash and Hackberry Gulch TSF analysis areas. See **Table 3-68, AGFD Habitat and SHCG Rankings.**

AGFD habitat and SHCG rankings do have some drawbacks for assessing site-specific project area resources since these rankings are not based on site-specific field studies but rather on relatively broadly scoped regional mapping and GIS analyses. In addition, habitat models used by SWAP are not based on site-specific survey data but on a much larger area encompassing the project analysis areas. For example, SWAP habitat models indicate the Ripsey Wash analysis area contains jaguar habitat. In addition, according to the SWAP habitat models, the Hackberry Gulch analysis area does not contain Sonoran desert tortoise habitat; however, the BLM has identified the sites for both the Ripsey Wash and Hackberry Gulch TSFs are located in both Category 2 and Category 3 desert tortoise habitat. Site-specific habitat surveys completed by Westland (2014n, 2014o, 2014r, 2014s) indicate both analysis areas support low populations of Sonoran desert tortoise, but suitable habitat for jaguar is not present in the Ripsey Wash analysis area. In addition, higher SGCN and/or SERI rankings for the Ripsey Wash area versus the Hackberry Gulch area are likely due to the arbitrary use of State Route 177 as the divider between game management units, which places the Gila River corridor entirely within the unit containing Ripsey Wash and not within the unit containing Hackberry Gulch. The Gila River corridor is a valuable wildlife habitat area and corridor to both the Ripsey Wash and Hackberry Gulch analysis areas.

Table 3-68, AGFD Habitat and SHCG Rankings

Habitat Indicators	Ripsey Wash	Hackberry Gulch
SGCN (Rating Scale: 1-10)	10 for bottom of Ripsey Wash and Gila River corridor; 6-8 for remainder of area	6-8 for entire area
SERI (Rating Scale: 1-10)	10 for entire area	5 for entire area
Sport fish (Rating Scale: 1-10)	1 for Gila River only; remainder of TSF - 0	1 for Gila River only; remainder of TSF - 0
Unfragmented Areas (Rating Scale: 1-10)	2 for entire area	5 for most of area; 1 for northwest edge nearest State Route 177
Riparian Habitat (Rating Scale: 1-10)	10 for Gila River corridor only; remainder of TSF - 0	10 for Gila River corridor only; remainder of TSF - 0
SHCG (Overall Rating Scale: 1-10)	6 for most of Ripsey Wash area and Gila River corridor	5 for most of Hackberry Gulch area; 3 for northwest edge nearest State Route 177; 6 for Gila River corridor

Notes:
1. SHCG is Species and Habitat Conservation Guide.
2. "0" represents no habitat present, while "1" represents the lowest ranking.
3. SGCN is Species of Greatest Conservation Need.
4. SERI is Species of Economic and Recreational Importance

3.15.1.2 Mammal Species of Economic and Recreational Importance (SERI)

Mammal game species potentially residing in or near the two TSF sites include: collared peccary or javelina (*Pecari tajacu*), mule deer (*Odocoileus hemionus*), desert bighorn sheep (*Ovis canadensis mexicana*), and mountain lion (*Puma concolor*). On-site field surveys documented the presence of mule deer, collared peccary, and mountain lion at the Ripsey Wash TSF site and mule deer and collared peccary at the Hackberry Gulch TSF site. Mule deer, collared peccary, desert bighorn sheep, and mountain lion are highly mobile species and could occur anywhere within the two TSF sites. Field surveys indicated populations of mule deer, collared peccary, and mountain lion are relatively low in both TSF sites and that the presence of desert bighorn sheep in either TSF sites is unlikely.

3.15.1.2.1 Ripsey Wash TSF

The Ripsey Wash TSF is located within GMU 37B. This 755,307-acre unit extends from Oracle in the south to Superior in the north. State Route 177 forms the eastern boundary of the unit and State Route 179 forms the western boundary. The northern boundary is U.S. Highway 60 in the vicinity of Superior. The Ripsey Wash TSF site comprises less than 0.3 percent of the total area of the GMU. Because of the large area and diverse habitats included within this GMU, not all of the game species within the GMU are likely to occur within or near the Ripsey Wash TSF site.

The AGFD SERI ranking for the Ripsey Wash TSF site, and for most of GMU 37B, is high (10). See **Table 3-68, AGFD Habitat and SHCG Rankings**. Based on AGFD information (AGFD 2016), hunting success within Unit 37B is below statewide averages for deer[41] (27.4 percent statewide to 18.7 percent in 37B for general firearm harvest, 2011-2015) and collared peccary (24.2 percent statewide average to 22.2 percent in 37B for the spring general hunt, 2012-2016). Based on information provided to hunters on the AGFD website[42], the area that includes the Ripsey Wash TSF site (Tortilla Mountains west of the town of Kearny) receives little hunting pressure, with most coming primarily from local hunters.

3.15.1.2.2 Hackberry Gulch TSF

The Hackberry Gulch TSF is within AGFD (GMU) 24A, a 518,566-acre unit that extends from State Route 177 (southwest of the Hackberry Gulch TSF) to the Salt River Canyon north of Globe, a distance of about 55 miles. State Route 177 separates this GMU from 37B. The Hackberry Gulch TSF site comprises less than 0.4 percent of the total GMU area. Because of the large area and diverse habitats, not all of GMU-listed game species are likely to occur within or near the Hackberry Gulch TSF site.

The AGFD SERI ranking for GMU 24B ranges from medium (5) to high (10), with the higher rated (8-10) areas in the GMU being correlated primarily to the Dripping Springs Mountains east of the Ray Mine and the Hackberry Gulch TSF site as well as most portions of the GMU north and northeast of the Globe and Miami area. The AGFD SERI ranking for the Hackberry Gulch TSF site is medium (5). See **Table 3-68, AGFD Habitat and SHCG Rankings**.

AGFD SERI rankings are based on demand for the game resource and economic value of the game resource for communities. These factors are determined by the AGFD evaluating a variety of parameters including hunting applications (first choice applicants ÷ permits issued), economic value (daily expenditures x hunter days/sq. mi.), and revenue ((tag + license cost) x permits issued/sq. mi.). The lower rating of the Hackberry Gulch TSF site compared to the Ripsey Wash TSF site is likely due to limited hunter access opportunities into the Hackberry Gulch TSF site in comparison to the Ripsey Wash TSF site. Based on information provided by the AGFD (2016), hunting success within GMU 24A is above statewide averages for deer (27.4 percent statewide to 38.8 percent in 24A for general firearm harvest, 2011-2015) and below statewide averages for collared peccary (24.2 percent statewide average to 18.8 percent in 24A for the spring general hunt, 2012-2016).

3.15.1.3 Predators and Furbearers

Based on known ranges and habitat preferences, a variety of mammalian predators and furbearers are likely to inhabit the two TSF sites. Species potentially occurring within the two TSF sites include coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), bobcat (*Lynx rufus*), mountain lion (discussed in Section 3.14.2), hooded skunk (*Mephitis macroura*), western spotted skunk (*Spilogale gracilis*), striped skunk (*Mephitis mephitis*), raccoon (*Procyon lotor*), ringtail (*Bassariscus astutus*), white-nosed coati (*Nasua narica*), and American beaver (*Castor canadensis*). These species are relatively widespread and common throughout the Desert Southwest.

Surveys documented the presence of these species within one or both of the TSF sites, except for western spotted skunk and striped skunk (WestLand 2014n and 2014o). All of these species, except for American beaver are wide-ranging and could occur throughout the TSF sites. American beaver is only present in aquatic habitats associated with the Gila River. Because of the nocturnal and relative

[41] Averages based on the percentage of hunters reporting a successful harvest during the 2011–2015 general firearm season for deer and 2012-2016 spring hunting season for collared peccary.

[42] http://www.azgfd.gov/h_f/hunting_units_37b.shtml, accessed January 3, 2014.

secretive habits of most of these species, their presence, distribution, and relative abundance is difficult to determine in any given area.

3.15.1.4 Other Mammals

No specific surveys for other mammals have been completed within the Ripsey Wash and Hackberry Gulch TSF sites, although incidental observations of mammals and mammal sign were recorded while conducting other surveys at the two TSF sites (WestLand 2014n and 2014o). Based on known distributions and habitat preferences, species of other mammals likely to occur in or near the TSF sites are listed in WestLand (2014n, 2014o). Other mammal species observed in or near the TSF sites were rock squirrel (*Spermophilus variegatus*), Harris antelope squirrel (*Ammospermophilus harrisii*), white-throated woodrat (*Neotoma albigula*), desert cottontail, and black-tailed jackrabbit (*Lepus californicus*) (WestLand 2014n and 2014o). Most of these species were observed throughout the two TSF sites, except for white-throated woodrat. Observations of this species and its sign (feces and nests) were recorded primarily in association with abandoned mine and mineral exploration features. All observed species are relatively widespread and common throughout the Desert Southwest.

A number of bat species, including five BLM-listed Sensitive bat species could occur in the region of the two TSF sites. Some of these bat species require caves for colonial winter hibernation, maternity, or day use sites. Abandoned mine features such as shafts and adits with suitable temperature regimes can also provide important roosting, hibernation, or maternity habitat for cave-dwelling bats. Surveys of abandoned mine and mineral exploration features were completed within the two TSF sites to evaluate potential bat and other species use of these features (WestLand 2014p and 2014q).

Within and near the Ripsey Wash TSF site, thirty-eight abandoned mine features, which included eleven shafts, fourteen adits, and thirteen test evacuations, were located and surveyed (WestLand 2014p). Most were relatively shallow with limited potential for bat use, but bat evidence was recorded in 11 of the old mine workings. A single Townsend's big-eared bat was observed in two features, and 10 features had bat guano and large insect wings on the adit floor, indicating use of the feature for night roosting by larger insectivorous bats such as California leaf-nosed (*Macrotus californicus*) and pallid bat (*Antrozous pallidus*). No evidence was found indicating more intensive hibernation or maternity use of these features. Elevations of the Ripsey Wash TSF abandoned mine features are too low to support hibernation use and surveys found no evidence, such as young or lactating females, to indicate possible maternity use of these features (WestLand 2014p).

Within or near the Hackberry Gulch TSF site, thirteen abandoned mine features, which included nine adits, three shafts, and one test excavation, were located and evaluated (WestLand 2014q). All of these, but one shaft (Hackberry shaft), are located outside of the proposed footprint area of the Hackberry Gulch TSF site. Evidence of bat use, primarily insectivorous bat guano, was found in four adits. These adits could be used as summer daytime roosts by several bat species, but the habitat conditions and quantity of guano suggested use by the cave myotis (*Myotis velifer*) (WestLand 2014q). Survey results for possible maternity or hibernation use of the Hackberry Gulch TSF abandoned mine features were similar to the Ripsey Wash TSF abandoned mine working features (WestLand 2014q).

3.15.1.5 Raptors

Several species of raptors are known to occur in the region of the two TSF sites. Most are present as year-round residents, but a few species: zone-tailed hawk (*Buteo albonotatus*), and elf owl (*Micrathene whitneyi*), are present only as summer residents. Turkey vulture (*Cathartes aura*) occurs as both a summer and year-round resident. Other possible year-round residents include prairie falcon (*Falco mexicanus*), American peregrine falcon (*Falco peregrinus anatum*), Harris's hawk (*Parabuteo unicinctus*), red-tailed hawk (*Buteo jamaicensis*), golden eagle (*Aquila chrysaetos*), barn owl (*Tyto alba*), great horned owl (*Bubo virginianus*), and western screech owl (*Megascops kennicottii*). Cooper's hawk (*Accipiter cooperii*) and sharp-shinned hawk (*Accipiter striatus*) are most likely present as winter residents.

Based on similarities in habitat and topographic features between the Ripsey Wash and Hackberry Gulch analysis areas, raptor presence and use is likely to be relatively similar between the two sites. Raptors observed within the TSF sites were Cooper's hawk, turkey vulture, Harris hawk, zone-tailed hawk, red-tailed hawk, and great horned owl (WestLand 2014n and 2014o). Possible evidence of barn owl presence (whitewash and pellets) was also observed in abandoned mine features at both TSF sites (WestLand 2014p and 2014q). Barn owl and great horned owl may also use abandoned mine features for nesting.

American peregrine falcon and golden eagle are listed by the BLM as sensitive species, and the black hawk is listed by the AGFD as a WSC. The American peregrine falcon, prairie falcon and elf owl are listed by the USFWS as Birds of Conservation Concern (BCC).

Suitable habitat for Cooper's hawk, sharp-shinned hawk, zone-tailed hawk, and western screech owl within or near the TSF sites is provided only by riparian and mesquite woodlands along and adjacent to the Gila River. These species may nest in these habitats, but breeding was not documented within or near the TSF sites (WestLand 2014n and 2014o), and breeding by Cooper's hawk and sharp-shinned hawk is unlikely since these species are most likely present only as winter residents.

Harris's hawk resides as year-round resident in desertscrub habitats where saguaros, velvet mesquite, paloverde, and ironwood are common. This species also occurs along edges of riparian areas dominated by Freemont cottonwood, willow, and mesquite (Corman 2005a). Harris's hawk typically constructs its nests in saguaros, paloverde, mesquite, and, less often, isolated Fremont cottonwoods (Corman 2005a). Suitable hunting and breeding habitat exists for this species in both TSF sites and along the Gila River, but no nesting was documented (WestLand 2014n and 2014o).

Turkey vulture is a summer breeder in Arizona and occurs over most of the state. They arrive in Arizona from late January through March with breeding and egg-laying from March through June. They nest in areas removed from human disturbance often in rock outcrop, caves, steep boulder strewn slopes, rocky ridges, abandoned mines, and Native American cliff structures (Corman 2005b). Evidence of possible turkey vulture nesting or roosting use of two abandoned mine features was found in the Ripsey Wash TSF site (WestLand 2014n).

Red-tailed hawks occur as year-round residents throughout most of Arizona and in most habitats in the state except for dense forest areas and the driest deserts (Wise-Gervais 2005). In Arizona, red-tailed hawks nest in trees, saguaros, cliffs, and artificial structures, including transmission line poles and towers (Wise-Gervais 2005). Nesting habitat in and near the two TSF sites is restricted primarily to saguaros and trees along the Gila River riparian corridor. Cliffs and areas of rock outcrop in the Dripping Spring Mountains east of the TSF sites may also provide suitable nesting habitat. Nesting by red-tailed hawk was not documented in or near the two TSF sites (WestLand 2014n and 2014o).

3.15.1.6 Waterbirds

Waterbirds include ducks, geese, wading birds, sandpipers, and other species dependent on aquatic habitats and associated shorelines and wetlands. Suitable habitat for waterbirds within the two analysis areas is restricted primarily to the Gila River and Mineral Creek. There are some spring-associated water sources in the more upland portions of the Hackberry Gulch analysis area (WestLand 2014b), but because of their small size and isolated nature they are not likely to receive much waterbird use. Because of the limited extent of aquatic habitat found near the TSF sites, recorded observations of waterbirds was restricted to great blue heron (*Ardea herodias*) and American coot (*Fulica americana*) (WestLand 2014n and 2014o). It is likely Gila River aquatic habitats would also occasionally be used by wintering or migrant puddle duck species such as mallard (*Anas platrhynchos*) and green-winged teal (*Anas crecca*) for loafing sites when water is present from fall through spring.

Several large, flat-platform stick nests were located in a large Fremont cottonwood at the edge of the Gila River near its confluence with Ripsey Wash during the Cedar Creek's early March 2014 reconnaissance of the Ripsey Wash TSF site. The clustering of nests and nest configuration was indicative of a great blue heron rookery. In lower elevation desert habitats in Arizona, great blue herons breeding activity begins by mid-January to mid-February with egg laying starting in late February and March (Latta 2005). Since no heron activity was noted in the vicinity of the rookery tree, it was assumed the rookery was unoccupied during the 2014 nesting season.

3.15.1.7 Upland Gamebirds

Upland gamebirds present in GMUs 24A and 37B are Gambel's quail, mourning dove, and white-winged dove. All three species were recorded by field surveys within the Ripsey Wash and Hackberry Gulch TSF sites (WestLand 2014n and 2014o), and populations of these species within the two analysis areas are likely to be similar. Dove populations may be somewhat higher within the Hackberry Gulch analysis area because of seeps and springs and associated surface water sources with some of these features. Gambel's quail and white-winged dove are classified as SERI species by AGFD. Gambel's quail prefer rugged, brushy habitats, while doves will often be found primarily around seeps, springs, stock tanks, and other locations with surface water. Populations will vary from year to year depending on rainfall and available forage and cover. No hunter use or harvest data is available for these species within GMUs 24A and 37B.

3.15.1.8 Other Migratory and Resident Birds

A number of songbird and other bird species associated with Sonoran Desertscrub communities may occur within the two TSF analysis areas, and field observations indicate songbird populations are relatively similar between the two areas. Some species winter in southern Arizona and areas farther south in Central and South America and move farther north to breed in spring and summer. Others, particularly species associated with riparian habitats along the Gila River and at seeps and springs, are spring/summer breeders in southern Arizona and migrate south to Central and South America to winter. Finally, a number of species remain as year-round residents and most of these occur in association with desertscrub habitats. Common year-round residents observed in desertscrub habitats at the Ripsey Wash and Hackberry Gulch analysis areas include: greater roadrunner (*Geococcyx californianus*), Gila woodpecker (*Melanerpes uropygialis*), common raven (*Corvus corax*), canyon wren (*Catherpes mexicanus*), rock wren (*Salpinctus obsoletus*), cactus wren (*Campylorhynchus brunneicapillus*), curve-billed thrasher (*Toxostoma curvirostre*), phainopepla (*Phainopepla nitens*), black-throated sparrow (*Amphispiza bilineata*), northern cardinal (*Cardinalis cardinalis*), and pyrrhuloxia (*Cardinalis sinuatus*).

The Migratory Bird Treaty Act (MBTA) provides federal protection for migratory bird species listed at 50 CFR 10.13. The USFWS places the highest management priority on BCC (USFWS 2008). The BCC list was developed as a 1988 amendment to the Fish and Wildlife Conservation Act. This Act mandated that the USFWS "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act (ESA) of 1973". The goal of the BCC list is to prevent or remove the need for additional ESA bird listings by implementing proactive management and conservation actions. Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds (January 10, 2001) stipulates, in part, that federal agency actions avoid or minimize, to the extent practicable, *adverse impacts on migratory bird resources*. In addition, the Executive Order also requires federal agencies to identify where unintentional take is likely to have *a measurable negative effect on migratory bird populations…….*, and the agency *shall develop and use principles, standards, and practices that will lessen the amount of unintentional take*, *developing any such conservation efforts in cooperation with the Service* (USFWS).

The habitats and ranges of the BCC for the Sonoran and Mojave Deserts U.S. Portion only (BCR-33) (USFWS 2008) were reviewed to create a list of BCC potentially occurring in the two TSF sites. Potential BCC breeding bird populations within this region are listed in **Table 3-69, Birds of Conservation Concern**. The remaining species on the BCC list for Sonoran and Mojave Deserts either have ranges outside of the TSF sites, prefer habitats not found in the TSF sites, or occur only as migrants near the TSF sites during spring and fall migration.

Table 3-69, Birds of Conservation Concern

Species Common Name/ Scientific Name	Potential to Occur	Range and Habitat
American peregrine/ *Falco peregrinus anatum*	Possible but not observed by baseline surveys (WestLand 2014f & 2014g)	TSF sites are within year-round range of this species. Prefers to nest on high cliff sites and hunt areas near riparian and aquatic habitat with abundant bird prey. Dripping Spring Mountain cliff sites East of Hackberry Gulch may represent potential nest sites. Gila River may provide foraging habitat.
Prairie falcon/ *Falco mexicanus*	Possible but not observed by baseline surveys	TSF sites are within year-round range of this species. Cliff sites and rock outcrop with ledges or cavities are used as nest sites. Hunts over open deserts and grasslands
Yellow-billed cuckoo/ *Coccyzus americanus*	Breeding presence documented in Gila River riparian habitat	Gila River is within summer breeding range of this species. Dense deciduous woodlands and mesquite stands near water.
Elf owl/ *Micrathene whitneyi*	Possible but not observed by baseline surveys	TSF sites are within summer breeding range of this species. Prefers riparian and desert habitats with saguaro cactus. Woodpecker cavities in trees and saguaros used for nesting
Costa's hummingbird/ *Calypte costae*	Possible but not observed by baseline surveys	TSF sites are within summer breeding range of this species. Prefers brushy desert and chaparral habitats.
Gila woodpecker/ *Melanerpes uropygialis*	Observed by baseline surveys in Ripsey Wash and Hackberry Gulch	TSF sites are within year-round range of this species. Sonoran desert habitats. Excavates cavities in saguaro cactus for nesting.
Gilded Flicker/ *Melanerpes uropygialis*	Possible but not observed by baseline surveys	TSF sites are within year-round range of this species. Sonoran desert habitats. Excavates cavities in saguaro cactus for nesting.
Bell's vireo/ *Vireo bellii*	Possible but not observed by baseline surveys	TSF sites near the northern edge of summer breeding range of this species. Riparian and mesquite brush lands near water.
Gray vireo/ *Vireo vicinior*	Possible but not observed by baseline surveys	Desert scrub, mesquite, chaparral, and mixed juniper, piñon pine and oak scrub woodlands.

Table 3-69, Birds of Conservation Concern (continued)

Species Common Name/ Scientific Name	Potential to Occur	Range and Habitat
Bendire's thrasher/ *Toxostoma bendirei*	Possible but not observed by baseline surveys	TSF sites are near edge of year-round and summer range of this species. Sonoran desert with scattered shrubs and cacti.
Lucy's warbler/ *Oreothlypis luciae*	Possible but not observed by baseline surveys	TSF sites are within year-round range of this species. Riparian mesquite woodlands.
Yellow warbler/ *Dendroica petechial*	Observed by baseline surveys in Gila River riparian habitat	TSF sites are within summer breeding range of this species. Riparian habitats near water.
Black-chinned sparrow/ *Spizella atrogularis*	Unlikely and not observed by baseline surveys	TSF sites are within summer breeding range of this species. Dense brushy habitats of sagebrush, chaparral, and manzanita.
Lawrence's goldfinch/ *Spinus lawrencei*	Possible but not observed by baseline surveys	TSF sites are within winter non-breeding range of this species. Dry open woodlands, woodland and forest edges, and shrubby habitats such as chaparral, usually near water.

3.15.1.9 Reptiles and Amphibians

No surveys for reptiles and amphibians other than Sonoran desert tortoise have been completed within the Ripsey Wash and Hackberry Gulch TSF sites. Suitable habitat for amphibians within the Ripsey Wash analysis area is limited by lack of surface water except for the Gila River and Mineral Creek. The Hackberry Gulch analysis area contains segments of the Gila River and also a few areas of perennial surface water associated with seeps and springs that could support breeding populations of amphibians. Based on known distributions and habitat preferences, species of reptiles and amphibians likely to occur in or near the TSF sites are listed in WestLand (2014n, 2014o). Reptile observations were similar between the two analysis areas, and species observed were zebra-tailed lizard (*Callisaurus draconoides*), ornate tree lizard (*Urosaurus ornatus*), regal horned lizard (*Phrynosoma solare*), reticulate Gila monster (*Heloderma suspectum*), and western diamondback rattlesnake (*Crotalus atrox*) (WestLand 2014n, 2014o). No amphibian species were recorded within the two analysis areas (WestLand 2014n, 2014o).

The Sonoran desert tortoise was formally a candidate species for listing under the ESA (USFWS 2010); but on October 6, 2015 the USFWS issued a determination that indicated listing the Sonoran desert tortoise was not warranted at that time (USFWS 2015a). It remains listed by the AGFD as WSC and is listed as a Sensitive Species by the BLM. The distribution of the desert tortoise ranges from northern Sinaloa, Mexico north to southern Nevada and southwestern Utah, and from south central California east to southeastern Arizona. It has been divided into two populations for purposes of the Endangered Species Act. The threatened Mojave population occurs north and west of the Colorado River and the unlisted Sonoran population occurs in Arizona, south and east of the Colorado River. Habitat for the Sonoran desert tortoise, south and east of the Colorado River, is conserved and managed by the BLM as described in Manual Section 6840 (Special Status Species) and is consistent with the joint Candidate Conservation Agreement (CCA) conservation commitments between the USFWS and Cooperating Agencies comprising the Arizona Interagency Desert Tortoise Team (USFWS 2015b).

The Sonoran desert tortoise population inhabits rocky slopes and bajadas of Mojave and Sonoran desertscrub. Caliche caves in cutbanks of washes (arroyos) are also used for shelter sites (AGFD 2010).

Adequate shelter is one of the most important habitat features of tortoises in the Sonoran Desert. Tortoises escape extreme temperatures in burrows, which stay cooler in the summer and warmer in winter than outside temperatures. Tortoises require loose soil to excavate (usually shallow) burrows below rocks and boulders, but they may also use rock crevices (AGFD 2010). They become active in the spring when temperatures warm, and activity then decreases during the drought months of May and June. Activity resumes and reaches its peak with the onset of the summer monsoon season in early August (AGFD 2010). Activity again decreases in October as tortoises withdraw to winter hibernacula.

The Sonoran desert tortoise has been reported within three miles of the Analysis Area (AGFD HDMS Database Distribution Mapping 1/21/14) and has been documented in both TSF sites by WestLand surveys (WestLand 2014r & 2014s). Surveys and data analysis completed by WestLand (2014r) for the Ripsey Wash TSF site suggest that Sonoran desert tortoise density within the site is low compared to many Sonoran desert tortoise populations that have been studied over the past 25 years. Similar results were reported by WestLand (2014s) for the Hackberry Gulch TSF site based on tortoise surveys completed for this area.

3.15.1.10 Gila River Associated Aquatic Species

Suitable habitat for fish species in or near the TSF sites is restricted to the Gila River and Mineral Creek. The Gila River is very dynamic river system with documented highly variable flows over the last 100 years. See Section 3.4, Surface Water Hydrology.

The operation of the upstream Coolidge Dam has moderated flows in the downstream segments of the Gila River, but channel-scouring high flows have still occurred, as evidenced by the 1993 flood. See Section 3.4, Surface Water Hydrology.

The majority of water in the middle Gila River is allocated for agricultural use and for several weeks water is not released from Coolidge Dam. Drought and increased demands for irrigation water, especially since 2000, often results in a zero streamflow measurement at the Kelvin stream monitoring gauge on the Gila River from June through November.

In contrast, during high flow periods when water is released from the Coolidge Dam, flows with high sediment loads scour the channel reducing riffle-run-pool heterogeneity and resulting in low aquatic habitat diversity with nearly homogeneous run habitat (King and Baker 1995). In addition, mining activities and smelters along the middle reach of the Gila River have resulted in some metal contamination of river sediments (Andrews and King 1997).

No specific fish surveys were completed in the Gila River for the Ripsey Wash and Hackberry Gulch TSF sites. However, fish surveys for the Central Arizona Project (CAP) constructed by the Bureau of Reclamation have been conducted in streams and canals in the Gila River Basin since 1995 (Marsh and Kesner 2006, Kesner and Marsh 2010). Four reaches of the Gila River have been surveyed as part of this effort. Two of these reaches (Hayden to Mineral Creek and Mineral Creek to Ashurst-Hayden Diversion Dam) are pertinent to the Ripsey Wash and Hackberry Gulch TSF analysis areas. A total of 13 species (three native, 10 non-native) have been documented in the Gila River by the CAP surveys since 1995 (Marsh and Kesner 2006, Kesner and Marsh 2010). Documented native species were desert sucker (*Catostomus clarki*), Sonora sucker (*Catostomus insignis*), and longfin dace (*Agosia chrysogaster*), which are listed as BLM sensitive species and may be present in reaches of the Gila River near the analysis areas (AGFD HDMS 2014). However, the more recent (2000-2009) CAP surveys have documented the disappearance of all native species in survey collections from the Gila River (Marsh and Kesner 2006, Kesner and Marsh 2010). Desert sucker was the last native species found (one individual) in the Gila River in 2006 in a reach upstream of Hayden (Kesner and Marsh 2010). Kesner and Marsh (2010) attributed the loss of native species primarily to the introduction of non-native species. No native fish have been found in the two river reaches near the analysis areas since 2002 (Marsh and Kesner 2006, Kesner and Marsh 2010).

Common, non-native fish species found by the CAP fish surveys in reaches of the Gila River near the analysis areas include red shiner (*Cyprinella lutrensis*), mosquitofish (*Gambusia affinis*), channel catfish (*Ictalurus punctatus*), yellow bullhead (*Ameiurus natalis*), and common carp (*Cyprinus carpio*) (Kesner and Marsh 2010). The presence of channel catfish and common carp has been documented near the TSF sites (King and Baker 1995).

3.15.1.11 BLM Sensitive Wildlife Species and Arizona Wildlife Species of Concern (WSC)

A screening analysis was conducted to determine the potential for any BLM sensitive species within or near the two TSF sites (WestLand 2014h, 2014j). This screening analysis was based on:

- Field observations and habitat assessments for the two TSF sites;
- Review of the known range, distribution and habitat requirements of BLM sensitive species; and
- Review of records of occurrences in published literature.

Principal sources of information used in the analysis included:

BLM Sensitive Species List for Arizona (February 2017);

- Various biological survey data collected by WestLand in or near the TSF sites;
- The AGFD HDMS on-line environmental review tool (AGFD 2013b);
- AGFD species abstracts (available at http://www.azgfd.gov); and
- Available published literature.

The AGFD HDMS on-line environmental review tool (AGFD 2013a, Appendix A) was also queried to locate WSC occurrence records within three miles of the TSF sites (WestLand 2014h and 2014j). A total of 17 BLM Sensitive species and/or AGFD WSC could be present in or near the two TSF sites. These species are listed in **Table 3-70, BLM Sensitive Wildlife Species and Arizona Wildlife Species of Concern**. Summaries of their range and habitat preferences are taken from WestLand (2014h, 2014j) and Arizona Game and Fish Department Heritage Data Management System - Animal Abstracts.

Table 3-70, BLM Sensitive Wildlife Species and Arizona Wildlife Species of Concern

Species and Status	Range and Habitat Preferences	Potential to Occur In or Near TSF Sites
FISH		
Desert sucker (*Catostomus clarki*) STATUS: BLM – Sensitive	RANGE: Lower Colorado River downstream from the Grand Canyon, and tributaries including the Bill Williams, Salt, Gila, and San Francisco River drainages. HABITAT: Rapids and flowing pools of streams and rivers primarily over bottoms of gravel-rubble with sandy silt in the interstices. ELEVATION: 480 to 8,840 ft. REFERENCES: AGFD 2002a	Possible[43]. This species could be present in the Gila River near the TSF sites. It has been reported in the Gila River within 5 miles of the TSF sites (AGFD HDMS Database Distribution Mapping 1/21/14). However, 15 years of CAP fish surveys (1995-2009) have not found this species in reaches of the Gila River near the analysis areas since 1999 (Marsh and Kesner 2006; Kesner and Marsh 2010).
Longfin dace (*Agosia chrysogaster*) STATUS: BLM – Sensitive	RANGE: Native to the Gila and Bill Williams drainages in Arizona, and the Magdalena and Sonoyta drainages in Mexico. HABITAT: Wide ranging, from intermittent hot low-desert streams to clear and cool brooks at higher elevations. ELEVATION: Generally below 4,900 ft., but has been recorded up to 6,700 ft. REFERENCES: AGFD 2013b	Possible. Potential to occur in the Gila River near the TSF sites. A subspecies (*A. c. chrysogaster*) has been reported in the Gila River within 5 miles of the TSF sites (AGFD HDMS Database Distribution Mapping 1/21/14). However, 15 years of CAP fish surveys (1995-2009) have not found this species in reaches of the Gila River near the analysis areas since 2001 (Marsh and Kesner 2006; Kesner and Marsh 2010).
Sonora sucker *Catostomus insignis* STATUS: BLM - Sensitive	RANGE: Colorado River drainage in New Mexico and Arizona, also in northern Sonora, Mexico. Widespread in Gila and Bill Williams systems in Arizona. HABITAT: Variety of habitats from warm water rivers to trout streams. ELEVATION: 1,210 to 8,730 ft. REFERENCES: AGFD 2002b	Possible. Potential to occur in Gila River near TSF sites. This species has been reported in the Gila River within 5 miles of the TSF sites (AGFD HDMS Database Distribution Mapping 1/21/14). However, 15 years of CAP fish surveys (1995-2009) have not found this species in the Gila River since 2002 (Marsh and Kesner 2006; Kesner and Marsh 2010).

[43] **Possible** – The species has not been documented in the TSF sites, but the known, current geographic range of the species includes the TSF sites and habitat characteristics required by the species appear to be present in the TSF sites.

Table 3-70, BLM Sensitive Wildlife Species and Arizona Wildlife Species of Concern (continued)

Species and Status	Range and Habitat Preferences	Potential to Occur In or Near TSF Sites
AMPHIBIANS		
Lowland leopard frog (*Lithobates yavapaiensis*) STATUS: BLM - Sensitive AGFD - WSC	RANGE: Across central Arizona from Mohave County to Cochise County. HABITAT: Usually along streams or rivers with dense vegetation, but also in ponds, cienegas, springs, cattle tanks, wetlands, and ditches. Sonoran Desertscrub to Great Basin Conifer Woodland or Madrean Evergreen Woodland. ELEVATION: 480 to 6,200 ft. REFERENCES: AGFD 2006a; Brennan and Holycross 2006	Likely to Occur. TSF sites are within geographic range and potentially usable habitat may be present in isolated areas with surface water and ephemeral drainages and in the Gila River and its riparian zone. This species has been reported in the Gila River within 5 miles of the TSF sites (AGFD HDMS Database Distribution Mapping 1/21/14).
REPTILES		
Sonoran desert tortoise (Gopherus morafkai) STATUS: BLM - Sensitive AGFD - WSC	RANGE: In Arizona south and east of Colorado River HABITAT: Rocky slopes and bajadas of Mojave and Sonoran desertscrub. Caliche caves in cut banks of washes (arroyos) are also used for shelter sites. Additional discussion in Section 3.15.1.9. ELEVATION: 500 to 5300 feet REFERENCES: AGFD 2015	Present. TSF sites are within geographic range and support suitable habitat, and relatively small populations of desert tortoise were documented in the Ripsey Wash and Hackberry Gulch TSF sites by WestLand surveys (2014r, 2014s).
Sonoran mud turtle (Kinosternon sonoriense sonoriense) STATUS: BLM - Sensitive	RANGE: It occurs in the Salt and Gila rivers and their tributaries across most of southeastern and sub-Mogollon Rim in central Arizona, tributaries of the Colorado River in west-central Arizona and near Yuma, and a number of drainages flowing from southeastern and south-central Arizona into Mexico. HABITAT: Rocky streams, creeks, rivers, ponds, cattle tanks, and ditches in Lower Colorado River Sonoran Desertscrub up through woodlands ELEVATION: Sea level to 6,700 ft. REFERENCES: AGFD 1999, Brennan 2008	Possible. Its range includes the Gila River and its tributaries and it could occur in the Gila River near the TSF sites. No AGFD distribution mapping is avaiable for this species. (https://www.azgfd.gov/w_c/edits/hdms_abstracts_reptiles.shtml).

Table 3-70, BLM Sensitive Wildlife Species and Arizona Wildlife Species of Concern (continued)

Species and Status	Range and Habitat Preferences	Potential to Occur In or Near TSF Sites
BIRDS		
American peregrine falcon (*Falco peregrinus anatum*) STATUS: BLM - Sensitive AGFD - WSC	RANGE: Breeds from central Alaska to central Mexico, wintering as far south as Chile. Found throughout Arizona where cliffs and prey are available. HABITAT: Steep, sheer cliffs overlooking woodlands, riparian areas, or other habitats supporting avian prey species in abundance. ELEVATION: 400 to 9,000 ft. REFERENCES: AGFD 2002c; Corman and Wise-Gervais 2005	Possible. Steep cliffs that could provide potential nest sites are available east and northeast of the TSF sites in the Dripping Spring Mountains, and suitable prey abundance may be available along the Gila River riparian zone near the TSF sites.
Common black-hawk (Buteogallus anthracinus) STATUS: AGFD - WSC	RANGE: Breeds from northern South America to the southwestern U.S. including Arizona, southwest New Mexico, western Texas, and southern Utah. HABITAT: Inhabits remote riparian streams with mature, undisturbed habitat and permanent flowing water. ELEVATION: 1,750 to 7,080 ft. REFERENCES: AGFD 2013c; Corman and Wise-Gervais 2005	Present. The breeding range in Arizona includes the upper Gila River drainages (eastern Arizona). This species has been reported along the Gila River within 5 miles of the TSF sites (AGFD HDMS Database Distribution Mapping 1/21/14). This species was also observed in the analysis area during WestLand's 2016 SWFL surveys along the Gila River.
Desert purple martin (*Progne subis hesperia*) Status: BLM - Sensitive	RANGE: Throughout North America from southern Canada to central Mexico. This subspecies limited to Sonoran desertscrub areas of south-central Arizona. HABITAT: Sonoran desertscrub, usually nesting in woodpecker cavities in saguaros. ELEVATION: 1,800 to 4,060 ft. REFERENCES: Corman and Wise-Gervais 2005	Possible. TSF sites are within geographic range and support suitable Sonoran desertscrub breeding habitat with saguaros.
Gilded flicker (*Colaptes chrysoides*) Status: BLM - Sensitive	RANGE: Western Arizona south to Sinaloa, Mexico. Limited to southwestern part of Arizona. HABITAT: Primarily Sonoran desertscrub, with saguaros. ELEVATION: 200 to 3,200 ft. REFERENCES: Corman and Wise-Gervais 2005	Possible. TSF sites are within geographic range and support suitable Sonoran desertscrub breeding habitat with saguaros.

Table 3-70, BLM Sensitive Wildlife Species and Arizona Wildlife Species of Concern (continued)

Species and Status	Range and Habitat Preferences	Potential to Occur In or Near TSF Sites
BIRDS		
Golden eagle (*Aquila chrysaetos*) Status: BLM - Sensitive	RANGE: Holarctic distribution. Throughout Arizona. HABITAT: Open country, in prairies, arctic and alpine tundra, open wooded country, and barren areas, especially in hilly or mountainous regions. They nest on rock ledges, cliffs or in large trees. ELEVATION: 1,300 to 9,000 ft. REFERENCES: AGFD 2002d; Corman and Wise-Gervais 2005	Likely to Occur. TSF sites are within geographic range and support potential foraging habitat. No suitable nesting habitat in TSF sites, but rock ledges on cliffs in the Dripping Spring Mountains, west of the Hackberry analsysis area represent the nearest potential nesting areas to the TSF sites. Golden eagles are known to nest about 5 miles west of the Ripsey TSF (McCarty and Jacobson 2012).
Mississippi kite (*Ictinia mississipiensis*) STATUS: AGFD - WSC	RANGE: Breeding resident in North America, non-nesting seasons in South America. In the United States, they range from the Gulf States to Nebraska and Wisconsin, west to Colorado and Arizona. During the winter, they range as far south as Paraguay and Argentina. HABITAT: Breeding habitat in Arizona consists of riparian deciduous forests that border desertscrub upland habitats. ELEVATION: 1,400 to 3,040 ft. REFERENCES: AGFD 2003a; Corman and Wise-Gervais 2005	Likely to Occur: TSF sites are within geographic range and the Gila River supports potential foraging and nesting habitat. HDMS records indicate recorded observations along the San Pedro River and Gila River near Kearney.
MAMMALS		
California leaf-nosed bat (*Macrotus californicus*) STATUS: BLM - Sensitive AGFD - WSC	RANGE: From southern Nevada and southern California south and east to Baja California, Sinaloa, Chihuahua, and Tamaulipas, Mexico. Below Mogollon Rim in Arizona. HABITAT: Sonoran desertscrub; primarily roosts in mines, caves, and rock shelters. ELEVATION: Below 4,000 ft. REFERENCES: AGFD 2001a; Adams 2003	Likely to Occur. TSF sites are within geographic range and support suitable foraging habitat. Abandoned mines for possible roost sites are available in the nearby Dripping Spring Mountains. This species has been reported from Dripping Spring Wash and the Tortilla Mountains within five miles of the TSF sites (AGFD HDMS Database Distribution Mapping 1/21/14)

Table 3-70, BLM Sensitive Wildlife Species and Arizona Wildlife Species of Concern (continued)

Species and Status	Range and Habitat Preferences	Potential to Occur In or Near TSF Sites
MAMMALS		
Cave myotis (*Myotis velifer*) STATUS: BLM - Sensitive	RANGE: Southern California and Kansas south to Honduras. Below Mogollon Rim in Arizona. HABITAT: Desertscrub of creosote, brittlebush, paloverde and cacti. Colonial roosts in caves, tunnels, and mineshafts, and under bridges, and sometimes in buildings within a few miles of water. ELEVATION: Mostly between 300 and 5,000 ft., but some records as high as 8,800 ft. REFERENCES: AGFD 2002e; Adams 2003	Likely to Occur. TSF sites are within geographic range and support potential foraging habitat. Abandoned mines for possible roost sites are available in the nearby Dripping Spring Mountains. Field surveys found evidence of myotis (likely cave myotis) in the Grey Horse Mine just outside of the Hackberry analysis area (WestLand 2014q).
Greater western mastiff bat (*Eumops perotis californicus*) STATUS: BLM - Sensitive	RANGE: Western U. S. to southern Mexico; also South America. Widely distributed across western and southern Arizona. HABITAT: Lower and upper Sonoran desertscrub near cliffs, preferring rugged rocky canyons with abundant crevices. Primary roosting sites in deep crevices. ELEVATION: 240 – 8,475 ft. REFERENCES: AGFD 2002f; Adams 2003	Likely to Occur. TSF sites are within geographic range and support potential foraging habitat. Roosting sites may be available in cliffs in the Dripping Spring Mountains west of the Hackberry analysis area.
Pocketed free-tailed bat (*Nyctinomops femorosaccus*) STATUS: AGFD - WSC	RANGE: Southern California to the Big Bend area of Texas south through Baja California and central-western Mexico to central Mexico. In Arizona it is found in primarily in south half of state in Cochise, Gila, Graham, La Paz, Maricopa, Mohave, Pima, Pinal, Yavapai, and Yuma counties. HABITAT: In Arizona, low desert, desertscrub, riparian, mesquite, and pine-oak forests. Roosts in crevices high on cliff faces in rugged canyons ELEVATION: 190 to 7,520 ft. REFERENCES: AGFD 2011a; Adams 2003	Likely to Occur. TSF sites are within geographic range and support potential foraging habitat. Roosting sites may be available in cliffs in the nearby Dripping Spring Mountains. This species has been reported from the Gila River and sites west of the Ray Mine within 5 miles of the TSF sites (AGFD HDMS Database Distribution Mapping 1/21/14).

Table 3-70, BLM Sensitive Wildlife Species and Arizona Wildlife Species of Concern (continued)

Species and Status	Range and Habitat Preferences	Potential to Occur In or Near TSF Sites
MAMMALS		
Spotted bat (Euderma maculatum) STATUS: BLM - Sensitive	RANGE: Locally distributed throughout western North America from southern British Columbia and Montana, south through California and Big Bend, Texas into Mexico HABITAT: In Arizona from low desert in southwest Arizona to high desert and riparian habitats in northwestern Arizona and conifer habitats in northern Arizona usually near rocky cliffs and water. Known to roost in rock crevices and cliff cracks. ELEVATION: in Arizona sea level to 8,670 ft. REFERENCES: AGFD 2003a; Adams 2003	Possible. TSF sites are within geographic range and support potential foraging habitat. Roosting sites may be available in cliffs in the nearby Dripping Spring Mountains.
Townsend' big-eared bat (*Corynorhinus townsendii*) STATUS: BLM - Sensitive	RANGE: Widespread across western U. S. south to central Mexico. Widely distributed across Arizona. HABITAT: Desert scrub up to woodlands and coniferous forests. Day roosts in caves and abandoned mines. ELEVATION: 550 and 7,520 feet, but most records above 3,000 ft. REFERENCES: AGFD 2003b; Adams 2003	Present. TSF sites are within geographic range and support suitable habitat but TSF sites are below most common elevation range. Abandoned mines for possible roost sites are available in the nearby Dripping Spring Mountains. This species has been reported from Dripping Spring Wash within 5 miles of the TSF sites (AGFD HDMS Database Distribution Mapping 1/21/14). Two Townsend's big-eared bats were found in abandoned mine features in the Ripsey Wash TSF site (WestLand 2014p).

3.15.1.12 Threatened, Endangered, Proposed and Candidate Wildlife Species

A screening analysis was conducted to determine the potential for any federal listed species within or near the two TSF sites (WestLand 2014g and 2014i). The potential for species to be present within or near the two TSF sites were based on the following:

- An evaluation of the known geographic and elevation range for the listed species;
- A review of the known habitat and natural history requirements of the listed species;
- A summary of field observations and habitat descriptions of the TSF sites;
- A review of occurrence records in published or gray literature; and,
- Data comparisons with the physical and biological conditions present in the TSF sites.

The principal sources of information for this analysis were:

- ESA-listed species for Pinal County (USFWS 2013a);
- The AGFD HDMS on-line environmental review tool;
- USFWS final and proposed listing and critical habitat rules;
- AGFD species abstracts;
- Accessible published literature;
- Biological survey results available for the TSF sites and vicinity; and,
- The USFWS Critical Habitat Portal on-line mapping tool.

Two listed species were identified as having the potential to occur within or near the TSF sites, and their presence has been confirmed by field surveys (WestLand 2014t and 2014u). They are southwestern willow flycatcher (*Empidonax traillii extimus*)-endangered, and the western DPS of yellow-billed cuckoo (*Coccyzus americanus*)-threatened.

One other species, northern Mexican garter snake (*Thamnophis eques megalops*), listed as threatened, is not present in or near the TSF sites or nearby segments of the Gila River but may be present along portions of the San Pedro River, upstream of its confluence with the Gila River (WestLand 2015a).

3.15.1.12.1 Southwestern Willow Flycatcher (Endangered).

Southwestern willow flycatcher (SWFL) is a neotropical migrant that winters in Mexico and Central America and breeds throughout the southwestern United States. In Arizona, this species breeds very locally along dynamic riparian systems, including the Colorado River, near the mouth of Little Colorado River downstream to Yuma; headwaters of the Little Colorado River near Greer and Eagar; middle Gila, Salt, and Verde Rivers; the middle to lower San Pedro River; and the upper San Francisco River near Alpine (AGFD 2002g). SWFL prefers to nest in cottonwood/willow and/or tamarisk riparian communities near water. Nests are typically placed in trees where the plant growth is most dense, where trees and shrubs have vegetation near ground level, and where there is a low-density canopy (USFWS 2013c).

The USFWS (2013c) has designated critical habitat for SWFL along a segment of the Middle Gila River from Dripping Spring Wash to the Ashurst-Hayden Dam, including a segment of the Gila River between the Ripsey Wash and Hackberry Gulch TSF sites. See **Figure 48, Southwestern Willow Flycatcher Designated Critical Habitat Near the TSF Sites**. This segment includes its confluences with Ripsey Wash, Zelleweger Wash. SWFL surveys completed by Graber and Koronkiewicz (2009, 2011) and Graber et al. (2012) from Dripping Springs Wash to the Ashurst-Hayden Dam have identified numerous SWFL nest sites along this segment of the Gila River, with the highest densities found between Kearny and Hayden and between Apache Springs and Dripping Spring Wash. One active nest location was found in 2009 and 2010 on the Gila River near its confluence with Ripsey Wash (Graber and Koronkiewicz 2009, 2012), and SWFL presence and likely nesting have been consistently documented near the Florence-Kelvin highway bridge from 2011 through 2017 (WestLand 2011b, 2013a, 2013b, and 2014t, 2015b, 2016a, and 2017a). Westland (2015b, 2016a, and 2017a) surveys also identified possible SWFL breeding birds in the vicinity of, and upstream of Ripsey Wash.

The Westland SWFL survey area was expanded in 2014 and 2015 to include portions of the Gila River down gradient from the Hackberry TSF site between Kearney and Riverside. SWFL presence and likely nesting was also documented along this reach of the Gila River (Westland 2014t, 2015b.)

3.15.1.12.2 Yellow-billed Cuckoo (Threatened)

Yellow-billed cuckoo is a neotropical migrant that winters in South America to central Argentina and Uruguay and breeds in North America west of the Rocky Mountains south to southern Baja California (Terres 1980). In Arizona, this species occurs in all counties but is generally found in the southern and central portions of the state (AGFD 2011b). Its breeding distribution is restricted primarily to mature cottonwood/willow riparian woodlands, but in Arizona they may also occur in larger mesquite bosques and ephemeral drainages supporting large mesquite and oak trees (AGFD 2011b, WestLand 2015a). Within the analysis area, suitable habitat for the yellow-billed cuckoo is restricted to riparian woodlands along the Gila River.

The western DPS of the Yellow-billed cuckoo was listed by the USFWS as threatened in 2014 (USFWS 2014a). The USFWS has also proposed critical habitat for this species (USFWS 2014b), and Unit 28: AZ-

20 lower San Pedro, Gila Rivers in Pinal, Pima, and Gila Counties, Arizona includes the reach of the Gila river near the Ripsey Wash and Hackberry Gulch TSF sites. See **Figure 49, Yellow-billed Cuckoo Proposed Critical Habitat Near the TSF Sites**. Unit 28 includes the of the Lower San Pedro River from above the Town of Mammoth in Pima County downstream to its confluence with the Gila River and the Gila River from the San Carlos Reservoir downstream of the Town of Riverside in Pinal County.

Surveys every year from 2012 through 2017 have documented the presence of yellow-billed cuckoo along the Gila River downstream of Kearney to Zelleweger Wash, with most detections in the vicinity of Riverside, the Florence-Kelvin highway bridge, and downstream of the bridge (WestLand 2012, 2013c, 2014u, 2015c, 2016b, and 2017b). No yellow-billed cuckoos were detected within the two TSF sites outside of the Gila River riparian corridor. The 2012, 2013, 2014, 2015, 2016, and 2917 surveys recorded 24, 9, 3, 10, 4, and 13 confirmed detections of yellow-billed cuckoo, respectively. Although breeding was not confirmed by the surveys, surveys based on USFWS approved protocol indicated possible breeding along this segment of the Gila River and that suitable nesting habitat is present (WestLand 2013c). Four detections recorded during the 2017 surveys were considered to represent two possible breeding territories, one approximately 0.9 river mile downstream of the Florence-Kelvin Bridge and the other approximately 0.5 mile upstream of the Copper Basin Railway Bridge (Westland 2017b).

3.15.1.12.3 Northern Mexican Gartersnake

The northern Mexican gartersnake is one of ten currently recognized subspecies of *Thamnophis eques* and the only subspecies that occurs in the U.S. (USFWS 2014c). A proposed designation of critical habitat and listing of the northern Mexico gartersnake was published on July 10, 2013 (USFWS 2013d), and a final rule to list the northern Mexican gartersnake as threatened under the ESA was published on July 8, 2014 (USFWS 2014c). Designated critical habitat for northern Mexican gartersnake is a proposed rule that is currently pending final publication.

Historically, northern Mexican gartersnake ranged throughout the lower Colorado River and Gila River basins in appropriate habitat in southern Arizona and extreme southwestern New Mexico and into the Sierra Madre Occidental and the Mexican Plateau of Mexico (USFWS 2014c). Currently the USFWS considers viable populations to only exist in five areas in Arizona: 1) the Bill Williams River, 2) upper Verde River, 3) Oak Creek (at the Page Springs and Bubbling Ponds State Fish Hatcheries), 4) Tonto Creek, and 5) the upper Santa Cruz River (USFWS 2014c). The USFWS (2014c) also indicates a possible extant, low-density population along the San Pedro River from the Mexico/U.S. border to its confluence with the Gila River.

In Arizona, northern Mexican gartersnake inhabit streams, cienegas, springs, and earthen stock ponds that support dense perimeter riparian vegetation (Brennan and Holycross 2006, Rosen and Schwalbe 1988). Northern Mexican gartersnakes are a highly aquatic species that are rarely found far from perennial to near-perennial waters and dense vegetation.

3.15.2 Environmental Consequences

3.15.2.1 Effects of the No Action Alternative

Under the no action alternative, neither the Ripsey Wash nor the Hackberry Gulch TSF would be constructed, but the Ray Mine would continue operations as discussed in Section 2.2, No Action Alternative. Wildlife habitats and populations within the Ripsey Wash or Hackberry Gulch TSF site and adjacent areas of the Gila River would remain unchanged. However, current land use trends in the region, including mining, livestock grazing and dispersed recreation activities, such as hunting, would have a continuing effect on wildlife populations and habitat.

3.15.2.2 Effects of the Ripsey Wash TSF Alternative

The Ripsey Wash TSF would cause the direct wildlife habitat loss from the area of disturbance. See **Table 2-1, Summary of Ripsey Wash TSF Alternative**.

General effects on wildlife would be the physical loss of habitat; habitat fragmentation and isolation displacement of wildlife; increased competition of wildlife; impacts to special wildlife habitats, and impacts to threatened, endangered and sensitive species. These effects can be classified as both short-term and long-term. Short-term impacts arise from displacement of wildlife due to construction activity, including human presence and noise. Long-term impacts would consist of permanent changes to habitats and the wildlife populations dependent on those habitats.

3.15.2.2.1 Habitat Loss and Fragmentation

Construction and operations would result in permanent loss of habitat. Direct impacts to wildlife habitats would occur from grading for infrastructure, harvesting of borrow material, and the progressive burial of vegetation and wildlife habitat features by placement of tailings material. Habitat loss through tailings deposition would occur incrementally within the tailings impoundment. Because of this incremental loss, portions of wildlife habitats subject to eventual burial by tailings may remain viable to some extent as the TSF footprint is progressively covered with tailings.

Permanent loss of vegetation communities and habitat features would also be associated with the construction of various TSF support facilities including starter dams, detention dams and diversion structures, seepage trenches, reclaim ponds, pumping stations, Florence-Kelvin Highway reroute, and the Arizona Trail realignment. Rock quarries would be established within the TSF footprint and would not contribute to additional habitat loss. The direct impacts resulting from the permanent burial of existing vegetation communities and wildlife habitats would be irreversible.

Habitat fragmentation and isolation are difficult to determine and probably vary species to species, but they could occur primarily as a result of the construction of the tailings facility. The size of the tailings facility would result in a movement barrier to many small and medium-sized land mammals and reptiles, thereby fragmenting habitat and possibly isolating some populations of these species. No specific "Diffuse or Landscape Movement Areas" have been identified by the AGFD (2013d) in the Ripsey Wash TSF site or the nearby Tortilla Mountains so disruption of wildlife movement between relatively large unfragmented areas ("Habitat Blocks" or "Wildland Blocks") is not likely with construction and operation of the Ripsey Wash TSF.

Other ancillary facilities such as roads, power lines, diversion structures, and pipeline corridors do not usually create physical barriers to wildlife movement. Although, the effective use of adjacent undisturbed habitats to these facilities could be diminished. Habitat fragmentation and isolation can be problematic in areas of limited habitat, such as along the Gila River, which has been identified as Riparian Movement Area (R4) for wildlife (AGFD 2013d). However, since the highway and pipeline bridge crossings of the Gila River would span the majority of the river corridor and not interrupt the continuity of riparian habitat along either side of the river, project development would not fragment riparian habitat or constrict wildlife movement along the Gila River corridor, except perhaps during the relatively brief construction phase of these two features.

3.15.2.2.2 Displacement of Wildlife.

The most common wildlife responses to noise and human presence are avoidance and accommodation.

Displacement is unavoidable in the short-term and long-term under both action alternatives, and this displacement has the potential to be the most significant effect on wildlife. Avoidance of disturbed areas would result in wildlife displacement from an area larger than the actual disturbed sites. The extent of this displacement would be related to the duration, magnitude and the visual prominence of the activity, as well as the extent of construction and operational noise levels above existing background levels. Visual prominence of facilities is dependent upon the surrounding topography.

Displacement would result in local reductions in wildlife populations if adjacent, undisturbed habitats are at carrying capacity. In this situation, animals are either forced into less than optimal habitats or they compete with other animals already occupying unaffected habitats. Possible consequences of such displacement are lower survival, lower reproductive success, lower recruitment, and ultimately lower carrying capacities and reduced populations.

Noise levels would be highest during construction of the starter dams when large equipment is operating. Noise levels are near 90 dBA within 50 feet of heavy equipment operation but dissipate at distance (66 dBA at 800 feet). Note that normal conversation is 60 dBA at 5 feet. Use of mobile equipment after construction would normally only occur during daylight hours, but tailings delivery pumps would operate 24 hours per day. The mobile equipment typically used during operations would involve a small excavator, dozer, and occasional water truck. Noise levels associated with this type of equipment is 80 dBA at 50 feet. Please refer to Section 3.8.2, Environmental Consequences (Noise), for more information on noise levels associated with the proposed project.

Reaction of animals to noise and human presence varies depending on the intensity of the noise source and whether it is continuous or intermittent. Transient loud noises would provoke alarm responses; however, many animals learn to ignore more constant, lower level noise sources that are not associated with negative experiences such as being chased or hunted.

The possible effect of nighttime lighting on wildlife would be a very minor issue for the proposed project since construction and operation activities would normally only occur during daylight hours, and no artificial lighting would be required except for occasional use of portable light plants to assist in possible, but unlikely, after-hours maintenance and/or safety issues.

The extent of wildlife displacement is impossible to predict for most species since the response severity varies from species to species and can even vary between different individuals of the same species. After initial avoidance, some wildlife species may acclimate to the activity and begin to reoccupy areas previously avoided. The acclimation and reoccupation would be expected to occur following the initial site development and construction activities when the project moves into the operation phase of tailings placement, where less noise and human activity would take place. Acclimation to activity may increase predation on some species. Wildlife acclimation and re-occupation of unaffected habitat areas adjacent to mining disturbance is relatively common response observed at many operational surface mines thoughout the Rocky Mountain West.

Early site development and construction noise have the potential of affecting wildlife species surrounding the actual disturbed areas, including within the vegetated floodplain of the Gila River. Construction of the tailings facility, including pipeline corridors, the Gila River pipeline bridge, diversion channels and detention dams, and roads, would reduce the use of surrounding habitat by wildlife.

These impacted sites reduce foraging due to direct loss of vegetation from ground disturbance. In addition, there is an area surrounding these sites that tends not to be utilized due to the increased human activity. This “zone” can extend up to a half mile from the developed area. Consequently, development impacts to wildlife can extend further offsite than the actual amount of disturbed area.

Although some animals can habituate to the increased infrastructure, it is generally assumed that an increased human footprint on a previously lightly developed area is detrimental to most species.

In addition to the avoidance response, increased human presence intensifies the potential for increased traffic levels on new and existing roads, which could increase the potential for wildlife-vehicle collisions.

Following early site development and construction, noise levels and human presence would decrease. The tailings and reclaim water pumps would be powered by electric motors. As a result, some species might acclimate to the TSF operations and utilize habitats immediately adjacent to such sites. This has been observed at the existing Elder Gulch TSF.

After mine closure and reclamation activities are complete, wildlife use of adjacent unaffected habitat areas may return to pre-existing conditions since active mining disturbance factors will have ceased. Some small mammal and reptile wildlife populations might eventually recolonize the TSF site if some natural establishment of vegetation communities occurs over the long term. However, based on current closure plans, the TSF would be developed as a solar farm and would never provide the productive wildlife habitat conditions present prior to disturbance.

3.15.2.2.3 Wildlife Mortality

During construction, most larger, mobile wildlife species would be displaced to adjacent habitats; however, direct habitat disturbance could result in direct loses of most smaller, less mobile species of wildlife, such as small mammals, reptiles (including Sonoran desert tortoise) and, possibly, ground nesting birds within proposed construction sites.

Predictions of wildlife population losses based on habitat disturbances and displacement are hard to make since accurate information on wildlife population numbers is difficult to obtain for many species. Even if accurate population numbers were available, projections of losses many not be accurate since it is impossible to account for the effects of weather and natural cyclical population changes. If it is assumed that the existing adjacent habitats are at carrying capacity for most species, locally displaced populations may be permanently eliminated. Upon site closure, and natural revegetation, wildlife species would be expected to reutilize the once disturbed sites. However, natural desert revegetation would take many years after site closure and reclamation, and the majority of the TSF site would not create wildlife habitat similar to existing conditions in the foreseeable future since the TSF site would be developed as a solar energy facility after closure.

3.15.2.2.4 Wildlife Exposure to Contaminated Surface Water

Results of geochemistry testing for the Ripsey Wash TSF tailings revealed a low potential for any acid generation from tailings materials and confirmed that alluvium material to be used for construction activities are not acid-generating. The meteoric water mobility testing on both tailings and alluvium material also revealed that the probability for dissolution and mobilization of leaching minerals from these materials is low (See Section 3.3, Geology, Geotechnical and Geochemistry). Therefore, no wildlife mortalities associated with exposure to ponded water on the Ripsey Wash TSF site are expected to occur. There have been no documented wildlife mortalities at the existing Elder Gulch TSF and ponded water at the upper end of that existing facility support a population of fish identified as mosquitofish by AGFD personnel.

3.15.2.2.5 Increased Competition for Wildlife

Currently, there is hunting activity within the areas of proposed TSF development and operation. Increased competition for wildlife resources could occur outside of the TSF site since hunting and other wildlife oriented recreation would be displaced out of this area. Hunting would also be expected to increase in the general area as recreation activities increase. However, given the hunting management polices of AFGD, no detrimental increased competition for wildlife resources is anticipated.

3.15.2.2.6 Special Habitat Features

Within the Ripsey Wash TSF site there are no seeps or springs and associated areas of surface water, wetlands, and riparian vegetation that would be lost to project development; however, there are two stock watering features that would be lost which currently could be used as a surface water source for wildlife. The extent of wildlife use of these stock watering features and the availability of off-site water sources (aside from the Gila River) is unknown, but the loss of these water sources could adversely impact wide-ranging wildlife species beyond the actual footprint of the Ripsey Wash TSF site. Diversion channels and detention ponds created to route and treat surface water runoff around the Ripsey Wash TSF site could create seasonal water sources available to wildlife after storm events.

Some segments of the Gila River and adjacent riparian habitat may be close enough to the TSF facility to create indirect impacts of construction and operation on wildlife populations using the Gila River corridor, but such indirect impacts are expected to be minor.

Existing Sonoran desert tortoise special habitat features such as caliche banks along washes, shelter sites under shrubs, and caves and burrows in wash banks and on slopes would be lost within the TSF site footprint.

No adverse effects are expected to wildlife as a result of the relocation of the Arizona Trail or the work in the areas proposed for waters of the U.S. mitigation (see **Appendix J, Compensatory Mitigation**). Some stretches of the new Arizona Trail couldbe constructed or cleared using manual labor, although there would be the short-term need for small equipment such as a skid-steer or compact track loader and a compact excavator to assist in constructing switchbacks or moving large rocks for the relocated trail. There might be some temporary displacement of wildlife species during the construction of new trail due to noise and human presence, but these impacts would be short-term and localized. The alignment of the new Arizona Trail was sited to avoid any potential Sonoran desert tortoise burrows or important habitat features such as caliche banks along washes and caves and burrows in wash banks so trail construction impact to Sonoran desert tortoise are unlikely.

As explained in **Appendix J, Compensatory Mitigation**, all or portions of Mitigation Sites A, B, C and D would require active management to enhance the riparian habitat values; this action would be primarily fencing and seeding. A mechanical posthole digger mounted on an off-road vehicle would be used for fence construction, and a farm tractor with a cultivator and a drill seed would be used for seeding, although hand seeding could also be used. For Mitigation Site E and on other sites where tamarisk would be removed, a bulldozer (Caterpillar D6 or equivalent) would be used to clear and grub burned trees and stumps. Given noise and human presence during the fencing and general upgrade (seeding and removal of tamarisk) within the proposed mitigation sites, there might be some temporary displacement of wildlife species, but these impacts would be short-term and localized. The proposed work should improve the wildlife habitat in the areas of mitigation sites.

3.15.2.2.7 Mammal and Bird Species of Economic and Recreational Importance (SERI)

SERI species potentially adversely affected by TSF site development include collared peccary, desert bighorn sheep, mule deer, mountain lion, Gambel's quail, and white-winged dove. All except desert bighorn sheep have been documented within the analysis area. All are highly mobile species, and project construction and operations would result in the displacement of the more mobile species from the TSF and associated facilities footprint and a larger perimeter area due to equipment operation and human presence. Once initial construction activities have been completed, local populations will likely adapt to the presence of the TSF facilities over time and reoccupy adjacent, undisturbed habitat areas.

Predictions of SERI wildlife population losses based on habitat disturbance and displacement are difficult to make since accurate information on wildlife population numbers are often not available for many species. Even if accurate population numbers were available, projections of losses may not be accurate since it is impossible to account for the effects of weather and natural cyclical population changes. If it is assumed that the existing adjacent habitats are at carrying capacity for most species, locally displaced populations may be eliminated.

3.15.2.2.8 Predators, Furbearers, and Other Mammals

Construction and operation of a TSF site would result in direct losses of smaller, less mobile mammal species such as rodents and rabbits. Most predators and furbearers are highly mobile and wide-ranging and would be displaced from disturbance areas. However, similar to SERI species, if it is assumed that the existing adjacent habitats are at carrying capacity for most species, locally displaced populations may be eliminated.

American beaver is only present in aquatic habitats associated with the Gila River and would not be directly affected by habitat loss with TSF site development. Although, there would be a very minor (0.01-acre) loss of river habitat associated with pipeline and bridge construction. Surface and ground water impact analyses (see Sections 3.4, Surface Water Hydrology, and 3.6, Groundwater Hydrology) indicate TSF site development and operation would not have adverse water quality effects on the Gila River and only negligible water quantity effects.

TSF site development and operation would result in the burial of abandoned mine features within the TSF site footprint. Loss of these features would eliminate bat roosting use of these subterranean structures. Surveys completed by WestLand (2014p) indicated relatively minor use of abandoned mine features within the Ripsey Wash TSF site by Townsend's big-eared bat, California leaf-nosed, and pallid bat and individuals of these species may be lost with TSF site development. However, the WestLand surveys did not document any large colonial winter hibernation, maternity, or day use sites within the proposed TSF facility sites so TSF development would not have any substantial adverse effect on local populations of bats.

3.15.2.2.9 Raptors

Raptors potentially occurring or observed within the TSF site are highly mobile species and project construction and operations would result in the displacement of these species from the TSF and associated facilities footprint and possibly a larger perimeter area due to equipment operation and human presence. Once initial construction activities have been completed, local populations will likely adapt to the presence of the TSF facilities over time and reoccupy adjacent, undisturbed habitat areas. Displacement from the TSF site would primarily affect raptor foraging use over the site. Although abandoned mine features in the Ripsey Wash TSF footprint exhibited evidence of possible nesting use of by great horned owl, barn owl, and turkey vulture that could be adversely affected by project development, no raptor nesting use of either TSF site was documented by field surveys (WestLand 2014n, 2014o). Nesting by species such as elf owl, screech owl, and American kestrel could be affected by development of the Ripsey Wash TSF site.

Construction of TSF starter dams and water control features would result in the immediate loss of raptor foraging habitats while the remainder of the TSF footprint would be lost as available hunting habitat incrementally with tailings deposition. Foraging habitat loss could result in a permanent reduction in local raptor populations over the long-term, but the extent of raptor population reductions is impossible to predict. The potential for incidental loss of nest sites, eggs, or young exists if abandoned mine features or saguaros are removed or impacted during the nesting season.

3.15.2.2.10 Waterbirds

Surface and ground water impact analyses (see Section 3.4, Surface Water Hydrology, and Section 3.6, Groundwater Hydrology) indicate TSF site development and operation would not have adverse water quality effects on the Gila River and only very negligible (if any) water quantity effects. Therefore, project development is not likely to have any direct adverse effects on waterbird use of the Gila River; however, indirect impacts could occur based on noise and general TSF activity, especially during early site development construction work. The Ripsey Wash TSF site would be over 0.5 mile away from the inactive great blue heron rookery on the Gila River and would probably not affect future heron use of this rookery site.

3.15.2.2.11 Other Migratory and Resident Birds

Since songbirds and other bird species are highly mobile, construction and operation of a TSF site would result in displacement of bird species from disturbance areas. If it is assumed that the existing adjacent habitats are at carrying capacity for most bird species, locally displaced populations may be eliminated resulting in a permanent reduction in local bird populations since the TSF site would not be reclaimed to pre-existing habitats.

In areas where TSF construction or tailings inundation occurs during the nesting season, there would likely be an incidental loss of occupied nests, eggs, or young for a variety of resident and migratory birds known to breed in habitats within the TSF footprint. This could include BCC species such as Costa's hummingbird, and Gila woodpecker. BCC species, such as Bell's vireo, Lucy's warbler, and yellow warbler, associated with riparian and mesquite woodlands, would not likely be adversely affected since these habitats would not be directly impacted by TSF site development. Construction of the tailings pipeline and bridge crossings over the Gila River would span most, if not all, riparian habitat so that potential impacts to riparian associated BCC species would be unlikely or very minor.

3.15.2.2.12 Reptiles and Amphibians

Construction and operation of a TSF site would result in direct losses of reptile populations over the entire TSF facility footprint and an overall reduction in local populations of reptiles, including Sonoran desert tortoise. Adverse impacts to local amphibian populations are likely to be relatively minor since most amphibian species are associated with the Gila River and adjacent riparian habitats not directly affected by TSF site development. Indirect impacts to amphibian populations through indirect impacts to riparian habitats and surface water quality and quantity in the Gila River are not likely since surface and ground water impact analyses (see Section 3.4, Surface Water Hydrology, and Section 3.6, Groundwater Hydrology) indicate TSF site development and operation would not have adverse water quality effects on the Gila River and only very negligible (if any) water quantity effects.

3.15.2.2.13 Gila River Associated Aquatic Species

Surface and ground water impact analyses (see Section 3.4, Surface Water Hydrology, and Section 3.6, Groundwater Hydrology) indicate TSF site development and operation would not have adverse water quality effects on the Gila River and only very negligible (if any) water quantity effects on the Gila River. The proposed new tailings pipeline and highway bridge crossing would span the Gila River and much of the adjacent wetland and riparian habitats. Therefore, project development is not likely to have any adverse effects on fish and other aquatic species populations in the Gila River.

3.15.2.2.14 BLM Sensitive and State Wildlife Species of Concern (WSC)

Based on a review of known ranges and habitat preferences, seven BLM sensitive species and two WSC species could be affected by project development. Project development is not likely to adversely affect BLM sensitive and WSC species associated with the Gila River and associated riparian habitats, since surface and ground water impact analyses (see Section 3.4, Surface Water Hydrology, and Section 3.6, Groundwater Hydrology) indicate TSF site development and operation would not have adverse water quality effects on the Gila River and only very negligible (if any) water quantity effects. The tailings pipeline and bridge construction required for the Ripsey Wash alternative over the Gila River would span most of the river and associated wetland and riparian habitats and would not have any measurable impact on BLM sensitive and WSC species associated with the Gila River and associated riparian habitats.

BLM Sensitive species potentially impacted by project development include Sonoran desert tortoise, desert purple martin, gilded flicker, golden eagle, California leaf-nosed bat, cave myotis, greater western mastiff bat, and Townsend's big-eared bat. WSC species are Sonoran desert tortoise, California leaf-nosed bat, and pocketed free-tailed bat. Project development could also affect potential nesting habitat for desert purple martin and gilded flicker, although these species were not documented in the TSF sites by field surveys. Project development would not impact golden eagle nesting habitat but could result in a minor reduction in foraging habitat for this wide-ranging species.

Field surveys documented likely roosting use of abandoned mine features by California leaf-nosed bat, cave myotis, and Townsend's big-eared bat (WestLand 2014p). Project development could result in the loss of a few individuals of these species if abandoned mine features are destroyed while occupied by these bats. However, project development is not likely to have substantial effect on local populations of these bats since field surveys did not document any large colonial winter hibernation, maternity, or day use sites within the proposed TSF facility sites. No potential roost sites for greater western bonneted bat or pocketed free-tailed bat would be affected by project development, but a reduction in potential foraging habitat could occur.

Without mitigation, existing, low-density populations of Sonoran desert tortoise within the TSF site footprint would be lost to development.

3.15.2.2.15 Threatened, Endangered, Proposed and Candidate Species

Two listed species were identified by WestLand (2014g, 2015a, 2015e) as having the potential to occur within or near the Ripsey Wash TSF site, and their presence has been confirmed by field surveys. They are southwestern willow flycatcher (Endangered), and yellow-billed cuckoo (Threatened).

Another species, northern Mexican gartersnake (Threatened) is not present in or near the TSF sites or nearby segments of the Gila River but may be present along portions of the San Pedro River, upstream of its confluence with the Gila River (WestLand 2015a). The following sections provide preliminary impact assessments for these three species. The Corps has consulted with the USFWS in formal Section 7 Consultation, which has addressed the effects of development of the Ripsey Wash TSF on listed threatened and endangered species. The following impact discussions are summarized from the Biological Assessment (BA) submitted to the USFWS for this project.

Southwestern Willow Flycatcher and Yellow-billed Cuckoo. The Arizona Department of Transportation (ADOT) and Pinal County have proposed a new highway bridge for the Florence-Kelvin Highway, immediately upstream from the existing Kelvin Bridge crossing of the Gila River. ADOT has indicated that Section 7 Consultation for the construction of the new highway bridge was initiated in 2016 (pers. comm. Joshua Fife, ADOT, as cited in Westland 2015a). Highway bridge construction began in 2017 and is scheduled for completion in 2018.. As a result, a portion of the proposed Ripsey Wash TSF pipeline bridge construction corridor has been previously disturbed by the construction of new highway bridge.

The Ripsey Wash TSF pipeline bridge construction would take place immediately upstream of the new highway bridge. Construction activities would occur on the north and south banks of the river within approximately 110-foot wide corridors on either side of the Gila River channel. These construction areas encompass approximately 0.7 acre. Access to the construction areas would be achieved from both the north and south sides of the river in order to avoid impacts to the river channel and Clean Water Act Section 404 jurisdictional areas. The design plans for the ADOT State Highway Project Florence-Kelvin Highway Bridge depict an area of approximately 0.8 acre as the construction work zone for the highway bridge. This area overlaps with approximately 0.3 acre within the Ripsey Wash TSF pipeline bridge construction area. Therefore, construction of the Ripsey Wash TSF pipeline bridge would require approximately 0.4 acre of additional vegetation disturbance within the Gila River riparian corridor.

The proposed pipeline bridge crossing of the Gila River would pass through designated critical habitat for SWFL and proposed critical habitat for yellow-billed cuckoo. As indicated, construction of the pipeline bridge would require vegetation clearing of approximately 0.4 acre. Permanent impacts would result from the placement of the approximately 14-ft wide pipeline bridge, resulting in approximately 0.2 acre of permanent impact along the Gila River. Construction impacts would lead to a temporary loss of 110 feet of vegetation within the SWFL Middle Gila-San Pedro Management Unit (50.1 miles of the Gila River and 78.4 mi of the San Pedro River). This impact represents approximately 0.02 percent of the river miles in this management unit. Riparian vegetation within the bridge construction area will recover over time except at bridge support structure locations.

Relocation of the Florence-Kelvin Highway and construction of the reclaim pond (in Ripsey Wash), drain down pond, and electrical switchgear (north of the Gila River) will also result in direct impacts to SWFL critical habitat (12.2 acres) and yellow-billed cuckoo proposed critical habitat (3.6 acres) mapped by the USFWS. However, yellow-billed cuckoo proposed critical and SWFL critical habitat potentially impacted by these project components are dominated by velvet mesquite, desert broom, and other xeroriparian plant species. There is no mesoriparian or hydroriparian vegetation in these areas, and they do not provide the dense shrub and/or tree cover required for SWFL nest sites. In addition, the xeroriparian vegetation is likely to provide less insect prey for SWFL and yellow-billed cuckoo than the hydroriparian zone adjacent to the Gila River. It is possible that SWFL and yellow-billed cuckoo could occasionally forage in these areas, but they are removed from perennial water and riparian habitats associated with the Gila River, and would not provide optimal foraging conditions.

Site clearing and pipeline bridge construction activities would directly impact two SWFL breeding territories and possible yellow-billed cuckoo breeding habitat, and bridge construction activities and related noise could impact other SWFLs and yellow-billed cuckoos in the vicinity. It is important to note that, although no evidence of yellow-billed cuckoo breeding has been observed, surveys (following USFWS approved protocol) near the pipeline bridge construction area have provided possible evidence of breeding in this area (Westland 2014u, 2015c, 2016b). Approximately 0.4 acre would be temporarily impacted, but the riparian vegetation within the construction area is expected to recover over time. The footprint of the approximately 14-foot wide pipeline bridge spanning the river and the associated six piers within the river's riparian corridor (approximately 0.2 acre) would remain as a permanent direct impact. The bridge would be elevated and existing vegetation remaining upstream and downstream of the bridge would eventually reestablish in proximity to the bridge. The bridge is not expected to act as a barrier to long distance migrations or local dispersal movements.

Construction of the new Florence-Kelvin highway bridge and tailings pipeline over the Gila River for the Ripsey Wash alternative has the potential to disturb breeding or nesting activity by SWFL and yellow-billed cuckoo if construction occurs during the nesting season. Disruption of breeding or nesting activity would be violation of the MBTA and the Endangered Species Act (ESA). Therefore, it is recommended that vegetation clearing occur outside of the breeding and nesting season of these two species prior to construction.

In addition to direct habitat loss and possible disturbance to individual birds by construction activities, increased levels of traffic, noise and dust generation have the potential to directly impact SWFL and yellow-billed cuckoo individuals. An evaluation of these impact vectors concluded that they may disturb individuals but would not likely result in any SWFL or yellow-billed cuckoo mortalities (Westland 2015a). Once construction is complete, noise and traffic levels should return to pre-existing background levels.

TSF site operation is not likely to have any indirect effects on the Gila River and associated SWFL and yellow-billed cuckoo riparian habitats since TSF site development and operation would not have adverse water quality effects on the Gila River and only very negligible (if any) water quantity effects.

Project mitigation activities will implement best management practices for SWFL and yellow-billed cuckoo and will be designed to avoid vegetation removal and restoration activities during the breeding/nesting periods. Mitigation actions along the San Pedro and Gila Rivers will exclude livestock grazing, off-road vehicle access, and wood harvesting. These beneficial actions should allow further development of mesquite bosque and riparian vegetation, which would be expected to enhance conditions within SWFL critical habitat and yellow-billed cuckoo proposed critical habitat.

Northern Mexican Gartersnake. There is no proposed critical habitat for northern Mexican gartersnake mapped along the Middle Gila River, and due to the presence and abundance of non-native aquatic species in the middle Gila River, northern Mexican gartersnake is not likely to occur along portions of the Gila River near the Ripsey Wash TSF site. As a result, project activities associated with construction of the Ripsey Wash TSF and associated infrastructure, including the proposed pipeline bridge crossing of the Gila River, would not have any direct or indirect adverse effects on populations of northern Mexican gartersnake.

Proposed northern Mexican gartersnake critical habitat mapped along the San Pedro River includes portions of proposed Clean Water Act, Section 404 mitigation sites. No activities are planned at the mitigation sites that would adversely impact proposed northern Mexican gartersnake critical habitat. Mitigation actions along the lower San Pedro River will exclude livestock grazing, off-road vehicle access, and wood harvesting. These actions would contribute to improving the aquatic and riparian conditions along the river within sections of northern Mexican gartersnake proposed critical habitat.

3.15.2.2.16 Conservation/Mitigation Measures

Asarco has identified four mitigation sites located along the San Pedro River (Sites A through D) that are about 29 river miles upstream from the analysis areas. A map showing the locations of these sites is provided in the Biological Assessment (WestLand 2015e). Proposed mitigation activities at these sites would compensate for unavoidable project impacts to Waters of the U.S. and also would enhance habitat for southwestern willow flycatcher, yellow-billed cuckoo, and northern Mexican garter snake.

All of these sites are associated with perennial or intermittent aquatic resources, support or have the potential to support high-value mesoriparian and hydroriparian habitats, and provide regional conservation benefit. **Table 3-71, Summary of Offsite Mitigation Areas for Threatened and Endangered Species**, provides a summary of the current ecological condition of these sites and mitigation measures planned to enhance habitat conditions (taken from WestLand 2015e).

Table 3-71, Summary of Offsite Mitigation Areas for Threatened and Endangered Species

Mitgation Site	Acreage	Description
Site A – PZ Ranch Northeastern Mesquite Bosque (Preservation)	29.8	Adjacent to an existing Corps mitigation site and is included within the fenced boundary of that mitigation site. Active management of this site through proposed preservation efforts will exclude cattle from the site, restrict fuel-wood- and other wood-harvesting, and restrict off-road vehicle access to the site to enhance its riparian habitat values. The existing bosque habitat is second growth and was likely part of an earlier agricultural operation or the mesquite had been harvested for fuel wood or some other purpose. Mesquite bosque habitats were once relatively common and widespread along Arizona's larger rivers and streams, but mature bosque habitat has become relatively rare. The preservation and active management of this site will facilitate the development and maintenance of this habitat.
Site B - PZ Ranch Southern Mesquite Field Site B - PZ Ranch Southern Mesquite Field (Restoration)	28.2	Former agricultural field on the eastern bank of the San Pedro River. This field is within an existing Corps mitigation site. In 1993, the field was planted with containerized mesquite. The portion of this field included here represents excess mitigation area not needed for the original project. The functional values of this site have increased as indicated by a measurable increase in vegetative cover. The restoration area is part of the San Pedro River riparian corridor and is contiguous with other Corps mitigation sites and conservation areas managed by the Bureau of Reclamation.
Site C - PZ Ranch Northwestern Mesquite Field (Restoration)	25.8	Adjacent to an existing Corps mitigation site on the western bank of the San Pedro River and included within the fenced boundary of that mitigation site. Active management of this site will exclude cattle from the site, restrict fuel-wood- and other wood-harvesting, and restrict off-road vehicle access to enhance its riparian habitat values. The site is vegetated by patches of native mesquite and an understory of native forbs and shrubs mixed with weedy forbs. Portions of the site are associated with prior agricultural practices, and it appears that fuel-wood-harvesting occurred at some point in the past. Proposed restoration activities will include the control of weedy non-native plant species (principally saltcedar [*Tamarix* spp.]), planting native mesquite trees, and seeding with native plant species. These activities will restore the functional values of the site as a riparian buffer for the San Pedro River.
Site D – San Pedro River Active Floodplain (Preservation)	14.1	Area within the active floodplain of the San Pedro River adjacent to an existing Corps mitigation site on the western bank of the San Pedro River. The dominant vegetation is saltcedar, although cottonwoods are also present. The site will be actively managed to exclude livestock and off-road vehicle traffic to enhance its riparian value.

3.15.2.3 Effects of the Hackberry Gulch Wash TSF Alternative

The Hackberry Gulch TSF would cause direct habitat loss in the area of disturbance. See **Table 2-2, Summary of Hackberry Gulch TSF Alternative**. General effects on wildlife would be similar to those described for the Ripsey Wash TSF Alternative.

3.15.2.3.1 Habitat Loss and Fragmentation

These impacts would be the similar to those described for the Ripsey Wash TSF Alternative except there would be no impact associated with the relocation of the Florence Kelvin Highway or the Arizona Trail.

3.15.2.3.2 Displacement of Wildlife

These impacts would be the similar to those described for the Ripsey Wash TSF Alternative, except the footprint of the Hackberry TSF site would be slightly smaller

3.15.2.3.3 Wildlife Mortality

These impacts would be the similar to those described for the Ripsey Wash TSF Alternative.

3.15.2.3.4 Wildlife Exposure to Contaminated Surface Water

These impacts would be the similar to those described for the Ripsey Wash TSF Alternative.

3.15.2.3.5 Increased Competition for Wildlife

These impacts would be the similar to those described for the Ripsey Wash TSF Alternative.

3.15.2.3.6 Special Habitat Features

Within the Hackberry Gulch TSF site there are 11 seeps, two springs, one water well, and one stock tank that would be lost with this alternative. Most of these provide at least a seasonal source of surface water for wildlife and five of the identified seeps support perennial surface water sources with associated riparian and wetland vegetation, which would also be lost with this alternative. The extent of wildlife use of these water sources and the availability of off-site water sources (aside from the Gila River) is unknown, but the loss of these water sources could adversely impact wide-ranging wildlife species beyond the actual footprint of the Hackberry Gulch TSF site. Diversion channels and detention ponds created to route and treat surface water runoff around the Hackberry Gulch TSF site may create seasonal survey water sources available to wildlife after storm events.

The Gila River and adjacent riparian habitat is separated from the Hackberry Gulch TSF site by State Route 177, and given this and the distance between the Hackberry Gulch TSF site, construction and operation of the TSF site is unlikely to have any indirect effects on wildlife use of the Gila River corridor.

Effects to wildlife as a result work in the areas proposed for waters of the U.S. mitigation (**Appendix J, Compensatory Mitigation**) would be essentially the same as described in Section 3.15.2.2.6, Special Habitat Features.

3.15.2.3.7 Mammal and Bird Species of Economic and Recreational Importance (SERI)

These impacts would be the similar to those described for the Ripsey Wash TSF Alternative except that the Hackberry Gulch has been given a lower SERI rating than the Ripsey Wash TSF site.

3.15.2.3.8 Predators, Furbearers, and Other Mammals

These impacts would be the similar to those described for the Ripsey Wash TSF Alternative, except there would be no bridge or pipeline crossing of the Gila River with the Hackberry Wash Alternative and no possible adverse effects to American beaver use of the Gila River.

TSF site development and operation would result in the burial of only one abandoned mine feature (Hackberry shaft) within the TSF site footprint. This shaft exhibited no evidence of bat use and possible evidence of occasional owl perching use. Therefore the Hackberry Gulch alternative is unlikely to have any adverse effects on regional bat populations or owl nesting use.

3.15.2.3.9 Raptors

These impacts would be the similar to those described for the Ripsey Wash TSF Alternative.

3.15.2.3.10 Waterbirds

These impacts would be the similar to those described for the Ripsey Wash TSF Alternative.

3.15.2.3.11 Other Migratory and Resident Birds

These impacts would be the similar to those described for the Ripsey Wash TSF Alternative.

3.15.2.3.12 Reptiles and Amphibians

These impacts would be the similar to those described for the Ripsey Wash TSF Alternative. However, loss of five seeps and supported areas of surface water and riparian and wetland habitats would result in the loss of any local amphibian populations possibly breeding in these habitats.

3.15.2.3.13 Gila River Associated Aquatic Species

These impacts would be the similar to those described for the Ripsey Wash TSF Alternative, except there would be no bridge or pipeline construction over the Gila River.

3.15.2.3.14 BLM Sensitive and State Wildlife Species of Concern (WSC)

These impacts would be the similar to those described for the Ripsey Wash TSF Alternative but for two exceptions. There would be no abandoned mine features affected by the Hackberry Gulch TSF alternative that support bat day roosting activity, and some of the more perennial springs and associated surface water areas in the Hackberry Gulch TSF footprint may provide suitable habitat for lowland leopard frog, a BLM sensitive and AGFD WSC species. Therefore, potential adverse impacts to these species would be increased with the Hackberry Gulch TSF alternative.

3.15.2.3.15 Threatened, Endangered, Proposed, and Candidate Species

Impacts to threatened, endangered, proposed, and candidate species for the Hackberry Gulch alternative would be relatively similar to the Ripsey Wash TSF `alternative except there would be no need for construction of the tailings pipeline bridge crossing the Gila River. As a result, the Hackberry Gulch TSF alternative would not have the potential for directs adverse impacts to SWFL and yellow-billed cuckoo foraging, breeding, nesting habitat, and designated or proposed Critical Habitat.

Water's of the U.S. and Threatened and Endangered Species mitigation at the four selected offsite mitigation areas would be the same for the Hackberry Gulch TSF alternative as described previously for the Ripsey Wash TAF alternative.

3.16 DESIGN CONSIDERATIONS / ACCIDENTS AND SPILLS

Protect worker health and safety. *Areas of concern include: (1) health and safety risks from the construction and operation of a tailings storage facility (compliance with Arizona BADCT); (2) the possibility of an accident that would necessitate an emergency response; (3) the potential for an accidental spill of tailings or other substances that could impact the environment, especially to the Gila River; and (4) TSF regulatory design requirements.*

3.16.1 Design Considerations

The engineering design of the TSF embankment and seepage control system and other associated structures such as the detention dams, diversion channels and ponds must be in compliance with the Arizona DEQ APP regulations and guidelines. The APP considers geotechnical, geohydrological and stability issues.

The Arizona DEQ specifies criteria in the APP application that the TSF design must meet Arizona BADCT. Specific criteria and the process to be followed in selecting Arizona BADCT are presented in the Arizona Mining Guidance Manual BADCT (ADEQ 2004) and in compliance with Arizona Revised Statue (ARS) 40-243.B.1.

This statute requires that permitted facilities must comply with Arizona BADCT in their design, construction andoperation. The requirements of the Arizona BADCT are met, according to ARS 49-243.B.1, if it is demonstrated:

> *"That the facility will be so designed, constructed and operated as to ensure the greatest degree of discharge achievable through application of the best available demonstrated control technology, processes, operating methods or other alternatives, including, where practicable, a technology permitting no discharge of pollutants. In determining BADCT, processes, operating methods or other alternatives the director shall take into account site specific hydrologic and geologic characteristics and other environmental factors, the opportunity for water conservation or augmentation and economic impacts of the use of alternative technologies, processes or operating methods on an industry-wide basis."*

In its review of the design for the Ripsey Wash TSF, the Arizona DEQ focused on seepage control to prevent discharge of potential pollutants to the environmental, as well as up-gradient stormwater handling and diversion.

3.16.1.1 Tailings Embankment Design and Construction Methods

The type of design and construction methods selected for a tailings embankment depends on prudent engineering that includes safety, technical components, logistical constraints, environmental aspects, regulatory requirements and economic considerations.

It is important to maintain a low phreatic surface in the embankment section. Embankments comprised of drained tailings materials should be designed and constructed to route the water fraction of the tailings away from the upstream embankment to eliminate the possibility of saturating the embankment, which could create stability issues. Both the Ripsey Wash and Hackberry Gulch TSF embankments have been designed to route water away from the upstream embankment face.

Tailings design engineers consider the seismic conditions in the technical analysis, because harmonic motions induced by earthquakes could influence embankment integrity. Seismic conditions are important in tailings embankment design work because there is a potential for a saturated embankment to "liquify" and potentially fail during an earthquake event. The Ripsey Wash and Hackberry Gulch TSF facilities are located in a region of Arizona with low seismic activity. See Section 3.3.1.3, Geotechnical Considerations.

For both the Ripsey Wash and Hackberry Gulch TSFs, Asarco plans to excavate earth and rock materials from the eventual footprint of the TSF (or from nearby areas) to construct a tailings starter embankment. This starter embankment is designed to contain tailings for the first few years of operation. Subsequent embankment lifts for the Ripsey Wash or Hackberry Gulch TSFs would be constructed of drained tailings.

There are three distinct construction methods used to add subsequent “lifts” on the starter embankment. These are:

- Downstream Construction;
- Upstream Construction; and,
- Centerline Construction.

Downstream Construction. In the downstream method, material used for subsequent lifts generally consist of earth or rock material, which is placed, starting at the downstream base of the embankment, then added in lifts to raise the top of the embankment. This method requires large volumes of material and increases the footprint of the embankment. The downstream method is generally considered to be the method with the lowest failure risk.

Upstream Construction. The upstream method is used in regions with low seismic potential. In the upstream method, the strength of the relatively dense, non-liquefiable tailings is used support the embankment lift. This method has the advantage of reduced embankment material, and subsequent embankment raises are contained within the TSF footprint. The disadvantage of this method is the potential risk of failure if the tailings materials forming the embankment become saturated. See Section 2.3.3.2, Upstream Construction.

Centerline Construction. The centerline construction method raises the tailings embankment vertically. In this method, it is also necessary to keep water away from the upstream embankment face. Drained tailings materials are used to construct each embankment lift. More tailings materials are required to construct the embankment than the upstream construction method. See Section 2.3.3.1, Centerline Construction.

For either the Ripsey Wash or Hackberry Gulch TSFs, Asarco plans to raise the starter dam by first using the centerline method, then transitioning to the upstream method. Asarco would initiate upstream construction techniques when the tailings impoundment becomes large enough so that the coarse sand fraction of the tailings has sufficient time to dry or “set-up”.

The Arizona DEQ has approved the APP for the Ripsey Wash TSF. The approved APP complies with Arizona BADCT stability criteria. If the Corps selects the Hackberry Gulch TSF as the preferred alternative, Asarco would be required to obtain an APP from the Arizona DEQ for that facility.

3.16.1.2 Seepage Control

Arizona BADCT guidelines for copper mining in Arizona discuss the use of soil and synthetic liners (with and without leak detection), with the stated purpose to prevent tailings seepage from impactinggroundwater. Given low precipitation associated with the arid and semi-arid climate in many areas of Arizona, the use of liners is contingent on the geology and resulting geohydrology of each individual TSF site. TSF sites that have a permeable underlying geology where seepage might enter underlyinggroundwater and/or downstream surface water may require the use of liners and leak detection.

The Ripsey Wash TSF is underlain by a competent, low permeable bedrock, known as the Ruin Granite. Decant water seepage at this Ripsey Wash TSF site would principally be contained in the underlying alluvium andcolluvium material (rather than enter the low-permeable bedrock). As discussed in Section 2.3, Ripsey Wash TSF: Proposed Action, Asarco plans to construct seepage control/collection trenches down-gradient of the TSF; these trenches would capture seepage throught the alluvium/colluvium material, where it would be pumped to double-line reclaim ponds and then pumped (recycled) back to the Ray Concentrator for reuse in the processing or pumped back to the tailings impounment. The Arizona DEQ approved this seepage control and collection process as BADCT for the Ripsey Wash TSF. Given the above-described geology and geohydrology system in the Ripsey Wash area, the Arizona DEQ did not believe that a liner system would be needed at this site.

3.16.1.3 Up-Gradient Stormwater Diversion

Both the Ripsey Wash and Hackberry Gulch TSFs would be constructed of tailings using both centerline and upstream methods. Tailings would be deposited to form "beaches" that would compel decant water to flow to the rear of the TSF. This tailings disposal process would prevent water from pooling against the upstream face of the tailings embankment. It is important that water not pool next to the face of the embankment for stability reasons.

In addition, to prevent upgradient water from entering the TSF (which could create water balance challenges and the obligation to unnecessarily handle water in a closed-loop system, Asarco would construct and maintain up-gradient detention dams and diversion structures to divert stormwater runoff around the tailings facility. The Ripsey Wash TSF main detention dam would ultimately be constructed to contain the runoff from a PMP storm event, thus preventing any upgradient stormwater runoff from entering the TSF.

The Hackberry Gulch TSF diversion structures would be designed, constructed and operatedin a similar manner as those approved by the Arizona DEQ for the Ripsey Wash TSF in the APP for the site. If the Hackberry Gulch TSF is selected as the preferred alternative for this NEPA analysis, Asarco would be required to obtain an APP for this site, and the Arizona DEQ would have to be satisfied that the design, construction methods and operational measures for the Hackberry Gulch TSF would meet Arizona BADCT before an APP could be approved.

3.16.1.4 Ripsey Wash TSF Design Parameters

Design parameters and capacities to establish Arizona BADCT compliance for the major structures associated with the Ripsey Wash TSF are shown below:

Table 3-72, General Design Parameters and Capacities

Description	Capacity	Depth
Ripsey Wash TSF	750 million tons of tailings	555 feet (maximum dam height)
Main Reclaim Pond	119.69 acre-feet	25 feet
East Reclaim Pond	23.63 acre-feet	16.5 feet
Drain-Down Pond	21.11 acre-feet	13.5 feet
Source: Ripsey Wash APP, Attachment 25E.		

Arizona BADCT has been demonstrated for the following Ripsey Wash TSF structures: (Source APP, Attachment 25E)

- Seepage collection trench in Ripsey Wash;
- Cut-off wall in the east drainage;
- Treatment of Hackberry fault in Ripsey Wash;
- Slime sealing (cycloned fines) beneath the decant pond;

- Cycloned tailings embankment construction to obtain a non-liquefiable stability zone;
- Routing of stormwater from up-gradient areas around the TSF;
- Control and collection of stormwater runoff from the down-gradient slopes of the tailings embankments; and,
- Design and implementation of a comprehensive Construction Quality Control Plan.

Main Reclaim Pond:

- Storage capacity of 34.5 million gallons (105.88 acre-feet) with sufficient capacity to handle the 100-year/24-hour stormwater runoff from the down-gradient tailings embankment and surrounding facility area. Total capacity provided is 39.0 million gallons (119.69 acre-feet);
- Two feet of freeboard;
- Side slopes of 3 horizontal to 1 vertical (3H:1V); and,
- Composite double liner system with an LCRS (leak detection) over prepared subgrade.

East Reclaim Pond:

- Storage capacity of 6.4 million gallons (19.64 acre-feet) with sufficient capacity to handle the 100-year stormwater runoff from the down gradient tailings embankment and surrounding facility area. Total capacity provided is 7.7 million gallons (23.63 acre-feet);
- Two feet of freeboard;
- Side slopes of 3H:1V; and,
- Composite double liner system with an LCRS (leak detection system) over prepared subgrade.

Drain Down Pond:

- Storage capacity of 5.55 million gallons (17.03 acre-feet) with sufficient capacity to handle the 100-year/24-hour stormwater runoff from surrounding drainage area. Total capacity provided is 6.88 million gallons (21.11 acre-feet),
- Two feet of freeboard;
- Side slopes of 3H:1V;
- Composite double liner system with an LCRS (leak detection system) over prepared subgrade; and,
- Base of the drain-down pond covered with 1 foot of reinforced concrete.

TSF Closure Stormwater and Seepage Control:

- Stormwater controls will remain until reclamation is complete and approved by ADEQ.
- Seepage control trenches and reclaim ponds will remain operational until reclamation is approved by ADEQ.

Major Ripsey Wash TSF structures are shown on **Figure 2, Site Plan Layout - Ripsey Wash TSF**.

ADEQ will review and approve detailed construction-level drawings for the Ripsey Wash TSF, which Asarco must complete prior to construction of the facility. The construction-level drawings will be completed under the supervision of an Arizona registered professional engineer qualified in the development of such engineering design. Throughout the development of these construction-level documents, Asarco will retain third-party professional engineering review for quality control and safety assurance.

The approved APP for the Ripsey Wash TSF contains design level drawings for the following structures:

- Main & East Starter Embankment;
- Main & East Tailings Embankment;
- Hackberry Fault Mitigation;
- Main & East Seepage Control Trenches;
- Main & East Reclaim Ponds;
- Pipeline Draindown Pond;
- East Diversion Channel;
- Stormwater Ponds;
- Up-Gradient Diversion Dam; and,
- Closure ponds

To demonstrate compliance with Arizona BADCT and other Arizona DEQ requirements, Asarco provided the Corps with following engineering design documents and technical memorandums:

- Arizona DEQ, Aquifer Protection Permit (APP) No. 511395 – Initially Submitted in 2014 – Approved 2016. The APP contains design drawings of the structures such as the upstream detention dam, the east diversion channel, stormwater ponds, reclaim ponds, seepage control trenches, TSF embankment and the drain-down pond. Also included in the APP is the TSF monitoring requirements and requirements for temporary cessation, final closure and the closure cost estimate.
- Arizona DEQ, Responses to Other Agency and General Public comments on the APP application No. 511395 dated May 12, 2016.
- Surface Water Controls, Technical Memorandum and Appendices, Proposed Ripsey Wash Tailings Storage Facility & Impoundments; AMEC, May 12, 2014. This document provides information on the hydrology (design storm, i.e. pump, 500 year/24 hour, 100 year/24 hour) used in volume and design peak flow calculations for the upstream detension dam the diversion channels, reclaim ponds, stormwater ponds and contact structures, and the hydraulics; channel and pond design (dimensions, side slopes, channel slope and erodibility factors). This document is submitted to the Arizona DEQ in support of the required AZNPDES permit.
- APP Requirements for TSF Embankment Stability, ASARCO LLc – Ray Operations, Technical Memorandum, AMEC, September 29, 2016. This document provides Arizona BADCT Stability criteria used in the design of the Ripsey Wash TSF and required by the Arizona DEQ. Criteria such as static stability, dynamic stability and geotechnical stability are provided.
- Engineering Analysis – Ripsey Wash Tailings Storage Facility, 1D – Water Balance Model. This document addressed the water balance within the tailings after TSF closure.
- Abandonded Mine Features, Ripsey Wash Tailings Storage Facility, Asarco Ray Operations, Pinal County, Arizona; AMEC October 4, 2016. This document was prepared in response to comments concerning abandonded exploration adits, trenches and shafts found within the TSF footprint.
- Review of Best Management Practices, Tailings Storage Practices Dust Mitigation Strategies, Technical Memorandum, AMEC, September 29, 2016. This document was prepared in response to comments on the DEIS.

If the Hackbery Gulch TSF alternative is chosen as the preferred alternative in this NEPA analysis, Asarco would have to complete an APP application for the design, construction, operation and reclamation of this facility, and the application must be reviewed and approved by the Arizona DEQ for compliance with Arizona BADCT.

3.16.2 Accidents and Spills

There are an infinite number of accident and spill scenarios that could be developed for a TSF project. Analysis of such scenarios can include varying levels of complexity and portray a variety of results.

The discussion in this section provides an assessment of risk from potential accidents and spills associated with a TSF. For a related perspective example, an accident assessment of a trip in an automobile or an airplane could be very frightening. We know that, but we continue to take those trips anyway. However, the knowledge of a certain type of accident may persuade us to take extra precautions en route.

There is a difference between a predicted effect and a potential effect or risk. Predicted effects are specifically identified as such and have been discussed in the preceding sections in terms of magnitude and duration. Effects or risks that are not predicted, but which have a potential to occur have been selected and presented in this section. These potential effects are recognized and described to ensure that reasonable steps are taken to minimize or prevent them. Potential effects or risks are not predicted to occur, but they are merely presented as examples of the effects or risks that could be associated with a TSF.

3.16.3 Environmental Consequences

3.16.3.1 Effects of the No Action Alternative

There would be no potential for new TSF accidents and spills under the no action alternative, as neither the Ripsey Wash nor the Hackberry Gulch TSF would be constructed. Since the Ray Mine would continue operations, there could be accidents and spills associated with the ongoing mine operations.

3.16.3.2 Effects of the Ripsey Wash TSF Alternative

The following discussion does not predict numerical probabilities for an accident or spill event, but instead discusses the type and relative magnitude that could result. With respect to these considerations, the following accident and spill scenarios are presented:

- Tailings or reclaim water pipeline break or leak;
- Leak through the TSF seepage trenches and reclaim ponds;
- Tailings dam failure; and,
- Transportation spill.

3.16.3.2.1 Tailings Pipeline Break or Leak

A rupture of or a leak from the Ripsey Wash TSF tailings pipeline could cause varying effects. The magnitude of effects would depend on a number of conditions including the location of the spill, the volume of spill, clean-up response time and effectiveness, and weather conditions.

For example, if the tailings pipeline and its secondary containment ruptured on the bridge over the Gila River, causing tailings to spill into the Gila River, there could be impacts to aquatic life, riparian vegetation and wetland areas, and possibly waterfowl. However, the likelihood of this event is very remote as the tailings pipeline across the Gila River would be sleeved within secondary containment, which would allow any tailings pipeline leakage or breakage to gravity drain to a lined tailings drain-down pond located on the northeast side of the Gila River. In addition, any tailings pipeline rupture or leakage would trigger an immediate shut-down of tailings pumping until the problem is fixed.

3.16.3.2.2 Leak through the TSF Seepage Trenches and Reclaim Ponds

The likelihood of a leak through the Ripsey Wash TSF seepage trenches or reclaim ponds causing down-drainage environmental problems to the Gila River is very low. The seepage trench systems on the Ripsey Wash drainage and the unnamed east side drainage have been designed and would be constructed to intercept any seepage through alluvium material in the major washes down-drainage of the TSF sites. The design and proposed construction techniques are based on protocol that would be approved by Arizona DEQ for the APP permit. The reclaim ponds downgradient of the seepage trenches would incorporate an engineered double synthetic liner system, which would include a leak detection system to detect any leakage through the liner system. In addition, Asarco plans to implement special precautions against leakage in the area of the Hackberry fault zone. If such leakage was detected beneath the Ripsey Wash TSF, the leakage water would be returned to the reclaim ponds to be pumped back to the Ray Concentrator or back to the tailings impoundment.

Wells down-drainage of the Ripsey Wash TSF seepage trenches, reclaim ponds and Hackberry fault internal containment structure would be monitored for water quality standards set by Arizona DEQ for the APP permit. Should a contamination problem in excess of APP permit standards be detected, mitigation measures such as pump-back of groundwater to the TSF from the wells down-gradient of the facility; installation of additional seepage containment structures; maintenance on existing containment facilities; and/or other appropriate measures would be required by the Arizona DEQ to stop or mitigate the contamination.

3.16.3.2.3 Tailings Dam Failure

A tailings dam failure could be initiated by circumstances such as a catastrophic event (earthquake, flood, etc.), a design or construction flaw, or oversaturation of the tailings embankment. These could result in severe structural damage to the embankment causing a breach or break in the embankment.

Two modes of failure are considered in this section: (1) Earthquake induced embankment failure (flow slide failure) and (2) dam breach by overtopping. Given engineering design, construction protocol and operational safeguards, these scenarios have an extremely remote possibility of happening. The Arizona DEQ has design oversight for tailings facilities within the state and reviews and approves the design of the facility. The Arizona State Mine Inspector and MSHA are responsible for safe operation of tailings facilities. See **Appendix C, Agency Responsibilities (Regulatory Framework)**.

3.16.3.2.3.1 Earthquake Inducted Failure

As explained in Section 3.3, Geology and Geochemistry, this region of Arizona has a low seismic risk. Strict safety procedures and precautions are mandated for construction and operation of a TSF, including the design of the facility to withstand a maximum credible earthquake (MCE) for this region of Arizona.

Unsaturated and compacted tailings embankments exhibit satisfactory behavior under intense earthquake loadings. Considering that dissipation of pore pressure across the embankment through drainage systems during centerline construction by chimney and blanket drains and the control of phreatic surface within the embankment. The TSF embankment would be capable of undergoing the design earthquake without a realistic possibility of a failure that would trigger an uncontrolled release of the tailings.

Although the plans are to design and construct a TSF embankment to withstand expected seismic events for the region, the TSF embankment could experience erosion, planar or cylindrical failures under more extreme events. An embankment failure could result in a flow slide failure of the tailings material within the embankment itself and/or in the impoundment behind the embankment.

A flow slide failure is essentially a mud slide, resulting from a partial or total embankment collapse, which could release part of the tailings deposit. The total release of tailings from the facility would be extremely unlikely, unless that the tailings were conservatively assumed to be in a total fluid state, which would not be the case. Under the proposed operating conditions, the tailings are expected to be drained and consolidated in the area of the embankment and impossible to liquefy. However, the extremely conservation assumption of total liquification would cause failure of the TSF embankment and tailings to flow (like a mud flow) down the ephemeral washes beneath the facilities. In this case, some tailings could flow into the Gila River.

3.16.3.2.3.2 Dam Breach by Overtopping

This would be an erosional failure caused by overtopping of the tailings embankment by flood events. Overtopping typically would result when the volume of run-on entering the tailings impoundment exceeds the capacity of the impoundment. This is an extremely unlikely scenario since one must assume either huge storm events or improper design or construction of detention and diversion of surface water around the TSF.

Tailings material that is situated five to ten feet below the level of tailings in the impoundment would be very unlikely to join a breach flow; however, the upper layer of tailings might be sufficiently saturated to flow, and the depth of any breaching would be assumed to stop somewhere in that range of depth. Lower tailings would be compressed. Since the TSF would be built in stages or lifts with tailings added during each stage or lift, the impoundment would never fill entirely with water.

Should the tailings embankment breach, a dam-break wave of saturated tailings would progress down-drainage of the TSF. The time from initial overtopping to breaching would undoubtedly be very short. The peak discharge would occur very rapidly, probably within minutes after the breaching starts. On both action alternatives, the peak flow of saturated tailings would probably reach the Gila River.

The magnitude of the impacts to vegetation, wetlands, wildlife, aquatic life and personal property is difficult to predict other than it is realized that environmental and property destruction would occur. Human life, personal property and domestic water sources in the washes and the down-drainage reaches of the Gila River would be in jeopardy. There would be loss of wildlife, aquatic life and wetlands with the downstream floodplain of the Gila River, and the erosional effects of the peak flow would be severe.

Within the flow slide area, vegetation, wetlands and aquatic habitats would be damaged or destroyed. Based on the geochemical testing of the tailings solids, there would be no toxic impacts, only the inundation of very fine-grained material within the slide zone. The impacts would remain until cleanup and restoration is completed.

3.16.3.2.4 Transportation Spill

An accident involving a diesel fuel tanker truck or a diesel fuel spill during the fueling process could cause varying effects. Any diesel fuel spill that reached Gila River could spread fuel downstream if containment measures, such as placement of oil booms, installation of temporary dikes, removal of the fuel source, etc. are not initiated quickly. There could be adverse impacts to aquatic life, riparian and wetland areas, and possibly waterfowl. Other effects that could possibly occur might be damage to private property and contamination of domestic water supplies in close proximity to the Gila River. The magnitude of effects would depend on a number of conditions including:

- Accident severity and volume of spill;
- Integrity of the transport containers;
- Clean-up response time and effectiveness;
- Weather conditions;
- Local soil and vegetation types;
- Proximity of accident to a drainage, in particular the Gila River; and,
- Volume of the receiving water body.

Isolated spills of diesel fuel could result in soil or vegetation contamination that could result in the affected soil or vegetation requiring removal and appropriate treatment. Spills would be handled in compliance with on-site SPCC plans, with affected soils disposed of according to those plans. It is expected that the area and volume of soils impacted by isolated spills would be limited, with a minor overall effect.

3.16.3.3 Effects of the Hackberry Gulch TSF Alternative

The potential for accidents and spills for the Hackberry Gulch TSF alternative would be essentially the same as addressed in Section 3.16.2.2, Effects of the Ripsey Wash TSF Alternative. There would be three primary differences for the Hackberry Gulch TSF Alternative versus the Ripsey Wash TSF Alternative.

First, the tailings and water return pipelines for the Hackberry Gulch TSF Alternative would not cross the Gila River, so there would be no potential for a break in pipelines that cross the river (because there would be no pipeline bridge).

Second, the Hackberry Gulch TSF Alternative would have seven seepage collection trenches and seven reclaim ponds (and the piping and ditching associated with these facilities), as compared to two seepage trenches and two reclaim ponds for the Ripsey Wash TSF Alternative. Having more seepage trenches, reclaim ponds, pipelines and ditches does not necessarily mean that there would be accidents or spills, but the increased number of these facilities does add design, construction and operational complexity.

Third, State Route 177 parallels (and is immediately downgradient of) the proposed Hackberry Gulch TSF embankment. In the event of a tailings dam failure, tailings could reach and cover portions of State Route 177. If vehicles happen to be traveling on State Route 177 at the time of the failure, there could be loss of life or injuries to people, as well as damages to vehicles. Depending on the size and extent of a tailings failure, tailings could reach and cause property damage to residences located downgradient of the Hackberry Gulch TSF between State Route 177 and the Gila River. This has the potential for loss of life and injuries to residents.

3.17 IRREVERSIBILE AND IRRETRIEVABLE RESOURCE COMMITMENT

3.17.1 Overview

Irreversible resource commitments are those that cannot be reversed (loss of future options), except perhaps in the extreme long-term. It relates primarily to non-renewable resources, such as minerals or cultural resources or those resources that are renewable only over long periods of time, such as mature desert vegetation. A tailings facility covers soils material, and this would result in an irreversible loss of that resource.

Irretrievable resource commitments are those lost for a period of time. An example here is the loss of area for livestock grazing until the site is closed and some form of vegetation returns to the area of disturbance.

3.17.2 Environmental Consequences

3.17.2.1 Effects of the No Action Alternative

There would be no potential for irreversible and irretrievable resource commitments under the no action alternative, as neither the Ripsey Wash nor the Hackberry Gulch TSF would be constructed.

3.17.2.2 Effects of the Ripsey Wash TSF Alternative

Use of land for the Ripsey Wash TSF would displace existing land uses. Existing grazing, wildlife habitat and recreation uses would be disrupted or eliminated during the estimated life of the tailings facility and for a long period thereafter. Closure and the return of vegetation through natural reclamation, land uses might eventually return to some resemblance of current uses, but this would take a long time for some resources such as mature wildlife habitat, which may never occur.

The irreversible commitment of resources associated with the Ripsey Wash TSF would include the consumption of non-renewable energy, such as diesel fuel and gasoline, during the construction, operation and closure of the TSF.

The soils overlying the surface of the Ripsey Wash TSF site would be buried by tailings deposition resulting in a permanent loss of productivity. Similarly, the soils overlying adjunct facility sites and reroute disturbances where the facilities would remain on the surface following site closure would also result in a permanent loss of soil productivity. These areas include detention dams and diversion structures, various facility ponds, and the reroute of the Florence-Kelvin Highway. Soil materials lost as a result of erosion during construction and prior to the application of rock cover would also be an irreversible commitment of the soil resource.

The topography would be permanently altered by the creation of the Ripsey Wash TSF. This would result in an irreversible loss of the current scenic quality, as viewed from the Arizona Trail, Florence-Kelvin Highway, and dispersed recreation sites. The contrasting form, line, color, and texture created by the TSF would represent an irreversible commitment of visual resources, since it would continue to be a highly dominant feature in the landscape. It is unlikely the Ripsey Wash or Hackberry TSF sites would be attractive for dispersed recreation after closure due to its flat surface and presence of solar panels.

The relocated Florence-Kelvin highway associated with Ripsey Wash TSF would create a permanent change in the character of the area, affecting portions of the Arizona Trail corridor.

Although the Hackberry Gulch TSF would create a permanent extension of the existing contrasting elements of the Ray Mine and Elder Gulch TSF, this TSF would be visible primarily from the SR 177 and the Arizona Trail corridors, but it would not require relocation of the Arizona Trail. Contrasts in color and texture under both TSF alternatives would be reduced as the natural revegetation process occurs over time, but this would occur very gradually over a long period of time and likely would not eliminate all contrasts entirely. As the vegetation gradually reduces color and texture contrasts, the contrasting form and line would be less noticeable. The addition of solar panels post-closure would create contrasts in form, line, color, and texture.

There would be a permanent loss of several primitive roads used by OHV users and dispersed recreation areas used by local residents. Under Ripsey Wash TSF Alternative, the Arizona Trail and Florence-Kelvin

Highway Trailhead would need to be permanently relocated outside the area of proposed TSF disturbance. The new trail segment would be located on relatively steep terrain on the east side of the Tortilla Mountains and thus visible from the Gila River Valley. Views of the TSF would result in irreversible visual effects on recreation facilities within the project viewshed, including the Arizona Trail.

Noise generated by sporadic traffic on the relocated Florence-Kelvin highway could reduce the quality of the recreation experience for those using the Arizona Trail and other dispersed recreation sites. Noise generated by the construction and operation of the TSF could affect the recreational experience for those using the Arizona Trail during the construction period and life of the TSF.

Cultural sites within the footprint of the TSF site would be lost; however, research values would be recovered prior to the physical loss.

The loss of specific surface water features buried by the Ripsey Wash TSF would be irreversible and irretrievable.

Although the results Asarco's condemnation drilling at the Ripsey Wash TSF site revealed no mineralized copper resources beneath the locations of the proposed TSF, federal mineral estate would be buried beneath tailings. This action would effectively preclude future mineral resource development beneath the facilities.

The loss of groundwater recharge to the Gila River alluvium from watersheds of the ephemeral washes where the Ripsey Wash TSF site would be located would represent an irreversible impact.

Tailings placed in the Ripsey Wash TSF would bury wells and could cause a reduction in water yield from wells down-gradient of the facility; these impacts would be irreversible and irretrievable.

Vegetation would be either removed (in the areas of the tailings embankment, reclaim ponds, drain-down ponds, and detention dams) or buried in the areas to be used for the TSF. This would result in the irretrievable commitment of vegetation. The tailings would become revegetated to some degree, but the site would never have the species composition or density of vegetation as that site currently exists.

There would be long-term irretrievable loss of land use at the Ripsey Wash TSF site, as the return to pre-project land use of dispersed recreation and wildlife habitat would not happen to the same extent as currently exists because the TSF will be covered with rock and only sparse vegetation is expected to return, and even that condition would only occur many years after full site closure.

The Ripsey Wash TSF activity would displace wildlife with the area of direct disturbance (e.g., loss of habitat) and some wildlife within a larger area (e.g., reduced habitat effectiveness due to human presence and noise). These effects would likely cause a reduction in wildlife population. Upon closure and the incursion of natural revegetation, wildlife habitat would eventually be restored, but probably never the same quality and quantity that would be lost, and certainly not for a long period of time.

Recreation opportunities would be restricted with the area of the Ripsey Wash TSF site, and these recreation values would be displaced to other sites during TSF construction and operation. Upon closure, dispersed recreation opportunities would be less that currently exists.

Wildlife habitats and populations within the disturbance footprint of the Ripsey TSF site and permanent adjunct facilities (detention dams, diversion structures, reclaim ponds, pumping structures, the Florence-Kelvin highway reroute, and any quarries outside the TSF footprint) would be buried resulting in a long-term loss of these resources.

3.17.2.3 Effects of the Hackberry Gulch TSF Alternative

The potential for irreversible and irretrievable resource commitments for the Hackberry Gulch TSF alternative would be essentially the same as addressed in Section 3.17.2.2, Effects of the Ripsey Wash TSF Alternative. There would be two primary differences for the Hackberry Gulch TSF Alternative versus the Ripsey Wash TSF Alternative. First, the Arizona Trail would remain in its existing location under the Hackberry Gulch TSF Alternative. Second, the Florence-Kelvin highway would not be relocated under the Hackberry Gulch TSF Alternative.

3.18 UNAVOIDABLE ADVERSE IMPACTS

There are unavoidable impacts that would occur as a result of tailings disposal. Some of these effects would be short-term (during operations), while others would be long-term (extending well into the future beyond tailings closure) or permanent.

3.18.1 Effects of the No Action Alternative

There would be no unavoidable adverse impacts under the no action alternative, as neither the Ripsey Wash nor the Hackberry Gulch TSF would be constructed.

3.18.2 Effects of the Ripsey Wash TSF Alternative

The following are unavoidable adverse effects that could occur with construction, operation and closure of the Ripsey Wash TSF:

- The generation of fugitive dust during construction (short-term) and during and following operation (long-term);
- The loss of soil productivity through burial, profile mixing and compaction (long-term and permanent);
- Loss of vegetation within the area of TSF disturbance (long-term);
- Loss of waters of the U.S. (short and long term, and permanent beneath the tailings);
- The consumption of water resources (short-term);
- The loss of a portion of the Arizona Trail under the footprint of the Ripsey Wash TSF (long term and permanent);
- Visual and noise effects on approximately 6.4 miles of the Arizona Trail's Gila River passage from relocation of the Florence-Kelvin highway (long term and permanent);
- The loss of several primitive roads used by OHV users and dispersed recreation acreage and displacement of recreation to nearby areas (long-term);
- The burial of cultural resources (long-term and permanent);
- The permanent alteration of topography (long-term and permanent);
- The loss of stormwater runoff from the footprint of the TSF sites during construction and operation (short term and long term);
- Increased road traffic (short-term); and,
- The loss of wildlife habitats and associated wildlife populations through permanent burial of the TSF and associated facility sites (short-term and long-term). Unavoidable impacts are also associated with the clearing of selected facility sites such as the diversion structures, pipeline corridor, electric transmission line structure base areas, and the rerouted segment of the Florence Kelvin highway road where vegetation would be cleared but not restored.

3.18.3 Effects of the Hackberry Gulch TSF Alternative

The potential for unavoidable adverse effects for the Hackberry Gulch TSF alternative would be similar to those addressed in Section 3.18.2, Effects of the Ripsey Wash TSF Alternative. The following are unavoidable adverse effects that could occur with construction, operation and closure of the Hackberry Gulch TSF:

- The generation of fugitive dust during construction (short-term) and during and following operation (long-term);
- The burial of nine water wells and the potential reduction of yield from another seven down-gradient water wells from the construction and operation of the Hackberry Gulch TSF (long-term);
- The loss of soil productivity through burial, profile mixing and compaction (long-term and permanent);
- Loss of vegetation within the area of TSF disturbance (long-term);
- Loss of waters of the U.S. (short and long term, and permanent beneath the tailings);
- The consumption of water resources (short-term);
- The loss of several primitive roads used by OHV users and dispersed recreation acreage and displacement of recreation to nearby areas (long-term);
- The burial of cultural resources (long-term and permanent);
- The permanent alteration of topography, which would be visible from portions of the Arizona Trail (long-term and permanent);
- The loss of stormwater runoff from the footprint of the TSF during construction and operation (short term and long term);
- Increases in noise levels to residents of the community of Riverside during construction of Hackberry Gulch TSF (short-term);
- Increased road traffic (short-term); and,
- The loss of wildlife habitats and associated wildlife populations through permanent burial of the TSF and associated facility sites (short-term and long-term). Unavoidable impacts are also associated with the clearing of selected facility sites such as the diversion structures, reclaim ponds and pipeline corridors, where vegetation would be cleared but not restored

4.0 CUMULATIVE IMPACTS

This EIS chapter discusses the potential cumulative impacts that would occur with the construction, operation and closure/reclamation of either the Ripsey Wash or Hackberry Gulch TSF alternatives.

The Council of Environmental Quality (CEQ), in the NEPA regulations, defines cumulative impacts as "the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such 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 vary by resource, and the area that influences cumulative impacts can also vary for each resource area. For this cumulative impact assessment, the Corps considered the expected extent to which the environmental impacts (direct and indirect) for each environmental resource could be reasonably detected and then used this area to define a general cumulative effect area for each resource discipline. See **Table 4-1, Cumulative Effects Study Areas**.

Table 4-1, Cumulative Effects Study Areas

Resource Identification Number	Resource Discipline	Cumulative Effects Study Area
1	Air Quality	Actions within eastern Pinal County.
2	Climate Change	Actions that have national or global importance.
3	Soils	Actions within the same watersheds as TSF alternatives.
4	Geochemistry	Actions within the same watersheds as TSF alternatives.
5	Surface Water	Actions within the same watersheds as TSF alternatives.
6	Waters of the U.S.	Actions within the same watersheds as TSF alternatives.
7	Groundwater	Actions within the same watersheds as TSF alternatives.
8	Land Use	Actions within eastern Pinal County.
9	Noise	Actions within the same watersheds as TSF alternatives.
10	Recreation (including primitive roads)	Actions within geographic area examined for TSF alternatives.
11	Cultural Resources	Actions within the same watersheds as TSF alternatives.
12	Socioeconomics	Communities in eastern Pinal County, including communities of Kearny, Kelvin, Gold Canyon, Hayden, Riverside, Superior and Winkelman.
13	Environmental Justice	Same as socioeconomics above.
14	Transportation	Actions within Eastern Pinal County with particular focus on U.S. Highway 60, Arizona State Route 177, and the Florence-Kelvin highway.
15	Vegetation	Actions within the same watersheds as TSF alternatives.
16	Visual Resources	Actions within geographic area examined for TSF alternatives.
17	Wildlife	Actions within geographic area examined for TSF alternatives.
18	Accidents and Spills	Actions within same watersheds as TSF alternatives.

The locations of regional activities considered as part of this cumulative impact assessment are shown on **Figure 50, Regional Activities/Actions Locations Map** The description of these activities, including the Ray Mine operations, is set forth in **Appendix D, Regional Activity**.

Many of the regional actions and activities, in combination with the Ripsey Wash or the Hackberry Gulch TSF alternatives, would not contribute to meaningful or significant cumulative impacts of individual resource disciplines. Some actions and activities were deemed outside the area of cumulative effects for a particular resource. The Corps reviewed each of the identified regional actions and activities and screened them for their relevance to a cumulative impact assessment for the Ripsey Wash or the Hackberry Gulch TSF alternatives. See **Table 4-2, Relevant Activities and Resources Evaluated for Cumulative Impacts**.

Table 4-2, Relevant Activities and Resources Evaluated for Cumulative Impacts

Activity [1]	Relevant (yes or no)	General Basis of Selection for Evaluation	Resources Evaluated [2]
Exploration, Mining and Related Industrial Activity			
Ray Mine	Yes	Mining has been conducted in this area for over 100 years, is currently ongoing, and expected to continue at this site, if a new TSF is constructed, into the future (projected life of 50+ years).	1-18
Resolution Copper Project	Yes	This underground copper mining and processing project is proposed. NEPA anaylsis is currently underway (projected life of 60+ years).	1, 2, 5, 8, 12, 14
Hayden Concentrator	Yes	Operation of the Hayden concentrator has been operating for over 50 years and is expected to continue into the future (projected life of 30+ years).	5
Hayden Smelter	Yes	The smelter is expected to continue to operate into the future (projected life of 50+ years).	1
Transportation and Utilities			
U.S. Route 60	Yes	This highway will continue to be used into the future. The ADOT is upgrading this highway from 2 to 4 lanes from the Florence Junction to Superior, Arizona (projected life of highway – indefinite)	1, 9, 14
State Route 77	No	Outside the area studied for transportation.	None
State Route 177	Yes	This highway will continue to be used into the future (projected life of highway – indefinite).	9, 14
Florence Kelvin Highway	Yes	This highway will continue to be used into the future. Pinal County is working to build a new bridge over the Gila River to replace the existing bridge. The existing bridge will remain as a footbridge and become part of the Arizona Trail. Pinal County has long term intent to eventually pave the entire Florence-Kelvin highway with asphalt (projected life of highway – indefinite).	1, 9, 14
Copper Basin Railroad	Yes	This railroad is expected to continue to operate into the future (projected life – indefinite).	8, 9, 14

Table 4-2, Relevant Activities and Resources Evaluated for Cumulative Impacts (continued)

Activity [1]	Relevant (yes or no)	General Basis of Selection for Evaluation	Resources Evaluated [2]
Transportation and Utilities			
SCIP 69 kV Electric Line	Yes	A portion of the powerline to be re-routed if the Ripsey wash TSF is constructed. No alignment change under Hackberry Gulch TSF. (Projected life – indefinite).	8
Arizona Public Service 500 kV Electric Transmission Line	No	Outside the areas studied for visual resources, recreation and noise.	None
Recreation and Wilderness			
Dispersed Recreation	Yes	Dispersed recreation (including use of primitive roads) is expected to continue in this area into the future (projected life – indefinite).	1,2, 5, 7
Arizona National Scenic Trail	Yes	Recreationalists are expected to continue to use this trail into the future (projected life – indefinite).	3, 8, 15, 16
Bryce Thompson Arboretum	No	This facility is outside of area studied for recreation.	None
Superstition Wilderness	No	Outside of area where air quality, visual and recreation effects expected.	None
White Canyon Wilderness	Yes	Recreationists are expected to continue to use this nearby wilderness into the future (projected life – indefinite).	15,16
Needle's Eye Wilderness	No	Outside of area where air quality, visual and recreation effects expected.	None
Aravaipa Canyon Wilderness	No	Outside of area where air quality, visual and recreation effects expected.	None
Communities			
Apache Junction	No	Outside economic area of influence for Asarco Ray Mine TSF alternatives.	None
Gold Canyon	Yes	Within economic area of influence for Asarco Ray Mine TSF alternatives (projected life – indefinite).	8, 12
Hayden	Yes	Within economic area of influence for Asarco Ray Mine TSF alternatives (projected life – indefinite).	8, 12
Kearny	Yes	Within economic area of influence for Asarco Ray Mine TSF alternatives (projected life – indefinite).	8, 12
Kelvin	Yes	Within economic area of influence for Asarco Ray Mine TSF alternatives (projected life – indefinite).	8, 9, 12
Riverside	Yes	Within economic area of influence for Asarco Ray Mine TSF alternatives (projected life – indefinite).	8, 9, 12
Superior	Yes	Within economic area of influence for Asarco Ray Mine TSF alternatives (projected life – indefinite).	8, 12
Winkelman	Yes	Within economic area of influence for Asarco Ray Mine TSF alternatives (projected life – indefinite).	8, 12

Table 4-2, Relevant Activities and Resources Evaluated for Cumulative Impacts (continued)

Activity [1]	**Relevant (yes or no)**	**General Basis of Selection for Evaluation**	**Resources Evaluated [2]**
Agriculture			
Livestock Grazing	Yes	Within and adjacent to areas of Asarco Ray Mine TSF alternatives (projected life – indefinite).	5, 7, 8
Farming	No	Outside of area of influence for Asarco Ray Mine TSF alternatives.	None
Dams and Reservoirs			
Coolidge Dam-San Carlos Reservoir	Yes	The Coolidge Dam is located on the Gila River upstream of Asarco Ray Mine TSF alternatives (projected life – indefinite).	5
Ashurst–Hayden Diversion Dam	No	This facility is located on Gila River downstream of TSF alternatives and outside of area of influence from the TSF alternatives.	None
Miscellaneous			
Ray Land Exchange	Yes	Pending. Involves land exchange between BLM and Asarco (projected life – indefinite).	8,10
BLM Special Management Areas	Yes	Special management policies and regulations will apply to these areas (projected life – indefinite).	8

Notes:
1. See **Appendix D, Regional Activity**.
2. These numbers are from listing in Table 4-1, Cumulative Effects Study Areas, and represent the resource disciplines for which the cumulative impacts are discussed for the pertinent activity.

There would be no cumulative impacts under the no-action alternative, because neither the Ripsey Wash TSF or the Hackberry Gulch TSF alternative would be constructed and operated. Impacts under the no action alternative would occur are addressed in the individual resource areas discussed in Chapter 3, Environmental Analysis.

The potential cumulative impacts associated with the Ripsey Wash and Hackberry Gulch TSF alternatives would be similar, and they are addressed in the following subsections. Although similar, there would be some differences between the proposed action TSF alternatives. It should also be noted that large-scale mining and mineral processing activities have been conducted for over 100 years at the Ray Mine site, and these activities have and will continue to create changes to the topography and to environmental integrity of the area.

The Ripsey Wash TSF or Hackberry Gulch TSF alternatives are planned to replace the existing Elder Gulch TSF; therefore, once a new TSF is constructed and in operation, and the Elder Gulch TSF is closed and reclaimed, the overall cumulative effects of a new TSF for most resource areas, in relation to the past and ongoing site mining activity and the expected 50 years of future mining activity, would mostly be minor.

4.1 AIR QUALITY CUMULATIVE IMPACTS

4.1.1 Ripsey Wash TSF

Fugitive dust and gaseous emissions associated with the Ripsey Wash TSF alternative would add to the overall emissions in the area within and surrounding the Ray Mine, particularly during the expected three years of initial site development and construction activities. However, the cumulative air quality impacts from the construction, operation and closure/reclamation of the Ripsey Wash TSF are not expected to be significant when added to the ongoing fugitive dust and gaseous emissions created by the adjacent Ray Mine that currently moves approximately 260,000 tons of rock material per day[44]. Cumulative impacts would decrease once construction of the Ripsey Wash TSF is completed and after the existing Elder Gulch TSF is closed and reclaimed. The additional or cumulative air emissions from the Ripsey Wash TSF construction, operation and closure/reclamation would be negligible when compared to the overall emissions from the region that already experiences mining (Ray Mine), industrial (Hayden smelter), urban (the Phoenix metropolitan area), transportation and agricultural activities.

In addition, this region of Arizona experiences significant thunderstorms during the late summer season with high out-flow winds that produce significant blowing dust. Because the portions of Ripsey Wash TSF would be partially dry, blowing dust from these areas of this TSF facility could add cumulatively to nature's generated emissions, but such emissions would be localized and short-term.

As shown on **Figure 20, Air Quality Zones Map**, the proposed Ripsey Wash TSF is located within the Hayden PM_{10} non-attainment area, but the Ripsey Wash TSF is merely slated to replace the existing Ray Mine Elder Gulch TSF and would be operated under the approved Title V permit issued by the Pinal County Air Quality Department. The construction, operation and closure/reclamation of the Ripsey Wash TSF would cumulatively add PM_{10} emissions, with the construction period generating the most annual PM_{10} emissions. However, the estimated annual PM_{10} emissions during construction would be below the EPA defined *de minimis* levels (40 CFR 93 §153) that would require a conformity determination by the Corps. See Section 3.1, Air Quality/Climate.

The proposed Ripsey Wash TSF is located outside the Hayden SO_2 non-attainment area, where the primary SO_2 emission source is from the Hayden Smelter[45]. The SO_2 emissions from the construction, operations and closure/reclamation of the Ripsey Wash TSF would have a negligible effect on regional SO_2 levels. See Section 3.1, Air Quality/Climate and Section 4.1.2, Hackberry Gulch TSF (Cumulative Air Quality Impacts).

As stated in Section 3.1.3, Air Quality Regulatory Framework, only a portion of one designated Class I area is located within 30 miles of the Ripsey Wash TSF site, the closest being the Superstition Wilderness Area, located more than 20 miles north-northwest of the proposed Ripsey Wash TSF site. Two other Class I areas are located approximately 40 miles from the Ripsey Wash TSF site. The Ripsey Wash TSF would emit emissions that could contribute to regional haze, but the amounts of these emissions would

---

[44] The Ray Mine complex operates under an approved Title V permit (Permit # V20654.R01) issued by the Pinal County Air Quality Department. The mine cmplex constitutes a "major emitting facility" within the meaning of CAA §165(a) and constitutes a "major source" within the meaning of CAA §302(j) or CAA §112.

[45] Asarco announced plans in 2014 for a $110 million upgrade of the Hayden Smelter to bring the facility into compliance with the new federal SO_2 emissions regulations. Asarco plans a converter retrofit, installation of improved primary and secondary hoods and an electrostatic precipitator for removal of emissions prior to SO_2 capture at the smelter's existing acid plant. The plan aims to reduce SO_2 emissions at the Hayden Smelter by 85%, with a planned total SO_2 capture rate of 99.7% of what is produced during the copper smelting process.

be negligible when compared to emissions released by the urban and industrial activities of the greater Phoenix metropolitan area.

It is assumed that the Ripsey Wash TSF would be constructed and in operations (replacing the existing Ray Mine Elder Gulch TSF) before the NEPA process and issuance of permits for the Resolution Copper Project is completed. Under this assumption, there would be no cumulative fugitive dust and gaseous emissions associated with the construction of the Ripsey Wash TSF, but the construction and operation of the proposed Resolution Copper Project would add to the cumulative air quality impacts of the region. The Forest Service is currently preparing a draft EIS for the Resolution Copper Project that would address the air quality (and other resource) effects of this new underground mining project.

The proposed Gila River Bridge on the Florence-Kelvin highway may be completed before any construction is initiated on the Ripsey Wash TSF; but, if the projects overlap, there would be minor cumulative air quality impacts as a result of this bridge construction. With the completion of the Gila River Bridge, there could be increased (non-Asarco related) traffic on the Florence-Kelvin highway. This traffic could create cumulative air quality impacts; but such traffic increases ae expected to be minor, with cumulative air emission impacts also being minor to negligible. Any increase in potential cumulative fugitive dust emissions from additional traffic would be lessened because Asarco plans to pave the Florence-Kelvin highway with asphalt from the new Gila River Bridge to any area west of the proposed Ripsey Wash TSF. Long term fugitive dust emissions could be further reduced when and if Pinal County decides to completely pave the Florence-Kelvin highway with asphalt.

The ongoing and planned road upgrades to U.S. 60 (between Florence Junction and Superior) would create fugitive and gaseous air emissions, but these emissions would be localized, and the construction upgrades would be nearly 15 areal miles northwest of the proposed Ripsey Wash TSF. Further, the upgrade of U.S. Highway 60 would probably be completed before there is any construction activity for the Ripsey Wash TSF.

The proposed Ripsey Wash TSF is slated to operate well into the future (+50 years), at which time it would be closed and the site reclaimed, or used as an industrial site for solar power generation. It is assumed that the closure of this tailings facility would also mean the closure of the entire Ray Mine complex. With this closure and subsequent reclamation work (i.e., placement of rock over the tailings material), the cumulative air quality impacts from the Ripsey Wash TSF would decrease.

4.1.2 Hackberry Gulch TSF

The cumulative air quality impacts associated with the proposed Hackberry Gulch TSF would be similar to those discussed for the proposed Ripsey Wash TSF; however, the Hackberry Gulch TSF site is immediately adjacent to the existing Elder Gulch TSF and the rest of the Ray Mine complex, which could create a commingling of fugitive dust and gaseous emissions in a more concentrated area, thereby causing more localized sumulative fugitive dust emissions. Similar to the proposed Ripsey Wash TSF, the cumulative impacts would decrease once construction of the Hackberry Gulch TSF is completed and after the existing Elder Gulch TSF is closed and reclaimed, although blowing dust would still be a problem for the Ray Mine and the Hackberry Gulch TSF site during wind storms and thunderstorms.

The proposed Hackberry Gulch TSF site is located within the Hayden SO_2 non-attainment area. However, the SO_2 air quality emissions from the Hackberry Gulch TSF, even during construction, are slated to be less than 0.1 tons of SO_2 per year during initial construction and approximately 4 tons of SO_2 per year during centerline and upstream operations. See Section 3.1, Air Quality/Climate. These additional SO_2 levels from the proposed Hackberry Gulch TSF are dwarfed by the SO_2 emissions from the Hayden Smelter that has produced over 21,000 tons of SO_2 per year; but, with the new emission control upgrades, that level will drop to approximately 2,000 tons of SO_2 per year. Even with this reduction in SO_2 emissions at the Hayden Smelter, the cumulative SO_2 impacts to the region from the proposed Hackberry Gulch TSF would be minor, almost negligible.

4.2 CLIMATE CHANGE CUMULATIVE IMPACTS

4.2.1 Ripsey Wash TSF

Although the proposed Ripsey Wash TSF is slated to replace the existing Elder Gulch TSF, the construction, operation and closure/reclamation of this new facility has the potential to cause cumulative climate change impacts, when combined with other activities in the area, such as the ongoing mining and processing at the Ray Mine, Copper Basin Railroad traffic, operation of the Hayden Concentrator and Hayden Smelter, continued traffic on State Route 177 and U.S. Highway 60 and within the local communities of Kevin, Riverside, Kearny, Hayden, Winkelman, Superior and Gold Canyon, the upgrade construction of U.S. Highway 60 from two to four lanes, livestock grazing, and the construction and operation of the Resolution Copper Project.

The BLM stated in their comments to the January 2016 Ray Mine Tailings Draft EIS that a new TSF at the Ray Mine would have the potential to exacerbate climate change with the increase in surface soil reflectivity (bare ground), increase in sedimentation and dust, and the decrease of groundwater recharge leading to potential degradation of riparian vegetative communities. However, climate change with the aforementioned regional activities surrounding the Ripsey Wash TSF, the cumulative impacts associated with these above mentioned direct impacts, combined with the climate change impacts associated with Ripsey Wash TSF, would be negligible to minor.

The EPA considers CO_2 to be the primary greenhouse gas emitted through human activities (http://www.epa.gov/ghgemissions/overview-greenhouse-gases). However, based on the projected amount of CO_2 to be released during the construction, operation and closure of the proposed Ripsey Wash TSF (see Section 3.1.2.2.3, Climate Change Associated with Ripsey Wash TSF Alternative) in association with potential and existing CO_2 emissions from the aforementioned sources listed in this section, cumulative climate changes from the construction, operation and closure of the proposed Ripsey Wash TSF as a result of projected CO_2 emissions would be negligible.

The proposed Ripsey Wash TSF is slated to operate well into the future (+50 years), at which time it would be closed and the site reclaimed, or the site might be used as an industrial site for solar power generation. It is assumed that the closure of this tailings facility would also mean the closure of the entire Ray Mine complex. With this closure and subsequent reclamation work (i.e., placement of rock over the tailings material), potential cumulative climate change impacts from the Ripsey Wash TSF would decrease.

4.2.2 Hackberry Gulch TSF

The potential cumulative climate change impacts associated with the proposed Hackberry Gulch TSF would be similar to those discussed for the proposed Ripsey Wash TSF.

4.3 SOILS CUMULATIVE IMPACTS

4.3.1 Ripsey Wash TSF

Other than the limited disturbance caused by the Florence-Kelvin highway, and the activities of dispersed recreation and livestock grazing, there would be negligible cumulative impacts to soils within the watersheds of Ripsey Wash and the adjacent East Wash, where the major disturbances of the Ripsey Wash TSF would occur. These actions have the minor potential for soil erosion that would contribute very limited amounts of sedimentation to the Gila River. The major current contributor to soil erosion is wind and the sheet flows and channel runoff resulting from intense thunderstorms.

Current land use practices in the broader region include mining activities (existing Ray Mine and the proposed Resolution Copper Project), livestock grazing, dispersed recreation use, such as off-road traffic, and residential and commercial developments along transportation corridors that connect towns in the project vicinity. These regional land use practices contribute to cumulative impacts on soils and have resulted in soil destruction or degradation.

Soil resources have and would continue to be impacted by the high winds during thunderstorms, winter cold fronts, and the erosive force of water resulting in sheet flow and channelization from major storms.

The proposed Ripsey Wash TSF is slated to operate well into the future (+50 years), at which time it would be closed and the site reclaimed, or the site would be used for solar power generation. It is assumed that the closure of this tailings facility would also mean the closure of the entire Ray Mine complex. With this closure and subsequent reclamation work (i.e., placement of rock over the tailings material), potential cumulative soils impacts associated with the Ripsey Wash TSF would decrease.

4.3.2 Hackberry Gulch TSF

The potential cumulative impacts to soils associated with the proposed Hackberry Gulch TSF would be similar to those discussed for the proposed Ripsey Wash TSF.

4.4 GEOLOGY, GEOTECHNICAL AND GEOCHEMISTRY CUMULATIVE IMPACTS

4.4.1 Ripsey Wash TSF

The geology in and around the Ray Mine has been and would continue to be altered by mining and mineral processing activities (Ray Mine), including tailings disposal at the existing Elder Gulch TSF, but there are no other major local or regional cumulative geologic or geotechnical effects expected for the Ripsey Wash TSF. There would be no cumulative geotechnical effects as a result of the construction, operation and closure/reclamation of the proposed Ripsey Wash TSF.

4.4.2 Hackberry Gulch TSF

The potential cumulative impacts to geology, geotechnical and geochemistry associated with the proposed Hackberry Gulch TSF would be similar to those discussed for the proposed Ripsey Wash TSF.

4.5 SURFACE WATER HYDROLOGY CUMULATIVE IMPACTS

4.5.1 Ripsey Wash TSF

Other than the limited disturbance caused by the Florence-Kelvin highway and the activities of dispersed recreation (such as off-road vehicular traffic) and livestock grazing, there would be minor to negligible hydrologic cumulative impacts to the local ephemeral drainages within the watersheds of Ripsey Wash and the adjacent East Wash, where the major disturbances of the Ripsey Wash TSF would occur. These cumulative actions have the potential for soil erosion that would cause limited sedimentation, but much of this sedimentation created in the upper area of the Ripsey Wash watershed would be trapped in the reservoir of the proposed detention dam that would be constructed up-drainage of the Ripsey Wash TSF. The major current causes of erosion (and subsequent sedimentation) in the Ripsey Wash and East

Wash watersheds are wind, and the sheet flows and channel runoff resulting from intense thunderstorms.

The Ripsey Wash TSF is slated to replace the existing Elder Gulch TSF. With required stormwater controls during construction, operation and closure/reclamation, along with the recycling of decant water back to the Ray Concentrator during operation of the TSF, there would be no additional cumulative water quality impacts to Gila River as a result of the Ripsey Wash TSF.

The ongoing Ray Mine operations are mainly located in the watershed of Mineral Creek, which is a north to south flowing perennial drainage that empties into the Gila River approximately two miles east of the confluence of Ripsey Wash with the Gila River. The state of Arizona has determined that Mineral Creek from Devil's Canyon to the confluence with the Gila River is listed on the Arizona 303(d) list as impaired for dissolved copper, dissolved oxygen, and selenium. Mineral Creek is diverted around the mine, partly through a tunnel, and this diversion is maintained to preclude potential surface runoff from the disturbed areas at the Ray Mine from entering this creek. There would be no cumulative surface water hydrologic impacts to Mineral Creek from the construction, operation and closure/reclamation of the Ripsey Wash TSF, as none of the planned major Ripsey Wash TSF facilities are located within the watershed of Mineral Creek.

Correspondingly, the proposed underground mining operations for the Resolution Copper Project would also be located within the upper Mineral Creek watershed, upstream of the Ray Mine. Although there is the possibility of surface water impacts to Mineral Creek associated with the construction and operation of the Resolution Copper Project, none of these potential effects would be cumulative impacts in the context of the construction, operation and closure/reclamation of the Ripsey Wash TSF, as the proposed Ripsey Wash TSF is not located within the Mineral Creek drainage. The Forest Service is currently preparing a draft EIS for the Resolution Copper Project, and the potential impacts to surface water will be addressed in this document.

The proposed Gila River Bridge on the Florence-Kelvin highway may be completed before any construction is initiated on the Ripsey Wash TSF, which would reduce cumulative negative impacts from sediment to the Gila River from the Ripsey Wash SF. With the completion of the Gila River Bridge, there could be increased (non-Asarco related) traffic on the Florence-Kelvin highway, but Asarco plans to pave the Florence-Kelvin highway with asphalt from the new Gila River Bridge to anarea west of the proposed Ripsey Wash TSF, thus eliminating sediment from the road surface. Long term sediment generation from road use could be further reduced when and if Pinal County decides to complete paving the Florence-Kelvin highway with asphalt.

The ongoing and planned road upgrades to U.S. 60 (between Florence Junction and Superior) would create sediment that could impact local drainages, but this activity would be localized, and the construction upgrades would be nearly 15 areal miles northwest of the proposed Ripsey Wash TSF. Further, the upgrade of U.S. 60 would probably be completed before there is any construction activity for the Ripsey Wash TSF.

The proposed Ripsey Wash TSF is slated to operate well into the future (+50 years), at which time it would be closed and the site reclaimed, or possibly used as an industrial site for solar power generation. It is assumed that the closure of this tailings facility would also mean the closure of the entire Ray Mine complex. With this closure and subsequent reclamation work (i.e., placement of rock over the tailings material), any cumulative surface water hydrologic impacts from the Ripsey Wash TSF would decrease, but Asarco would continue to maintain the detention dam and reservoir upstream of the Ripsey Wash

TSF, along with the infrastructure to pump, channel and discharge flows into the adjacent Zelleweger Wash (see Section 2.3.2.5, Detention Dams and Diversion Structures).

Flows in the Gila River near the Ripsey Wash TSF are dramatically affected by down-river irrigation demands and would continue to be influenced by upstream storage and water releases from the San Carlos Reservoir behind the Coolidge Dam, which is controlled by SCIP.

The Hayden well field supplies water to the Ray Mine, the Ray concentrator process including tailings handling, a golf course, and the towns of Hayden and Kelvin. The total water use from the Hayden well field correlates to approximately 1.8 to 3.1% of the flows in the Gila River at the Kelvin gaging station. The portion of the water supply from the Hayden well field used by the Ray Mine is approximately 1.0% to 1.7% of the flows in the Gila River at the Kelvin gaging station. The aforementioned Gila River surface flows do not reflect that amount of water underflow and water storage contained in the alluvial material surrounding the Gila River.

4.5.2 Hackberry Gulch TSF

The potential cumulative impacts to surface water hydrology associated with the proposed Hackberry Gulch TSF would be similar to those discussed for the proposed Ripsey Wash TSF. However, the Hackberry Gulch TSF would disturb nine drainages (see **Table 3-27, Hackberry Gulch TSF Affected Drainage Area**s, in Section 3.4, Surface Water Hydrology). Also dissecting these drainages are State Route 177, the Copper Basin Railroad, an unpaved gravel/dirt road (situated between State Route 177 and the Cooper Basin Railroad), and several residences. There is also existing disturbance from activities of dispersed recreation (such as off-road vehicular traffic) and livestock grazing within the watersheds of these drainages.

These roads, railroad bed, residences and other activities would create minor cumulative hydrologic impacts, in the form of soil erosion, to these nine watersheds. In particular, the impacts would be sediment generation from the unpaved existing roads and the cuts and fills of the roads and railroad bed in these watersheds. Similar to the Ripsey Wash TSF, the principal causes of erosion (and subsequent sedimentation) in these watersheds are wind, and the sheet flows and channel runoff resulting from intense thunderstorms. During operations of the Hackberry Gulch TSF, much of the sedimentation created in the upper reaches of these drainages would be trapped in the reservoir of the proposed detention dam that would be constructed up-drainage of the Ripsey Wash TSF.

Other, broader cumulative impacts as a result of the Ray Mine operations and the proposed operations of the Resolution Copper Project would be similar as those discussed for the Ripsey Wash TSF.

4.6 WATERS OF THE U.S. CUMULATIVE IMPACTS

4.6.1 Ripsey Wash TSF

Over thirty vegetated wetlands were identified along the banks of the Gila River downstream of the Ripsey Wash TSF alternative; combined, they total approximately one half acre in size, (WestLand, 2013b). Although the construction and operation of the Ripsey Wash TSF would result in a loss of approximately 0.2% of the surface and groundwater flow to the Gila River and its Quaternary deposits, this loss would have a minor indirect effect on downstream waters of the U.S. and wetlands. On a cumulative impact basis, with only limited activities (dispersed recreation, livestock grazing and the routing of the Florence-Kelvin highway) within Ripsey Wash and the adjacent East Wash, there would be negligible cumulative impacts on downstream waters of the U.S. and wetlands in the Gila River immediately down-drainage of the Ripsey Wash TSF. The construction and operation of the detention dam up-drainage of the proposed Ripsey Wash TSF could provide water (even on a periodic basis and given that Asarco would pump water in the reservoir for release in Zellweger Wash) to create or enhance vegetation at the reservoir site or immediately down-drainage of the release point. This water might be enough for some limited wetland vegetation to develop.

Appendix B, Alternative Screening and Clean Water Act Section 404(b)(1) Alternative Analysis, provides a broader discussion of cumulative impacts to waters of the U.S. that would be expected from the construction and operation of the Ripsey Wash TSF alternative, which is located in Box O Wash-Gila River watershed (HUC 1505010003). Based on previous Clean Water Act permitting records, the Corps has authorized the fill of 3.03 acres (linear feet measurement not available) in this Box O Wash-Gila River watershed. Using the U.S. Geological Survey's National Hydrography Database, the Corps determined that this alternative would impact 168,490 linear feet of drainages in this watershed, which is less than 2% of the total estimated linear feet of waters within this watershed.

Other regional land use activities would continue to contribute to the cumulative impacts on wetlands and waters of the U.S. These activities include continued mining and mineral processing operations at the Ray Mine, proposed mining and mineral processing activities at the Resolution Copper Project, livestock grazing, dispersed and developed recreation use, residential and commercial developments along the Gila River and its tributaries, construction of the Gila River bridge on the Florence-Kelvin highway, other road construction (U.S. Highway 60), and release of water from the upstream Coolidge Dam on the Gila River.

The proposed 404 Mitigation plan for the Ripsey Wash TSF site would enhance or improve waters of the U.S. in the region (see **Appendix J, Compensatory Mitigation**).

4.6.2 Hackberry Gulch TSF

The potential cumulative impacts to waters of the U.S. associated with the proposed Hackberry Gulch TSF would be similar to those discussed for the proposed Ripsey Wash TSF.

The construction and operation of the Hackberry Gulch TSF would dissect nine watersheds and result in a combined loss of approximately 0.2% of the surface and groundwater flow to the Gila River and its Quaternary deposits; this loss would have a minor indirect effect on downstream waters of the U.S. and wetlands. There would be negligible cumulative impacts to down-drainage waters of the U.S. along the Gila River given the varied activities within these nine watersheds (State Route 177, the Copper Basin Railroad, an unpaved gravel/dirt road [situated between State Route 177 and the Cooper Basin Railroad], several residences, livestock grazing and dispersed recreation (such as off-road vehicular traffic).

Similar to the Ripsey Wash TSF, the construction and operation of the detention dams up-drainage of the proposed Hackberry Gulch TSF could provide water (even on a periodic basis and given that Asarco would pump water in these reservoirs for release in unnamed tributaries of the Gila River) to create or enhance vegetation at the reservoir sites or immediately down-drainage of the release point. This water might be sufficient for some limited wetland vegetation to develop.

The 404 mitigation that would be required for the Hackberry Gulch TSF site (and that would be similar to that proposed for the Ripsey Wash TSF as set forth in **Appendix J, Compensatory Mitigation**) would enhance or improve waters of the U.S. in the region.

4.7 GROUNDWATER HYDROLOGY CUMULATIVE IMPACTS

4.7.1 Ripsey Wash TSF

Potential cumulative impacts to groundwater would be negligible for the Ripsey Wash TSF site. The only activities occurring in the Ripsey Wash or the adjacent East Wash are dispersed recreation (such as hiking along the Arizona Trail and off-road vehicular traffic), livestock grazing, and the Florence-Kelvin highway that cuts across the lower ends of these watershed; these activities have no quantifiable effect on the existing groundwater hydrology (quantity or quality of the Quaternary deposits of the Gila River or in bedrock groundwater.

Mining and mineral processing will continue at the Ray Mine; the open pit mine is located on the north side of the Gila River (the Ripsey Wash TSF is located south of the Gila River), nearly 5 miles from the Ripsey Wash TSF, so there are not expected to be any cumulative groundwater impacts from the construction, operation and closure/reclamation of the Ripsey Wash TSF to those groundwater impacts already existing at the Ray Mine site.

The proposed underground mining operations for the Resolution Copper Project are located more than 15 miles north of the Ripsey Wash TSF, and it is not expected that the construction and operation of this mine would cause cumulative groundwater impacts to the Ripsey Wash TSF. The Forest Service is currently preparing a draft EIS for the Resolution Copper Project that would address its effect on regional groundwater resources.

4.7.2 Hackberry Gulch TSF

The potential cumulative impacts to groundwater hydrology associated with the proposed Hackberry Gulch TSF would be similar to those for the proposed Ripsey Wash TSF. Some impacts could result from changes in availability of groundwater recharge to down-gradient water right holders, but the construction and operation of the proposed Hackberry Gulch TSF, in combination with the other relatively few activities occurring in the nine watersheds where this TSF is proposed, is not expected to have any adverse cumulative impact to the groundwater quality in the Quaternary deposits of the Gila River or the general bedrock groundwater in the area.

4.8 LAND USE CUMULATIVE IMPACTS

4.8.1 Ripsey Wash TSF

No significant cumulative land use effects are anticipated as a result of the construction, operation and eventual closure/reclamation of the Ripsey Wash TSF. Mining[46], livestock grazing, and dispersed recreation would remain the dominant land uses in the region.

Given that the proposed Ripsey Wash TSF is slated to replace the existing Elder Gulch TSF facility, no cumulative land use impacts are expected from this activity because the construction activities would be short-term and probably not sufficient to spur anynew commercial and residential development in the communities of Kearny, Hayden, Winkelman, Riverside or Kelvin. Once in operations, the Ripsey Wash TSF would be handled by the existing Ray Mine workforce.

[46] This would include continued mining at the Ray Mine, as well as the possible future underground copper mining at the proposed Resolution Copper Project in an area east of the town of Superior, Arizona, north of the Ray Mine.

The communities of Superior and Gold Canyon would experience growth and impacts to land use from the construction and operation of the Resolution Copper Project; the Forest Service is currently preparing a draft EIS for this project that would address land use impacts. Upgrade to U.S. Highway 60 (making this highway a divided highway) is removing some currently undeveloped lands and switching this to a transportation land use.

The BLM would continue to administer its special management areas in the region with no expected cumulative impacts as a result of the construction and operation of the Ripsey Wash TSF. The proposed BLM-Asarco Ray Land Exchange would not affect the construction and operation of the Ripsey Wash TSF.

4.8.2 Hackberry Gulch TSF

The potential cumulative land use impacts associated with the proposed Hackberry Gulch TSF would be similar to those discussed for the proposed Ripsey Wash TSF.

As discussed **Appendix D, Regional Activity**, Asarco has been working with the BLM since 1994 on a land exchange, known as the BLM-Asarco Ray Land Exchange, which would involve the transfer of certain federal administered lands to private land in the area of the Ray Mine, including portions of the site proposed for the Hackberry Gulch TSF[48]. Transfer of BLM-administered lands to Asarco would mean the federal land would become private ownership. The BLM would benefit from this land exchange by receiving private acreages (that would be transferred to federal ownership) in other parts of the state of Arizona (see www.blm.gov/az/st/en/prog/lands/land_tenure/ray-mine/about.html). The BLM has deemed the lands that they would receive in the land exchange as valuable for scenic, wildlife, and recreation purposes. This transfer would not affect the land uses of the area. See **Figure 32, Surface Ownership**. This proposed land exchange is mainly for land parcels within or adjacent to the Ray Mine, where there is limited livestock grazing and dispersed recreational activities.

4.9 NOISE

4.9.1 Ripsey Wash TSF

Noise levels, especially during the expected three-year construction period for the proposed Ripsey Wash , would attenuate to near background noise levels within a relative short distance from its source. Noise levels during operation and closure/reclamation of this facility would be minor. See Section 3.7, Noise.

Given the lack of general other activity around the proposed Ripsey Wash TSF (dispersed recreation, including off-road traffic, and livestock grazing) and the lack nearby residents surrounding the proposed Ripsey Wash TSF, there would be negligible cumulative noise impacts for the Ripsey Wash TSF alternative. Non-project related traffic on the Florence-Kelvin highway would create some elevated noise levels adjacent to the road, but the non-project traffic on this road is limited, although some elevated traffic may occur in the future given the Florence-Kelvin highway improvements planned by

[48] Presently, the Hackberry Gulch TSF Alternative would require development of approximately 1,149 acres of BLM-administered lands. See **Figure 32, Surface Ownership**. Even if the land exchange is consummated, development of the Hackberry Gulch TSF Alternative would impact approximately 105 acres of BLM-administered lands as the southeast corner of the TSF, and a portion of the stormwater diversion infrastructure on BLM-administered lands outside the Ray Land Exchange parcel RM-18.

Pinal County (i.e., new bridge over Gila River and additional paving work). See Section 3.11, Transportation.

Cumulative impact noise created by dispersed recreational use (i.e., use of the Arizona Trail and off-road vehicular traffic) in the area of the Ripsey Wash TSF is expected to be limited and sporadic.

4.9.2 Hackberry Gulch TSF

The potential cumulative noise impacts for the Hackberry Gulch would be similar to those discussed for the proposed Ripsey Wash TSF, but the Hackberry Gulch TSF is immediately adjacent to the existing Ray Mine, and the noise levels created by the construction, operation and closure/reclamation activities of the Hackberry Gulch TSF would tend to blend with those from the Ray Mine operations. Infrequent cumulative noise impacts would be created by railroad traffic on the Copper Basin Railroad that serves the Ray Mine, as well as Ray Mine-related and other traffic along State Route 177. Residents of the communities of Kelvin and Riverside would be subject to these noise impacts, which already occur given the operation of the Ray Mine, ongoing operations of the Copper Basin Railroad and traffic on State Route 177.

4.10 RECREATION CUMULATIVE IMPACTS

4.10.1 Ripsey Wash TSF

Past disturbance and present actions resulting from urban development, mining, ranching, farming and road construction have resulted in the incremental loss of lands available for dispersed recreation, and this would continue under the construction, operation and closure/reclamation of the proposed Ripsey Wash TSF. See Section 3.8, Recreation.

The proposed Resolution Copper Project east of Superior and the increasing recreation demand generated by new commercial and residential development associated with urban growth in the greater Phoenix area, are expected to incrementally affect developed recreation resources in the future, such as the Arizona Trail. Dispersed recreational opportunities in this region are also likely to experience the indirect effect of increasing demand for recreation caused by expected increases in tourism.

The proposed state land sale at the Ripsey Wash TSF site would transfer state-administered lands to private ownership (Asarco). Recreational activities would be eliminated with the TSF construction and restricted on these new private lands immediately surrounding the TSF site, which could cause recreationists to find other sites to recreate, thereby causing cumulative impacts to other developed recreation sites or other lands used for dispersed recreation.

In Pinal County, the Arizona Trail could experience direct cumulative impacts from the construction and operations of the Ripsey Wash TSF, in combination with the potential development of the Resolution Copper Project, which is currently considering alternative tailings facility sites, some of which would require Arizona Trail relocation. Multiple Arizona Trail relocations have the potential to change and potentially degrade the visual and recreational experience of the Arizona Trail users, depending on the location, design, and character of the new trail.

Planned development of new recreation facilities and improved access to public lands, such as those proposed in the Pinal County Open Space and Trails Master Plan, would help mitigate the impacts of increased demand for recreational resources. The plan proposes the preservation or development of 802,000 acres of open space, focusing on open space protection and connectivity, such as mountainous and riparian area preservation, open space buffers, wildlife corridors, open space connections, and regional connectivity. Improved recreation corridors and additional open space preservation would help mitigate the loss of primitive trails and open space resulting from the proposed TSF and other past and foreseeable actions.

4.10.2 Hackberry Gulch TSF

The potential cumulative impacts to recreation associated with the proposed Hackberry Gulch TSF would be similar to those discussed for the proposed Ripsey Wash TSF. Although the proposed Hackberry Gulch alternative would contribute to some visual effects to the cumulative recreation effects on the Arizona Trail, these would be a much lesser extent than the proposed Ripsey Wash TSF alternative, and the construction, operation and closure/reclamation of the Hackberry Gulch TSF alternative would not require a re-routing of the Arizona Trail.

The Ray Land Exchange would transfer BLM land to private ownership (Asarco). Recreational opportunities could be restricted on these new private lands.

4.11 CULTURAL RESOURCES CUMULATIVE IMPACTS

4.11.1 Ripsey Wash TSF

Land disturbances and permanent facility siting from past, present, and future urban and residential development, mining, road use and construction, ranching, farming and recreation activities in the project and surrounding areas typically have disturbed, and would continue to disturb, cultural resources. The locations of these potential resources are not currently known, but the density of known archaeological sites in the area suggests that substantial numbers of sites are present. For these reasons, the Ripsey Wash TSF alternative would contribute incrementally to an adverse cumulative effect to cultural resources in the region.

Adverse effects to historic properties would be mitigated through avoidance and preservation in place, or through data recovery excavations that would conform to an approved Historic Properties Treatment plan.

It can be reasonably assumed that urban and residential development, mining and related activities, road construction and upgrades, ranching, farming and dispersed and developed recreation would continue in the future. These future activities would incrementally contribute to cumulative effects to cultural resources.

4.11.2 Hackberry Gulch TSF

The potential cumulative impacts to cultural resources associated with the proposed Hackberry Gulch TSF would be similar to those discussed for the proposed Ripsey Wash TSF.

4.12 SOCIOECONOMIC CUMULATIVE IMPACTS

4.12.1 Ripsey Wash TSF

Given the lack of other major activities in the immediate area of the Ripsey Wash TSF, there would be no measurable cumulative socioeconomic effect on the community and public services of Kearny and other Pinal County communities. Because the proposed Ripsey Wash TSF is simply designed to replace the existing Elder Gulch TSF; no or only a few new employees are expected to be added to Asarco's payroll for the operation of this new Ripsey Wash TSF.

The proposed State Land Sale at the Ripsey Wash TSF site would convert the lands from public (state owned and administered) to private. Property taxes would then apply to these lands and would be paid to Pinal County. These tax revenues would be considered a positive cumulative impact.

The communities of Superior, Gold Canyon and Apache Junction in Pinal County could experience cumulative socioeconomic impacts from the potential development of the Resolution Copper Project, which is located east of the town of Superior. This project would create additional employment opportunities and tax revenues but would potentially add the need for additional housing and services in the aforementioned communities. The Forest Service is currently preparing a draft EIS for this project that would address socioeconomic impacts.

4.12.2 Hackberry Gulch TSF

The potential cumulative socioeconomic impacts associated with the proposed Hackberry Gulch TSF would be similar to those discussed for the proposed Ripsey Wash TSF, except that no State Lands sale would be involved.

As discussed **Appendix D, Regional Activity**, Asarco has been working with the BLM since 1994 on a land exchange, known as the BLM-Asarco Ray Land Exchange, which would involve the transfer of certain federal administered lands to private land in the area of the Ray Mine, including portions of the site proposed for the Hackberry Gulch TSF[49]. Transfer of BLM-administered lands to Asarco would mean the federal land would become private ownership. Property taxes would then apply to these lands and would be paid to Pinal County. These tax revenues would be considered a positive cumulative impact.

4.13 ENVIRONMENTAL JUSTICE CUMULATIVE IMPACTS

4.13.1 Ripsey Wash TSF

There are no expected cumulative impacts associated with environmental justice, as the proposed TSF is slated to replace the existing Elder Gulch TSF.

4.13.2 Hackberry Gulch TSF

There would be no expected environmental justice cumulative impacts associated with the proposed Hackberry Gulch TSF, the same as projected for the proposed Ripsey Wash TSF.

4.14 TRANSPORTATION CUMULATIVE IMPACTS

4.14.1 Ripsey Wash TSF

During the projected three years of initial construction for the Ripsey Wash TSF, construction traffic, combined with Ray Mine traffic, would result in cumulative impacts, but such additional traffic is not expected to affect the operational or safety conditions of State Route 177 or the Florence-Kelvin highway.

---

[49] Presently, the Hackberry Gulch TSF Alternative would require development of approximately 1,149 acres of BLM-administered lands. See Figure 32, Surface Ownership. Even if the land exchange is consummated, development of the Hackberry Gulch TSF Alternative would impact approximately 105 acres `of BLM-administered lands as the southeast corner of the TSF, and a portion of the stormwater diversion infrastructure on BLM-administered lands outside the Ray Land Exchange parcel RM-18.

Pinal County and the ADOT are currently constructing the new bridge over the Gila River for the Florence-Kelvin highway; this new bridge construction will probably be finished prior to the initiation of construction activities for the Ripsey Wash TSF. Given the timeframes, there would be no cumulative increase to traffic on the Florence-Kelvin highway from the bridge construction workforce and the workforce for construction activities of the Ripsey Wash TSF.

The construction and operation of the Resolution Copper Project is expected to cumulatively add several hundred vehicles a day to the existing traffic load on U.S Highway 60; the Forest Service is currently preparing a draft EIS for the Resolution Copper Project that would analyze traffic loads associated with the construction and operation of this project. At present, U.S. Highway 60, between Florence Junction and Superior, Arizona, is being upgraded to a four lane highway. This upgrade should handle the traffic from the Resolution Copper Project, and cumulative impacts would be minor.

4.14.2 Hackberry Gulch TSF

The potential transportation related cumulative impacts associated with the proposed Hackberry Gulch TSF would be similar to those discussed for the proposed Ripsey Wash TSF.

4.15 VEGETATION CUMULATIVE IMPACTS

4.15.1 Ripsey Wash TSF

Other than the limited disturbance caused by the Florence-Kelvin highway, and the activities of dispersed recreation and livestock grazing, there would be no cumulative impacts to vegetation within the watersheds of the Ripsey Wash and the adjacent East Wash, where the major disturbances of the Ripsey Wash TSF would occur.

Current land use practices in the broader region include urban and residential development, mining activities (existing Ray Mine and the proposed Resolution Copper Project), livestock grazing, and dispersed and developed recreation use along transportation corridors that connect towns in the project vicinity. These regional land use practices contribute to cumulative impacts on vegetation communities and have resulted in vegetation destruction or degradation.

The proposed Ripsey Wash TSF is slated to operate well into the future (+50 years), at which time it would be closed and the site reclaimed, or possibly used as an industrial site for solar power generation. It is assumed that the closure of this tailings facility would also mean the closure of the entire Ray Mine complex. With this closure and subsequent reclamation work (i.e., placement of rock over the tailings material), potential cumulative vegetation impacts associated with the Ripsey Wash TSF would decrease.

4.15.2 Hackberry Gulch TSF

The potential cumulative impacts to vegetation associated with the proposed Hackberry Gulch TSF would be similar to those discussed for the proposed Ripsey Wash TSF.

4.16 VISUAL RESOURCE CUMULATIVE IMPACTS

4.16.1 Ripsey Wash TSF

The proposed Ripsey Wash TSF site would cumulatively add to the existing visual effects created by area highways (State Route 177 and the Florence-Kelvin highway), the Ray Mine, the Copper Basin Railroad, electric utility lines (such as SCIP's 69kV electric transmission line) and the structures and housing in nearby residential communities, such as Kelvin, Riverside and Kearney.

Cumulative effects resulting from continued and new mining, bridge construction (Florence-Kelvin highway bridge over the Gila River), development and expansion of residential areas (particularly along the U.S. 60 highway corridor, utility line installation, and other commercial and industrial projects could have the potential to cumulatively degrade the overall visual experience of Arizona Trail users and to affect the values for which the Arizona Trail was designated, as described in Section 4.10, Recreation.

The surface facilities and surface infrastructure (i.e., tailings facilities) of the proposed Resolution Copper Project, along with any surface topographic changes created from subsidence from the proposed underground operations, would also add to the cumulative visual effects in the region.

4.16.2 Hackberry Gulch TSF

The potential cumulative impacts to visual resources associated with the proposed Hackberry Gulch TSF would be similar to those discussed for the proposed Ripsey Wash TSF. Although the proposed Hackberry Gulch alternative would contribute to some cumulative visual effects to the users of the Arizona Trail, these would be a much lesser extent than the proposed Ripsey Wash TSF alternative, and the construction, operation and closure/reclamation of the Hackberry Gulch TSF alternative would not require a re-routing of the Arizona Trail. Development of the Hackberry site would expand visual impacts in a landscape already affected by major modifications related to the Ray Mine operation and other developments.

4.17 WILDLIFE CUMULATIVE IMPACTS

4.17.1 Ripsey Wash TSF

Historic and ongoing land use practices and activities, such as development and expansion of the local communities of Kevin, Riverside, Kearny, Hayden, Winkelman, Superior and Gold Canyon, the mining and processing at the Ray Mine, Copper Basin Railroad traffic, operation of the Hayden Concentrator and Hayden Smelter, traffic on State Route 177 and U.S. Highway 60 and other local roads, the upgrade construction of U.S. Highway 60 from two to four lanes, livestock grazing, and dispersed recreation (including hunting and off road traffic), have resulted in the loss of native wildlife habitats and the fragmentation of wildlife habitat.

Although the proposed Ripsey Wash TSF is slated to simply replace the existing Elder Gulch TSF, the construction, operation and closure/reclamation of this new facility has the potential to cause minor to moderate cumulative wildlife impacts, when combined with other activities in the area. The potential future construction and operation of the Resolution Copper Project, north of the proposed Ripsey Wash TSF site, would incrementally add to wildlife habitat losses and overall habitat fragmentation in the area to be disturbed by this project and within the surrounding region; the Forest Service is currently preparing a draft EIS for the Resolution Copper Project and will assess wildlife impacts of this project.

Land use practices that contribute to cumulative effects on vegetation communities and wildlife habitats include urban and residential use and development, mining, livestock grazing, traffic and increased developed recreation, such as use of the Arizona Trail, and dispersed recreation activities, such as hunting. Increased and ongoing human presence in the area would continue to cause cumulative effects to wildlife through vehicle mortalities, increased legal or illegal hunting, noise effects, and harassment.

The proposed Gila River Bridge on the Florence-Kelvin highway may be completed before any construction is initiated on the Ripsey Wash TSF, but there could be cumulative wildlife impacts as a result of this bridge construction, although Pinal County and the ADOT plan to avoid construction on this bridge during the nesting periods for the southwestern willow flycatcher and the yellow-billed cuckoo.

With the completion of the Gila River Bridge, there could be increased (non-Asarco related) traffic on the Florence-Kelvin highway. This traffic could create cumulative wildlife impacts, such as vehicle mortalities and noise effects, but such traffic increases are expected to be minor, so future cumulative wildlife effects would be minor. However, the potential for vehicle mortalities may increase because Asarco plans to pave the Florence-Kelvin highway with asphalt from the new Gila River Bridge to any area west of the proposed Ripsey Wash TSF, although speed limits will be set. Long term cumulative wildlife impacts, such as increased noise and vehicle mortalities could occur when and if Pinal County decides to completely pave the Florence-Kelvin highway with asphalt, which would probably mean that speeds along this highway would probably increase.

The ongoing and planned road upgrades to U.S. 60 (between Florence Junction and Superior) would create wildlife impacts, such as further habitat loss and fragmentation, increased noise, and increased potential for vehicle-wildlife collisions, but these impacts would be localized, and the construction upgrades would be nearly 15 areal miles northwest of the proposed Ripsey Wash TSF. Further, the upgrade of U.S. 60 would probably be completed before there is any construction activity for the Ripsey Wash TSF.

The proposed Ripsey Wash TSF is slated to operate well into the future (+50 years), at which time it would be closed and the site reclaimed, although the site might be used for future solar power generation. It is assumed that the closure of this tailings facility would also mean the closure of the entire Ray Mine complex. With this closure and subsequent reclamation work (i.e., placement of rock over the tailings material), the cumulative wildlife impacts from the Ripsey Wash TSF would decrease, but with the continued operation of the detention dam and pumping system to route stormwater runoff for release in Zellweger Wash and a possible post-project use of the tailings facility for solar power generation, cumulative impacts would probably continue well into the future.

4.17.2 Hackberry Gulch TSF

The potential wildlife cumulative impacts associated with the proposed Hackberry Gulch TSF would be similar to those discussed for the proposed Ripsey Wash TSF, although the Hackberry Gulch TSF site is immediately adjacent to the existing Elder Gulch TSF and the rest of the Ray Mine complex, which would create wildlife habitat destruction in a more concentrated area and limit wildlife habitat fragmentation. There would also be no or limited TSF and related construction traffic on the Florence-Kelvin highway which would lessen the potential cumulative impacts of vehicle-wildlife collisions and noise on this road.

4.18 CUMULATIVE IMPACTS FROM ACCIDENTS AND SPILLS

4.18.1 Ripsey Wash TSF

The construction, operation and closure/reclamation of the proposed Ripsey Wash TSF would add to the infrastructure from past, present and future mining and mineral processing activities in the region. Although a new Asarco TSF is simply designed to replace the existing Elder Gulch TSF, and safeguards are planned, the construction and operation of a new TSF would introduce industrial facilities in Ripsey Wash and the surrounding area. Similarly, the proposed Resolution Copper Project would also introduce additional industrial facilities and infrastructure in the region. Given the numerous regulatory and company safeguards placed on these types of industrial facilities, the cumulative potential for accidents and spills is expected to be low.

4.18.2 Hackberry Gulch TSF

The potential cumulative impacts from accidents and spills associated with the proposed Hackberry Gulch TSF would be similar to those discussed for the proposed Ripsey Wash TSF.

5.0 CONSULTATION AND COORDINATION

In March 2013, Asarco submitted a permit application (that was subsequently revised) to the U.S. Army Corps of Engineers (Corps) for the proposed Ripsey Wash TSF. This permit application was designed to comply with regulations promulgated under Section 404 of the Clean Water Act. This Section 404 permit is required because the Corps determined the Ripsey Wash drainage and other ephemeral washes within the proposed project footprint are "waters of the United States" and subject to Corps jurisdiction under Section 404 of the Clean Water Act. Asarco, as the applicant, is proposing to place fill material within Waters of the United States, which triggers the requirement for a Section 404 permit.

With the Section 404 permit application submittal, the Corps determined that an EIS would be prepared to comply with NEPA and that the Corps) would serve as the lead agency for the EIS preparation work.

The Corps contacted various federal, state, and local agencies regarding the proposed TSF. The agencies are as follows:

- Environmental Protection Agency;
- United States Department of the Interior, Bureau of Land Management;
- United States Department of the Interior, Bureau of Indian Affairs, San Carlos Irrigation Project;
- United States Department of Agriculture, Forest Service;
- United States Department of Interior, Fish and Wildlife Service;
- Arizona Department of Environmental Quality;
- Arizona Department of Game and Fish;
- Arizona State Lands Department;
- Arizona Department of State Parks;
- Arizona State Historic Preservation Office;
- Arizona Department of Transportation; and
- Pinal County.

The participation of agencies in the EIS is based upon their interest, their legal requirements involved with potential future permitting responsibilities, and their expertise. The EPA, BLM and SCIP agreed to serve as formal cooperating agencies with the Corps on the EIS Preparation.

In addition, because the 404 permitting process is a federal undertaking, the Corps, under the National Historic Preservation Act, initiated consultation with Native American Tribes that might have an interest in this project. The Corps has directly contacted 14 tribal government entities to seek their input on archaeological resources, including traditional cultural properties that might be impacted by the project.

On August 26, 2013, a Notice of Intent (NOI) for the Corps to prepare an EIS was published in the *Federal Register*; this notice officially began the scoping period for the project. Written comments on the proposed action were solicited and received. Public scoping "open house" meetings were held in Kearny, Arizona on September 24, 2013 and in Apache Junction, Arizona on September 25, 2013.

The Corps also hosted several meetings with cooperating and interested agencies. On September 10, 2013, the Corps and Asarco met with representatives of the Environmental Protection Agency (EPA) at their offices in San Francisco, California. Then, on September 26, 2013, the Corps hosted a meeting at its Phoenix office for cooperating and interested agencies; at this meeting, there were representatives from Asarco, Bureau of Land Management (BLM), San Carlos Irrigation Project (SCIP), Arizona Department of Environmental Quality (DEQ), and the Arizona Department of Game and Fish. The purpose of these agency meetings was to describe the proposed project, outline the planned NEPA work, and solicit input about any issues or concerns that the agencies might have about the project.

The Corps allowed for a 60-day comment period, which was originally scheduled to close on October 28, 2013. However, with the October 2013 shut-down of portions of the federal government, the Corps extended the scoping comment period for another 21 days, until November 18, 2013, to allow for comment from federal agencies affected by the shut-down.

Twenty-two comment letters were received during the scoping period. Although a court recorder was available at both public scoping "open house" meetings, none of the meeting attendees provided verbal comments to the court recorder.

6.0 LIST OF PREPARERS

The U.S Army Corps of Engineers (Corps) is the lead agency for the Ray Mine TSF EIS and is responsible for the contents of this EIS document. The Environmental Protection Agency (EPA), the Bureau of Land Management (BLM), and the San Carlos Irrigation Project (SCIP) served as cooperating agencies on this EIS document. Czar Inc. was retained as the third-party contractor and utilized numerous subcontractors for the preparation of the EIS.

6.1 U.S. ARMY CORPS OF ENGINEERS (LOS ANGELES DISTRICT)

Sallie Diebolt – Chief (Arizona Branch)
Mike Langley – Senior Project Manager (Arizona Branch)

6.2 ENVIRONMENTAL PROTECTION AGENCY (REGION 9)

Jeanne Geselbracht – Environmental Scientist, Federal Activities Office
Sarvy Mahdavi, Wetlands Regulatory Program
Patrick Kelly - Hydrologist

6.3 BUREAU OF LAND MANAGEMENT (TUCSON FIELD OFFICE)

Francisco Mendoza – Oudoor Recreation Planner
Darrell Tersey – Natural Resource Specialist
Daniel Moore – Geologist
Ben Lomeli – Hydrologist
Susan Bernal – Lands and Realty Specialist
Kristen Duarte – Rangeland Management Specialist
Amy Sobiech – Archaeologist
Amy Markstein – Planning and Environmental Specialist
Jeff Garrett – Mining Law Program Lead, Arizona State Office
Lislie Uhr – Realty Specialist
Margarita Guzman – Assistant Field Manager
Jaymie Lopez – Tuscon Field Manager
Dave Murray - Hydrologist
Margaret Hartney – Realty Specialist
Kim Ryan - Archaeologist

6.4 SAN CARLOS IRRIGATION PROJECT (BUREAU OF INDIAN AFFAIRS)

Beau Goldstein - Project Manager (Contractor, Transcon Environmental Inc.)

6.5 CZAR INC.

Alan Czarnowsky – Project Manager
Daniel Keuscher, PE – Assistant Project Manager
Sally Edwards – NEPA Compliance and Quality Control
Nick Maltby – Computer Specialist and 508 Compliance

6.6 CZAR INC. PRIMARY SUBCONTRACTORS

Susan Corser – Recreation and Visual Resources (ECA Community Planning)
Cindy Gilbert – Geochemistry (Western Exposure LLC)
Jay Jones – Air Quality (Four Peaks Environmental & Engineering LLC)
Thomas Lishner – Graphics (Lishner Cad Design LLC)
Steve Long – Soils, Vegetation and Waters of the U.S. (Cedar Creek Associates)
Joe Nagengast – Graphics (Nagengast Brothers Limited Partnership)
Mike Phelan – Wildlife (Cedar Creek Associates)
Janet Shangraw – Surface Water Hydrology (Janet N. Shangraw, Inc.)
Timothy Shangraw, PE – Ground Water Hydrology (Engineering Management Support, Inc.)

7.0 REFERENCES

Adams, R. A. 2003. Bats of the Rocky Mountain West. University Press of Colorado, Boulder, CO. 289 pp.

ADEQ 2004. Arizona Mining guidance Manual BADCT. Accessed via the internet at https://legacy.azdeq.gov/environ/water/wastewater/download/badctmanual.pdf.

ADEQ 2014. Arizona's 2012/14 Impaired Waters. Accessed via the internet at https://www.azdeq.gov/environ/water/assessment/assess2012_2014.html. Select Middle Gila Watershed.

ADOA 2012. Office of Employment and Population Statistics 2012-2050

ADOT Undated Arizona Department of Transportation (ADOT). Undated. Arizona Scenic Roads. Copper Corridor Scenic, Road West. http://www.arizonascenicroads.com/phoenix/

ADOT 1989. Arizona Highways, Travel Arizona – The Back Roads. Phoenix, Arizona.

ADOT 1993. Highway Drainage Design Manual – Hydrology, Arizona Department of Transportation, March, 1993.

ADOT 2017. Traffic statistics for 2017. www.adcot.gov

ADWR 2009. Arizona Department of Natural Resources, Arizona Water Atlas, Volume 3, Southeastern Arizona Planning Area. June 2009.

ADWR 2014. Arizona Department of Natural Resources, Surface Water Filings Active. http://www.azwater.gov/azdwr/gis/ Accessed via the internet on 5-13-14.

AFW, 2016a. Technical Memorandum, Engineering Analysis, Ripsey Wash Tailings Facility, ID – Water Balance Model, AMEC Foster Wheeler, September 29, 2016.

AFW 2016b. Draft EIS Comment Responses, Hackberry Gulch TSF Site Considerations, Asarco Ray Mine Operations. November 28, 2016.

AFW 2017. Technical Memorandum, Ripsey Wash Tailings Storage Facility Post-Closure Water Balance Model: Supplement to the ID – Water Balance Model, AMEC Foster Wheeler, August 21, 2017.

AMEC 2013. Geochemical Characterization Sampling and Analysis Plan, Ray Mine tailings

AMEC 2014a. Hydrogeologic Characterization Report, Proposed Ripsey Wash Tailings Storage Facility, ASARCO Ray Operations, Pinal County, Arizona. July 10, 2014.

AMEC 2014b. Sediment Yield and Transport Analysis for the Ripsey Tailing Storage Facility Project. AMEC, Phoenix, AZ, March, 2014.

AMEC 2014c. Technical Memorandum, Tailings Storage Facility, Ripsey Wash Tailing Storage Facility Surface Water Controls. AMEC, Phoenix, AZ, May 12, 2014.

AMEC 2014d. Technical Memorandum, Fault Reconnaissance, Hackberry Gulch TSF Site, ASARCO Ray Mine Complex, Pinal County Arizona, by W. Harrison. July 10, 2014.

AMEC 2015. Humidity Cell Test results (52 weeks) Geochemical Characterization.

Andrews, B. J. and K. A. King 1997. Environmental contaminants in sediment and fish of Mineral Creek and the Middle Gila River, Arizona. U.S. Fish and Wildlife Service, Region 2, Arizona Ecological Services State Office, Phoenix, AZ. 18 pp. Available at: https://www.fws.gov/southwest/es/arizona/Documents/ECReports/MineralCreekMidGilaRiverAZ.pdf

AORCC 2012. Arizona Outdoor Recreation Coordinating Commission (AORCC) p. 48. 2012. Draft 2013 Statewide Comprehensive Outdoor Recreation Plan (SCORP). September 7, 2012.

Arizona Department of Administration 2012. Office of Employment and Population Statistics: Arizona State and County Population Projections, 2012-2050: Methodology Report. December 7, 2012.

Arizona Game & Fish Department (AGFD) 1999. *Kinosternon sonoriense sonoriense*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game & Fish Department, Phoenix, AZ. 5 pp. Available at: http://www.azgfd.gov/w_c/edits/documents/Kinososo.d_000.pdf.

Arizona Game & Fish Department (AGFD) 2001a. *Macrotus californicus*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game & Fish Department, Phoenix, AZ. 5 pp. Available at: http://www.azgfd.gov/w_c/edits/documents/Macrcali.fi_001.pdf

Arizona Game & Fish Department (AGFD) 2002a. *Catostomus clarki*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game & Fish Department, Phoenix, AZ. 4 pp. Available at: http://www.azgfd.gov/w_c/edits/documents/Catoclar.fo_003.pdf.

Arizona Game & Fish Department (AGFD) 2002b. *Catostomus insignis*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game & Fish Department, Phoenix, AZ. 5 pp. Available at: http://www.azgfd.gov/w_c/edits/documents/Catoinsi.fo_004.pdf.

Arizona Game & Fish Department (AGFD) 2002c. *Falco peregrinus anatum*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game & Fish Department, Phoenix, AZ. 5 pp. Available at: http://www.azgfd.gov/w_c/edits/documents/Falcpean.fi_004.pdf.

Arizona Game & Fish Department (AGFD) 2002d. *Aquila chrysaetos*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game & Fish Department, Phoenix, AZ. 4 pp. Available at:

Arizona Game & Fish Department (AGFD) 2002e. *Myotis velifer*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game & Fish Department, Phoenix, AZ. 7 pp. Available at: http://www.azgfd.gov/w_c/edits/documents/Myotveli.fi_002.pdf.

Arizona Game & Fish Department (AGFD) 2002f. *Eumops perotis californicus*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game & Fish Department, Phoenix, AZ. 6 pp. Available at: http://www.azgfd.gov/w_c/edits/documents/Myotveli.fi_002.pdf.http://www.azgfd.gov/w_c/edits/documents/Eumopeca.fi_001.pdf.

Arizona Game & Fish Department (AGFD) 2002g. *Empidonax traillii extimus*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game & Fish

Arizona Game & Fish Department (AGFD) 2003a. *Corynorhinus townsendii*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game & Fish Department, Phoenix, AZ. 6 pp. Available at: http://www.azgfd.gov/w_c/edits/documents/Corytopa.fi_002.pdf.

Arizona Game & Fish Department (AGFD) 2003b. *Corynorhinus townsendii*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game & Fish Department, Phoenix, AZ. 6 pp. Available at: http://www.azgfd.gov/w_c/edits/documents/Corytopa.fi_002.pdf.

Arizona Game & Fish Department (AGFD) 2006a. *Lithobates yavapaiensis*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game & Fish Department, Phoenix, AZ. 10 pp. Available at: http://www.azgfd.gov/w_c/edits/documents/Ranayava.fi_003.pdf.

Arizona Game & Fish Department (AGFD) 2010. *Gopherus morafkai*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game & Fish Department, Phoenix, AZ. 11 pp. Available at: http://www.azgfd.gov/w_c/edits/documents/Gophagas.fi_004.pdf.

Arizona Game & Fish Department (AGFD) 2011a. *Nyctinomops femorosaccus*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game & Fish Department, Phoenix, AZ. 5 pp. Available at: http://www.azgfd.gov/w_c/edits/documents/Nyctfemo.fi_002.pdf.

Arizona Game & Fish Department (AGFD) 2011b. *Coccyzus americanus*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game & Fish Department, Phoenix, AZ. 6 pp. Available at: http://www.azgfd.gov/w_c/edits/documents/Coccamer.fi.pdf.

Arizona Game & Fish Department (AGFD) 2013a. Arizona Game and Fish Department Habimap - GIS program. Available at: www.habimap.org. March 2013. Accessed on June 10, 2014.

Arizona Game & Fish Department (AGFD) 2013b. *Agosia chrysogaster*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game & Fish Department, Phoenix, AZ. 7 pp. Available at: http://www.azgfd.gov/w_c/edits/documents/Agoschch.fo_002.pdf.

Arizona Game & Fish Department (AGFD) 2013c. *Buteogallus anthracinus*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game & Fish Department, Phoenix, AZ. 7 pp. Available at: http://www.azgfd.gov/w_c/edits/documents/Buteanth.d_003.pdf.

Arizona Game & Fish Department (AGFD) 2013d. The Pinal County wildlife connectivity assessment: report on stakeholder input. AGFC, Phoenix, AZ. 44 pp.

Arizona Game and Fish Department (AGFD) 2014a. 2014 Fishing Regulations. Accessed online March 3, 2014 at http://www.azgfd.gov/regs/fishingregs.pdf. Accessed online March 3, 2014.

Arizona Game and Fish Department (AGFD) 2014b. 2014 Fishing Regulations, 2014 Summer Trout Stocking Schedule. http://www.azgfd.gov/pdfs/h_f/fishing/stocking/TroutStockingSchedule.pdf. Accessed online at on May 24, 2014.

Arizona Game and Fish Department (AGFD) 2014c. Where to Hunt. http://www.azgfd.gov/h_f/hunting_units_37b.shtml. Accessed online May 24, 2014.

Arizona Game & Fish Department (AGFD) 2016. Hunt Arizona, 2016 Edition; survey, harvest and hunt data for big and small game. Arizona Game and Fish Department, Phoenix, AZ. 206 pp.

Arizona Game & Fish Department (AGFD), Heritage Data Management System (HDMS) 2014. AGFD HabiMapArizona. Accessed on 1/21/2014. Available at: http//www.habimap.org.

Asarco 2016. Technical Memorandum from Duane Yantorno to James Stewart – Elder Gulch Construction Material Geochemistry". November 1, 2016.

ATA 2014. http://www.aztrail.org/. Arizona Trail Association. Accessed online April 17, 2014.

Bearce, Neil R. 2006. Minerals, Fossils, and Fluorescents of Arizona, A Field Guide for Collectors. Arizona Desert Ice Press. Tempe, Arizona.

BLM 1984. Manual 8400, Visual Resource Management. April, 1984.

BLM 1986a. Manual H-8410-1 Visual Resource Inventory. http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/blm_handbook.Par.31679.File.dat/H-8410.pdf. Accessed online on May 28, 2014.

BLM 1986b. Manual 8431 Visual Resource Contrast Rating. Jan, 1986a.

BLM 1989. Phoenix Resource Management Plan (RMP), dated September 1988.

BLM 1999. Final Environmental Impact Statement Ray Land Exchange/Plan Amendment. June 1999.

BLM 2010. Middle Gila Canyons Transportation and Travel Management Plan. October 2010.

BLM 2011. BLM Manual 8320 – Planning for Recreation and Visitor Services. March, 2011.

BLM 2013. Gila River Sites. Shores and Christmas Recreation Areas. Last Updated: March 29, 2013. http://www.blm.gov/az/st/en/prog/recreation/camping/dev_camps/griver-rec.html. Accessed online April 1, 2014.Brennan, T. C. and A. T. Holycross 2006. A Field Guide to Amphibians and Reptiles in Arizona. Arizona Game and Fish Department, Phoenix. 150 pp.

Brennan, T. C. 2008. Sonoran mud turtle, *Kinosternon sonoriense.* In: Online Field Guide to the Reptiles and Amphibians of Arizona. Available at: http://www.reptilesofaz.org/index.html.

Brown, D. E. and C. H. Lowe 1980. Biotic Communities of the Southwest [map]. Scale 1:1,000,000. General Technical Report RM-78. U. S. Forest Service, Fort Collins. Reprinted (and revised) 1994 by University of Utah Press, Salt Lake City.

Corman, T. E. and C. Wise-Gervais 2005. Arizona Breeding Bird Atlas. University of New Mexico Press, Albuquerque, NM. 636 pp.

Corman, T. E. 2005a. Harris's hawk. pp. 140-141 In: Corman, T. E. and C. Wise-Gervais. 2005. Arizona Breeding Bird Atlas. University of New Mexico Press, Albuquerque, NM. 636 pp.

Corman, T. E. 2005b. Turkey vulture. pp. 118-119 In: Corman, T. E. and C. Wise-Gervais. 2005. Arizona Breeding Bird Atlas. University of New Mexico Press, Albuquerque, NM. 636 pp.

Cornwall, H.R., and Krieger, M.H. 1971. Geologic Map of the Kearney Quadrangle, Pinal County, Arizona.

Cornwall and Krieger 1975. Cornwall, H.R., Banks, N.G., and Phillips, C.H., 1971. Geologic Map of Sonora Quadrangle, Pinal and Gila Counties, Arizona.

ECA Community Planning (ECA) 2014. Field observations during February 5, 2014, site visit to Arizona National Scenic Trail.

EEC 2016. Stormwater Pollution Prevention Plan, Asarco LLC – Ripsey Wash Tailings Storage Facility. Arizona Pollution Discharge Elimination System Permit Number AZMSG2010-003, Mining Multi-Sector General Permit. Engineering and Environmental Consultants, Inc., April 21, 2016.

ERM Consultants 2015. Construction Emissions Report 2015.

FEMA 2014. Federal Emergency Management Agency, National Flood Hazard Layer. Accessed via the internet at: https://hazards.fema.gov/femaportal/NFHL/on 3-27-2014

Freeze and Cherry 1979. Groundwater, Prentice Hall, Englewood Cliffs, New Jersey.

JE Fuller/Hydrology & Geomorphology, Inc. 2012. Ripsey Wash Hydrologic FLO-2D Modeling in Pinal, County AZ. Memorandum dated June 8, 2012. JE Fuller/Hydrology & Geomorphology, Inc. Tucson, Arizona. 18 pp + appendix.

Graber, A.E. and T.J. Koronkiewicz 2009. Southwestern Willow Flycatcher Surveys and Nest Monitoring along the Gila River between Coolidge Dam and South Butte, 2008. Annual summary report submitted to U.S. Bureau of Reclamation, Glendale, Arizona. Flagstaff, Arizona by SWCA Environmental Consultants. 25 pp. + appendices.

Graber, A.E. and T.J. Koronkiewicz 2011. Southwestern Willow Flycatcher Surveys and Nest Monitoring along the Gila River between Coolidge Dam and South Butte, 2010. Annual summary report submitted to U.S. Bureau of Reclamation, Glendale, Arizona. Flagstaff, Arizona by SWCA Environmental Consultants. 28 pp. + appendices.

Graber, A.E., T.J. Koronkiewicz, and J.L. Granger 2012. Southwestern Willow Flycatcher Surveys and Nest Monitoring along the Gila River between Coolidge Dam and South Butte, 2011. Annual summary report submitted to U.S. Bureau of Reclamation, Glendale, Arizona. Flagstaff, Arizona by SWCA Environmental Consultants. 35 pp. + appendices.

Huckleberry 1996. Huckleberry, G. 1996. Historical Geomorphology of the Gila River, Open-File Report 96-14, Arizona Geological Survey. Tucson, AZ. http://www.gardguide.com.

Hutchison, Ian P.G and Ellison, Richard D. 1992. Mine Waste.

Jerla 2018. *A Cultural Resources Summary for the Ripsey Wash Tailings Storage Facility Area of Potential Effect.* Christine Jerla. September, 16, 2013. Revised March 20, 2018. Cultural Resources Report 2013-46. WestLand Resources, Tucson, Arizona.

King 2014. Cultural Resources Analysis Report for the Asarco Ray Mine Hackberry Gulch Tailings Storage Facility Analysis Area Near Kelvin, Pinal County, Arizona. Anna M. King. February 7, 2014. Cultural Resources Report 2014-05. WestLand, Tucson, Arizona.

King K. A. and D. L. Baker 1995. Contaminants in fish and wildlife of the Middle Gila River, Arizona. U.S. Fish and Wildlife Service, Region 2, Arizona Ecological Services State Office, Phoenix, AZ. 17 pp. Available at: http://azmemory.azlibrary.gov/cdm/ref/collection/feddocs/id/320.

Latta, M. J. 2005. Great blue heron. pp. 104-105 In: Corman, T. E. and C. Wise-Gervais. 2005. Arizona Breeding Bird Atlas. University of New Mexico Press, Albuquerque, NM. 636 pp.

Marsh, P.C.and B. R. Kesner. 2006. Analysis of fish population monitoring data for selected waters of the Gila River Basin, Arizona, for the five-year period 2000-2004. Prepared for Bureau of Reclamation, Glendale, AZ by Marsh & Associates, LLC, Tempe, AZ, September 12, 2006. 44 pp.

Kesner, B.R. and P. C. Marsh. 2010. Central Arizona Project fish monitoring final report. Prepared for Bureau of Reclamation, Glendale, AZ by Marsh & Associates, LLC, Tempe, AZ, October 15, 2010. 50 pp.

McCarty, K.M. and K.V. Jacobson 2012. Arizona golden eagle nest survey 2012. Nongame and Endangered Wildlife Program Technical Report 271. Arizona Game and Fish Department, Phoenix, Arizona.

McGuire C.E., W. A. Sveltlik, Jr. and C. A. Prink 2009. Soil Survey of Eastern Pinal and Southern Gila Counties, Arizona. Natural Resources Conservation Service. www.nrcs.usda.gov.

McGuire 2009. *Soil Survey of Eastern Pinal and Southern Gila Counties, Arizona.*

Nelson, Matthew 2014. Email communication between Susan Corser of ECA Community Planning and Matthew Nelson, Executive Director, Arizona Trail Association. March 10, 2014.

NWQMC 2015. National Water Quality Monitoring Council data portal sponsored by USGS, USEPA, NWQMC which serves data collected by over 400 state, federal, tribal, and local agencies.

Pinal County 2007. Pinal County Open Space and Trails Master. Florence, AZ. October, 2007.

Pinal County 2009. Pinal County Comprehensive Plan, Pinal County 2007. Pinal County Open Space and Trails Master. Florence, AZ. October, 2007.

Price, W.A. and Errington, J.C. 1998. Guidelines for Metal Leaching and Acid Rock drainage at Minesites in British Columbia. Energy and Minerals Division, British Columbia Ministry of Employment and Investment.

Purcell, David 2014. Email communication between Susan Corser of ECA Community Planning and David Purcell of WestLand Resources. March 10, 2014. And Purcell 2014b. *A Cultural Resources Inventory of Alternate Alignments To The Ripsey Wash Segment Of The Arizona Trail Near Kelvin, Pinal County, Arizona.* David E. Purcell. May 19, 2014. Cultural Resources Report 2014-25. WestLand, Tucson, Arizona.

Redfield, Shawn 2014. Email communication between Susan Corser of ECA Community Planning and Shawn Redfield, Arizona Trail Director. March 9, 2014.

Rosen, P. C. and C. R. Schwalbe 1988. Status of the Mexican and narrow-headed garter snakes (*Thamnophis eques megalops* and *Thamnophis rufipunctatus rufipunctatus*) in Arizona. Unpublished report from Arizona Game and Fish Department, Phoenix, Arizona submitted to U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 50 pp + appendices.

Schmidt 1971. Schmidt, E.A. 1971. A Structural Investigation of the Northern Tortilla Mountains, Pinal County, Arizona (PhD Dissertation), University of Arizona, Tucson, 1971.

SHB 1989. Sargent, Hauskins & Beckwith (SHB), 1989. Geotechnical and Hydrogeological Investigation Report, ASARCO Elder Gulch Tailings Facility and Ray Concentrator, Pinal County, Arizona, November 15, 1989.

SWCA Environmental Consultants 1991. Biological Evaluation for Alternative Tailing Impoundment Locations at Asarco-Ray Unit Mine. Report Dated January 1001. 26 pp. with attachments.

Terres, J. K. 1980. The Audubon Society encyclopedia of North American birds. Alfred A. Knopf, New York. 1109 pp.

Town of Kearny. Undated. Town of Kearny, Arizona-Attractions. Accessed online April 3, 2014 at http://www.townofkearny.com/attractions.html.

U. S. Army Corps of Engineers (USACE) 1987. Corps of Engineers Wetland Delineation Manual: Technical Report Y-87-1.

U. S. Army Corps of Engineers (USACE) 2008. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2.0) ERDC/EL TR-08-28, Washington D.C.

U.S. Department of Commerce, Bureau of the Census 2008-2012. American Community Service.

U.S. Department of Labor 2016. "Occupational Noise Exposure", Code of Federal Regulations, Title 29, Part 1926.

U.S. Fish and Wildlife Service (USFWS) 2003. Biological Opinion.

U.S. Fish and Wildlife Service (USFWS) 2008. Birds of Conservation Concern 2008. U.S. Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia.87 pp. Online version available at http://www.fws.gov/migratorybirds/.

U.S. Fish and Wildlife Service (USFWS) 2010. Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition to List the Sonoran Population of the Desert Tortoise as Threatened or Endangered. Federal Register 75(239):78094–78146.

U.S. Fish and Wildlife Service (USFWS) 2013a. Federally Listed Threatened, Endangered, and Candidate Species for Pinal County, updated August 21, 2013. Arizona Ecological Field Services Office. Available at: http://www.fws.gov/southwest/es/arizona/Documents/CountyLists/Pinal.pdf. Accessed January 8, 2014.

U.S. Fish and Wildlife Service (USFWS) 2013b. AESO Listing Workplan and Current Schedule as of 5/14/13. Arizona Ecological Services Office.

U.S. Fish and Wildlife Service (USFWS) 2013c. Endangered and threatened wildlife and plants; designation of critical habitat for southwestern willow flycatcher. Federal Register 78(2):344-534.

U.S. Fish and Wildlife Service (USFWS) 2013d. Endangered and Threatened Wildlife and Plants: Designation of Critical Habitat for the northern Mexican gartersnake and the narrow-headed gartersnake; Proposed Rule. Federal Register 78(132):41500-41547.

U.S. Fish and Wildlife Service (USFWS) 2014a. Endangered and threatened wildlife and plants; determination of threatened status for the western distinct population segment of the yellow-billed cuckoo (*Coccyzus americanus*). Federal Register 79 (192):59992–60038.

U.S. Fish and Wildlife Service (USFWS) 2014b. Endangered and threatened wildlife and plants; designation of critical habitat for the western distinct population segment of the yellow-billed cuckoo (*Coccyzus americanus*). Federal Register 79 (158):48548–48652.

U.S. Fish and Wildlife Service (USFWS) 2014c. Endangered and Threatened Wildlife and Plants: Threatened Status for the northern Mexican gartersnake and narrow-headed gartersnake: Final rule. Federal Register 79 (130):38678-38746.

U.S. Fish and Wildlife Service (USFWS) 2015a. Endangered and Threatened Wildlife and Plants; 12-month finding on a petition to list Sonoran desert tortoise as an Endangered or Threatened species. Federal Register 80 (193):60321-60335.

U.S. Fish and Wildlife Service (USFWS) 2015b. Candidate Conservation Agreement for the Sonoran Desert Tortoise (*Gopherus morafkai*) in Arizona. Between the U.S. Fish and Wildlife Service and Cooperating Agencies comprising the Arizona Interagency Deert Tortoise Team. Available at: https://www.fws.gov/.../SonoranTort/Final_SDT-CCA_201500527%20v2.%20all%20sig...

U.S. Geological Survey (USGS) 2010. Quaternary Fault and Fold Database for the United States, http://earthquake.usgs.gov/hazards/qfaults/, accessed July 2013.

U.S. Geological Survey (USGS) 2016. USGS Water Data Report 2016, 09474000 Gila River At Kelvin, AZ. Accessed via the internet at https://waterdata.usgs.gov/nwis/wys_rpt?dv_ts_ids=5541&wys_water_yr=2016&site_no=09474000&agency_cd=USGS&adr_water_years=2006%2C2007%2C2008%2C2009%2C2010%2C2011%2C2012%2C2013%2C2014%2C2015%2C2016&referred_module=.

U.S. National Vegetation Classification (USNVC) 2013. National Vegetation Classification System. Available at: http://usnvc.org.

WestLand 2011a. Native Plant and Noxious Weed Inventory on ASLD Land for the Ripsey Wash Project Area, Pinal County, Arizona. WestLand, Tucson, Arizona. 15 pp. + figures and appendices.

WestLand 2011b. 2011 Southwestern willow flycatcher survey along the Gila River near the Florence-Kelvin Bridge. October 25, 2011. Unpublished report submitted to ASARCO LLC and on file with the U.S. Army Corps of Engineers, Phoenix Office. 7 pp. + Figures & Appendix.

WestLand 2012. 2012 Western yellow-billed cuckoo survey along 2.5 miles of the Gila River. September 13, 2012. Unpublished report submitted to ASARCO LLC and on file with the U.S. Army Corps of Engineers, Phoenix Office. 6 pp. + Figures & Appendix.

WestLand 2013a. Jurisdictional Waters Determination for the Ripsey Wash Analysis Area. WestLand, January 15, 2013 (Supplemented August 30, 2013).

WestLand 2013b. Methods Used for the Functional Assessment of Waters in the Ripsey Wash Project Area, Pinal County, Arizona. 10 pp. + figures and attachments.

WestLand 2013c. Jurisdictional Waters Determination for the Ripsey Wash Analysis Area, Pinal County, Arizona. WestLand 12 pp. + figures and attachments.

WestLand 2013d. 2011 Western yellow-billed cuckoo survey along 3.9 miles of the Gila River. October 18, 2013. Unpublished report submitted to ASARCO LLC and U.S. Army Corps of Engineers, Phoenix Office. 7 pp. + Figures & Appendix.

WestLand 2014a. Ray Mine Tailings Storage Facility, Ripsey Wash Alternative 3 Project Area, Surface Water Features Survey.

WestLand 2014b. Ray Mine Tailing Storage Facility, Hackberry Gulch Alternative 2 Project Area, Surface Water Features Survey.

WestLand 2014c. Ray Mine Proposed Tailings Storage Facility, Regional Study Area, Recreational Uses.

WestLand 2014d. Ray Mine Tailings Storage Facility – Ripsey Wash Analysis Area – Vegetation Baseline. WestLand 15 pp. + figures and appendices.

WestLand 2014e. Ray Mine Tailings Storage Facility – Hackberry Gulch Analysis Area – Vegetation Baseline. WestLand, 15 pp. + figures and appendices.

WestLand 2014f. Ray Mine Tailings Storage Facility – Hackberry Gulch Analysis Area – Supplemental Vegetation Analysis. WestLand 6 pp. + figure.

WestLand 2014g. Ray Mine Tailings Storage Facility – Ripsey Wash Analysis Area – Endangered Species Act - Listed Species Screening Analysis. 26 pp. + figures and appendices.

WestLand 2014h. Ray Mine Tailings Storage Facility – Ripsey Wash Analysis Area – Bureau of Land Management- Sensitive Species Screening Analysis. 26 pp. + figures and appendices.

WestLand 2014i. Ray Mine Tailings Storage Facility – Hackberry Gulch Analysis Area – ESA - Listed Species Screening Analysis. WestLand, 25 pp. + figures and appendices.

WestLand 2014j. Ray Mine Tailings Storage Facility – Hackberry Gulch Analysis Area – Bureau of Land Management - Listed Species Screening Analysis. 37 pp. + figures and appendices.

WestLand 2014k. Unpublished Contrast Rating Forms for the Ray Mine Tailings Storage Facility EIS. WestLand Resources, Tucson, AZ.

WestLand 2014l. Ray Mine Tailings Storage Facility, Ripsey Wash Alternative 3, Visual Resources Assessment. WestLand Resources, Tucson, AZ. January 11, 2014.

WestLand 2014m. Ray Mine Tailings Storage Facility, Hackberry Gulch Alternative 2, Visual Resources Assessment. WestLand Resources, Tucson, AZ. March 21, 2014.

WestLand 2014n. Ray mine tailings storage facility Ripsey Wash Analysis Area wildlife resources. January 29, 2014. Unpublished report submitted to ASARCO LLC and U.S. Army Corps of Engineers, Phoenix Office. 13 pp. + Figures.

WestLand 2014o. Ray mine tailings storage facility Hackberry Gulch Analysis Area wildlife resources summary. March 14, 2014. Unpublished report submitted to ASARCO LLC and U.S. Army Corps of Engineers, Phoenix Office. 16 pp. + Figures & Appendices.

WestLand 2014p. Ray mine tailings storage facility Ripsey Wash analysis area abandoned mine feature survey. February 6, 2014. Unpublished report submitted to ASARCO LLC and the U.S. Army Corps of Engineers, Phoenix Office. 9 pp. + Figures & Appendix.

WestLand 2014q. Ray mine tailings storage facility Hackberry Gulch analysis area abandoned mine feature survey. April 18, 2014. Unpublished report submitted to ASARCO LLC and the U.S. Army Corps of Engineers, Phoenix Office. 7 pp. + Figures & Appendix.

WestLand 2014r. Ray mine tailings storage facility Ripsey Wash survey area Sonoran Desert Tortoise survey. February 14, 2014. Unpublished report submitted to ASARCO LLC and the U.S. Army Corps of Engineers, Phoenix Office. 13 pp. + Figures & Appendices.

WestLand 2014s. Ray mine tailings storage facility Hackberry Gulch Alternative 2 Sonoran desert tortoise survey. May 29, 2014. Unpublished report submitted to ASARCO LLC and the U.S. Army Corps of Engineers, Phoenix Office. 10 pp. + Figures & Appendices. WestLand, 2014t. 2014 Southwestern willow flycatcher survey along the Gila River. September 24, 2014. Unpublished report submitted to ASARCO LLC and on file with the U.S. Army Corps of Engineers, Phoenix Office. 11 pp. + Figures & Appendix.

WestLand 2014u. 2014 Western yellow-billed cuckoo survey along the Gila River. November 21, 2014. Unpublished report submitted to ASARCO LLC and on file with the U.S. Army Corps of Engineers, Phoenix Office. 10 pp. + Figures & Appendix.

WestLand 2015a. Asarco LLC Ripsey Wash Tailings Facility threatened and endangered species effects analysis. January 30, 2015. Unpublished report submitted to ASARCO LLC and on file with the U.S. Army Corps of Engineers, Phoenix Office. 46 pp. + Figures.

WestLand. 2015b. 2015 Southwestern willow flycatcher survey portions of the middle Gila River, Pinal County, Arizona. September 28, 2015. Unpublished report submitted to ASARCO LLC and on file with the U.S. Army Corps of Engineers, Phoenix Office. 10 pp. + Figures & Appendix.

WestLand 2015c. 2015 Yellow-billed cuckoo survey portions of the middle Gila River, Pinal County, Arizona. September 28, 2015. Unpublished report submitted to ASARCO LLC and on file with the U.S. Army Corps of Engineers, Phoenix Office. 8 pp. + Figures & Appendix.

WestLand 2015d. Asarco LLC. Ripsey Wash tailings storage facility Sonoran desert tortoise effects analysis. May 1, 2015. Unpublished report submitted to ASARCO LLC and on file with the U.S. Army Corps of Engineers, Phoenix Office. 23 pp. + Figures.

WestLand 2015e. Ripsey Wash tailings storage facility Biological Assessment. December 2, 2015. Unpublished report submitted to ASARCO LLC and on file with the U.S. Army Corps of Engineers and U.S. Fish and Wildlife Service, Phoenix Offices. 47 pp. + Figures.

WestLand 2016a. 2016 Southwestern willow flycatcher survey; middle Gila River from upstream of the Kelvin Bridge to downstream of Zelleweger Wash, Pinal County, Arizona. October 25, 2016. Unpublished report submitted to ASARCO LLC and on file with the U.S. Army Corps of Engineers, Phoenix Office. 8 pp. + Figures & Appendix.

WestLand 2016b. 2016 Yellow-billed cuckoo survey: middle Gila River from upstream of the Kelvin Bridge to downstream of Zelleweger Wash, Pinal County, Arizona. October 25, 2016. Unpublished report submitted to ASARCO LLC and on file with the U.S. Army Corps of Engineers, Phoenix Office. 5 pp. + Figures & Appendix.

WestLand 2017a. 2017 Southwestern willow flycatcher survey: middle Gila River, Gila River south of Kearny, and San Pedro River at PZ Ranch, Pinal County, Arizona. September 29, 2017. Unpublished report submitted to ASARCO LLC and on file with the U.S. Army Corps of Engineers, Phoenix Office. 9 pp. + Figures & Appendix.

WestLand 2017b. 2017 Yellow-billed cuckoo survey: middle Gila River, Gila River southeast of Kearny, and San Pedro River at PZ Ranch, Pinal County, Arizona. November 10, 2017. Unpublished report submitted to ASARCO LLC and on file with the U.S. Army Corps of Engineers, Phoenix Office. 6 pp. + Figures & Appendix.

White 2014. Telephone conversation with Laura White, Arizona National Scenic Trail Administrator, U.S. Forest Service, Southwestern Region. April 23, 2014.

White 2016. Letter submitted by Laura White, Arizona National Scenic Trail Administrator, U.S. Forest Service, Southwestern Region, to Mike Langely, Senior Project Manager, U.S. Army Corps of Engineers, Phoenix, AZ in response to Draft Environmental Impact Statement, Ray Mine Storage Facility. March 11, 2016.

Wilson 2014a. Wilson, R. Personal Communication. State Resources Inventory Coordinator. Natural Resources Conservation Service. April 4, 2014.

Wilson 2014b. (soils), Personal Communication. April 17, 2014.

Wise-Gervais, C. 2005. Red-tailed hawk. pp. 146-147 In: Corman, T. E. and C. Wise-Gervais. 2005. Arizona Breeding Bird Atlas. University of New Mexico Press, Albuquerque, NM. 636 pp.

OTHER REFERENCED WEBSITES

www.azgfd.gov/w_c/edits/hdms_abstracts_reptiles.shtml

www.azgfd.gov/h_f/hunting_units_37b.shtml, accessed January 3, 2014.

www.blm.gov/az/st/en/prog/lands/land_tenure/ray-mine/about.html

www.epa.gov/climatechange/Basics. (Link goes to site with directions to connect to archived EPA site "January_19_snapshot").

www.epa.gov/climatechange/impacts-adaptation/southwest.html (2015). Link goes to site with directions to connect to archived EPA site "January_19_snapshot").

www.epa.gov/ghgemissions/overview-greenhouse-gases

www.epa.gov/climatechange/ghgemissions/usinventoryreport.html. (Link goes to site with directions to connect to archived EPA site "January_19_snapshot").

www.epa.gov/statelocalclimate/documents/pdf/CO2FFC_2012.pdf.

http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml.

www.gardguide.com.

www.nrcs.usda.gov. 357 pp. + appendices and maps.

www.waterqualitydata.us, National Water Quality Monitoring Council, Water Quality Portal.

www.websoilsurvey.sc.egov.usda.gov/App/Homepage.html.

www.wrcc.dri.edu/cgi-bin/cliMAIN.pl/az8348 (Superior, AZ, 1920-2006, climate data)

www.wrcc.dri.edu/cgi-bin/cliMAIN.pl/az9420 (Winkelman 6 S, AZ, 1893-1980, climate data)

www.wrcc.dri.edu/cgi-bin/cliMAIN.pl/az4590 (Kearny, AZ, 1984-2013)

www.wrcc.dri.edu/cgi-bin/cliMAIN.pl/az9420 (Winkelman 6 S, AZ, 1893-1980 climate data)

www.wrcc.dri.edu/htmlfiles/westevap.final.html (Winkelman 6 S, AZ, 1942-1980 climate).Stitzer

8.0 ACRONYMS, GLOSSARY AND SCIENTIFIC TERMINOLOGY

8.1 ACRONYMS

AAWQS	Arizona Aquifer Water Quality Standards
ABA	Acid Base Accounting
ACEC	Area of Critical Environmental Concern
ADOT	Arizona Department of Transportation
ADT	Average Daily Traffic
ADWR	Arizona Department of Water Resources
AGFD	Arizona Game and Fish Department
AGP	Acid Generating Potential
AMD	Acid Mine Drainage
AMSL	Above Mean Sea Level
ANP	Acid Neutralization Potential
ANST	Arizona National Scenic Trail (Arizona Trail)
AORCC	Arizona Outdoor Recreation Coordinating Commission
APE	Area of Potential Effects
APLIC	Avian Power Line Interaction Committee
APP	Aquifer Protection Plan
ARD	Acid Rock Drainage
ASLD	Arizona State Land Department
ASTM	American Society for Testing Materials
ATA	Arizona Trail Association
AUM	Animal Unit Month
AWC	Available Water Capacity
BA	Biological Assessment
BADCT	Best available demonstrated control technology
BCC	Birds of Conservation Concern
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management

BO	Biological Opinion
CAA	Clean Air Act
CAP	Central Arizona Project
CCA	Candidate Conservation Agreement
CEQ	Council of Environmental Quality
Corps	United States Army Corps of Engineers
CWA	Clean Water Act
DA	Department of the Army
DEQ	Department of Environmental Quality
DPS	Distinct Population Segment
DR	Deferred Rotation
DWR	Department of Water Resources
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FCAA	Federal Clean Air Act
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FLMPA	Federal Lands Management Policy Act
GARD	Global Acid Rock Drainage
GIS	Graphics Information System
GLO	General Land Office
GMU	Game Management Unit
GPS	Global Positioning System
HAP	Hazardous Air Pollution
HCT	Humidity Cell Test(s)
HDMS	Heritage Data Management System
HDPE	High Density Polyethylene
HMMP	Habitat Mitigation and Monitoring Plan
HPTP	Historic Mitigation and Monitoring Plan

INAP	International Network for Acid Prevention
KOP	Key Observation Point
LEDPA	Least Environmentally Damaging Practicable Alternative
LSPRWA	Lower San Pedro River Wildlife Area
MACT	Maximum Available Control Technology
MBTA	Migratory Bird Treaty Act
MCE	Maximum Credible Earthquake
MEND	Mine Environmental Neutral Drainage
MOA	Memorandum of Agreement
MPO	Mine Plan of Operations
MSGP	Multi-Sector General Permit
MSHA	Mine Safety and Health Administration
MWMP	Meteoric Water Mobility Procedure
NAAQS	National Ambient Air Quality Standards
NEI	National Emissions Inventory
NEPA	National Environmental Policy Act
NFHL	National Flood Hazard Layer
NHPA	National Historic Preservation Act
NNP	Net Neutralizing Potential
NOI	Notice of Intent
NRCS	National Resource Conservation Service
NRHP	National Register of Historic Places
NSHM	National Seismic Hazard Maps
NSPS	New Source Performance Standards
OHV	Off-Highway Vehicle
OHWM	Ordinary High Water Mark
OSHA	Occupational Safety and Health Administration
PMP	Probably Maximum Precipitation
PSD	Prevention of Significant Deterioration
RMP	Resource Management Plan

ROD	Record of Decision
ROS	Recreational Opportunity Spectrum
ROW	Right-of-Way
RUS	Rural Utility Services
SCIP	San Carlos Irrigation Project
SDWA	Safe Drinking Water Act
SERI	Species of Economic and Recreational Importance
SGCN	Species of Greatest Conservational Need
SHCG	Species and Habitat Conservation Guide
SHPO	State Historic Preservation Office(r)
SIP	State Implementation Plan
SPCC	Spill Prevention Control Countermeasures
SQRU	Scenic Quality Rating Unit
SR	State Route (Arizona)
STS	Southwest Trail Solutions
SWAP	State Wildlife Action Plan
SWCA	Steven W. Carothers & Associates
SWFL	Southwestern Willow Flycatcher
SWMP	Stormwater Management Plan
SWPPP	Stormwater Pollution Prevention Plan
SX-EX	Solvent Extraction/Electrowinning
TCP	Traditional Cultural Property
TDS	Total Dissolved Solids
THPO	Tribal Historic Preservation Office(r)
TSF	Tailings Storage Facility
TVV	Total Vegetation Volume
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

VOC	Volatile Organic Compound
VRI	Visual Resource Inventory
VRM	Visual Resource Management
WEG	Wind Erodibility
WSC	Wildlife Species of Concern
XRD	X-Ray Diffraction

8.2 GLOSSARY

A

Arboretum: A plot of land on which many different trees or shrubs are grown for display.

Acceleration (Accelerate): An increase of speed or velocity.

Acid Base Accounting (ABA): An evaluation of the acid generating potential (AGP) by comparing various levels and forms of acid-forming and acid-neutralizing materials found in ore or waste rock.

Acid Plant: Infrastructure/facilities to capture and treat Sulfur Dioxide gas (SO_2) emissions for re-use at tailings leaching operations.

Acid Drainage: Low pH drainage (range 2.0 to 4.5) resulting from the oxidation of sulfides. Acid drainage can mobilize and transport heavy metals which are often the characteristic of metals deposit.

Adit: An underground mining term; a horizontal or near horizontal access opening to an ore deposit with a single opening to the surface (a tunnel has two openings).

Aesthetic (Aesthetics): Concerned with the art or nature of beauty and the appreciation of beauty.

Alkaline: Having the quality of a basic substance; with a pH greater than 7.0 holds the ability to neutralize acid.

Allotment: A plot of land that has been divided and distributed by share or portion.

Alluvial: Said of a placer deposit or sediment, formed by the action of running water, as in a stream channel or an alluvial fan.

Alluvium: Unconsolidated sedimentary material including clay, silt, sand, gravel and mud deposited by flowing water.

Alternative(s): In an EIS, alternatives are options to compare against the proposed action. An EIS must include a no-action alternative.

Alunite: A hydrated aluminum potassium sulfate mineral, yellow to white-grey in color; formed by the action of sulfuric acid bearing solutions on these rocks during the oxidation and leaching of metal sulfide deposits.

Ambient Air: In this EIS, a set of primary and secondary air quality standards set by the EPA; standards require minimum pollutants of Carbon Monoxide (CO), Lead (Pb), Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2), Ozone and particulate matter.

Anode: An electrode with a positive electric charge.

Anode Copper: Specially shaped copper slabs used as anodes in electric refinement.

Anoxic: Containing no or an abnormally low amount of oxygen.

Antimony (Sb): A native, metallic element, silver and white in appearance; occurs in granular or shapeless masses.

Aplite Porphyry: A light-colored igneous rock characterized by fine grained, granular texture consisting of quartz, potassium feldspar and acid plagioclase.

Appurtenant: Pertaining or belonging to.

Aquatic: Growing, living in, frequenting or taking place in water.

Aquifer: A zone, stratum or group of strata acting as a hydraulic unit that stores or transmits water in sufficient quantities for beneficial use.

Arizona Trail (Arizona National Scenic Trail): A recreational and scenic trail that is approximately 800 miles long that crosses Arizona stretching from Utah to Mexico.

Arsenic (As): Native metallic element with a steel-grey appearance; commonly occurs in granular or kidney-shaped masses.

Artesian: Refers to ground water under hydrostatic pressure, water in a well rises above the level of the water table due to hydrostatic pressures (artesian) usually flowing at the surface.

Asymmetrical: Not identical on both sides of a central line; lacking symmetry.

Audible: Able to be heard.

Avian: Of or pertaining to birds.

Axis: A line that dissects a two or three-dimensional object or figure.

B

Base Flow: A sustained or fair-weather flow of a stream

Baseline: In an EIS, a surveyed line established with care which serves as a reference point to which all associated surveys are coordinated and compared.

Basin: A depressed area with no surface outlet, term widely applied; lake basin, groundwater basin, river basin or drainage basin.

"Beach": Unconsolidated material that covers a gently sloping zone due to the accumulation of loose, water-borne material.

Bed: A small, formal unit given to the deposited space of sedimentary rocks.

Bedding: Within a bed, the arrangement of sediments and rocks in layers of varying thicknesses and composition.

Bedrock: The rock, usually solid, that underlies soil or other unconsolidated material.

Bench (Benches): In open-pit mines and quarries, A ledge which forms a single level of operation where ore and/or waste rock is excavated.

Beryllium (Be): A chemical element, blue-grey in color; an alloying element to copper and other metals.

Biotic: Pertaining to life.

Blast-hole Drills: A piece of mining equipment purposed with drilling the holes in which explosives will be loaded.

Blast-hole Drill

Bosque: The name for areas of gallery forest found along the riparian flood plains of stream and river banks in the southwestern United States.

Box Culverts: Structures that allow water to flow under a road, railroad, trail, or similar obstruction.

Breccia: A coarse-grained rock composed of broken angular segments held together by a mineral cement or fine grained matrix.

Bulldozer: A highly versatile piece of mining equipment; a tractor with a curved blade on the front and a ripper arm(s), primarily used for the manipulation of material.

Bulldozer

C

Cadmium (Cd): A native element, a soft bluish-white transition metal

Calcium (Ca): A chemical element, a soft grey alkaline metal.

Carbonate: A mineral compound characterized by the ionic compound CO_3^{-2} also used to refer to sediments formed of carbonates of calcium.

Cathode: the electrode from which a conventional current leaves a polarized electrical device. The polarity depends on the system.

Cathode Copper: Electrolytically refined copper that has been deposited on the cathode of an electrolytic bath of acidified copper sulfate solution.

Centerline Construction: A common construction method used for tailings facilities; tailings are cycloned and spigotted d off the crest of the starter dams. The centerline of the embankment is maintained as fill and progressive raises would occur on both the beaches (up-drainage side) and the downstream face of the embankment.

Centrifugal Force: The apparent force that draws the body away from the center of rotation while spinning.

Cessation: The temporary or complete stopping.

Chalcocite: A copper sulfide mineral (Cu_2S)

Chalcopyrite: A copper iron sulfide mineral ($CuFeS_2$)

Coke Oven: A chamber of brick or other heat-resistant material in which coal is destructively distilled.

Colluvium: A term applied to any loose heterogeneous and incoherent mass of soil, material and/or rock deposited by rainwash, sheetwash or slow continuous creep, usually collecting at the base of hillsides.

Compensatory: To counterbalance or offset for a loss, lack or injury.

Compliance: The act of cooperation or obedience.

Composite Samples: Sample made up of separate parts or elements.

Compound: A pure substance composed of two or more elements whose composition is constant.

Concentrates [copper]: the valuable fraction of ore that is left after waste material is removed in processing. This material is what is sent to the smelter.

Concentrator: Another name for a mill. (*See Mill*)

Conceptual: Pertaining to an idea or formulation of an idea.

Concurrence (Concurrent): Acting in according with general agreement.

Condemnation Drilling: Also known as Sterilization drilling, a test of a mine site area to ensure there are no valuable minerals, so that infrastructure may be built on that land.

Confluence: A flowing together of two rivers or streams.

Conglomerate: A coarse grained sedimentary rock comprised on fragments larger than 2mm (pebbles, cobbles, boulders) set in a matrix of silt or sand cement.

Conical: Having the form of or resembling a cone.

Coniferous Trees (Conifers): Flora hosting needlelike or scale-like leaves and naked seeds borne in cones. Conifers include pines, furs and spruces.

Consultation: An inclusive meeting for deliberation, discussion and/or decision.

Contemporaneous: Living or occurring during the same period of time; contemporary.

Contingent: In this EIS, dependent on for construction/existence.

Contouring (Re-contouring): Utilizing bulldozers and graders to reshape ground material into a final landform.

Converter Furnace: One of the various types of furnaces used for smelting copper. In this process, air is combined with the matte to burn away excess iron and sulfide gases.

Conveyor: Mechanical infrastructure, generally electrically driven, which extends from a receiving point to a discharge point and conveys, transports, or transfers material between those points.

Copper (Cu): A red to salmon-pink native element. Copper is ductile, malleable, and a good conductor of heat and energy.

Raw Copper (Cu)

Copper is the only metal that occurs abundantly in large masses. It has many uses including electrical wiring, piping and the base metal in brass, bronze and other metals.

Copper Basin Railroad: An Arizona short-line railroad that operates from Magma to Winkelman (54 miles).

Crest: In mining, the highest point on a working bench.

Curvilinear: Consisting of or defined by curved lines.

Cyanide: A naturally occurring organic compound composed of carbon and nitrogen (CN_3). The solid chemical compound is dissolved in water to form a solution suitable for the extraction of precious metals from ore by using a leaching process.

Cyanidation: A type of milling were prepared ore is exposed to cyanide under a set of specific conditions to extract precious metals.

Cyclone(d): A water process that separates finer material from coarse material.

D

Decant (Decanted): to flow so as not to disturb the sediment. The goal being to separate water from sediment and fines.

Decibel (dBA): A unit for expressing the relative intensity (loudness) of sound weighted along audible frequencies.

Deciduous: Flora that loses their leaves seasonally.

Degradation: The wearing down of the land by the erosive action of water or wind.

Delineate (Delineation): To trace the outline of; either on a map and/or on the physical landscape.

Demography (Demographics): A statistical study of the characteristics of human populations with reference to size, density, growth, distribution, migration and effect on social and economic conditions.

Density: the number of inhabitants or the like per unit area.

Density [physics]: Mass per unit volume

Deposit [ore]: An accumulation of natural resources, such as precious minerals, metals, coal, oil, gas, etc. that may be pursued for its intrinsic value; copper deposit.

Deposit (Deposited): Something precipitated, delivered and left, or thrown down, as by a natural process:

Detention Dams/Ponds: Structures constructed by excavation and/or building an embankment whose purpose is to temporarily detain water and allow for fines settlement and/or to reduce the flow.

Detraction: The act of disparaging or belittling the reputation or worth.

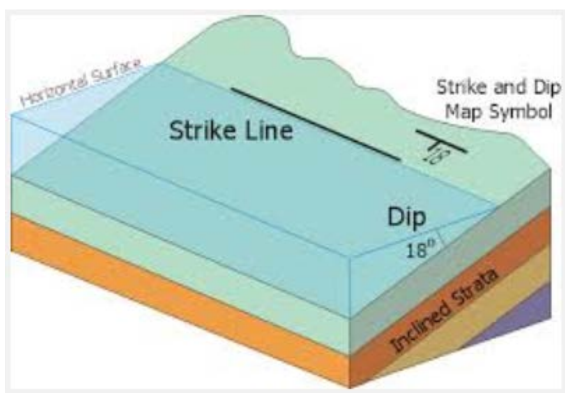
Development Rock: or waste rock, the uneconomic rock material that must be broken, removed and disposed of to gain access to and excavate ore.

Diabase: A rock which comprises a majority of the tailings material. The major rock-forming minerals in this unit are hornblende, plagioclase and biotite; minor minerals are magnetite and quartz. Other minerals that occur in small quantities (less than 5 percent) are chlorite, ilmenite, apatite, hematite, montmorillonite, sphene and epidote.

Diabase rock specimen

Dike(s): A tabular igneous intrusion that cuts across the bedding or foliation of the host rock.

Dip: The angle at which a bed, stratum, or vein is inclined from the horizontal plane; measured perpendicular to the strike and in the vertical plane.



Strike/Dip diagram

Discharge: The volume of water flowing past a point per unit time; commonly expressed as cubic feet per second (cfs).

Dissolution: A process of chemical weathering by which mineral and rock material passes into solution.

Diversion Channels: Pathways which remove water from its natural course and location; in this EIS, mostly by means of a ditch.

Diversion Structures*: see diversion channels*

Diversity: An expression of community structure; high if there are many types of abundant species; low if there are minimal types of abundant species.

Dredge(d): Very fine mineral matter held in suspension in water; usually in relation to material left in suspension while increasing width and/or depth of a canal.

"Dry Stack" Tailings: A system that promotes dewatering of tailings material so that the dry “cake” material can be repeatedly transported, piled and spread on an unsaturated tailings deposit.

E

Easements: An intangible right distinct from the ownership of the soil, consisting of a liberty, privilege, or use of another's land without profit or compensation; a right-of-way.

Ecological/Ecology: the study of relationships between organisms and their environment.

Eco-tourism: A form of tourism involving visiting relatively undisturbed natural areas, intended as a low-impact and often small scale alternative to standard mass tourism.

Edaphic: Said of ecologic formations or effects resulting from or influenced by local conditions of the soil or substrate; soil conditions that affect plants.

Effects: In an EIS, environmental changes resulting from the proposed action.

Direct Effects: caused by the action at the exact location and time

Indirect Effects: caused by the action at a later time and distance

Egress: A mean of going out or exiting.

Electric Switchgear Facility: TSF infrastructure that would help safely supply power to pumping operations.

Elevation: A vertical survey method to a point on the Earth’s surface to indicate height; usually from the datum of mean sea level.

Embankment [eng]: A linear structure, usually constructed of earth or gravel, as an extension above the natural ground surface so as to hold back water from overflowing or to retain water.

Emissions: In this EIS, emissions pertain to air, dust and gas; the action and amount of certain parameters of particulate matter that enters our atmosphere.

Energy Dissipaters: Structures, usually built of concrete, to disrupt and steady the flow of water and the like.

Ephemeral Wash (or channel or drainage): A channel that is at all times above the water table and flows only in response to precipitation (see A.A.C. R18-11-101(18)).

Erosion: The wearing away of the land surface by running water, wind, ice or other geologic agents including gravitational creep.

Escarpment: A long more or less continuous cliff or steep slope, generally facing in the same direction.

Evaporation: The process by which a substance changes from a solid or liquid state into a vapor/gaseous state.

Excavation (Excavated): The process of removing soil and/or rock and materials from one location and transporting them to another.

Excavator: A piece of heavy construction or mining equipment consisting of a boom, stick, bucket and cab on a rotating platform known as the house.

Excavator

Exploration: The search for deposits of useful minerals and fossil fuels.

F

Fault: A displacement of rock along a sheer surface or linear plane.

Federal Register: The daily journal of the United States government; posting of rules, regulations, publications and significant documents. www.federalregister.gov

Fill Material: Soil or loose rock used to raise the surface of low-lying land, such as an embankment to fill a hollow.

Fiscal: Of or pertaining to money or financial matters.

Floodplain: Any low-level flat land the borders a stream that may be covered by its waters during a flood stage.

Flux: A substance used to refine metals by combining with impurities to form a molten mixture that can be removed.

Folding: Curving or bending of the rock strata, bedding planes, foliation or cleavage.

Foliation (Foliated): A planar arrangement of textural or structural features in any type of rock.

Forage: the act of searching for food.

Fossil: Any remains or trace or imprint of a plant or animal that has been preserved by the Earth's crust.

Fractures: Any break in the rock due to mechanical failure by stress; includes cracks, joints and faults.

Frequency: the number of occurrences of an event per unit time.

Frequency [sound]: Measured in hertz (Hz), the number of sound wave cycles per second.

Front End Loaders: A piece of heavy construction or mining equipment consisting of a large bucket connected to a hydraulic boom system mounted on a body; usually fitted with rubber tires.

Front End Loader

Froth Floatation: Part of the milling process used to separate cooper minerals from other non-economic rock material in the ore.

Fugitive Dust: Dust particles suspended randomly in the air, usually from road travel, excavation, and rock loading operations.

Furbearers: any animal that has a coat of fur.

G

Geochemistry: The study of the distribution and amounts of chemical elements in minerals, ores, rocks, soils, water and the atmosphere and the study of the circulation of these elements in nature.

Geology: The study of the planet Earth: the materials by which is made, the processes that act on these materials, the products formed and the history of the planet and its life forms since origin.

Geotechnical [eng]: Concerned with the engineering design aspects of slope stability, settlement, Earth pressures, bearing capacity, seepage control and erosion.

Graben: The depressed block bounded by the fault structure or system, on the long sides.

Gradational: Pertaining to leveling of the land or bringing the land surface or area to a uniform or close to uniform slope of grade through erosion and deposition.

Grade [ore]: based on the degree of copper purity of the mineral.

Graders (Motor Graders): A piece of heavy construction or mining equipment; self-propelled or towed machine provided with a row of removing or digging teeth and (behind) a blade to spread and level the material.

Grader

Grading: The act of manipulating and leveling ground surface.

Granite (Granitic): A hard, igneous rock with mainly quartz constituents and a granular texture.

Groundwater: Water beneath the land surface in the zone of saturation below the water table.

Gulch (Gulches): A narrow, deep ravine with steep sides or a short cleft in a hillside.

H

Habitat: The natural environment of a plant or animal including all biotic, climatic and soil conditions or other environmental influences affecting living conditions; the place where an organism lives.

Heavy Metals: A group of elements including copper, cobalt, chromium, iron, zinc, etc.

Haul Road: A road used by large (typically off-road vehicles) trucks to relocate material for deposition or construction purposes.

Heterogeneity: A concept relating to the uniformity in a substance; one that is heterogeneous is distinctly non-uniform in a quality.

Hibernacula: A protective case or covering, especially for winter, as of an animal or a plant bud. Winter quarters for a hibernating animal.

Holarctic: Belonging or pertaining to a geographical division comprising the Nearctic and Palearctic regions.

Homogenous: A concept relating to the uniformity in a substance; one that is homogeneous is distinctly uniform in a quality.

H-poles: Wooden structures used to lift, hold-up and secure power lines.

Hue: A gradation or variety of a color; tint.

Hydraulic Conductivity: The measure of the ability of rock or soil to permit the flow of groundwater under a pressure gradient; permeability.

Hydrogeology: The science that deals with subsurface waters and with the related geologic aspects of surface waters.

Hydrologic Systems: A complex of related parts: both the physical and conceptual study forming an orderly body of hydrologic units and their man-related aspects such as the use, treatment, reuse and disposal of water and the costs and benefits thereof. The interaction of hydrological factors impacting sociology, economics and ecology.

Hydrology: The science that deals with global water (both liquid and solid form), its properties, circulation, distribution on the Earth's surface and in the atmosphere.

I

Income: Money that an individual or business receives in exchange for providing a good or service or through investing capital.

Infiltration: The movement of water or other fluid into the soil (or other medium) through pores or other openings.

Infrastructure: The underlying foundation or basic framework; substructure of a community (i.e. schools, police, fire department, roads, water, sewer systems, etc.)

Ingress: A means of coming in or entering.

Interfingering: The disappearance of sedimentary bodies in laterally adjacent masses owning to splitting into many thin "tongues" or "fingers".

Intermittent: Stopping or ceasing for a time or alternately ceasing and starting again.

Interstice(s): Occupying the spaces between sediment particles.

Intrusion (Intrusive): In this EIS, the injection or emplacement of scenic forms.

Ionized (Deionized): To separate into ions; electrically charged atoms or group of atoms formed by the loss or gain of one or more electrons.

J

Jurisdiction: the right, power or authority to administer justice to an extent of law; the land over which authority is exercised.

Juxtaposition: an act or instance of placing close together or side by side, especially for comparison or contrast.

K

K-factor [erodibility]: A means or factor used to express the erosion potential of soils through use of the "Revised Universal Soil Loss Equation." (RUSLE)

Kilovolts (kV): A unit of measurement for electrical potential energy; 1kV = 1000 Volts.

Kinetic Test: A category of tests used to predict the occurrence of acid drainage from mine waste or workings (e.g. Humidity Cell Test – HCT). Kinetic tests involve cycles of leaching and monitoring under controlled conditions ideally yielding information of acid generation.

L

Landform: Any physical, recognizable form or feature and the Earth's surface having characterizing shape that was formed naturally.

Landscape: The sum of total characteristics that distinguish a certain area on the Earth from another area. These distinctions are due to both natural causes and human occupancy.

Laramide Age: A time of deformation, typically recorded in the Eastern Rocky Mountains of the United States, whose several phases lasted from late Cretaceous until the end of Paleocene period.

Laws: Principles and regulations established in a community by some authority and applicable to its people, whether in the form of legislation or of custom and policies recognized and enforced by judicial decision.

Leachate: The solution obtained by leaching.

Leaching: The process of applying a chemical agent to bond preferentially with and dissolve materials, such as precious metals, into solution.

Lead Agency: In the NEPA process, the lead agency is the agency or agencies with the main responsibility to comply with NEPA (and SEPA if applicable) procedural requirements such as preparation of the EIS.

In this EIS, the lead agency is the U.S Corps of Engineers.

Limestone: A sedimentary rock consisting mostly of calcium carbonate.

Lineated: Marked with lines.

Liners: synthetic material (80 mil HDPE or equivalent) used to create a barrier between TSF and the ground surface. These liners have leak detection systems incorporated into their design and operation.

Loam: A rich, permeable soil composed of a mixture of clay (7-27%), silt (28-50%) and sand (23-52%) particles; composition is important for classification.

Logistics: The planning, implementation, and coordination of the details of a business or other operation.

Logarithmic: a nonlinear scale used when there is a large range of quantities. Common uses include acoustics, optics and chemistry. It is based on orders of magnitude, rather than a standard linear scale.

M

Magnesium (Mg): a chemical element with symbol Mg and atomic number 12. Its common oxidation number is +2. It is an alkaline earth metal and the eighth-most-abundant element in the Earth's crust.

Magnesium (Mg)

Matrix [geology]: The fine grain material enclosing or filling the interstices between larger grains or particles or sediment.

Matte: Part of the smelting process, matte is the bottom valuable layer containing copper and some traces of iron; a metallic sulfide mixture made by melting the roasted product in smelting sulfide ores.

Mesozoic: An era of geologic time; from 225 to 65 million years ago.

Siemens (Micro Siemens)[µs]: Unit of electric conductance and electric admittance.

Milling: The general process of separating the valuable constituent (copper) from the undesirable or non-economic constituent of the ore material.

Mine: An opening or excavation in the ground for the purpose of extracting minerals.

Mine Life: The time in which, through labor, capital and tangible resources the ore reserves will be extracted.

Mineralization: The process by which a mineral or minerals are introduced to rock, resulting in a valuable or potentially valuable deposit; a zone of ore.

Mineral Reserves: Identified resources of mineral-bearing rock from which a mineral can be extracted profitably with existing technologies under present market conditions.

Mineral Resource: Reserves plus all other mineral deposits that may become available – either known deposits that are not economical or technologically recoverable, or deposits that have been inferred yet not fully discovered. *(See Mineral Reserves).*

Mineralogy: The study of minerals.

Mining: The science, technique, and business of mineral discovery and exploitation; the act of extracting ore out of the ground.

Mitigation (Mitigate): Includes:

(a) Avoiding an impact altogether by not taking action or certain parts of an action;

(b) Minimizing impacts by limiting the degree of magnitude of the action and its implementation;

(c) Rectifying the impact by repairing, rehabilitating or restoring the environmental effects;

(d) Reducing or elimination of the impact over time by preservation and maintenance of operations during the life of the action;

(e) Compensating for the impact by replacing or proving substitute resources or environments.

(40 CFR Part 1508.20)

Modification(s) [scenic]: A quality objective: man's activity may dominate the characteristic landscape, yet must utilize natural form, line, color and texture.

Moisture Content: The amount of moisture in the medium. Moisture is defined as water diffused in the atmosphere or the sample.

Motor Graders: *see grader.*

N

Negligible: So small, trifling, or unimportant that it may generally be disregarded.

NEPA Process: Measures necessary to comply with all requirements of Section 2 and Title I of the National Environmental Policy Act.

Neutralization: A chemical reaction in which an acid and a base react quantitatively with each other. In a reaction in water neutralization results in there being no excess of hydrogen or hydroxide ions present in solution. The pH of the neutralized solution depends on the acid strength of the reactants. Neutralization is used in many applications.

No Action Alternative: As part of the NEPA process, the alternative in which project conditions remain the same. It is mandatory to consider a No-Action Alternative.

Nocturnal: Active at night.

Noise: Unwanted sound, unpleasant sound that interferes with hearing or lacks agreeable quality.

Noxious Weed: A weed that has been designated by country, state, provincial, or national agricultural authority as one that is injurious to agricultural and/or horticultural crops, natural habitats and/or ecosystems, and/or humans or livestock.

O

Off-highway Trucks: Also known as a Haul Truck, a truck of such size, weight, or dimensions that it cannot be used on public highways.

Off-Highway (Haul) Truck

Open-pit Mining: A type of surface mining that involves excavation of the ore and overburden by above ground techniques. The result of such an operation is known as an "open pit."

Ore (Ore Material): A deposit of rock from which valuable material or minerals can be economically mined for profit.

Outcrop: That part of a geologic formation or structure that breaches the Earth's surface.

Outfall Location: The location of the mouth of the stream or the outlet of the lake; or

The vent or end of a drain pipe, tube, ditch, canal that carries tailings slurry.

Overburden: Barren rock material, either made loose or unconsolidated, overlying a mineral deposit which must be removed prior to mining; aka Development rock or waste rock.

Oxide: A mineral compound characterized by link between oxygen and one or more metallic elements.

Oxygen Flash Furnace: Part of the smelting process, the structure where oxygen is added to the copper concentrate in extreme heat producing matte, slag and sulfur dioxide (SO_2)

Ozone (O_3): Form of oxygen compound found largely in the stratosphere; a product of reaction between ultraviolet light and oxygen.

P

Packer Tests: A test in which water is forced under pressure into rock through the walls of a borehole. The test provides a means of determining the apparent permeability of the rock, and yields information regarding its soundness.

Paleontology: The science of the forms of life existing in former geologic periods, as represented by their fossils.

Panorama: An unobstructed and wide view of an extensive area in all directions; an extended pictorial representation of a landscape or other scene.

Parameter: A variable as a part of a set of comparable variables or limits, boundaries or guidelines.

Particulates: Small particles suspended in the air; generally considered pollutants.

Pediment: A broad gently sloping rock-floored erosion surface or plain of low relief. Typically located in an arid or semiarid region at the base of an abrupt or receding mountain or plateau and underlain by bedrock (bare or with a thin veneer of alluvium).

Perch (Perching): a pole or rod, usually horizontal, serving as a roost for birds.

Percolating: To cause liquid to pass through a porous body

Perennial: Lasting or continuing throughout the entire year, as a stream.

[Of plants] Having a life cycle lasting more than two years.

Permanent Disposal Facilities (dumps): Areas for the tipping and dumping of overburden.

Permeable (Permeability): The property or capacity for porous rock, sediment or soil for transmitting fluid; a measure of relative ease of fluid flow under uneven pressure.

Pertinent: Relating directly and significantly to the matter at hand; relevant:

Petrocalcic Horizon (Cemented Horizon): A diagnostic subsurface soil horizon that is characterized by an induration with calcium carbonate.

Phreatic Surface: The surface between the zone of saturation and the zone of aeration (unsaturated ground).

Physiographic Province: A region having a particular pattern of relief features and landforms that differs significantly from that of adjacent regions.

Piezometer: A device for measuring moderate groundwater pressures.

Pinal Schist: A common Arizona rock which comprises a majority of the tailings material; the major rock-forming minerals in this unit are quartz, orthoclase, plagioclase, sericite and biotite.

Pinal Schist Rock Specimen

Pitch [sound]: An auditory sensation in which a listener assigns musical tones to relative positions on a musical scale based primarily on the frequency of vibration.

Point Source: Under the Clean Water Act, under Section 502(14), the term "point source" means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture.

Policy (Policies): A guiding principle upon which is based a specific decision or set of decisions.

Porphyry: An igneous rock of any composition that contains phenocrysts in a fine grained groundmass.

Practicable: Capable of being done; feasible under practical conditions.

Precambrian Age: The span of time older than 570 million years.

Precipitation: Rain or snow.

Preclude: To prevent the presence or occurrence of; make impossible.

Professional Engineer (PE): A qualification from the National Society of Professional Engineers (NSPE). To become PE licensed and certified, engineers must complete a four-year college degree, work under a Professional Engineer for at least four years, pass two intensive competency exams and earn a license from their state's licensure board.

Profit (Profitability): Revenue less costs; a company's ability to make money.

Project: The whole of an action, which has the potential in resulting in a physical change in the environment. An organized effort to achieve an objective identified by location, timing, activities, output, effects, and responsible execution all within a given time period.

Promulgated: To make known by open declaration.

Proposed Action: A description of the proposed project. In NEPA, this is the description of the project as proposed by the project applicant or proponent. A plan that contains sufficient details about the intended actions to be taken, (40 CFR 1508.23).

Public Scoping: Giving the public the opportunity for oral or written comments concerning the intentions, activities, or influence of a project on an individual, community and/or environment

Pump-back Wells (Monitoring Wells): A critical part of the tailings facility, these wells have the ability to monitor ground water conditions and if necessary, to return water to the reclaim ponds.

Pumping Booster Station: Infrastructure which forces tailing slurry to the tailings storage facility through pipeline by mechanical action.

Q

Quadrangle Maps: In geology or geography, the word "quadrangle" refers to USGS 7.5-minute quadrangle maps, which are usually named after a local physiographic feature.

Quarry: An open or surface mineral working, usually for the extraction of building stone, as slate, limestone, etc. It is distinguished from a mine because a quarry usually is open at the top and front, and, in ordinary use of the term, by the character of the material extracted.

Quaternary: A sediment system consisting of a mixture of four components or end members; Quaternary is also a geologic time period, the second period of the Cenozoic. It began 3 million years ago and extends to the present.

R

Radioactivity: The emission of energetic particles and/or radiation during radioactive decay.

Radionuclides: A radioactive nuclide; an atomic species characterized by the specific constitution of its nucleus.

Radium [Ra-226 228+]: A chemical element with an atomic of number 88. It is the sixth element in group 2 of the periodic table, also known as the alkaline earth metals.

The most stable isotope of Radium is Radium-226, which has a half-life of 1600 years and decays into radon gas.

Raptor-deterring: A design that minimizes the available space on top of a utility pole and restricts the clearance for the birds to fly, build nests and perch.

Ray Concentrator: Part of the milling process, A concentrator is used to grind and process copper ore through froth floatation.

The Ray Concentrator produces a copper concentrate that is loaded into railroad cars and shipped to the Hayden Smelter.

Recharge(d): Absorption and addition of water to the zone of saturation.

Reclaim Ponds: Down-gradient of the seepage trenches, to intercept and store any water seepage that might migrate under the tailings facility through the alluvium material located above the bedrock and pump either back to the Ray Concentrator or to the tailings facility.

Reclamation: Returning disturbed land to an approved post-mining land use, such as required in conformity with a government regulatory program such as the Arizona Mined Land Reclamation Act and Rules.

Reconnaissance Surveys: A preliminary survey, quick and low-cost, prior to mapping in detail and with greater precision.

Recreation Opportunity Spectrum (ROS) Classification: The ROS continuum describes the existing conditions that define a land area's capability and suitability for providing a particular range of recreation experience opportunities.

Refinery: A facility in which relatively crude smelter products such as blister copper are refined and emerge as acceptably pure products.

Regulations: A law, rule, or other order prescribed by authority, especially to regulate conduct. Usually a regulation supports a law.

Residuum: The structureless groundmass of microscopic constituents; particles less than 1-2 microns in size.

Revenue(s): The return or yield from any kind of property, patent, service, etc.; income.

Richter Scale: A numerical logarithmic measure of earthquake intensity.

Right-of-Way: A strip of land or corridor over which a powerline, pipeline, access road or maintenance road can pass.

Rill Erosion: The development of numerous minute closely spaces channels resulting from uneven removal of surface soil or material by running water that is concentrates in streamlets of sufficient discharge to cause cutting power.

Riparian: A type of ecological community that occurs next to streams and rivers directly influence by water. It is characterized by certain types of vegetation, soils, hydrology, and fauna and requires free or unbound water conditions more moist that normally found within that area.

Riparian Zone: Terrestrial areas where the vegetation and microclimate are influenced by perennial and intermittent water, associated with high water tables.

Runoff: Precipitation that is not retained on the site where it falls, not absorbed by the soil; the natural drainage away from an area.

S

Saline: A natural deposit of halite or any soluble slat.

Scenic Quality: The essential attributes of landscape that when viewed by people, elicit a realized beauty and benefit to a person and the community.

Schematic: A diagram, plan, or drawing.

Scoping Process: As part of the National Environmental Policy Act (NEPA) and State Environmental Policy Act (SEPA) process, early and open activities used to determine the scope and significance of the issues, and range of actions, alternative and impacts, to be considered as part of the Environmental Impact Statement. (40 CFR 1501.7 & WAC 197-11-360)

Sediment: Earth material transported, suspended and deposited by air, water or ice; also the some material once it has been deposited.

Sedimentary Rocks: A rock resulting from the consolidation of loose sediment that has accumulated in layers.

Sedimentation: The act or process of accumulating sediment in layers; including the deposition, transportation and actual diagenetic changes to form ultimate consolidation.

Seepage Trench: Down-gradient of the starter dams, a ditch to intercept any water leakage that might migrate under the tailings facility through the alluvium material located above the bedrock.

Seismic: Of or pertaining to earthquakes or Earth vibration, including those that are artificially produced.

Sensitive Species: A plant or animal species that is susceptible or vulnerable to activity impacts or habitat alterations.

Sensitivity Level(s): A particular degree of measure of viewer interest in and concern for the scenic quality of the landscape.

Separated Fines Fraction (Slimes): The fines that overflow out of the top of the cyclone separation process.

Shaft (Mine Shaft): A vertical or near-vertical tunnel from the top down used to pull ore out of the mine or transport men in and out of the mine.

Shear (Sheared)[geology]: A deformation resulting from stresses that cause parts of a body to slide opposite to each other in their parallel contact plane.

Shovel(s): Any bucket-equipped machine used for digging and loading earthy or fragmented rock materials; shovels can be electrically (rope) or hydraulically powered.

Rope Shovel

Significant: Requires consideration of both context and intensity.

Context means that the significance of an action must be analyzed in several contexts such as society, interests and locality.

Intensity refers to the severity of the impacts; the severity of the impact should be weighted and gauged alongside the likelihood of occurrence.

Silica: The naturally occurring, chemically resistant dioxide of silicon (SiO_2).

Silt(s): A rock fragment with a particle size smaller than very fine sand and larger than coarse clay (4 to 62 microns)

Sinuosity (Sinuous): The ratio of the length of the channel to the down valley distance; a ratio of larger than 1.5 is called "meandering".

Slag: The lighter, top layer bi-product of the oxygen flash furnace; comprised of mostly iron and silica.

Slimes: *See Separated Fines Fraction*

Sloughing: Fragmented soil and rock material has crumbled and fallen away from the bank.

Slurry: A highly fluid mixture of water and finely divided material; either naturally occurring such as a muddy lake-bottom deposit; or man-made like the tailings slurry sent through pipe for treatment.

Smelter: A furnace in which the raw materials of ores are melted to produce metal.

Socioeconomic: Pertaining to or signifying the combination or interaction of social and economic factors.

Sodic: Salt affected.

Sodium: A chemical element with symbol Na and atomic number 11. It is a soft, silver-white, highly reactive metal and is a member of the alkali metals; commonly related to salts.

Soil: The natural medium for the growth of plants; a term used in the soil classification for the collection of natural earthy materials on the Earth's surface.

Soil Productivity: The capacity of the soil, in-situ, to produce a specified plant or sequence of plants under a certain ecosystem. Productivity is generally dependent on availability of soil moisture and nutrients as well as length of growing seasons.

Soil Profile: A vertical section of the soil through all of its horizons and extending into the parent material at a depth of 60 inches.

Solicit: To seek to influence or entice action.

Solvent Extraction-Electrowinning (SX-EW): A metallurgical technique, so far applied only to copper ores, in which metal is dissolved from the rock by organic solvents and recovered from solution by electrolysis.

Spectrometer: An optical instrument where scales are provided for reading angles. A wavelength spectrometer is one designed or equipped in a manner to measure the wavelengths at which absorption bands occur in an absorption spectrum.

Spigot(s): a faucet or cock for controlling the flow of liquid from the pipeline.

Standard: A model, example or goal set by an authority, custom or general consent as a rule for the measurement of quantity, weight, extent, value or quality.

Sterilize: In this EIS, a sterilized area is one void of ore after being drilled and tested for mineralization.

Stipulation(s): A condition, demand, or promise in an agreement or contract.

Stockpile: Material piled for future use.

Stormwater: The runoff reaching stream channels immediately after rainfall or snowmelt.

Strike/(Dip): The direction or trend taken by a structural surface; e.g. a bedding plane as it intersects the horizon. (*See Dip diagram)*

Substance(s): Matter of the same physical and chemical make-up.

Suitability: The appropriateness of applying certain resource management practices to a particular area of land, as determined by an analysis of the environmental and economic consequences and alternate uses foregone.

A unit of land may be suitable for a variety of individual or combined management practices (FSM 1905).

Sulfide: A mineral compound characterized by the bonding with the native element of Sulfur (S).

Supernatant Pool: In a tailings impoundment, the water than gathers above the settled tailings material.

Surficial: Pertaining to or occurring on the surface.

Susceptible (Susceptibility): capable of having an impression left or being changed.

Synthetic liner (HDPE): A protective layer comprised of man-made materials installed along the bottom, sides and/or top of a disposal area to reduce the fluid migration into or out of that disposal area.

T

Tackifier: Chemical compounds used in formulating adhesives to increase the tack, the stickiness of the surface of the adhesive.

Tailings: The non-economic, ground rock material that remains after the valuable minerals have been removed from the ore by milling.

Tailings Drain Down Ponds: In case of need, a pond capable of draining and storing water from tailings facility.

Tailings Storage Facility: The tailings dam and all associated infrastructure needed to safely, efficiently and successfully manage and separate tailings slurry from water.

Tectonism: A branch of geology dealing with the broad architecture of the outer part of the Earth, a study of structural and deformation relationships of large features.

Tertiary: The span of time between 65 and 3 to 2 million years ago.

Texture: The visual manifestation of the interplay of light and shadow created by variations in the surface of an object.

Theoretical: Of or pertaining to a group of tested general propositions, commonly regarded as correct, that can be used as principles of explanation and prediction.

Thickening (Thickened): The process of concentrating a relatively dilute slime pulp into a thick pulp i.e. one containing a lower percentage of water by rejecting liquid that is substantially solid-free.

Topography: A configuration of surface including its relief, elevation, and the portion of natural and human created features.

Topsoil: A presumably fertile soil; the dark colored upper portion of a soil varying in depth and contour.

Tranmissivity: The rate at which water is transmitted through rock under a unit hydraulic gradient.

Tributary (Tributaries): A stream, feeding, joining, or flowing into a larger stream or into a lake.

Tuff: A compacted deposit of volcanic ash and dust that may contain up to 50% sediments, sand or clay.

U

Ubiquitous: Existing or being everywhere, especially at the same time.

Underflow: Movement of water through subsurface material.

Underground Mining: A mining method consisting of an adit or shaft access where ore is mined using various methods and hauled out by mine car or conveyor belt. Usually the underground mining option is selected due to economic factors or environmental constraints.

Undulating: A landform having a wavy outline or form.

Upland: A general term for high land or an extensive region of high land; the higher ground of a region.

Upstream Method: The tailings construction method Asarco plan to use after the Tailings Storage Facility reaches a height of 2,200m. This would be an activity similar to the centerline method, but the cyclone used for centerline construction would no longer be used. Coarse material would be deposited and remain close to the pipeline spigot, and that material would be used in construction of the next lift.

V

Variegated: Varied in appearance or color.

Vegetation: All the plants or plant life of a place, taken as a whole.

Velocity: The rate of change of the position of an object, equivalent to a specification of its speed and direction of motion, e.g. 60 km/h to the North.

Veneer(s): A weathered or otherwise altered coating on a rock surface.

Viable: practical and capable of being done.

Visual Resources: The composite of basic terrain, geological features, water features, vegetation patterns and land use effects that influence the visual appeal for the viewer.

W

Waste Rock: The non-ore rock that is removed to access the ore zone. It contains no copper or copper below the economic cut off level.

"Waters of the United States": The term as applies to the jurisdictional limits of the authority of the U.S. Army Corps of Engineers under the Clean Water Act. See 33 CFR §328.1 and33 CFR §328.3(a). The Clean Water Act was enacted in 1972 to restore and maintain the chemical, physical and biological integrity of U.S. Waters and is used to oversee federal water quality programs for areas that have a "water of the U.S." The term "waters of the U.S." was derived from the Rivers and Harbors Act of 1899 to identify waters that were involved in interstate commerce and were designated as federally protected waters. Since then, a number of court cases have further defined "waters of the U.S." to include waters that are not traditionally navigable. This could include lakes, rivers, streams, mudflats, sand flats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes and natural ponds.

Watershed: The entire land area that contributes water to a particular drainage system or stream.

Water Quality: The interaction between certain parameters that affects the usability of the water for on-site or downstream purposes.

Such factors include temperature, turbidity, suspended sediment, conductivity, and pH.

Water Table: The level of the saturated zone where the pressure head is equal to atmospheric pressure.

Weathering: The process whereby larger particles of soils and rock are reduced to finer particles by wind, water, temperature changes, and plant and bacteria action.

Weld (Welded): A fabrication process that joins materials, usually metals or thermoplastics, by melting the work pieces and adding a filler material to form a pool of molten material (the weld pool) that cools to become a strong joint.

Wetland(s): A land area that is saturated with water, either permanently or seasonally, such that it takes on the characteristics of a distinct ecosystem.

Windrow (Windrowed): A ridge of soil pushed up by a grader or bulldozer; usually for the purposes of safety or delineation.

8.3 SUBSTANCES AND SCIENTIFIC TERMINOLOGY

Term	Phrase
amsl	above mean sea level
CO	Carbon Monoxide
Cu	Copper
dB	Logarithmic Decibel
dBA	Decibel
kV	Kilovolts
NO_2	Nitrogen Dioxide
NOx	Nitrous Oxide
O_3	Ozone
Pb	Lead
pH	Power of Hydrogen - chemistry scale of the acidity/base as compared to water
PM_{10}	Inhalable Particulate Matter
$PM_{2.5}$	Fine Particulate Matter
ppm	Parts Per Million
Q_{al}	Alluvial Deposits
Q_{og}	Older Gravels
SO_2	Sulfur Dioxide

9.0 INDEX