Draft Final Engineering Evaluation/ Cost Analysis Report

Gold Hill Mill Site
Death Valley National Park (DEVA)

August 2021

Revision Log

Revision #	Revision Date	Revision Description
0	July 14, 2020	Draft
1	August 12, 2021	Draft Final

Signatories

Submitted By:		
CST Federal Government Lead on behalf of the CST	Signature	Date
Routed Through:		
Park Superintendent	Signature	Date
Regional Point-of-Contact	Signature	Date
Regional Director	Signature	Date

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List of Abbreviations and Acronyms

ARAR	applicable or relevant and appropriate requirements
BERA	baseline ecological risk assessment
CEC	contaminant of ecological concern
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHF	Central Hazardous Materials Fund
COC	contaminant of concern
COPC	contaminant of potential concern
COPEC	contaminant of potential ecological concern
CSEM	conceptual site exposure model
DEVA	Death Valley National Park
DU	decision unit
DWR	Department of Water Resources
ECM	Environmental Cost Management, Inc.
EE/CA	Engineering Evaluation/Cost Analysis
EPC	exposure point concentration
ESL	Environmental Screening Levels
ESV	ecological screening value
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
HR	hydrologic region
ICs	institutional controls
ISM	Incremental Sample Methodology
LDR	land disposal restrictions
LOAEL	lowest observed adverse effect level
LOEC	lowest observed effect concentration
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAEL	no observed adverse effect level
NOEC	no observed effect concentration
NOREAS	NOREAS, Inc.
NPS	National Park Service
PA	Preliminary Assessment
PRG	preliminary removal goal
RAA	removal action alternative
RAO	removal action objective
RCRA	Resource Conservation and Recovery Act
RG	removal goal
RSL	U.S. Environmental Protection Agency Regional Screening Level
SAP	sampling and analysis plan
SI	Site Inspection
S/S	solidification/stabilization

SLERA	screening-level ecological risk assessment
TBC	to be considered
TRV	toxicity reference value
UCL	upper confidence limit
µg/dL	micrograms per deciliter
USC	United States Code
USDOI	U.S. Department of Interior
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WASO	National Park Service Washington Support Office

Draft Final
Gold Hill Mill Site Engineering Evaluation/ Cost Analysis Report

Executive Summary

The Engineering Evaluation/Cost Analysis (EE/CA) Executive Summary contains a summary of the Site description, including Site investigation results and an updated conceptual Site model based on these results. A summary of the risk assessment and of applicable or relevant and appropriate requirements is also included along with the scope and objectives of the removal action. The final sections of the Executive Summary provide information on the removal action alternatives analyzed and the recommended removal action.

ES 1. Introduction and Purpose

Gold Hill Mill (Site) is located within Death Valley National Park (DEVA), which is owned by the United States and managed by the National Park Service (NPS). The Site is being investigated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). NPS is the lead agency under CERCLA at the Site because the Site is under the jurisdiction, custody, or control of NPS.

This EE/CA has been prepared pursuant to the authorities of Section 104(b) of CERCLA and Section 300.415 (b)(4)(i) of the National Oil and Hazardous Substances Pollution Contingency Plan, commonly called the National Contingency Plan (NCP), which authorizes NPS to conduct investigations and studies to characterize the nature and extent of contamination at the Site and to evaluate the need for a response to such contamination to protect public health or welfare or the environment.

The purpose of the EE/CA is to document the release, nature, and extent of hazardous substances at the Site, conduct human health and ecological risk assessments, and provide a framework for evaluating removal action alternatives. The EE/CA identifies removal action objectives and analyzes the effectiveness, implementability, and cost of removal action alternatives that may be used to satisfy the objectives.

ES 2. Site Description, Investigation Results, and Conceptual Site Model

The Gold Hill Mill Site is located 35 miles south of Furnace Creek, California, in Warm Springs Canyon at an elevation of 2,360 feet above sea level (Figure 1). The Gold Hill region is located within the southwest corner of DEVA, in the Panamint Mountain Range and approximately 1,000 feet north of Warm Springs (Figure 2). The Site is moderately visited due to its location next to the Warm Springs Mining Camp and along the road to Butte Valley.

While mining activity in the area dates to the 1870s, Gold Hill Mill was established in the 1930s. The mill remained in use until the 1950s. The mill ruin is considered to be of regional significance and warrants nomination to the National Register of Historic Places. The mill ruin is important because of the combination of old and newer technological processes displayed and is a prime example of an early ore-processing plant.

The Site (Figure 3A) covers less than 1 acre and consists of a complete and well-preserved mill with evidence of mercury amalgamation. Small piles of mill tailings from the amalgamated mercury process used to extract the gold have accumulated in and around the mill workings, primarily on the east side, scattered in and around the equipment, and comingling with native rock. Based on sampling results, metals and cyanide were identified as the principal Contaminants of Concern (COCs). The total area impacted by mill tailings at the Site is estimated at approximately 3,000 square feet, with a volume less than 50 cubic yards. Analytical results were compared to NPS Ecological Screening Values (ESVs) USEPA human health Regional Screening Levels (RSLs), Water Board Environmental Screening Levels (ESLs) and to background.

Mill foundation (decision unit [DU]-1) soil samples indicated elevated (above background) concentrations of antimony, arsenic, barium, beryllium, chromium, copper, cyanide, lead, manganese, mercury, molybdenum, selenium, silver, thallium, vanadium, and zinc. The 95% upper confidence limit (UCL) for lead was 14,661 milligrams per kilogram (mg/kg), and the 95% UCL for cyanide was 0.618 mg/kg, both of which exceed at least two screening levels and by up to four orders of magnitude. Several other metals (antimony, arsenic, copper, mercury, and silver) had 95% UCLs several orders of magnitude over the 95% background UCL and exceeded at least two of the screening levels.

Analytical results from the mill tailings in the wash (DU-2) indicated elevated (above background) concentrations of all 17 analyzed metals with the exception of cobalt and nickel. The 95% UCL for lead was 12,579 mg/kg and significant concentrations of other metals (antimony, arsenic, copper, manganese, and zinc) above their respective 95% background UCLs were reported in DU-2 soils, all of which exceeded at least two of the screening criteria by up to three orders of magnitude.

Results from the two (duplicate) surface water samples at GOLD-SW2 indicated concentrations of arsenic, barium, and selenium above their respective NPS ESVs but not above their respective USEPA RSLs or Water Board ESLs. Comparison of the results of these samples to an upgradient, background surface water sample sourced from water emanating from Warm Springs (GOLD-SW1), does not indicate that contaminants from Gold Hill Mill are directly impacting surface water downgradient of the Site.

Conceptual site exposure models were developed for potential exposure of human and ecological receptors to Site contaminants. Humans can be exposed by incidental ingestion, dermal contact and inhalation of wind-blown material. For ecological receptors such as plants and animals, the assumed principal exposure pathway is ingestion. Ecological receptor exposure through inhalation

and dermal contact are also likely but ecological data are not available to evaluate those pathways and they are likely less important than ingestion for exposure to metals.

ES 3. Risk Assessment Summary

Human Health Risk Assessment:

Arsenic and lead were identified as the primary contaminants of potential concern (COPCs) by comparing maximum detected concentrations in each media to the lowest appropriate human health risk-based screening levels.

Potential human health impacts were estimated based on activity type, frequency and duration for three populations: Tourist Visitor, Mining Enthusiast Visitor, and NPS Worker.

Arsenic concentrations in the mine tailings within the mill foundation area and mill tailings generally adjacent to the mill structure were found to represent an incremental cancer risk[1] probability of 1 in 25,000 ($4x10^{-5}$) (for the Mining Enthusiast group). This exceeds the target *de minimis* excess lifetime cancer risk of 1 in 1 million ($1x10^{-6}$).

Non-carcinogenic health impacts can occur as a result of lead exposure. Childhood exposures to lead are of greater impact than adults because of their neurological development stage and sensitivity to lead which can cause a decrease in cognitive performance and functions of the nervous system. To assess the lead concentrations, Site concentrations were compared to health-based concentrations developed by the California Department of Toxic Substances Control (DTSC) and U.S. Environmental Protection Agency (USEPA). The USEPA defines a 1,200 mg/kg standard for the non-play area of a *residential* site (USEPA 2001). At Gold Hill Mill, lead concentrations were found at 13,900 mg/kg, which exceeds the 1,200 mg/kg comparison level. However, the use of this model to assess short-term exposures is uncertain, since it was designed for long-term occupational or residential exposures.

Ecological Risk Assessment: Ecological risks were assessed using Site-specific exposure factors and information regarding species known or likely to be present at or near the Site. Based on the known or presumed plant, invertebrate, bird, mammal and reptile populations, preliminary removal goals (PRGs) for ecological protection were developed using the most at-risk community or receptor identified (i.e., the black-throated sparrow, plant community and invertebrate community). Contaminants of ecological concern identified include antimony, arsenic, cadmium, chromium, copper, lead, mercury, selenium, vanadium and zinc. Compared to the minimum acceptable hazard quotient level of 1, lead was 130, zinc was 202 and antimony was 327.

[1] Risk estimates represent the incremental probability that an individual will develop cancer over a lifetime as a result of a specific exposure to a carcinogenic chemical.

ES 4. Identification and Analysis of Applicable or Relevant and Appropriate Requirements (ARARs)

For proposed actions at the Site, and for evaluation of a No Action alternative, ARARs were identified for chemical, location, and action-specific categories. The most pertinent ARARs include those: governing identification, handling and disposal of hazardous wastes; requiring preservation of water quality downgradient of the Site; and various ARARs (including the Organic Act, historic preservation acts, and National Park resource protection ARARs) which restrict impairment of natural and historic resources.

ES 5. Removal Action Objectives and Preliminary Removal Goals

The removal action objectives for this EE/CA are as follows:

1. Eliminate, or reduce to the extent practicable, levels of metals in soil that present unacceptable risk via direct human contact.
2. Eliminate, or reduce to the extent practicable, levels of metals in soil that present unacceptable risk for ecological receptors.
3. Eliminate contaminant-related constraints on the full enjoyment and utilization of park resources consistent with NPS mandates.

Preliminary Removal Goals (PRGs) were developed to be protective of human and ecological receptors. Final Removal Goals are presented based on the most protective need (human or ecological), or background concentration where appropriate.

ES 6. Identification of Removal Action Alternatives

Four alternatives were initially considered:

1) No action: Retained and evaluated in detail.
2) Excavation and off-site disposal: Retained and evaluated in detail.
3) Institutional controls: Institutional controls (i.e., restrict access to the site or other means to limit current and/or future land uses) were not considered further, as NPS generally considers institutional controls as not appropriate when other alternatives are feasible.
4) In-situ solidification/ stabilization: In-situ capping was not carried forward for detailed analysis due to the proximity of the Site to an ephemeral wash.

For both of the retained alternatives, the following factors were evaluated:

- Effectiveness, including: overall protection of public health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility or volume through treatment; and short-term effectiveness.

- Implementability, including: technical feasibility, administrative feasibility, availability of services and materials; and State and community acceptance.
- Cost, including: direct and indirect capital costs, and ongoing operation and maintenance costs.

ES 7. Comparative Analysis of Removal Action Alternatives

Protective of human and ecological health: The no-action alternative is within an acceptable range for human health, but Alternative 2 is fully protective of human health. The no-action alternative is not protective of plants or wildlife, while Alternative 2 is fully protective.

Complies with ARARs: The no-action alternative does not comply, but Alternative 2 does.

Effectiveness Duration: The no-action alternative does not reduce volume, toxicity or mobility in the short- or long-term. Alterative 2 does not reduce volume. Alternative 2 does reduce toxicity and mobility in both the short- and long-term.

Feasibility: Both alternatives are technically and administratively feasible.

Cost: The no-action alternative has no cost. Alternative 2 is estimated to cost $334,000.

ES. 8 Recommended Removal Action Alternative

Taking into consideration the evaluation criteria presented in this EE/CA, the recommended Removal Action Alternative (RAA) for the Site is Alternative 2. Alternative 2 includes Excavation and Removal of Material Exceeding the RGs, at an estimated cost of $334,000.

Alternative 2 is selected as the recommended RAA based on the results of the comparative analysis completed in Section 7, showing that this alternative is the most protective of human health and the environment, complies with ARARs, is the most effective in both the short and long-term, is feasible to implement, and can be completed at an estimated cost of approximately $334,000.

Once the EE/CA is finalized, it will be made available for public comment for 30 days to allow for public comment on the EE/CA and the Administrative Record supporting this EE/CA. Following receipt and evaluation of public comments, NPS will prepare an Action Memorandum. The Action Memorandum, as the decision document selecting a NTCRA, summarizes the need for the removal action, identifies the selected action, provides the rationale for the action, and addresses significant comments received from the public, including those received from other jurisdictions (e.g., states, tribes, USEPA).

1. Introduction

The purpose of Section 1 is to describe the National Park Service (NPS) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) authority and the purpose of the Engineering Evaluation/Cost Analysis (EE/CA) Report.

This EE/CA Report has been prepared to evaluate the nature and extent of contamination for the Gold Hill Mill Site (the Site; see Figures 1 through 3), assess potential human health and ecological risk, and, as needed, evaluate removal alternatives and provide the basis for recommending a non-time-critical removal action for the Site located in Death Valley National Park (DEVA) in the state of California. The Site is an abandoned mine land site.

1.1. CERCLA and National Park Service Authority

NPS is authorized under CERCLA, 42 United States Code (USC) Section 9601 et seq., to respond as the lead agency to a release or threatened release of substances, pollutants or contaminants that may present an imminent and substantial danger to public health or the environment, on NPS-managed land. Section 104(b) of CERCLA, 42 USC Section 9604(b), authorizes NPS to conduct investigations and other studies to characterize the nature and extent of a release or threat of release, determine if response is necessary to protect public health or welfare or the environment, and evaluate response alternatives. Section 104(a) of CERCLA, 42 USC Section 9604(a), authorizes NPS to select and implement a response action when NPS determines a response is necessary.

CERCLA's implementing regulations for responding to such releases and threatened releases are codified in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300.

Based on preliminary investigations at the Site, NPS determined that Site conditions warranted additional response to address the release of hazardous substances and that consideration of a non-time-critical removal action is appropriate at the Site as specified in 40 CFR Section 300.415(b). This determination was formalized in an EE/CA Approval Memorandum, signed on October 4, 2019 by Mike Reynolds, Superintendent, DEVA, and included in the Administrative Record for the Site.

This EE/CA Report was generated in accordance with CERCLA Section 104(b) and the NCP, 40 CFR Section 300.415(b)(4)(i), the U.S. Environmental Protection Agency (USEPA) *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (USEPA 1993), and the U.S. Department of the Interior (USDOI) Environmental Compliance Memorandum 16-3 (USDOI 2016).

1.2. EE/CA Purpose and Development

This EE/CA Report is organized by the following topical headings, which also represent the overall objectives of the EE/CA:

- Characterize the nature and extent of contamination at the Site and conduct risk assessments (Sections 2 and 3).
- Identify applicable or relevant and appropriate requirements (ARARs) (Section 4).
- Develop removal action objectives (RAOs) and preliminary removal goals (PRGs) (Section 5).
- Identify and analyze potential removal action alternatives (RAAs) (Section 6).
- Conduct a comparative evaluation of the RAAs (Section 7).
- Recommend an RAA (Section 8).

1.2.1. *Impact of NPS-Specific Regulations and Policies on EE/CA Development*

The NPS has several requirements and policies that must be satisfied when undertaking a response to the release of hazardous substances, or pollutants or contaminants, on NPS-managed land (see NPS 2015), including the NPS Organic Act of 1916 (Organic Act) (54 USC Sections 100101et seq.; 36 CFR Chapter 1, Part 1), which requires that the NPS manages parks to conserve the scenery, natural and historic objects, and wildlife and provide for their enjoyment by such means as will leave them unimpaired for the enjoyment of future generations. In accordance with this mandate, NPS strives to clean up contaminated sites with long-term, comprehensive solutions that, to the maximum extent practicable, do not rely on post-removal Site controls which would limit public enjoyment.

This EE/CA Report is the basis for selecting what is intended to be a final, permanent response action to address human health risk, ecological risk, and ARARs at the Site. Consequently, in accordance with NPS policy this EE/CA Report includes a baseline human health risk assessment (HHRA), a screening-level ecological risk assessment (SLERA), and a baseline ecological risk assessment (BERA).

1.2.2. *Park-Specific Considerations during EE/CA Development*

NPS has articulated the parameters and considerations for non-impairment determinations in Section 1.4 of the 2006 NPS Management Policies. Two of the key provisions (which are “to be considered” [TBCs]) are:

1. “The ‘park resources and values’ that are subject to the no-impairment standard include:
    - The park’s scenery, natural and historic objects, and wildlife, and the processes and conditions that sustain them, including, to the extent present in

the park: the ecological, biological, and physical processes that created the park and continue to act upon it; scenic features; natural visibility, both in daytime and at night; natural landscapes; natural soundscapes and smells; water and air resources; soils, geological resources; paleontological resources; archeological resources; cultural landscapes; ethnographic resources; historic and prehistoric sites, structures, and objects; museum collections; and native plants and animals;…." (NPS 2006, Section 1.4.6.)

2. "Before approving a proposed action that could lead to an impairment of park resources and values, an NPS decision-maker must consider the impacts of the proposed action and determine, in writing, that the activity will not lead to an impairment of park resources and values. If there would be an impairment, the action must not be approved." (NPS 2006, Section 1.4.7.)

2. Site Description, Investigation Results, and Conceptual Site Exposure Model

The purpose of Section 2 is to provide information on the extent of contamination and the physical characteristics of the Site and to present the conceptual site exposure model (CSEM) so that the location and fate and transport of contamination is understood.

This section includes a summary of Site features, operational history, historical sources and releases of contaminants, the specific hazardous substances released at the Site, and other factors that influence contaminant migration such as hydrogeology, hydrology, climate, extent of contaminants in Site media, and contaminant transport pathways and behavior. All these elements contribute to the development of the CSEM, which is presented in Section 2.11 and shown on Figure 4 (Human Health CSEM) and Figure 5 (Ecological Pathway-Receptors).

2.1. Site Description

The Gold Hill Mill Site is located 35 miles south of Furnace Creek, California, in Warm Springs Canyon at an elevation of 2,379 feet above sea level (Figure 1). The Gold Hill region is located within the southwest corner of DEVA, in the Panamint Mountains and approximately 1,000 feet north of Warm Springs (Figure 2).

The Site is moderately visited due to its location next to the Warm Springs Mining Camp and along the road to Butte Valley. This Site is accessed via 14 miles of infrequently graded dirt roads requiring high clearance, four-wheel drive vehicles.

The Site (Figure 3A and 3B) covers less than 1 acre and consists of a complete and well-preserved mill with evidence of mercury amalgamation. A spring and an abandoned mining camp are located south of the mill ruins. Small piles of mill tailings from the amalgamated mercury process used to extract gold have accumulated in and around the mill workings, primarily on the east side, scattered in and around the equipment, and comingling with native rock.

Creosote bush scrub vegetation community occurs within the Site and immediate vicinity (Appendix C, Attachment 1). This vegetation community is dominated by widely-spaced creosote (*Larrea tridentata*) and white bursage (*Ambriosa dumosa*), with bare ground between them. Other common flora present include white ratany (*Krameria bicolor*), jointfir (*Ephedra* sp.), pencil cholla (*Cylindropuntia ramosissima*), and wire-lettuce (*Stephanomeria pauciflora*).

Wildlife species observed within the study area consisted of commonly-occurring species including, but not limited to, European starling (*Sturnus vulgaris*), common raven (*Corvus corax*), red-tailed hawk (*Buteo jamaicensis*), side-blotched lizard (*Uta stansburiana*), bighorn sheep (*Ovis canadensis*), and nonnative feral donkeys (*Equus asinus*).

The Site area includes no U.S. Fish and Wildlife Service (USFWS)-designated critical habitat for plants or wildlife. Nonetheless, several special status plants and wildlife species have been documented within 10 miles of the Site and the Site vicinity includes the substantive habitat requirements necessary to support several special-status plants and wildlife species. Special-status

species known to occur within 10 miles of the Site and their potential for occurrence within the study area are detailed within Appendix C, Attachment 1.

2.2. Operational History

Gold Hill Mill crushed gold-bearing ore from Gold Hill mines located nearby to the northwest. Gold was located in a quartz vein in limestone.

The milling structure consist of several different types of mill operations. The mill contains a power-driven arrastra which was used to grind the ore; an oil-burning hot-shot engine that drove an elaborate arrangement of flywheels, a belt and pulley system, and drive shafts that operated the mill machinery; a Blake jaw crusher; a cone crusher; concentrating tables; a cylindrical ball mill; an ore bin and chute; an unloading platform; a conveyor system; and other related mining paraphernalia (Appendix A; photo 1 and photos 5 through 9). Slurry exiting the ball mill was collected in an amalgamation box (missing) from the end of the mill to the classifier (Appendix A; photos 1 and 5). Immediately west of the mill are the concrete foundations of a mill house. An erosion-control berm is located upslope of the mill to assist in channeling surface flow away from the mill Site.

The arrangement of the milling equipment was considered innovative for the time. Instead of using a linear processing flow, with the ore moving in one direction, the ore at Gold Hill Mill was processed in a complete circle. The ore travelled east from the primary crusher to the secondary ore bin, north and west through finer crushing and classification, and then west and south through the recovery circuit. The arrangement was not ideal for repair or maintenance due to the compact design and restricted access to internal machines.

2.3. Historically and Culturally Significant Features

The Gold Hill Mining District is one of the oldest mining areas within DEVA, with prospecting and work dating from the 1870s. The first attempt at utilizing Warm Springs for mining purposes was in 1889. Frank Winters and Stephen Arnold filed a Notice of Appropriation of Water on May 27, 1889, to take water from the spring, develop it by ditches, pipes, and flumes, and use it for mining and milling purposes connected with their claims in the Butte Valley Mining District. By at least the 1880s and 1890s, the spring area, with its dependable water supply and lush vegetation, was undoubtedly considered a comfortable home base from which to conduct mining exploration in the surrounding hills.

Louise Grantham established Gold Hill Mill Site on February 5, 1933, immediately prior to establishment of Death Valley National Monument. Some of the milling structures were likely installed earlier. A date imprinted in a cement slab at the mill Site would seem to indicate that the complex, or at least part of it, was built in November 1939. The mill remained in use until the 1950s.

The mill ruin is considered to be of regional significance and warrants nomination to the National Register of Historic Places. The mill ruin is important because of the combination of old and newer

technological processes displayed and is a prime example of an early ore-processing plant (Greene and Latschar, 1981).

By the time the mill was a going concern, Mrs. Grantham was also becoming involved in talc mining in the vicinity (Greene and Latschar 1981) and she built a camp on the Gold Hill Mill Site primarily to serve nearby talc mines. The mining camp consists of two houses, a mess hall and office, and a powder house and garage across the entrance road.

The profuse waters of Warm Springs have created a very pleasant environment in Warm Springs Canyon. For a number of years, an irrigation system has fostered the growth of wild grape, giant reeds, oleander bushes, and fig trees planted just above the camp. There is also plenty of water for domestic purposes and for leisure activities such as swimming. Further north are the gold-processing ruins of Gold Hill Mill.

2.4. Waste Characteristics

Small piles of mill tailings from the amalgamated mercury process used to extract the gold have accumulated in and around the mill workings, primarily on the east side, scattered in and around the equipment, and comingling with native rock. Vegetation is stabilizing the tailings in some areas, and the erosion-control berm acts to minimize erosion. Most of the fine pinkish-orange mill tailings are downslope from the arrastra outlet, extending upslope past the mill about 20 feet and downslope about 45 feet. No visible tailings are present around the large adjacent concrete slab. The tailings continue to the small entry road adjacent to the northeast of the mill foundation, and three- to four-inch layers of tailings are visible on both sides of the wash at several locations along the road. Less than 50 cubic yards of tailings are currently visible at the Site.

Based on operational history and information gathered during the Preliminary Assessment (Environmental Cost Management (ECM 2014) and the Site Inspection (SI) (NOREAS 2016b), the principal contaminants of concern (COCs) are metals and cyanide.

2.5. Geology and Hydrogeology

DEVA is in the Basin and Range Geomorphic Province and is considered the westernmost part of the Great Basin. The province is characterized by subparallel, fault-bounded ranges separated by rotated and down-dropped basins which receive interior drainage resulting in lakes and playas. Death Valley, the lowest area in the United States (282 feet below sea level at Badwater), is one of these basins. DEVA is comprised of many geologic formations, including alluvial fans and lacustrine depots, salt flats, volcanism, and mineral-rich rock formations. Carbonate rocks of Precambrian and Paleozoic age are extensively metamorphosed by folding and faulting and are highly fractured and fissured. A salt-encrusted playa extends for 200 square miles in the southern portion of the valley.

2.5.1. *Regional and Local Geology*

Gold Hill Mill is located on the southwest portion of the Panamint Range immediately adjacent to and west of Death Valley. Bedrock in the vicinity of the Site is pre-Cenozoic-age granitic and

metamorphic rocks (USGS 1962). This undifferentiated unit includes assemblages of quartzite, marble, talc, schist, and meta-igneous rocks. The mill ruins rest in the bottom of an east-west trending, narrow mountain canyon wash that slopes eastward at a moderate rate toward Death Valley. The Site resides on a flat-bottomed ledge of recent Quaternary sediments (ECM 2014).

2.5.2. *Hydrogeology*

DEVA is in the South Lahontan Hydrologic Region (HR) (California Department of Water Resources 2003), which covers approximately 21 million acres in eastern California. The HR is bounded on the west by the crest of the Sierra Nevada, on the north by the watershed divide between Mono Lake and East Walker River drainages, on the east by Nevada, and on the south by the crest of the San Gabriel and San Bernardino mountains and the divide between watersheds draining south toward the Colorado River and those draining northward. This HR includes the Owens, Mojave, and Amargosa river systems, the Mono Lake drainage system, and many other internally drained basins. Runoff is about 1.3 million acre-feet per year.

The bedrock in many of the South Lahontan HR's groundwater source areas consist of mineralized metamorphic rock containing ores of copper, gold, silver, lead, mercury, zinc, and other metals. Potential impacts to groundwater are anticipated to predominantly derive from these natural sources, with only a very minor cumulative contribution is expected from the historic mining and milling operations (ECM 2014).

Seventy-seven (77) groundwater basins and subbasins are delineated in the South Lahontan HR (DWR 2003). The groundwater basins and subbasins underlie approximately 14,800 square miles, or 55 percent of the hydrologic region (DWR 2015a). Of the 2005-2010 average annual total water supply, groundwater contributed to 66 percent of total water (441 thousand-acre-feet). In most of the smaller basins, groundwater is found in unconfined alluvial aquifers; however, in some of the larger basins, or near dry lakes, aquifers may be separated by aquitards that cause confined groundwater conditions. Depths of the basins range from tens or hundreds of feet in smaller basins to thousands of feet in larger basins. The thickness of aquifers varies from tens to hundreds of feet. Well yields vary in this region depending on aquifer characteristics and well location, size, and use. The Gold Hill Mill Site is located in the Butte Valley subbasin (basin # 6-81) with an approximate basin area of 8,853 acres and 13.8 square miles (DWR 2105b). The depth to groundwater is not recorded but water in this basin is likely to be found in alluvium of Quaternary age. Based on topographic surface, local groundwater flow is generally to the east, toward Death Valley.

The chemical character of the groundwater varies throughout the region, but most often is calcium or sodium bicarbonate. Near and beneath dry lakes, sodium chloride, and sodium sulfate-chloride water is common. In general, groundwater near the edges of valleys contains lower total dissolved solids content than water beneath the central part of the valleys or near dry lakes.

Groundwater Use

Based upon federal database records research and available United States Geological Services topographic maps, there are no wells within 4 miles of the Site. No residences are found within 200 yards, and groundwater is not used as a drinking water source (ECM 2014).

2.6. Site Surface Water

Ephemeral surface water at the Site is generated from infrequent, heavy precipitation sourced in the headwaters of the northern portion of Butte Valley approximately 4.5 miles west. Surface water flow during rainfall events would include sheet flow over the portions of the Site at relatively higher elevation and channeled flow for 4.4 miles from west to east toward the Site. The channelized runoff within Warm Springs Canyon flows east and northeast approximately 4 miles until it empties into Death Valley toward the playa depression at Badwater.

An unnamed spring and Warm Springs emanate from a north-facing wall of a canyon, located south and 500 and 1000 feet respectively, of the Site and (Figure 3A). Both springs are upslope and flow in an easterly direction, south (cross-gradient) of the Site, and discharge into the wash forming a small riparian area, also south of the Site (Figure 3A). The springs provide a stream of water flowing north and east that typically infiltrates into the subsurface within approximately 500 feet of their discharge point. Overland drainage from the Site rapidly infiltrates the soil matrix or evaporates into the atmosphere.

There are no lakes or permanent ponds within the target distance of 15 miles downgradient of the site, and because of the arid climate and rapid infiltration rate, transport of waterborne waste constituents a significant distance off-site is unlikely. Three wetlands are mapped within a 1-mile radius, but are upgradient of the Site (Figure 3A). One wetland is supplied by Warm Springs and the other two are supplied by unnamed seeps (ECO 2014; Appendix B).

The Site is a popular tourist attraction, and the spring waters attract both humans and wildlife in the desert climate. Surface water may be affected by tailings migrating into the wash down gradient of the mill.

2.7. Local Climate

DEVA covers over 3 million acres of Mojave and Great Basin Desert terrain, with elevations ranging from 282 feet below mean sea level at Badwater Basin to 11,049 feet on the summit of Telescope Peak. Temperatures in the valley range from 130 degrees Fahrenheit in the summer to below freezing in the winter. Annual precipitation varies from a 2.5-inch, 30-year average on the valley floor to over 15 inches in the higher mountains.

NPS maintained a climate station at Furnace Creek in DEVA until 2007. Although exact wind speeds were not archived, daily wind movement, which measures the total distance the wind moves each day, was recorded. According to those records, average daily wind movement is lowest during the winter and peaks during the early spring. Within DEVA, it is not uncommon for fine-grained

material to become airborne and redistribute great distances from its source. Prevalent wind direction is from the south; however, conditions vary greatly in specific locations.

2.8. Sensitive Environments

The Site area includes no USFWS-designated critical habitat for plants or wildlife. Nonetheless, several special status plants and wildlife species have been documented within 10 miles of the Site, and the Site vicinity includes the substantive habitat requirements necessary to support several special-status plants and wildlife species. Special-status species known to occur within 10 miles of the Site, and their potential for occurrence within the study area are detailed within Appendix C, Attachment 1.

2.9. Previous Investigations and Response Actions

The following subsections summarize the results of previous investigations and contaminant fate and transport. A Preliminary Assessment (ECM 2014) and a Site Investigation (NOREAS 2016b) have been done at Gold Hill Mill.

2.9.1. *Nature and Extent of Contaminants Controlled or Treated through Previous Cleanup Actions*

No previous cleanup action or actions have been undertaken at this Site.

2.9.2. *Treatability of Compounds*

There have been no treatability studies conducted in association with any remediation activity at this Site.

2.9.3. *Equipment/Utilities/Installations at the Site*

The Gold Hill Mill Site is the location of a former mill Site. For the most part, all equipment and structures are old and in weathered condition.

2.9.4. *Site Contaminants*

Based on detected concentrations of metals and cyanide above the background levels and exceeding the screening levels in soil and surface water, Site contaminants of potential concern (COPCs) were identified as antimony, arsenic, lead, and mercury in the SI Report.

2.9.5. *Data Summary*

Sampling activities conducted as part of the SI at Gold Hill Mill were performed in February 2016 and are discussed in further detail in the *Final SI Report* (NOREAS 2016b), which included SI reporting of six other sites within DEVA. Appendix A includes the SI sampling approach, sampling locations, and data summaries as excerpts from the *Final SI Report,* relevant to Gold Hill Mill. All sampling activities were conducted in accordance with the *Final Sampling and Analysis Plan* (SAP; NOREAS 2016a), and samples were analyzed for metals (USEPA Methods 6020A/7470A/7471A), cyanide (USEPA Method 9012A), soil pH (USEPA Method 9045D), and acid-base accounting (Modified Sobek Method).

Three decision units (DUs) were identified at the Site: the mill foundations (DU-1), eroded mill tailings in the wash along the road (DU-2), and background native soils (DU-3). Three (3) incremental sampling methodology (ISM) samples were collected from DU-3; four ISM samples were collected from DU-1; and seven discrete samples were collected from DU-2. Two surface water samples were collected from the stream that flows from Warm Springs, one from the foot of the slope located approximately 330 feet south of the mill (GOLD-SW1), and the other downgradient approximately 1,000 feet east of the mill next to Warm Springs Road (GOLD-SW2) (Figure 3). Analytical results collected from each DU were used to calculate 95% upper confidence level (UCL) concentrations using the USEPA ProUCL (USEPA 2013) software program. For samples collected using ISM, the 95% UCL is determined using the Chebyshev method, which is recommended for use in ISM-based samples, as it provides a conservative estimate of the UCL (ITRC 2012).

Analytical results from DU-1 indicated elevated (above background) concentrations of antimony, arsenic, barium, beryllium, chromium, copper, cyanide lead, manganese, mercury, molybdenum, selenium, silver, thallium, vanadium, and zinc. The 95% UCL for lead was 14,661 milligrams per kilogram (mg/kg), and the 95% UCL for cyanide was 0.618 mg/kg, both of which exceeded at least two screening levels (Section 2.9.8) by up to four orders of magnitude. Several other metals (antimony, arsenic, copper, mercury, and silver) had 95% UCLs several orders of magnitude over the 95% background UCL and exceeded at least two of the screening levels (Section 2.9.8).

Analytical results from DU-2 indicated elevated (above background) concentrations of all 17 analyzed metals with the exception of cobalt and nickel. The 95% UCL for lead was 12,579 mg/kg, and significant concentrations of other metals (antimony, arsenic, copper, manganese, and zinc) above their respective 95% background UCLs were reported in DU-2 soils, all of which exceeded at least two of the screening criteria (Section 2.9.8) by up to three orders of magnitude. The sample collected farthest downgradient from the mill Site (sample DEVA-GOLD-02-007) reported much lower concentrations of arsenic and lead (11.9 and 71.2 mg/kg, respectively) than the samples collected near the mill foundation. This indicates that this sample, although of fine-grained characteristic and similar in appearance to mill tailings, was not likely composed of mill tailings, or mill tailings within the sample were highly diluted, supporting a conclusion that the current distribution of mill tailings at Gold Hill mill is limited in areal extent to the vicinity of the mill Site.

Results from the two (duplicate) surface water samples at GOLD-SW2 indicated concentrations of arsenic, barium, and selenium above their respective NPS Ecological Screening Values (ESVs) (Section 2.9.8) but not above their respective USEPA human health Regional Screening Levels (RSLs) or Water Board Environmental Screening Levels (ESLs). Comparison of the results of these duplicate samples to an upgradient, background surface water sample sourced from water emanating from Warm Springs (GOLD-SW1), does not indicate that contaminants from Gold Hill Mill are directly impacting surface water downgradient of the Site.

2.9.6. *Contaminant Fate and Transport*

Historical operations and the Site topography led to a high potential for exposure to metals, particularly lead, through direct contact with soil. Potential human exposure receptors are limited to Site visitors and NPS employees. The Site is accessible by vehicle, and the property is not secured. The potential for direct contact with contaminated soil at the Site is high. The exposure is moderated by the limited time that Site visitors and NPS employees currently spend at the Site, however, resident ecological receptors could receive frequent exposure.

As discussed in Section 2.5.2, there are no groundwater wells within 4 miles of the Site, and groundwater is not used as a drinking water source. Surface water is generated from infrequent, heavy precipitation (Section 2.6), and there are two springs (Warm Springs and an unnamed spring) approximately 600 feet to the east. There are no lakes or permanent ponds within the target distance of 15 miles downgradient of the Site, and because of the arid climate and rapid infiltration rate, transport of waterborne waste constituents a significant distance off-site is unlikely (Section 2.6). The results of the surface water sampling did not indicate an influence of contaminants from the Site directly impacting surface waters downgradient of the Site (Section 2.9.5).

2.9.7. *Chemical and Physical Properties of Site Contaminants*

The Site contaminants are found primarily in the mill tailings material. Through the milling process, including mercury amalgamation and cyanide processing, gold was separated from crushed ore rock and the resulting tailings can contain more concentrated metals than originally present in the ore rock. The mill tailings are generally a silty clay/clayey silt with fine sands, making the metals more bioavailable through both direct contact and inhalation of particulates. When present in stockpiles, mill tailings are moderately resistant to wind erosion, as the clay mineral bonds harden the mill tailings. When disrupted by processes such as foot traffic, animal burrowing or flowing water, the mill tailings are more susceptible to erosion.

2.9.8. *Background and Screening Level Concentrations*

For initial risk-screening purposes, sample results (95% UCL concentrations) from the SI were compared to screening levels established in the SAP (NOREAS 2016a), including NPS (2014) ESVs, Regional Water Board ESLs, and USEPA (2016) RSLs.

As mentioned in Section 2.9.5, three (3) ISM samples were collected from areas designated as background/native soils (DU-3) and analyzed for metals. Sample data for individual samples for soil and surface water are presented in Appendix A, Tables 8 and 9, respectively.

The background/native soil contain high levels of metals. The 95% UCL for antimony, arsenic, barium, beryllium, chromium, lead, manganese, mercury, molybdenum, thallium, vanadium, and zinc) calculated from the background/native soils (DU-3) ISM samples exceeded their respective NPS ESVs. In addition, arsenic in soil exceeded its Regional Water Board ESL and the USEPA Regional Screening Level; however, arsenic concentrations in California soils are commonly elevated above those screening levels, and the calculated 95% UCL concentration is consistent with background values commonly observed in California (NOREAS 2016b).

Note that the initial risk-screening methods described above are only for the purpose of identifying COPCs or COPECs.

2.9.9. *Physical Site Characteristics Affecting Contaminant Migration*

As discussed in Section 2.7, it is not uncommon for fine-grained material to become airborne and redistribute great distances from its source. The mill Site is adjacent to, and several feet higher in elevation, from an ephemeral wash to the north. Accumulated mill tailings were observed between the mill structure and the wash, and immediately adjacent to the wash. High flow events in the wash may result in erosion of mill tailings.

2.9.10. *Site-Specific Contaminant Transport*

Contaminants may be transported by surface erosion caused by wind or water (during heavy precipitation). Evidence of likely historical erosion of mill tailings into the wash was observed north of the mill structure and adjacent to the wash, however, one downgradient wash sample (GOLD-02-007) indicated that tailings had not migrated down the wash or had been substantially diluted with native material. Visually-discernable mill tailings were not observed within the wash during the SI.

2.10. Current/Future Land Uses

The current land use is for resource conservation and recreational use and as a historical site. Gold Hill Mill is a favorite destination of tourists wishing to study the well-preserved mill and camp ruins. Visitors often hike through tailings as they explore the mill Site ruins. DEVA staff and contractors may also access the Site. Future land use will remain the same.

2.11. Conceptual Site Exposure Models

The potential human and ecological exposure pathways and routes are illustrated in the CSEMs presented on Figures 4 and 5, respectively. The principal human exposure pathways are through incidental ingestion, dermal contact, and inhalation of wind-blown material. The likelihood of realization of human beneficial use of groundwater, if present, at the Site is very low due to its remoteness and protections from future Site development

For ecological exposures, the assumed principal pathway is incidental ingestion. Exposure through inhalation and dermal contact are also likely but are not evaluated in the BERA because the ecological data needed to evaluate these exposure routes is not available. The potential exposure pathways for aquatic receptors are assumed to be limited to sites with significant nearby standing or running waters, such as Warm Springs (and other unnamed spring) near the Site. The presence of the springs attracts wildlife.

3. Risk Assessment Summary

The purpose of Section 3 is to describe the potential risks to human health and ecological receptors posed by contamination at the Site.

Risk assessments provide an estimation of the potential threat to human health and the environment posed by Site contaminants. The results of the risk assessment are used to determine if potential risks are unacceptable and, if so, to establish risk-based removal goals (RGs) that must be satisfied by the recommended removal action. A human health risk assessment (HHRA) and a screen-level ecological risk assessment (SLERA) must be developed in order to select a final response action (USDOI 2016). A baseline ecological risk assessment (BERA) is required if the SLERA identifies the need to refine the ecological risk assessment with Site-specific or receptor-specific information. In accordance with risk assessment guidance, a baseline risk assessment is to evaluate potential adverse effects caused by hazardous releases from a Site in the absence of any actions to control or mitigate these releases (i.e., under an assumption of no action).

3.1. Human Health Risk Assessment

The HHRA was prepared according to USEPA guidance on conducting HHRAs at CERCLA sites (USEPA 1989). The data used for the risk assessment are soil and surface water analytical results collected during the Site inspection (NOREAS 2016b) (Section 2.9.5).

The HHRA includes:

- Hazard identification
- Exposure assessment
- Toxicity assessment
- Risk characterization (including an uncertainty analysis)

The above components are described in detail in HHRA report, Appendix B. The following sections describe the key steps and findings.

3.1.1. *Hazard Identification*

Based on an understanding of the contaminant sources, contaminants of potential concern (COPCs) were identified by comparing maximum detected concentrations in each media to the lowest appropriate risk-based screening levels. These screening levels are based on a target excess lifetime cancer risk of 1 in 1 million ($1x10^{-6}$) and a target non-cancer hazard quotient (HQ) of 0.1 based on residential exposure assumptions.

Based on this process, the COPCs were identified as: antimony, arsenic, cadmium, cobalt, copper, lead, mercury, silver, thallium, vanadium, and zinc.

3.1.2. *Exposure Assessment*

The exposure assessment characterizes and estimates exposures based on Site-specific scenarios. In addition, for information purposes only, a residential exposure scenario is considered which represents completely unrestricted use. Based on Site visitation and usage, the following Site-specific potentially exposed populations (PEPs) are identified:

<u>NPS Park Worker - Adult</u>

The evaluation of this scenario will identify potential health impacts to NPS workers that actively visit the Gold Hill Mill Site. These workers are estimated to have 30 minutes of exposure per visit, 20 visits per year, over 25 years. Their soil ingestion rate is estimated at 100 mg/day.

<u>Tourist Visitor – Adult and Child</u>

The scenario is descriptive of the common tourist family that could visit the Site and is mostly trail bound. This scenario identifies potential health impacts to the common Site visitor. Tourist visitors are estimated to have 30 minutes of exposure per visit, 1 visit per years, over 6 years duration. Adults are estimated to have a soil ingestion rate of 100 mg/day. Children are estimated to have a soil ingestion rate of 200 mg/day.

<u>Mining Enthusiast Visitor – Adult and Child 23</u>

This scenario is descriptive of the Mining Enthusiast family that is off the trail, physically handles rocks/soil/tailings. In general, more involved in exploring the mill/mine sites than the typical tourist. This scenario represents the potential upper-bound exposures to the Site visitors (adult and child). Mining enthusiasts are estimated to have 4 hours of exposure per visit, 1 visit per year, over 6 years. Adults are estimated to have a soil ingestion rate of 330 mg/day. Children are estimated to have a soil ingestion rate of 400 mg/day.

<u>Residents – Adult and Child</u>

No people live at the Site and no residents are expected in the future. As a health-protective screening procedure, theoretical residential exposures were evaluated in the contaminant screening process and identification of COPCs. Adult residential exposure was estimated with 24 hours per day, 350 days per year, over 26 years. Child residential exposure was estimated with 24 hours per day, 350 days per year, over 6 years. The adult's soil ingestion rate was 100 mg/day and the child's soil ingestion rate was estimated at 200 mg/day.

Additional exposure factors for each of the scenarios are presented in Appendix B.

3.1.3. *Toxicity Assessment*

The purpose of the toxicity assessment is to identify current and relevant toxicity criteria, also known as toxicity reference values (TRVs), for the COPCs. Toxicity criteria are used to assess potential health impacts characterized as carcinogenic and noncarcinogenic. Some COPCs may be

characterized as both carcinogens (either known or potential) and noncarcinogens. For example, arsenic is considered both a carcinogen and noncarcinogen, whereas other COPCs such as mercury, silver, thallium and zinc are only evaluated for noncarcinogenic effects. For carcinogens, toxicity criteria are based on the assumption that any level of exposure to a carcinogenic compound can cause an effect[2]. For noncarcinogens, toxicity criteria represent exposure concentrations of COPCs that are the upper limit protective of human health for oral and/or inhalation exposure over a lifetime. For this HHRA, toxicity criteria from USEPA (2020) are used unless there are more stringent criteria that have been promulgated by the State of California (DTSC, 2019). See Appendix B, Table 4.1 for a list of the toxicity criteria used for this HHRA.

Blood lead levels (BLLs) (i.e., concentration of lead in blood) are considered to be the primary indicator of potential lead exposure and effects. The USEPA identifies a BLL of 10 micrograms of lead per deciliter of blood (µg/dl) as a level of concern, and the DTSC identifies a BLL of 1 µg/dl as a level of concern.

To assess the lead concentrations at the Site, Site concentrations were compared to health-based levels of the California DTSC and USEPA. For example, the DTSC value of 80 mg/kg reflects exposures to a residential toddler who plays on bare soil, exhibits hand-to-mouth behavior, and therefore ingests higher- than-average amounts of soil (OEHHA 2015). The USEPA defines a 1,200 mg/kg standard for the *non-play area* of a residential site (USEPA 2001). The use of this model to assess short-term exposures is uncertain.

3.1.4. *Risk Characterization*

Risk characterization is the process of quantifying the significance of exposure to chemicals in the environment in terms of their potential to cause adverse health effects. The quantitative estimates are expressed in terms of a probability statement for the potential excess lifetime cancer risk and a hazard quotient (HQ) for the likelihood of adverse non-cancer health effects. When there are multiple COPCs that cause non-cancer effects, the cumulative hazard index (HI) is calculated as the sum of HQs.

Arsenic, cadmium and cobalt were evaluated for their carcinogenic potential. All COPCs were evaluated for noncarcinogenic health impacts. As noted below, however, lead is evaluated differently than other noncarcinogens.

[2] For oral exposures, the cancer slope factor (CSF) is the 95 percent upper bound on the slope of the dose-response curve in the low dose region and has dimensions of risk of cancer per unit dose. For inhalation exposures, cancer risk is characterized by an inhalation unit risk (IUR) value, which represents the upper-bound excess lifetime cancer risk estimated to result from continuous lifetime exposure to a chemical at a concentration of 1 $\mu g/m^3$ in air.

De minimis[3] cancer risk (risks greater than 1x10^{-6}) exceeded under all scenarios at both DUs. The probability of excess lifetime cancer risk is 2x10^{-5} for NPS Workers, 2x10^{-6} for Tourist Visitors, and 4x10^{-5} for Mining Enthusiast Visitors at both DU-1 and DU-2. Arsenic was the COPC resulting in the highest risks and hazards.

The noncarcinogenic hazard quotient exceeded the generally regarded threshold value of 1 under several exposure scenarios. It is 2 for NPS Workers and less than 1 for Tourist Visitors at both DU-1 and DU-2. The hazard quotient for Mining Enthusiast Visitors is 8 at DU-1 and 9 at DU-2.

To assess lead, concentrations were compared to values provided by the USEPA that are hazard standards for child soil lead exposure in residential play areas with bare soil (400 mg/kg) and industrial adult occupational soil exposure (800 mg/kg) (TSCA §403 Soil Hazard Rule). An additional, soil lead residential hazard standard is 1,200 mg/kg for non-play areas with bare soil, as defined under the TSCA §403 Soil Hazard Rule. The Site's lead exposure point concentration was 12,575 mg/kg at DU-1 and 8.940 mg/kg at DU-2, which greatly exceeds the residential and occupational lead standards. However, this is not indicative of potential health impacts because exposures at the Gold Hill Mill Site are short-term, and do not reflect daily residential or industrial exposures.

The most prominent routes of exposure were found to be oral (soil ingestion) and dermal absorption. The inhalation of particulates was found not to contribute significantly to risks and hazards. This is important if risk management is considered as an option.

3.1.5. *Uncertainty Assessment*

The uncertainties inherent to each component of the HHRA process and how they may affect the quantitative risk estimates and conclusions of the risk analysis are discussed in Appendix B. A summary of the uncertainties is provided in this Section.

Soil sampling and analysis designs were structured to characterize impacted areas and identified features at the Site, and the overall sampling design may not represent overall exposure areas. The focus on characterizing Site features may overestimate Site exposures, as visitors to the Site will likely have random exposures throughout the mill Site and not solely on the Site features.

Additional informational uncertainty stems from assumptions related to estimates of exposure and chemical toxicity. For example, in the HHRA, to account for uncertainties in the development of exposure assumptions, conservative assumptions are made to ensure estimated risks are protective of sensitive subpopulations or the maximum exposed individuals, resulting in a bias toward over-predicting both cancer and non-cancer risks.

[3] EPA's generally acceptable risk range is 10^{-6} to 10^{-4} as discussed in the National Contingency Plan (NCP), 40 CFR 300.430. Therefore, risks below 10-6 are considered *de minimis*,

Uncertainties associated with the following subjects are discussed in Appendix B.

- Exposure zones – DU Exposures
- Toxicity Criteria
- Assessment of Lead
- Exposure Factors

3.2. Ecological Risk Assessment

Both a screening-level environmental risk assessment (SLERA) and a baseline environmental risk assessment (BERA) were conducted for Site. Appendix Cpresents both the SLERA, the BERA and supporting documentation. Attachment 1 to Appendix C is the biological assessment completed to support the BERA. Attachment 2 to Appendix C contains all of the SLERA comparisons in Tables 1-9, exposure factors, uptake factors and toxicity reference values are shown in Tables 10 – 12 and the wildlife hazard quotients calculations for DU-1 and DU-2 are shown in Tables 13 – 28. A summary of the Preliminary Remediation Goals is presented in Table 29. A Table of Contents for Attachment 2 of Appendix C is presented at the beginning of Attachment 2. This section presents a summary of the SLERA, the BERA and the resulting PRGs.

The objective of the SLERA is to identify and document conditions that may warrant further evaluation (i.e., potential unacceptable risk). The goal is to eliminate insignificant hazards while identifying contaminants whose concentrations are sufficiently high to potentially pose unacceptable risks to ecological receptors. For a SLERA, it is important to minimize the chances of concluding that there is no risk when in fact a risk exists. Thus, selected exposure and toxicity values and assumptions are consistently biased toward overestimating risk. This ensures sites that might pose an ecological risk are studied further (i.e., a SLERA is deliberately designed to be protective in nature, not predictive of effects).

The SLERA includes the identification of contaminants of potential ecological concern (COPECs), based on a comparison of maximum concentrations to lowest ecological screening levels. COPECs identified for the Site included all of the metals and cyanide except for barium, beryllium, cobalt and nickel. The identification of COPECs indicates that a BERA be completed as the next step.

The level of refinement and evaluation in the BERA depends upon the complexity of the Site. It can range from a “simple” BERA, which characterizes potential ecological risks based only on refined HQ estimates, to a “detailed” BERA, which employs multiple lines of evidence (e.g., refined HQs, toxicity tests, ecological community evaluations) to determine if the weight of evidence indicates the potential for unacceptable ecological risks.

An ecological risk assessment (both a SLERA and a BERA) includes the following components (described in detail in the SLERA/BERA report; Appendix C):

- Problem formulation
- Exposure and effects assessment
- Risk characterization (including an uncertainty analysis)

For the COPECs identified in the SLERA for Gold Hill Mill, a BERA was conducted that applies Site-specific receptors and exposure assumptions to determine the risk for protection of important groups of ecological receptors.

3.2.1. *Problem Formulation*

During the problem formulation, the goals, breadth, and focus of the ecological risk assessment are established through the selection and description of the characteristics (e. g. reproductive success) of valuable ecological resources (e.g., species, ecological resource, or habitat type) that are to be protected (USEPA 1997). Valuable ecological resources include those without which ecosystem function would be significantly impaired, those providing critical resource and those perceived by valuable by humans (e.g., endangered species). The selected assessment endpoints are:

- Protection of birds, mammals, reptiles and invertebrates with no unacceptable effects on species diversity, abundance and reproduction due to Site-related metals and cyanide in surface soils.
- Protection of plant communities with no unacceptable effects on species diversity and abundance due to Site-related related metals and cyanide in the surface soils.

Ecological receptors are generally defined by available habitat. Habitats and potential receptors for the Site include:

- The Site is predominantly creosote bush scrub habitat, providing for a variety of terrestrial receptors including plants, invertebrates, reptiles, birds, and mammals.
- For surface soil, it is assumed that mammals, birds, reptiles, invertebrates and plants could be exposed directly or indirectly to contaminated soil.
- Cross-gradient riparian areas south of the mill may provide habitat for invertebrates and semi-aquatic wildlife.

Ecological receptors are outlined in the ecological pathway-receptor diagram (Figure 5), and complete, incomplete, or not applicable pathways are identified. Direct exposure to surface water is considered potentially complete but insignificant. Direct exposures to soil and soil particulates are considered complete.

The Gold Hill Mill Site and surrounding area potentially provide habitat for a variety of reptiles, birds, and mammals. Wildlife species observed within the study area consisted of commonly-occurring species including European starling, common raven, red-tailed hawk, side-blotched lizard, bighorn sheep, and feral donkeys. Other wildlife species known within the vicinity of the study area that were not observed at the Site include several species of small rodents such as the southern grasshopper mouse. The Panamint pocket gopher, black-throated sparrow, Gambel's quail, and desert spiny lizard could also be present in the area. Several special-status species are potentially present on-site and include: desert bighorn sheep, pallid bat and Townsend's big-eared bat. Attachment 1 to Appendix D presents the biological resource habitat assessment conducted in 2019.

The vegetation community at the Site is dominated by widely-spaced creosote and white bursage, with bare ground between them. Soils in this community are well drained, alluvial, and sandy. Plant species observed at the Site includes the following species: creosote bush, brittlebush, white bursage, white ratany, jointfir, pencil cholla, wire-lettuce, beavertail cactus, rubber rabbitbrush, cheesebush, sticky snakeweed, cotton catclaw, sandbar willow, honey mesquite, and tamarisk. Attachment 1 of Appendix D presents a habitat assessment of the study area.

3.2.2. *Summary of Screening-level Ecological Risk Assessment*

As discussed in detail in Appendix C, a SLERA and a refined SLERA were conducted to identify the COPECs.

Exposure areas for this assessment include the two source DUs. The source DUs are:

- DU-1 – Mill Foundation (2,800 square feet or 0.06 acres)
- DU-2 – Mill Tailings in Wash along Road (300 linear feet)

A summary of the Refined-SLERA is shown below. Antimony, arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, selenium, silver, thallium, vanadium, zinc and total cyanide exceeded ecological screening values for some or all of the ecological receptors. Barium, beryllium, cobalt and nickel were below ESV levels and were removed from further evaluation.

Table 3.1 Summary of Refined SLERA

COPEC	Terrestrial Plants (ESV in mg/kg)	Soil Invertebrate (ESV in mg/kg)	Mammals (ESV in mg/kg)	Birds (ESVs in mg/kg)	Gold Hill Mill Foundation (DU-3) Background levels mg/kg	Gold Hill Mill Foundation (DU-1) Maximum mg/kg	Gold Hill Eroded Tailings in Wash along Road (DU-2) Maximum mg/kg
Antimony*	**5.0***	**78.0***	**0.3***	No ESV	**0.932***	**1,070***	**1,490**
Arsenic*	**18***	**60***	**46***	**43***	4.37	**612***	**854***
Barium	500	330	2,000	720	102	129	175
Beryllium	10	40	21	No ESV	0.299	0.38	0.52
Cadmium*	32	140	**0.36***	**0.77***	0.181	**1.58***	**22.8***
Chromium*	**1.0***	**0.4***	63.0	23.0	**6.71***	**10.0***	**9.94***
Cobalt	13	No ESV	230	120	4.98	3.73	5.70
Copper*	**70***	**80***	**49***	**28***	7.59	**1,260***	**1,920***
Lead*	**120***	**1700***	**56***	**11***	6.79	**13,900***	**12,000***
Mercury*	**0.3***	**0.1***	**1.7***	**0.013***	0.0161	**25***	**8***
Molybdenum*	2.0	No ESV	**0.5***	15.0	0.139	**0.51**	**0.94**
Nickel	38	280	130	210	6.82	7.37	9.17
Selenium*	**0.52***	**4.1***	**0.63***	**1.2***	0.200	**4.07***	**5.51***
Silver*	560	No ESV	**14***	**4.2***	0.0349	**86.5***	**63.6***
Thallium*	**1.0***	No ESV	**0.4***	4.5	0.142	**2.07***	**1.62***
Vanadium*	**2.0***	No ESV	280	**7.8***	**203**	**178**	**151**
Zinc*	**160***	**120***	**79***	**46***	31.5	**306***	**13,300***
Cyanide, Total*	No ESV	No ESV	330	**0.098***	Not Sampled	**0.47***	Not Sampled

Concentrations representing DU-1 and DU-2 is a maximum concentration and is bolded and asterisked if it exceeds at least one refined ESV. Concentrations representing DU-3 (background) is the 95% UCL as baseline comparison and is bolded and asterisked if it exceeds at least one refined ESV.

Bolded and asterisked ESVs are those that are exceeded by at least one of the DU concentrations.

3.2.3. *Summary of Baseline Ecological Risk Assessment*

In the BERA, the risk from exposure to COPECs identified in the Refined SLERA to the four receptor groups (plants, invertebrates, birds and mammals) undergo further assessment. The BERA is described in detail in Appendix C.

The BERA uses a mean value for the exposure point concentration (EPC), modeling of COPECs into biological media (e.g., plants and insects), food web modeling using relevant wildlife receptors, and toxicity reference values to estimate risk.

An exposure area of 1 acre was applied in the BERA and includes both the mill foundations (DU-1) (approximately 2,800 square feet) and the mill tailings in the wash along the road (DU-2)

(approximately 300 feet downgradient from the mill). Visually observable mill tailings in the wash were of limited extent, within approximately 50 feet of the mill Site.

In the SLERA, risk estimates were based on the lowest ESV across multiple NPS-approved screening value sources. However, in the BERA, risk estimates are revised using more species-specific concentrations and/or dose-based toxicity reference values TRVs.

For the plant and invertebrate communities, the geometric mean of the no observed effect concentration (NOEC) and lowest observed adverse concentration (LOEC) from the Los Alamos Ecological Database (2017) were used as the TRVs. Tables 3.5 and 3.6 show that the exposure point concentrations and HQs that exceed the threshold value of 1 for the terrestrial plant and soil invertebrate communities. An HQ greater than 1 in a SLERA indicates that the resource may be at risk and additional assessment is warranted.

Table 3.2 COPECs with Hazard Quotients Above 1 for Terrestrial Plants

COPEC	DU-1 Exposure Point Concentration (mg/kg)	DU-1 Hazard Quotient	DU-2 Exposure Point Concentration (mg/kg)	DU-2 Hazard Quotient
Antimony	1,017	40	1,054	42
Arsenic	557	14	621	15
Chromium	8.83	7	8.19	7
Copper	1,133	6	1,358	7
Lead	12,575	48	8,940	34
Selenium	3.58	3	4.67	4
Vanadium	169	2	126	2
Zinc	--	--	13,300	103
Cyanide	0.37	No LOEC/NOEC	--	No LOEC/NOEC

Table 3.3 COPECs with Hazard Quotients Above 1 for Terrestrial Invertebrates

COPEC	DU-1 Exposure Point Concentration (mg/kg)	DU-1 Hazard Quotient (HQ)	DU-2 Exposure Point Concentration (mg/kg)	DU-2 Hazard Quotient (HQ)
Antimony	1,017	4	1,054	4
Arsenic	557	26	621	29
Chromium	8.83	8	8.19	8
Copper	1,133	6	1,358	7
Lead	12,575	3	8,940	2
Mercury	21	133	8	47
Silver	80.78	No LOEC/NOEC	51.24	No LOEC/NOEC
Thallium	1.48	No LOEC/NOEC	1.29	No LOEC/NOEC
Vanadium	169	No LOEC/NOEC	126	No LOEC/NOEC
Zinc	252	2	13,300	40
Cyanide	0.374	No LOEC/NOEC	--	No LOEC/NOEC

The risk to mammals, birds and reptiles was completed using reasonable exposure assumptions and chemical-specific TRVs. TRVs were developed through a review of ecotoxicological databases in addition to scientific literature. Each COPEC has a TRV based on a lowest observed adverse effect level (LOAEL) and on a no observed adverse effect level (NOAEL). The contaminant exposure point concentrations (EPC) used in the BERA were 1) the mean value if the data were from ISM samples or 2) the lower of the maximum or the 95% UCL if the samples were discretely collected.

The HQs based on NOAEL and LOAEL were calculated by dividing the estimated ingestion intakes by the TRVs for each of the COPECs for each of the species. An HQ value of 1 is considered the threshold for indicating that adverse effects may occur. An HQ less than or equal to a value of 1 (to one significant figure) indicates that adverse impacts to wildlife are considered unlikely. An HQ greater than 1 is an indication that further evaluation may be necessary to evaluate the potential for adverse impacts to wildlife. HQs equal to 1 using TRVs that are based on NOAELs should be considered protective of individuals and are commonly used in the evaluation of special-status species. HQs equal to 1 using TRVs that represent LOAELs may indicate a potential for low effects and are commonly used for evaluation of populations. Summary tables of COPECs based on NOAEL-HQ and LOAEL-HQ above 1 by species are presented below. Additionally, an HQ based on the geometric mean of the NOAEL-TRV and LOAEL-TRV is presented.

Table 3.4a Hazard Quotients Above 1 for Black-throated Sparrow

COPEC	DU-1 NOAEL Hazard Quotient	DU-1 LOAEL Hazard Quotient	DU-1 Geomean Hazard Quotient	DU-2 NOAEL Hazard Quotient	DU-2 LOAEL Hazard Quotient	DU-2 Geomean Hazard Quotient
Antimony	316	32	100	327	33	104
Arsenic	26	3	8	29	3	9
Cadmium	<1	<1	< 1	8	3	5
Copper	7	6	6	9	7	8
Lead	130	13	41	92	9	29
Mercury	19	9	13	7	3	5
Selenium	2	1	2	3	2	2
Vanadium	2	1	2	2	1	1
Zinc	4	< 1	1	202	22	67

Table 3.4b Hazard Quotients Above 1 for Common Raven

COPEC	DU-1 NOAEL Hazard Quotient	DU-1 LOAEL Hazard Quotient	DU-1 Geomean Hazard Quotient	DU-2 NOAEL Hazard Quotient	DU-2 LOAEL Hazard Quotient	DU-2 Geomean Hazard Quotient
Antimony	3	< 1	< 1	3	< 1	< 1
Zinc	< 1	< 1	< 1	3	< 1	< 1

Table 3.4c Hazard Quotients Above 1 for Southern Grasshopper Mouse

COPEC	DU-1 NOAEL Hazard Quotient	DU-1 LOAEL Hazard Quotient	DU-1 Geomean Hazard Quotient	DU-2 NOAEL Hazard Quotient	DU-2 LOAEL Hazard Quotient	DU-2 Geomean Hazard Quotient
Arsenic	3	< 1	2	4	< 1	2
Cadmium						
Copper				2	< 1	< 1
Lead	13	1	4	9	1	3
Mercury						
Selenium						
Vanadium						
Zinc	< 1	< 1	< 1	4	2	3

Table 3.4d Hazard Quotients Above 1 for White-Tailed Antelope Squirrel

COPEC	DU-1 NOAEL Hazard Quotient	DU-1 LOAEL Hazard Quotient	DU-1 Geomean Hazard Quotient	DU-2 NOAEL Hazard Quotient	DU-2 LOAEL Hazard Quotient	DU-2 Geomean Hazard Quotient
Arsenic	16	4	8	18	4	9
Cadmium	< 1	< 1	< 1	2	< 1	< 1
Lead	26	3	8	19	2	6
Mercury	2	< 1	< 1	1	< 1	< 1
Zinc	< 1	< 1	< 1	4	2	3

Table 3.4e Hazard Quotients Above 1 for Side Botched Lizard

COPEC	DU-1 NOAEL Hazard Quotient	DU-1 LOAEL Hazard Quotient	DU-1 Geomean Hazard Quotient	DU-2 NOAEL Hazard Quotient	DU-2 LOAEL Hazard Quotient	DU-2 Geomean Hazard Quotient
Lead	6	< 1	2	5	< 1	1

Ecological risks for the plant community, invertebrate community, birds, mammals and reptiles are presented in Appendix C. The black-throated sparrow, common raven, grasshopper mouse, and white-tailed antelope squirrel and side botched lizard were found to be potentially at risk from exposure to antimony (birds only), arsenic, lead and zinc. These metals were carried forward in the evaluated as the primary contaminants of ecological concern (CECs).

3.2.4. *Uncertainty*

Due to the multiplicity of potential receptor species and general lack of detailed knowledge and/or variability surrounding their life cycles, feeding habits, and relative toxicological sensitivity, the uncertainty surrounding estimates of ecological hazard can be substantial. The criteria used in BERA are intended to provide a conservative, yet reasonable, assessment of potential ecological hazards. The BERA (Appendix D) did not account for Site-specific factors such as chemical bioavailability over time, adaptive tolerance, reproductive potential or recruitment from similar adjoining areas. Additional discussion of sources of uncertainty for the BERA is included in Appendix D.

3.3. Development of Preliminary Removal Goals

The preliminary removal goals (PRGs) generally establish the concentrations for chemicals identified as contaminant of concern (COCs) for human health and contaminant of ecological

concern (CECs) that will not present unacceptable risk to human health or ecological receptors based on Site-specific conditions and estimated exposure.

3.3.1. *Selection of Human Health Risk-Based Preliminary Removal Goals*

The NCP establishes a risk range for excess cancer risk of between 10^{-6} and 10^{-4} and sets a threshold value for cumulative non-cancer adverse effects at a hazard index of 1. PRGs related to carcinogenic compounds are initially established at the 10^{-6} level. Final removal goals (RGs) can deviate from this "point of departure," if necessary, based on compelling Site-specific factors relevant to risk management decisions. Risk-based PRGs are established using the same exposure parameters and toxicity values used in the HHRA but reversing the risk equation to solve for the exposure point concentration (EPC). RGs were only developed for those chemicals that are identified as COCs in the risk assessment: arsenic and lead.

PRGs were developed for each potential receptor, including Tourist Visitor, Mining Enthusiast and NPS Worker. The PRGs for contaminants identified as human health COCs are provided in Appendix C, Table C5.4. A carcinogenic risk of $1x10^{-6}$ and health index of 1 were used to calculate the human health preliminary removal goals.

The preliminary removal goals vary between the tourist, mining enthusiast, and NPS worker exposure models. Preliminary removal goals also vary to avoid carcinogenic and non-carcinogenic effects. The most protective of these preliminary removal goals are 14 mg/kg of arsenic (to avoid carcinogenic effects in the mining enthusiast) and 1,200 mg/kg of lead (to avoid noncarcinogenic health impacts on both the tourist and mining enthusiast visitors).

3.3.2. *Selection of Ecological Risk-Based Preliminary Removal Goals*

Ecological risk-based PRGs were derived using the same exposure parameters and toxicity values used in the BERA but reversing the risk equation to solve for the exposure point concentration (EPC) and using the geometric mean of the no effect (NOAEL) and lowest effect (LOAEL) concentrations to represent the TRVs. Generally, PRGs are only developed for those chemicals that are identified as contaminants of ecological concern (CECs) in the risk assessment. CECs are defined as those chemicals for which the estimated hazard quotient (HQ) greater than 1 and the risks were derived with reasonable exposure assumptions and taking into account the Site conditions. The PRGs for the Gold Hill Mill Site are summarized below in Table 3.5. In each case, only the receptor with the lowest, or most protective, preliminary removal goal is listed.

Table 3.5 Gold Hill Mill Site Ecological Preliminary Remediation Goals

CEC	Recommended PRG (mg/kg)	Receptor
Antimony	10	Black-throated sparrow
Arsenic	40.47	Plants
Cadmium	5	Black-throated sparrow
Copper	175	Black-throated sparrow
Mercury (Inorganic)	0.16	Invertebrates
Selenium	1.25	Plants
Vanadium	69.28	Plants
Zinc	205	Black-throated sparrow

4. Identification and Analysis of Applicable or Relevant and Appropriate Requirements

The purpose of Section 4 is to summarize key ARARs for the Site. ARARs include standards, requirements, criteria, or limitations under federal, or more stringent State, environmental law (CERCLA Section 121 (d)(2)(A)). To be adopted as an ARAR at an NPS CERCLA site, NPS must determine that the requirement is either "applicable" to conditions at the Site (i.e., if compliance is legally required). If not applicable, NPS must determine if the requirement is both "relevant" and "appropriate" based on Site conditions. A requirement that is not applicable may be relevant and appropriate. A requirement is relevant and appropriate if NPS determines, based on its discretion, that the requirement is well suited to addressing Site conditions. In addition, State requirements are ARARs if they are more stringent than federal ARARs.

The identification of ARARs is a prerequisite to evaluating and selecting a cleanup action (CERCLA Section 121(d)(2)(A)). "Under circumstances where a non-time-critical removal action is expected to be the first and final action at the Site, the selected removal action must satisfy all adopted ARARs" (USDOI 2016).

There are four basic criteria that define ARARs (NPS 2015; EPA 1988). ARARs are (1) substantive rather than administrative or procedural, (2) applicable or relevant and appropriate, (3) promulgated, and (4) categorized as one of the following.

Chemical-specific: ARARs that address specific hazardous substances and are typically health or risk-based numerical values that cleanups must achieve.

Location-specific: ARARs that that must be achieved because of the specific location of the release and the related response action (e.g., requirements that address the conduct of activities in sensitive areas such as national parks, floodplains, wetlands, and locations where endangered species or significant cultural resources are present). Therefore, NPS-specific ARARs typically fall within this category.

Action-specific: ARARs that are typically technology- or activity-based requirements or limitations on actions conducted to respond to the release of hazardous substances. Action-specific ARARs generally prescribe *how* a selected alternative must be implemented rather than *what* alternative may be selected.

In addition to ARARs are other factors "to be considered" (TBCs). TBCs are non-promulgated criteria, advisories, guidance, and proposed standards issued by federal or state governments. TBCs are not enforceable and a response action is not required to attain TBCs but TBCs may be appropriate in shaping or guiding the development or implementation of a response action in certain circumstances, for example, where ARARs do not provide sufficient direction.

Mine Waste-Specific ARAR Considerations

The Gold Hill Mill Site is an historic Abandoned Mine Land (AML) that operated in the 1930s. The waste to be managed at the Site during the removal action is excluded from Resource Conservation and Recovery Act (RCRA) Subtitle C regulation as "hazardous waste" by the so-called "Bevill exclusion," which provides that solid waste from the extraction and beneficiation, as well as solid waste from specified processing streams, of ores and minerals is not hazardous waste for purposes of Subtitle C (42 U.S.C. §§ 6921 *et seq*.; 40 CFR Part 260 *et seq*.). The specific activities that constitute extraction and beneficiation have been described by USEPA in 40 CFR section 261.4(b)(7) and in a series of guidance documents on the Extraction and Beneficiation of Ores and Minerals, including a document on gold (USEPA 1994a). The beneficiation practices reportedly used at the Gold Hill Mill entailed crushing, possibly grinding, flotation, mercury amalgamation, and cyanide leaching. Each of these processes is included in the regulatory description of beneficiation. This operational history suggests that activities conducted at the Site were limited to extraction and beneficiation and, therefore, the Site tailings are not regulated as "hazardous waste" under RCRA Subtitle C. This fact can influence chemical-, location-, and action-specific ARARs. Additionally, in 36 CFR Part 9 – Subpart A Mining and Mining Claims, NPS specifically regulates the disposition of mining activities and claims "to prevent or minimize damage to the environment or other resource values, and to ensure that the pristine beauty of the units is preserved for the benefit of present and future generations," including specific reclamation requirements (Section 9.11(b)).

Pursuant to its delegated CERCLA lead agency authority, NPS has identified ARARs and TBCs for the Gold Hill Mill EE/CA. Key ARARs and TBCs are summarized in the following text. For all the State ARARs identified for this Site, it was determined either (1) that there are no corresponding federal ARARs or (2) that the State ARARs were more stringent than corresponding federal ARARs.

4.1. Chemical-Specific ARARs

Chemical-specific ARARs are generally health or risk-based numerical values or methodologies applied to site-specific conditions that result in the establishment of a cleanup level. The human health COCs for this removal action are arsenic and lead. Antimony, arsenic, cadmium, copper, lead, mercury (inorganic), selenium, vanadium and zinc are identified as CECs. As described above, under federal law, the Gold Hill Mill Site wastes are excluded from RCRA Subtitle C regulation as hazardous waste. California has been authorized to carry out a State Hazardous Waste Program which also recognizes the Bevill exclusion.

Key chemical-specific ARARs and TBCs are:

- Basin Plan: This is an applicable state requirement. It is based on the Comprehensive Water Quality Control Plan for the Lahontan Region (Basin Plan) (Cal. Water Code §

13240), which establishes beneficial uses of groundwater and surface water, establishes water quality objectives (WQOs), including narrative and numerical standards, establishes implementation plans to meet WQOs and protect beneficial uses, and incorporates statewide water quality control plans and policies. Surface water in DEVA drains into enclosed desert basins where it is lost to evaporation and infiltration. Near Gold Hill Mill, a stream is present that flows from Warm Springs. Although there is no water in the stream most of the time, there may be rain during the removal action. The response action selected will not discharge water or contaminants to surface waters.

- Regional Screening Levels (RSLs) for chemical contaminants at Superfund sites. This is USEPA Regional guidance (EPA/903/R-93-001) "to be considered" except where California standards are more stringent. The guidance establishes chemical-specific concentrations for contaminants in air, drinking water and soil that may warrant further investigation or site cleanup.

4.2 Location-Specific ARARs

The Gold Hill Mill Site is located within a national park and wilderness area and contains historic and cultural resources; it is therefore subject to several location-specific requirements. Historical, cultural, and desert protection requirements, among others, are identified as ARARs for the Site.

Three of the most important NPS-specific ARARs related to the Site are the Organic Act (54 U.S. Code § 100101, et seq.), the California Desert Protection Act (16 U.S. Code § 410aaa), and the federal statute and implementing regulations restricting solid waste disposal in national parks (54 U.S. Code § 100903; 36 CFR Part 6). The NPS Mission, as stated in the 1916 Organic Act is: "to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." The non-impairment mandate is the cornerstone of the NPS Organic Act and establishes the fundamental purpose and responsibility of the NPS. In the context of a contaminated site within a national park, the non-impairment mandate prohibits NPS from selecting a response action that would result in the permanent or long-term impairment of a park's fundamental resources and values. By this standard, a response action is acceptable only if it is designed to protect park resources and values and to eliminate impaired conditions resulting from the release to the greatest extent practicable.

DEVA was established by the California Desert Protection Act of 1994 (Pub. L. 103-433), which Congress enacted to preserve scenic, geologic, and wildlife values; perpetuate diverse ecosystems of the California desert; protect and preserve historical and cultural values of the California desert associated with, *inter alia*, sites exemplifying the mining history of the Old

West; provide outdoor public recreational opportunities while protecting natural features; and retain and enhance opportunities for scientific research in undisturbed ecosystems.

In 1984, Congress enacted Public Law No. 98-506 (now codified at 54 U.S. Code § 100903) prohibiting the operation of solid waste disposal sites within units of the National Park System, except for those already operating (as of September 1, 1984), or those used only for disposal of wastes generated solely from National Park Service activities within that unit, and only if such disposal does not degrade park resources. In 1994 NPS promulgated the 36 CFR Part 6 regulations entitled, "Solid Waste Sites in Units of the National Park System," with 12 conditions (36 CFR § 6.4) that must be met before a new solid waste disposal site may be authorized within the boundaries of any national park system unit. Thus, if the selected response action for this Site is deemed to create a new solid waste disposal site within DEVA, it must meet the 12 conditions specified in 36 CFR § 6.4(a). Additional NPS requirements concerning the management and disposal of mining waste in national park units are addressed in 36 CFR § 6.7, with mining or mineral operation reclamation requirements detailed in 36 CFR Part 9.

The above requirements are summarized below along with other key location-specific ARARs and TBCs.

- National Park Service Organic Act of 1916 ("Organic Act"), 54 U.S. Code § 100101(a), 36 CFR Part 1: This is an applicable federal requirement "to promote and regulate the use of . . . national parks . . . by such means and measures as conform to the fundamental purpose of the said parks . . . which purpose is to conserve the scenery, natural and historic objects, and wild life in the System units and to provide for the enjoyment of the scenery, natural and historic objects, and wild life in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." The response action selected for the Site must not result in the permanent or long-term impairment of a park's fundamental resources and values. The General Authorities Act further provides that "the protection, management, and administration of the System units shall be conducted in light of the high public value and integrity of the System and shall not be exercised in derogation of the values and purposes for which the System units have been established, except as directly and specifically provided by Congress." (General Authorities Act, as amended, 54 U.S. Code § 100101(b)(2)).

- NPS policy on implementation of the non-impairment standard: This policy is "to be considered" in applying the Organic Act and is set out in the 2006 NPS Management Policies, Section 1.4. This policy describes the fundamental purpose of all parks and what constitutes park resources and values. It provides guidance for determining what constitutes impairment of those resources and values, and states that an action that would result in an impairment may not be approved by NPS decision-makers.

- Establishment of Death Valley National Park: This is an applicable federal requirement. The California Desert Protection Act of 1994 (Public Law 103–433, 16 U.S. Code § 410aaa) established Death Valley National Park as a unit of the National Park System in order to— (A) preserve scenic, geologic, and wildlife values associated with unique natural landscapes; (B) perpetuate in their natural state significant and diverse ecosystems of the California desert; (C) protect and preserve historical and cultural values of the California desert associated with ancient Indian cultures, patterns of western exploration and settlement, and sites exemplifying the mining, ranching and railroading history of the Old West; (D) provide opportunities for compatible outdoor public recreation, protect and interpret ecological and geological features and historic, paleontological, and archeological sites, maintain wilderness resource values, and promote public understanding and appreciation of the California desert; and (E) retain and enhance opportunities for scientific research in undisturbed ecosystems. The response action selected for the Site must be consistent with the enumerated objectives of the California Desert Protection Act which include protection of historical mining sites, such as the Gold Hill Mill Site, that may be affected by the response action.

- Death Valley National Park General Management Plan: The General Management Plan is to be considered in developing and evaluating response action alternatives for this Site. The Plan establishes management objectives for DEVA, including rehabilitation of abandoned mine sites and mitigation of impacts to bats at abandoned mines. The response action selected and implemented will be informed by the values and goals of the Plan and must be consistent with those values and goals.

- Solid Waste Sites in Units of the National Park System, 54 U. S. Code § 100903, 36 CFR Part 6: This is an applicable federal requirement if the preferred removal action alternative entails the operation of a new solid waste disposal site within the boundaries of DEVA. As noted above, the statute prohibits operation of any solid waste disposal site that was not in operation on September 1, 1984, except for sites used only for disposal of wastes generated solely from NPS activities within the park unit, and only if such disposal does not degrade natural or cultural resources. The regulations implementing this law prohibit the creation of new solid waste disposal sites except as specifically provided for in those regulations. Section 6.4 specifies 12 conditions that must be met before a new solid waste disposal site may be authorized. These regulations would apply to the on-site disposal of mining waste as defined in 36 CFR § 6.7, including the mining wastes at this Site. With respect to the Gold Hill Mill Site, none of the alternatives retained for further analysis contemplate the on-site management or disposal of solid wastes.

- NPS Policies Concerning Waste Management and Contaminants, 2006 NPS Management Policies, Section 9.1.6: This policy requires NPS to minimize disposal of

solid and hazardous waste at NPS sites and to "make every reasonable effort to prevent or minimize the release of contaminants on or that will affect NPS lands or resources, and . . . take all necessary actions to control or minimize such releases when they occur." This policy also provides that all disposal of solid waste on lands and waters within the boundaries of a park system unit must comply with the regulations in 36 CFR Part 6. It is to be considered in developing and executing the selected removal action at the Site.

- Reclamation of mine sites in national parks, 36 CFR § 9.11(b): This regulation is relevant and appropriate for response actions at former mine sites. The provision states that reclamation of such sites must provide for "the safe movement of native wildlife, the reestablishment of native vegetative communities, the normal flow of surface and reasonable flow of subsurface waters, the return of the area to a condition which does not jeopardize visitor safety or public use of the unit, and return of the area to a condition equivalent to its pristine beauty."

- Historic Sites, Buildings, and Antiquities Act, 54 U. S. Code § 320101: This is an applicable federal requirement that requires federal agencies to preserve for public use historic sites, buildings, and objects of national significance for the inspiration and benefit of the people of the United States and to consider, *inter alia*, historic or prehistoric sites, buildings, objects, and properties of national historical or archaeological significance, when evaluating response action alternatives. The Act is applicable to soil disturbance and other Site response activities that could impact areas of historical or archaeological significance.

- Archaeological and Historic Preservation Act, 54 U.S. Code § 312502 *et seq*.: This is an applicable federal requirement. The Act establishes requirements for evaluation and preservation of historical and archaeological data, including Native American cultural and historic data, which may be destroyed through alteration of terrain as a result of federal construction projects or a federally licensed activity or program. If eligible scientific, pre-historical, or archaeological data are discovered during Site activities, such data must be preserved in accordance with these requirements. Applicable to Site removal action activities that could result in the destruction or alteration of archeological or historical resources.

- National Historic Preservation Act, 54 U.S. Code §§ 300101 *et seq.;* 36 C.F.R. Part 800: This is an applicable federal requirement. This act requires federal agencies to consider the effect of any federally assisted undertaking on any district, site building, structure, or object that is included in, or eligible for, the Register of Historic Places and to minimize or mitigate reasonably unavoidable effects. Indian cultural and historical resources must be evaluated, and effects avoided, minimized, or mitigated. Applicable to the extent that response action activities at the Site could impact historic or cultural resources.

- Archaeological Resources Protection Act, 16 U.S. Code §§ 470aa *et seq*.; 43 CFR §§ 7.1 *et seq*.: This is an applicable federal requirement that provides for the protection of archeological resources that are at least 100 years old and located on public or tribal lands. Establishes criteria that must be met for the land manager's approval of any excavation or removal of archaeological resources if a proposed activity involves soil disturbances. Applicable to soil-disturbing activities that could result in the disturbance of eligible archeological resources.

- Protection and Enhancement of the Cultural Environment, Executive Order 11593: This order instructs federal agencies to provide leadership in preserving, restoring and maintaining the historic and cultural environment of the Nation and to administer the cultural properties under their control in a spirit of stewardship and trusteeship for future generations. It is to be considered in developing and executing the selected removal action at the Site.

- NPS Policies for Cultural Resource Management, 2006 NPS Management Policies, Section 5.3: Establishes NPS policies for managing cultural resources including protection, preservation, and restoration of such resources. It is to be considered in developing and executing the selected removal action at the Site.

- Native American Graves Protection and Repatriation Act (NAGPRA), 25 U.S. Code § 3001; 25 U.S. Code § 3002(d); 43 CFR §§ 10.1 – 10.17: This is an applicable federal requirement that provides for the disposition of Native American remains and objects inadvertently discovered on federal or tribal lands after November 1990. If the response activities result in the discovery of Native American human remains or related objects, the activity must stop while the head of the federal land management agency (in this case, NPS) and appropriate Native American tribes are notified of the discovery. After the discovery, the response activity must cease and a reasonable effort must be made to protect the Native American human remains or related objects. The response activity may later resume. . Applicable if any Native American remains or objects are discovered during removal action activities.

- NPS Policies for Management of Wilderness Resources, 2006 NPS Management Policies, Section 6.3: Establishes NPS policies for managing wilderness resources and provides that the principle of non-degradation should be applied to wilderness management. It is to be considered in developing and executing the selected removal action at the Site.

- National Park Resource Protection, Public Use and Recreation regulations, 36 CFR Part 2): These are applicable federal regulations that provides for protection of the National Park resources by prohibiting activities that may have a detrimental effect on

those resources. The response action selected may not have a detrimental effect on Death Valley National Park resources.

- National Park Area Nuisance regulations, 36 CFR § 5.13: These are applicable federal requirements that prohibit the creation or maintenance of a nuisance upon the federally owned lands of a park area or upon any private lands within a park area under the exclusive legislative jurisdiction of the United States. The response action selected may not create or maintain a nuisance on park lands.
- NPS Policies for Managing Biological Resources, 2006 NPS Management Policies, Section 4.4.1: This policy establishes management policies and principles to preserve, restore, and minimize impacts to biological resources including plants and animals. It is to be considered in developing and executing the selected removal action at the Site.
- NPS Policies for Managing Water Quality, 2006 NPS Management Policies, Section 4.6.3: Establishes NPS policy, among other things, to take all necessary actions to maintain or restore the quality of surface waters and groundwaters within the parks consistent with the Clean Water Act and all other applicable federal, state, and local laws and regulations. It is to be considered in developing and executing the selected removal action at the Site.
- NPS Policies for Soil Resource Management, 2006 NPS Management Policies, Section 4.8.2.4: Establishes NPS policy to "understand and preserve the soil resources of parks, and to prevent, to the extent possible . . . contamination of the soil or its contamination of other resources." It is to be considered in developing and executing the selected removal action at the Site.
- NPS Policies Concerning Revegetation and Landscaping, 2006 NPS Management Policies, Section 9.1.3.2: This policy requires that, to the maximum extent possible, plantings selected for revegetation will consist of species that are native to the park, and that low water use practices should be employed. This provision also addresses use of fertilizers and other soil amendments. It is to be considered in developing and executing the selected removal action at the Site.

4.3. Action-Specific ARARs

The removal action alternatives that survived the preliminary screening of alternatives in this EE/CA are:

1) No Action
2) Removal (excavation) with off-site disposal (would likely require off-site treatment such as soil binding to comply with receiving facility land disposal restrictions (LDRs))

Alternative 1 is no action. There is no need to identify action-specific ARARs for the no action alternative because, by definition, no actions are involved.

Alternative 2 includes removing contaminated soil and mining wastes for disposal off-site. The soil may be staged on-site for characterization. Characterization and mine reclamation requirements were identified as ARARs for this alternative. The soil disturbance could trigger stormwater runoff controls and the need to comply with substantive requirements of the Stormwater Construction General Permit if land disturbance exceeds 1 acre.

If soil is not placed directly into trucks for off-site disposal, staged soil will be managed in accordance with 40 CFR § 264.554(d)(1) (i–ii) and (d)(2), (e), (f), (h), (i), (j), and (k).

The action-specific ARARs and TBCs are:

- RCRA Staging Pile requirements: These are federal requirements that are relevant and appropriate to Alternative 2. Staging piles must be designed using appropriate measures (e.g., liners, covers, run-on/runoff controls) to prevent or minimize releases and cross-media transfers of hazardous wastes and constituents. For units located in a previously contaminated area of the facility, all remediation wastes, contaminated containment system components, structures, and equipment that are contaminated with waste or leachate must be removed or decontaminated within 180 days after the operating term of the staging pile expires. In addition, contaminated subsoils must be decontaminated (40 CFR § 264.554(d)(1)(i–ii) and (d)(2), (e), (f), (h), (i), (j), and (k)). This requirement is not applicable under the federal standard because the Site soil is not hazardous waste. However, the definition of remediation waste covered by these requirements is more stringent in California and includes hazardous substances. Therefore, if staging piles are used, the removal action will comply with these requirements as relevant and appropriate.

- Discharges to surface waters, including construction discharges, 33 U.S. Code § 1342; 40 CFR § 122.26: This is a federal requirement that regulates, among other things, the discharge of stormwater from construction activities into waters of the United States. Owners and operators of construction activities must comply with discharge standards, including the substantive provisions of the general requirements for stormwater plans and best management practices. This requirement is applicable if removal action activities disturb one or more acres of land; otherwise the requirement is relevant and appropriate.
- Air Emissions, Great Basin Unified Air Pollution Control District Rules 401-402: These State requirements are applicable to on-site activities that generate particulate emissions or discharge or airborne contaminants. Rule 401 requires reasonable precautions to prevent visible particulate matter from becoming airborne. Rule 402 prohibits the

discharge of air contaminants or other materials in quantities that would cause injury, detriment, nuisance or annoyance to the public or which cause or have a natural tendency to cause injury or damage to business or property. Applicable to on-site activities that generate particulate emissions.

- Waste pile closure, CCR title 22, § 66264.258(a): This State requirement is relevant and appropriate, requiring the site owner to remove or decontaminate all waste residues, contaminated containment system components, contaminated subsoils, and structures and equipment contaminated with waste and leachate, and manage them as hazardous waste at closure. The requirement is not applicable since the Site soil is not potentially hazardous waste. However, if staging piles are used, these requirements are relevant and appropriate and the removal action must comply with these requirements.

- Unauthorized discharge prohibition: This is an applicable state requirement. California Fish and Game Code § 5650(a) prohibits the passage of enumerated substances or materials into waters of the state deleterious to fish, plant life, or birds. Removal action activities must not allow the discharge of pollutants to waters.

- Antidegradation Policy, SWRCB Res. 68-16: Statement of policy with respect to maintaining high quality waters in California. Establishes the policy that high quality waters of the state "shall be maintained to the maximum extent possible" consistent with the "maximum benefit to the people of the State." It provides that whenever the existing quality of water is better than that required by applicable water quality policies, such existing high-quality water will be maintained until it has been demonstrated to the state that any change will be consistent with maximum benefit to the people of the state, will not unreasonably affect present and anticipated beneficial use of such water, and will not result in water quality less than that prescribed in the policies. There may be potential for downstream degradation of water during the removal action. The selected removal action will not allow discharge to the surface water that would degrade water quality.

5. Removal Action Objectives and Final Removal Goals

The purpose of Section 5 is to present the RAOs and scope for the non-time-critical removal action (e.g., remove contaminated soils that pose an unacceptable risk to human health and the environment). RAOs define what the removal action is intended to accomplish.

5.1. Identification of Removal Action Objectives

The RAOs for this EE/CA are as follows:

1. Eliminate, or reduce to the extent practicable, levels of metals in soil that present unacceptable risk via direct human contact.
2. Eliminate, or reduce to the extent practicable, levels of metals in soil that present unacceptable risk for ecological receptors.
3. Eliminate contaminant-related constraints on the full enjoyment and utilization of park resources consistent with NPS mandates.
4. Attain all other federal and state ARARs.

5.1.1. *Determination of Removal Action Scope*

A removal action at Gold Hill Mill is anticipated to be the only action taken at the Site. Post-removal action sampling would confirm removal of impacted soils (mill tailings) to the extent practical to concentrations at or below the removal goals. Adequate documentation should be provided to demonstrate that activities performed at the Site are sufficient to meet completion requirements. Site restoration activities may include measures to ensure protection-in-place of existing historical features. Restoration of surface grade and/or vegetation may be required if it is determined that significant ground disturbance was required to remove impacted soils to RG levels.

5.2. Removal Goals Selection

RGs are selected by selecting the lowest of all risk-based PRGs and chemical-specific ARARs and then selecting the higher value of the risk-based PRG or background value as the RG.

5.2.1. *Background and Reference Concentrations*

To ensure cleanup will be technically feasible and cost effective, and to reduce the potential for recontamination of clean areas from surrounding sources, the PRGs are compared to background values for naturally occurring constituents (e.g., metals) in all media at the Site.

For Gold Hill Mill, the risk-based preliminary removal goals are all above background concentrations, therefore, the lowest risk-based PRG was selected as the RG.

5.2.2. *Removal Goal Selection*

When multiple PRGs exist for both human health and ecological protection, the lower (i.e., more protective) value is chosen as the removal goal.

The removal goals for arsenic are based on human health PRGs. The ecologically-based PRG for arsenic was 40.47 mg/kg, but the final RG of 26 mg/kg was based on the human health PRG.

The removal goals for the other contaminants of concern were set by the lower (more protective) ecologically-based PRG. They are: 10 mg/kg of antimony, 5 mg/kg of cadmium, 175 mg/kg of copper, 262 mg/kg of lead, 0.16 mg/kg of mercury, 1.25 mg/kg of selenium, 69.28 mg/kg of vanadium and 205 mg/kg of zinc.

6. Identification and Analysis of Removal Action Alternatives

The purpose of this section it to present the RAAs proposed to achieve the RAOs identified in Section 5.

The selected removal action must meet the RAOs and comply with ARARs. The location of the Site within a unit of the NPS must be considered when evaluating removal alternatives. The following potential removal actions were rejected following a preliminary screening of alternatives:

Institutional Controls. Institutional controls restrict access to or control the use of a Site, such as by zoning, deed restrictions, environmental control easements and access restrictions. Enforcement of such controls require periodic inspections and patrols, training for park personnel required to access the contaminated area, as wells as legal action against violators. Institutional controls do not reduce the volume or toxicity of the contaminated material. Although ICs may be designed to be in compliance with ARARs to the extent they would be protective of human health, concentrations of contaminants of ecological concern (CEC) at the Site would remain that may pose a hazard to wildlife. Use of institutional controls at NPS units is generally not appropriate.

Capping in-situ. Capping the mill tailings in-situ would raise the elevation of the area being capped, significantly altering site grading and impacting existing drainage patterns. In order to maintain current site grading, all or nearly all of the mill tailings would need to be removed prior to applying the cap, thus making this alternative impracticable.

Soil (metals) stabilization. This is a proven method to hold metals in place and reduce their bioavailability to people and wildlife. It generally requires digging up all of the contaminated material and then mixing it and adding a soil-binding agent, such as Portland cement, and other constituents such as pH buffering agents, to reduce the solubility and bioavailability (toxicity) of metals such as arsenic and lead in soils. This technology uses auger-type mixers either in-situ or ex-situ, however, ex-situ mixing is much more effective and permanent, meaning all of the impacted mill tailings would need to be excavated for treatment. Soil stabilization requires addition of some (typically 5 to 15% by volume) off-site materials to the Site soils, which would alter the erosional and ecological characteristics of the Site soils, as well as the appearance of the historic landscape around Gold Hill Mill. The location of Gold Hill Mill in area prone to flood events makes implementability of in-situ stabilization very difficult, as on-site consolidation would not provide for assured long-term permanence of consolidated/stabilized mill tailings. Therefore, this alternative is not carried forward for detailed evaluation.

The following RAAs were retained for further analysis:

- No Action (as required by the NCP)
- Excavation and Off-site Disposal

Each alternative is described in the following subsections. Cost estimate details for each alternative are provided in Appendix E.

6.1. Alternative 1: No Action/No Further Action

Consistent with the NCP and CERCLA guidance, a "no action" alternative is considered as a baseline for comparison. Under this alternative, no additional monitoring or maintenance would be performed.

6.1.1. *Description*

No Action is described as no monitoring or corrective measures being taken at the Site.

6.1.2. *Analysis*

The No Action alternative provides a baseline for alternative comparison. The no action alternative does not meet the RAO for protection of human health. The Site carcinogenic risk was determined to be $4x10^{-5}$, which is within the possibly acceptable carcinogenic risk range of 10^{-4} to 10^{-6}. However, the non-carcinogenic removal goal for arsenic (26 mg/kg) was above acceptable levels for human health. Site lead concentrations exceed the PRG of 1,200 mg/kg, this screening value is conservative, and estimated blood lead concentrations resulting from lead concentrations at the Site soils under likely exposure scenarios (see Section 3.1.2) may not exceed USEPA guidelines. The No Action alternative would not meet RAOs for protection of ecological resources. This alternative would preserve the cultural resources present at Gold Hill Mill.

6.1.3. *Effectiveness*

The effectiveness of Alternative 1 is evaluated using the following criteria:

- Overall protection of public health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness

Overall Protection of Public Health and the Environment – Under this alternative, the Site would remain as it currently exists with no active efforts to minimize contaminated areas or migration pathways. No efforts would be made to reduce any potential risks to human health or the environment. If no action is taken, the COCs in soils would continue to pose a low risk to human and pose a risk to ecological receptors.

Compliance with ARARs – Alternative 1 is not compliant with chemical-specific ARARs; specifically exceeding removal goals for human receptors receptor, including Tourist Visitor, Mining Enthusiast and NPS Worker for arsenic, and exceeding ecological removal goals for plant,

bird and mammalian wildlife for arsenic, lead, antimony, cadmium, copper, mercury, selenium, vanadium and zinc.

Long-Term Effectiveness and Permanence – Alternative 1 does not provide long-term effectiveness or a permanent remedy for the COC-contaminated material. This alternative does not manage the risks to ecological receptors.

Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative 1 does not reduce the toxicity, mobility, or volume of contamination at the Site. Site COCs are not biodegradable, as evidenced by their presence since mining was last performed, and will continue to pose a risk to humans and the environment if not treated.

Short-Term Effectiveness – The impact to the environment is not reduced, and the length of time until protection is achieved under this alternative is indefinite under this alternative.

6.1.4. *Implementability*

The implementability of Alternative 1 is evaluated using the following criteria:

- Technical feasibility
- Administrative feasibility
- Availability of services and materials
- State and community acceptance

No technical or administrative feasibility concerns are associated with this alternative because no action is being taken. No services or materials are required. State and community acceptance is unknown, but the alternative may be determined as not acceptable based on the exceedances of screening criteria protective of human health and ecological receptors.

6.1.5. *Cost*

The cost of Alternative 1 is evaluated using the following criteria:

- Direct capital costs
- Indirect capital costs
- Ongoing operation and maintenance (O&M) costs

There are no capital costs or operation and maintenance costs associated with the No Action alternative. However, there could be future costs associated with existing impacts or future releases from the unsecured Site.

6.2. Alternative 2: Excavation and Removal of Materials Exceeding RGs

6.2.1. *Description*

Excavation and off-site disposal are the removal of contaminated materials, final classification of the waste as RCRA Subtitle C or other regulated hazardous waste, and subsequent disposal at a facility licensed to accept the waste. The type of facility is dependent on the class and concentration of hazardous materials in the waste. Wastes found to exceed state or federal guidelines for hazardous material must be transported to a RCRA landfill for disposal. Wastes not exceeding the guidelines can be placed in any landfill licensed to accept the waste. All excavated wastes would be managed in accordance with all applicable federal, state, and local requirements.

6.2.2. *Analysis*

Alternative 2 is a tested and widely accepted alternative for contaminated soils. The process involves the delineation, excavation, transport, and disposal at a facility licensed to accept contaminated soils. Based on the concentrations of the COCs characterized to date (NOREAS 2016b), the removed material will likely be required to be disposed of in a RCRA Class I landfill.

As depicted on Figure 2, there are two DUs (the mill foundation area [DU-1] and eroded mill tailings in wash [DU-2]) that contain concentrations of at least one COC that exceed a Site RG. The estimated total volume of material assessed in this EE/CA is 50 cubic yards. This alternative would provide the maximum protection of Site ecological resources, as well as human health.

6.2.3. *Effectiveness*

The effectiveness of Alternative 2 is evaluated using the following criteria:

- Overall protection of public health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment, and
- Short-term effectiveness

Overall Protection of Public Health and the Environment – Removal of anthropogenic material exceeding RGs would provide the highest level of protection to human health and the environment as all materials characterized by this EE/CA would be removed.

Compliance with ARARs – Alternative 2 is compliant with chemical-specific ARARs. Alternative 2 is also compliant with location-specific ARARs, which require action to conserve cultural and natural resources, and action-specific ARARs. Alternative 2 may result in some degree of modification of the grading and vegetation surrounding the Site, as it would be altered by excavation activities. As the volume of material is limited, less than 50 cubic yards, excavation would be conducted largely by hand, although use of small mechanical excavation equipment may

be cost effective. As such, some degree of Site disturbance would occur; however, after removal the surface will be revegetated and regraded through backfilling and/or recontouring to re-establish pre-removal surface water flow, vegetation, and appearance of the site to the extent practicable. These site regrading and revegetation activities (including re-establishing pre-removal surface grades and/or revegetation) would enable Alternative 2 to meet the RAO for preservation of the Park cultural and natural resources. Alternative 2 would not result in any modification or disruption to the mill structure and associated features, other than removal of surficial small amounts of mill tailings present on these features. Such removal would be conducted using methods that would prevent damage to these features.

Long-Term Effectiveness and Permanence – Alternative 2 provides the highest level of long-term effectiveness and is a permanent remedy for the contaminated soils. This alternative effectively eliminates the risks to human health and the environment.

Reduction of Toxicity, Mobility, or Volume through Treatment – Reduction in the mobility of the contaminants using Alternative 2 would be achieved by removing wastes to a RCRA or other appropriately licensed facility (based on final characterization) as well as by treatment of certain lead-containing material before internment at the facility. Land disposal restrictions at the receiving facility may require soil solidification/stabilization prior to land disposal, which would reduce the toxicity of the COCs by reducing the bioavailability. No reduction of contaminant volume would be achieved.

Short-Term Effectiveness – This RAA could be completed in a relatively short period of time, estimated at 22 field work days, and no permanent facilities would be required. A small increase in short-term risk to human health would be encountered during the excavation and transport phase of this work due to the number of truck trips required and the increase in dust generation. However, dust generation can be reduced by various well-known and available techniques.

The following impacts associated with construction activities are considered short-term, and should not significantly impact human health.

- Short-term air quality impacts to the immediate environment may occur during excavation of contaminated soils.
- Control of fugitive dusts may be required both on-site and for trucks on route to the disposal facility.

6.2.4. *Implementability*

The implementability of Alternative 2 is evaluated using the following criteria:

- Technical feasibility
- Administrative feasibility
- Availability of services and materials, and

- State and community acceptance

Technical Feasibility – Alternative 2 is considered a technically feasible presumptive remedy, having been implemented with consistent success at numerous sites. The alternative would require technical oversight and confirmation sampling to ensure complete removal of soils exceeding RGs and contractors licensed to perform hazardous waste removal. The Site, although remote, is generally accessible by 4-wheel drive vehicles, except during seasonal rains/flooding along the route.

Administrative Feasibility – Implementation of Alternative 2 would require coordination with the NPS and regulatory agencies, but is a common and well understood approach. With the exception of transportation and disposal, the work would be performed entirely within the park and would not require off-site permitting or coordination.

Availability of Services and Materials – Services and materials for Alternative 2 are readily available.

State and Community Acceptance – Alternative 2 is a common and well-understood remedy. As such, state and community acceptance of the remedy is considered likely.

6.2.5. *Cost*

The cost of Alternative 2 is evaluated using the following criteria:

- Direct capital costs
- Indirect capital costs, and
- O&M costs

The capital cost to implement Alternative 2 is estimated to be $334,000. There are no on-going O&M costs associated with Alternative 2. Based on uncertainties in the exact amount of material to be removed, disposal cost at the time of removal, and contractor-specific rates and costs, it is estimated that actual cost may vary by -30% to + 50%. The estimated volume of soil requiring removal to meet RGs for Site COCs in anthropogenic materials is approximately 50 cubic yards (equivalent to approximately 80 tons). Site restoration will follow excavation of contaminated soils to return the site to pre-removal surface water flow, and vegetation, and to maintain public use and preserve the cultural landscape as much as possible. The cost estimate was developed using RACER® Version 11 3.18.0 cost estimating software. Supporting documentation is provided in Appendix E.

7. Comparative Analysis of Removal Action Alternatives

The results of the evaluation of the effectiveness, implementability, and cost criteria for each alternative are summarized below.

- **Protective of human and ecological health**: The no-action alternative is not within an acceptable range for human health, but Alternative 2 is fully protective of human health. The no-action alternative is not protective of plants or wildlife, while Alternative 2 is fully protective.
- **Complies with ARARs**: The no-action alternative does not comply, but Alternative 2 does.
- **Effectiveness Duration**: The no-action alternative does not reduce volume, toxicity or mobility in the short- or long-term. Alterative 2 does not reduce volume. Alternative 2 does reduce toxicity and mobility in both the short- and long-term.
- **Feasibility**: Both alternatives are technically and administratively feasible.
- **Cost**: The no-action alternative has no cost. Alternative 2 is estimated to cost $334,000.

8. Recommended Removal Action Alternative

The purpose of Section 8 is to describe the recommended RAA and the reason for the selection.

Taking into consideration the evaluation criteria presented in this EE/CA, the recommended RAA for the Site is Alternative 2. Alternative 2 includes Excavation and Removal of Material Exceeding the RGs, at an estimated cost of $334,000.

Alternative 2 is selected as the recommended RAA based on the results of the comparative analysis completed in Section 7, showing that this alternative is the most protective of human health and the environment, complies with ARARs, is the most effective in both the short and long-term, is feasible to implement, and can be completed at an estimated cost of approximately $334,00

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FIGURES

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LEGEND

- Site Location
- National Park Lands

N

0 5 10 20 Miles

UNITED STATES ARMY CORPS OF ENGINEERS

LOS ANGELES, CALIFORNIA

DEATH VALLEY NATIONAL PARK
CALIFORNIA AND NEVADA

FIGURE 1

GOLD HILL MILL LOCATION MAP

NOREAS
Environmental Engineering and Science

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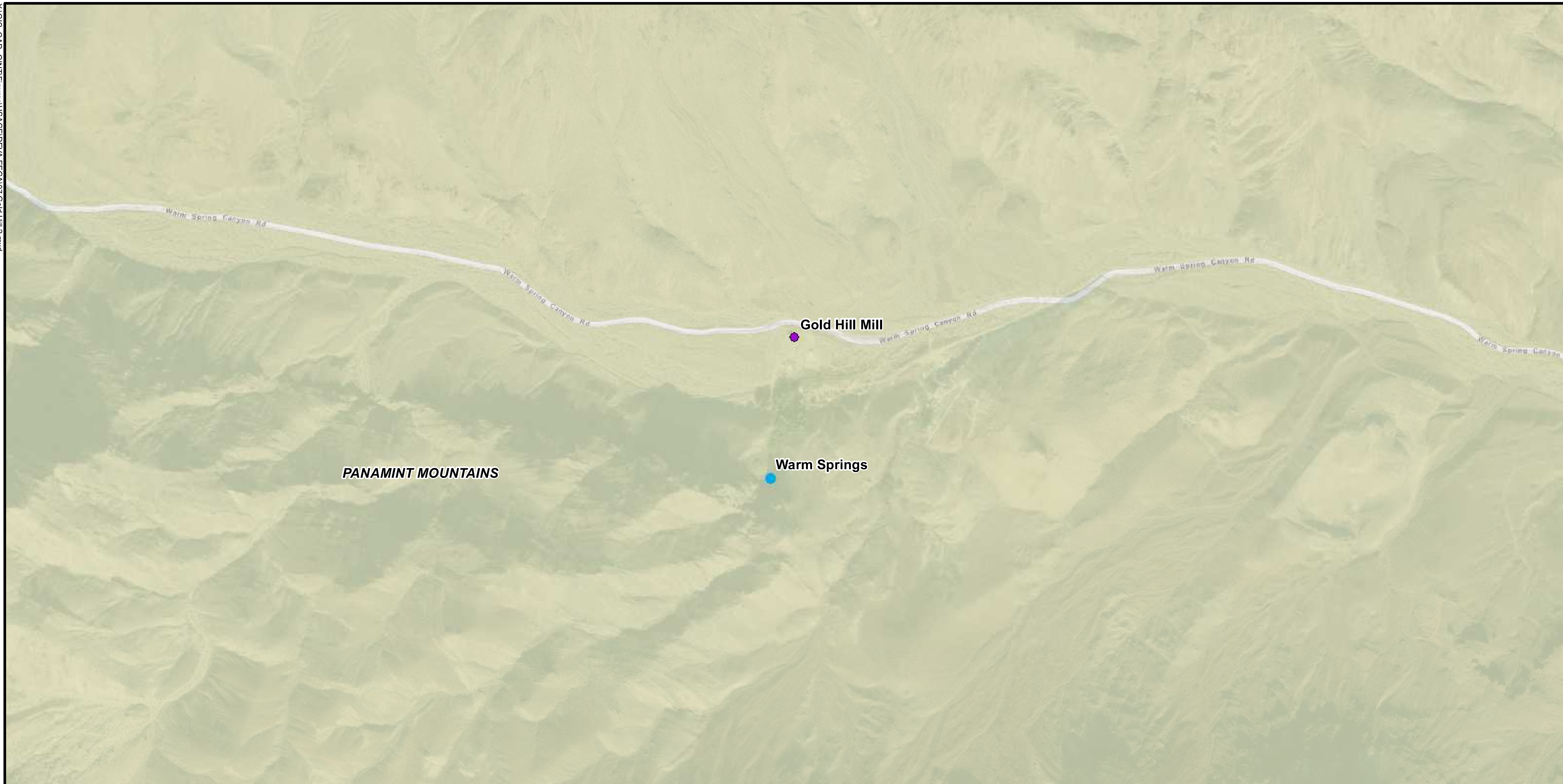

LEGEND

- Site Location
- National Park Lands

N

0 250 500 1,000 Feet

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LOS ANGELES, CALIFORNIA

DEATH VALLEY NATIONAL PARK
CALIFORNIA AND NEVADA

FIGURE 2

GOLD HILL MILL VICINTY MAP

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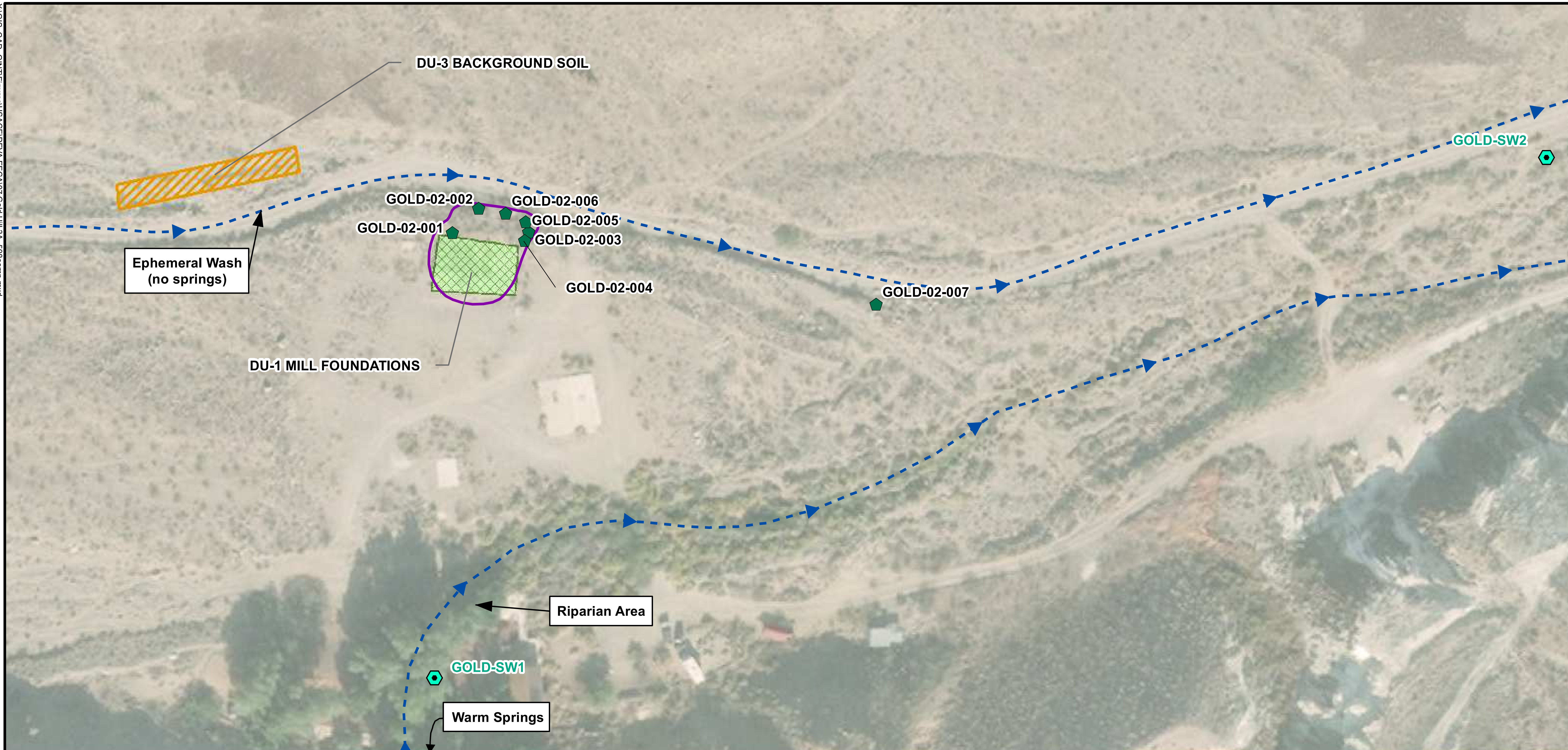

LEGEND

- SURFACE WATER SAMPLE
- DU-1 MILL FOUNDATIONS
- DU-2: TAILINGS IN WASH ALONG ROAD (DISCRETE SOIL SAMPLES)
- DU-3 BACKGROUND SOIL
- FLOW DIRECTION, EPHEMERAL
- EXTENT OF MINE TAILINGS

N

0 40 80 160 Feet

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FIGURE 3A

GOLD HILL MILL SITE MAP

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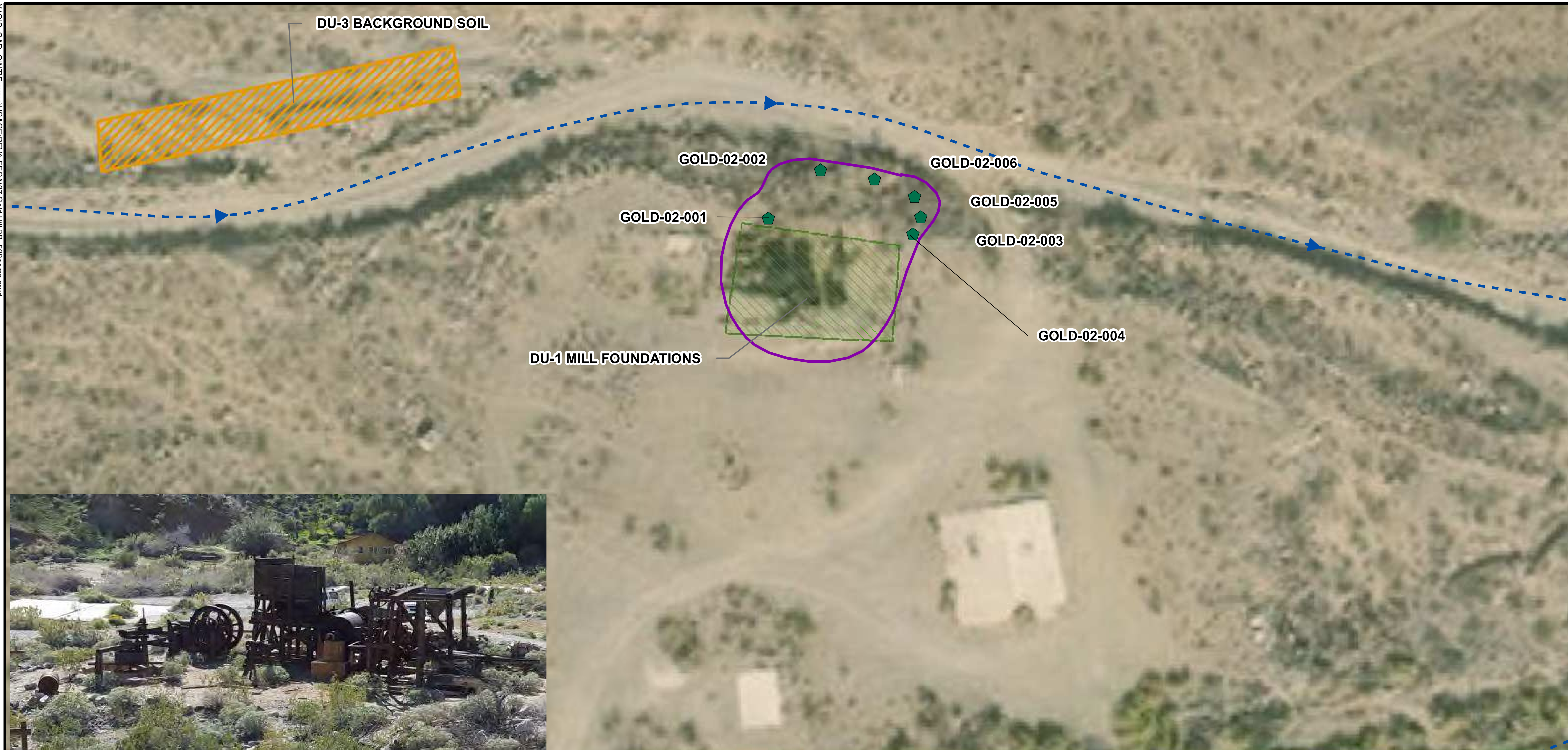

LEGEND

- DU-1 MILL FOUNDATIONS
- DU-2: TAILINGS IN WASH ALONG ROAD (DISCRETE SOIL SAMPLES)
- DU-3 BACKGROUND SOIL
- FLOW DIRECTION, EPHEMERAL
- EXTENT OF MINE TAILINGS

N

0 20 40 80 Feet

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LOS ANGELES, CALIFORNIA

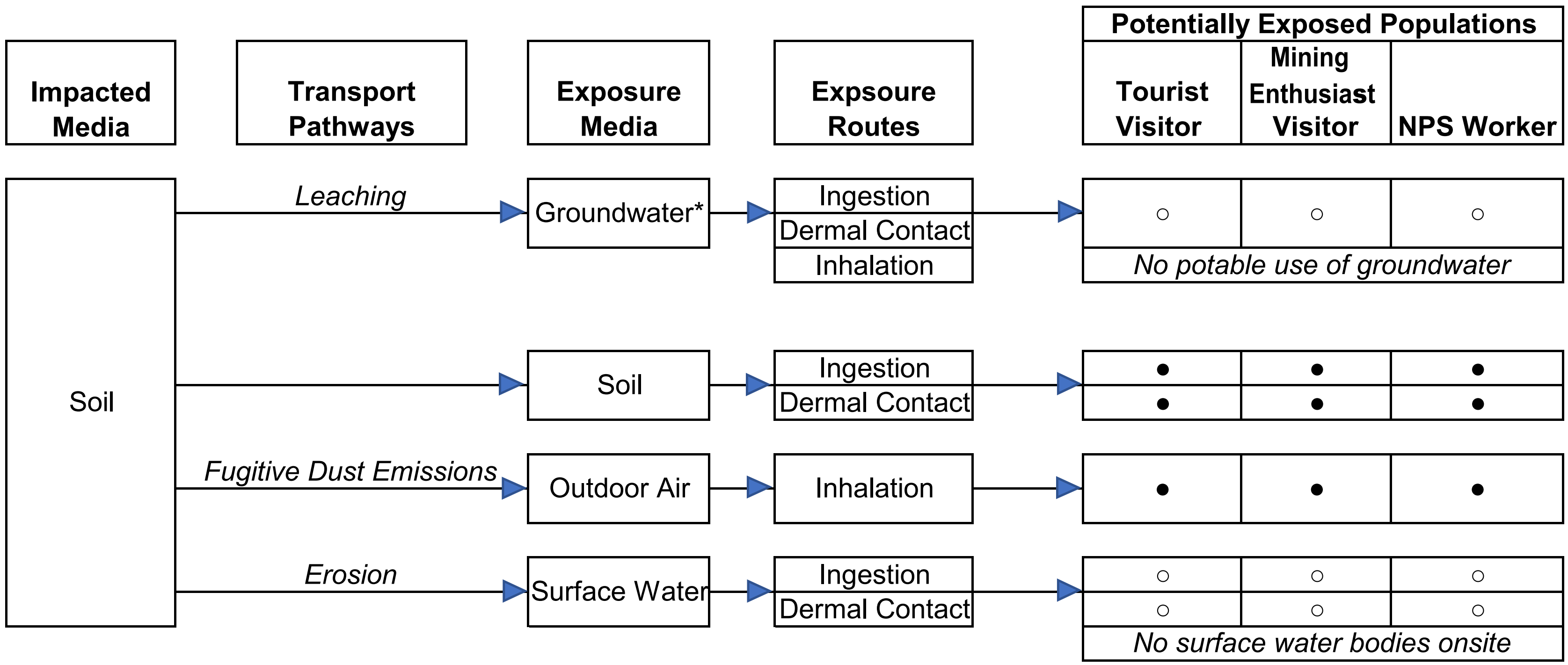
DEATH VALLEY NATIONAL PARK
CALIFORNIA AND NEVADA

FIGURE 3B

GOLD HILL MILL SITE of DU-1 and DU-2 and HISTORIC FEATURES

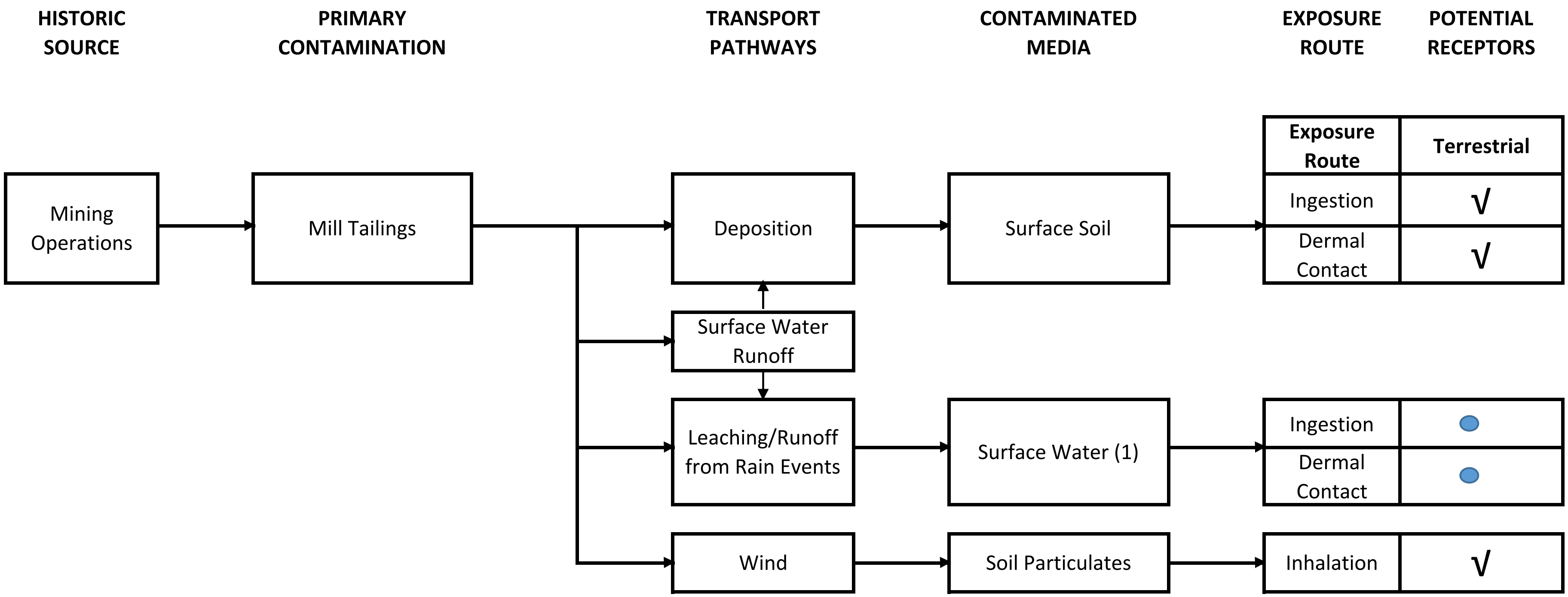
NOREAS
Environmental Engineering and Science

Figure 4
Human Receptor Conceptual Site Model



Notes
* Groundwater impacts are currently unknown
○ Incomplete pathway.
● Potentially complete pathway.

Figure 5
Ecological Pathway-Receptor Diagram
Gold Hill Mill Site



√ Pathway is complete

Pathway is potentially complete but insignificant

1 - Surface water is present in Warm Spring, not impacted by the site.
2 - Birds and mammals assessed though ingestion, although dermal contact and inhalation are potentially complete pathways.
2- Terrestrial receptors inlcude birds, mammals, reptiles, the plant community and invertebrate community.

APPENDICES

Appendix A – Site Investigation Report

The Site Investigation Report (NOREAS 2016) is included for Gold Hill Mill. As this report included investigation of six additional sites within DEVA, only data tables, figures and appendices (including the site photographic log) relevant to Gold Hill Mill are included in this Appendix.

Final Site Inspection Report

Death Valley National Park

Site Inspections of Abandoned Mineral Lands (AML) Sites

(Skidoo, Homestake, Journigan's, Starr, Tucki, Cashier and Gold Hill)

California and Nevada

Prepared under contract to U.S. Army Corps of Engineers
Contract No. W912PL-15-D-0016 Delivery Order 0001

October 2016

Prepared by

NOREAS, Inc.

PROFESSIONAL GEOLOGIST
JEFFREY S. OSLICK
exp. 11/17
No. 7531
STATE OF CALIFORNIA

PROFESSIONAL GEOLOGIST
E. ESSI ESMAILI
No. 4469
exp. 3/18
STATE OF CALIFORNIA

Jeff Oslick, PhD, PG, Project Geologist

for Essi Esmaili, PhD, PG, CHG, Project Manager

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List of Abbreviations and Acronyms

ABA	acid-base accounting
Ag	silver
AGP	acid-generating potential
AML	Abandoned Mineral Lands
ANP	acid-neutralization potential
As	arsenic
Ba	barium
Be	beryllium
CAM	California Administrative Manual
Cashier	Cashier Mill
Cd	cadmium
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Co	cobalt
COCs	Constituents of Concern
CSM	Conceptual Site Model
CSP	Contaminated Sites Program
Cr	chromium
Cu	copper
DEVA	Death Valley National Park
DL	detection level
DoD	Department of Defense
DQO	Data Quality Objective
DU	decision unit
ECM	Environmental Cost Management, Inc.
ELAP	Environmental Laboratory Accreditation Program
EPA	U.S. Environmental Protection Agency
ESV	Ecological Screening Value
FSP	Field Sampling Plan
Gold Hill	Gold Hill Mill
GPS	Global Positioning System
Hg	mercury
Homestake	Homestake Mill
HR	Hydrologic Region
ISM	Incremental Sampling Methodology
ITRC	Interstate Technology Regulatory Council
Journigan's	Journigan's Mill

LCS	laboratory control sample
LOQ	limit of quantitation
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
Mo	molybdenum
Mn	manganese
MS	matrix spike
MSD	matrix spike duplicate
Ni	nickel
NOREAS	NOREAS, Inc.
NPS	National Park Service
PA	Preliminary Assessment
pH	Hydrogen potential
Pb	lead
QAPP	Quality Assurance Project Plan
QA	Quality Assurance
QC	Quality Control
QSM	Quality Systems Manual
RPD	Relative percent difference
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan
Sb	antimony
Se	selenium
Skidoo	Skidoo Mill
SI	Site Inspection
SU	sampling unit
TCLP	Toxicity Characteristics Leaching Procedure
TestAmerica	TestAmerica Laboratories, Inc.
Th	thallium
Tucki	Tucki Mill
UCL	upper confidence limit
USC	United States Code
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
V	vanadium
Water Board	California Regional Water Quality Control Board
Zn	zinc
µg/L	micrograms per liter
%	percent

1 Introduction

This document reports on the results of Site Inspections (SIs) performed at six Abandoned Mineral Lands (AML) Sites at Death Valley National Park (DEVA), located in California and Nevada (Figure 1). These sites include: Skidoo Mill (Skidoo) (Figure 2), Homestake Mill (Homestake) (Figure 3), Journigan's Mill (Journigan's) (Figure 4), Starr Mill[1] (Figure 5), Tucki Mill (Tucki) (Figure 6), Cashier Mill (Cashier) (Figure 7), and Gold Hill Mill (Gold Hill) (Figure 8). Sampling activities were conducted in February and March 2016.

These SIs were conducted based on the findings of a Preliminary Assessment (PA) of 27 AML sites at DEVA, conducted by Environmental Cost Management (ECM 2014).

1.1 CERCLA and National Park Service Authority

These SIs were conducted on behalf of the United States Department of the Army, Los Angeles District Corps of Engineers (USACE) as Task Order No. 0001 and as requested in the USACE's Performance Work Statement, dated July 13, 2015, under the Contract No. W912PL-15-D-0016.

DEVA is a unit of the National Park System, created by Congress on October 31, 1994, in the California Desert Protection Act. The National Park Service (NPS) has the responsibility under the Comprehensive Environmental Recovery, Compensation and Liability Act (CERCLA) to determine if potential hazardous substances exist within each NPS unit.

The SIs were conducted in accordance with the Sampling Analysis Plan, Death Valley National Park, Site Inspections of Abandoned Mineral Lands (AML) Sites, California and Nevada (NOREAS 2016). The NPS is authorized under CERCLA, 42 United States Code (USC) §§ 9601 et seq., to respond as the Lead Agency to a release or threatened release of hazardous substances and/or a release or threatened release of any pollutant or contaminant that may present an imminent and substantial danger to public health or welfare on NPS land.

NOREAS understands that the mine wastes and mill tailings at the DEVA AML sites investigated herein should qualify as ore "beneficiation" solid wastes under 40 Code of Federal Regulations (CFR) Chapter 1; qualifying for exemption from categorization as a hazardous wastes under Resource Conservation and Recovery Act (RCRA) Subtitle C regulation. However, this issue may require further review and confirmation.

[1] Starr Mill was not originally part of the SI activities. However, during the initial SI activities at Journigan's Mill, it was determined, with USACE and NPS approval, that sampling of Starr Mill, located approximately a mile west of Journigan's Mill and sharing both northern and the southern washes, would be included in the SI.

The NPS has a number of regulations that apply to the release of hazardous substances on NPS land (see NPS 2014a) including the NPS Organic Act of 1916 (16 USC §1, et seq. 36 Code of Federal Regulations Part 1), which requires that the NPS manage parks in order to conserve the scenery, natural and historic objects, and wildlife and to provide for their enjoyment by such means as leaving them unimpaired for the future generations. Therefore, whether the Site poses risks to organisms due to interactions with the environment is especially relevant to the NPS responsibility to protect park resources.

1.2 Purpose of Field Sampling

The goal of these SIs was to obtain and analyze environmental samples, to assess human and environmental exposure to hazardous substances, and to evaluate the basis for further actions, if needed. In accordance with the recommendations of the PA (ECM 2014), the SIs collected data for characterization of the mining/milling wastes and background (native) soil. A limited number of surface water samples were also obtained. This SI Report compares concentrations of constituents of concern (COCs) to risk screening values to evaluate potential risk to human health or the environment at the six subject sites. The results of the PA are documented in the PA report (ECM 2014). Complete delineation of the extent of contaminants was not a goal of these SI activities.

The NPS will use data collected during this field investigation to support potential response actions that may be undertaken by the NPS or other parties.

The following data was collected during the SIs:

- Soil samples using the Incremental Sampling Methodology (ISM) – The samples were analyzed for Title 22 metals (California Administrative Manual [CAM] 17 metals), cyanide, acid-base accounting (ABA) and soil pH;
- Surface water (where practical) – The samples were analyzed for Title 22 metals (CAM 17 metals);
- Testing of soil leaching characteristics by Toxicity Characteristics Leaching Procedure (TCLP).

1.3 Site Location

DEVA is located east of the Sierra Nevada Mountains between the Great Basin and Mojave Desert. The park is located primarily in the state of California within Inyo and San Bernardino counties (Figure 1). DEVA and surrounding area consists of approximately 3 million acres of badlands, valleys, canyons, and mountains. The area was declared a national monument in 1933 and formally became a national park in 1994. It includes the entire Death Valley, which runs for approximately 150 miles between the Amargosa and Panamint ranges. DEVA occupies an area

of physical extremes from Badwater Basin, located at 282 feet below sea level, to Telescope Peak, located at 11,049 feet above sea level. It is the hottest, lowest, and driest area in North America.

1.4 Geologic Setting and Hydrogeology

DEVA is located in the Basin and Range Geomorphic Province and is considered the westernmost part of the Great Basin. The province is characterized by subparallel, fault-bounded ranges separated by rotated and down-dropped basins which receive interior drainage resulting in lakes and playas. Death Valley, the lowest area in the United States (282 feet below sea level at Badwater), is one of these basins. DEVA is comprised of many geologic formations including alluvial fans and lacustrine deposits, salt flats, active volcanism, and mineral-rich rock formations. Carbonate rocks of Precambrian and Paleozoic age are extensively metamorphosed by folding and faulting and are highly fractured and fissured. A salt encrusted playa extends for 200 square miles in the southern portion of the valley.

Average annual precipitation over the last 30 years in DEVA has been 2.5 inches, with higher elevations receiving over 15 inches per year. Surface water is scarce at DEVA. Dry washes of all sizes flow only after thunderstorms or heavy winter rains. Surface water drains into enclosed desert basins, where it is lost to evaporation and infiltration. Near Gold Hill Mill, a stream is present that flows from Warm Springs (Figure 8).

DEVA is located in the South Lahontan Hydrologic Region (HR) which covers approximately 21 million acres in eastern California. The HR is bounded on the west by the crest of the Sierra Nevada, on the north by the watershed divide between Mono Lake and East Walker River drainages, on the east by Nevada, and the south by the crest of the San Gabriel and San Bernardino mountains and the divide between watersheds draining south toward the Colorado River and those draining northward. This HR includes the Owens, Mojave, and Amargosa river systems, the Mono Lake drainage system, and many other internally drained basins. Runoff is about 1.3 million acre-feet per year. Areas within the South Lahontan HR where groundwater occurs outside alluvial groundwater basins are called groundwater source areas. These areas are associated with the igneous intrusive and extrusive, metamorphic, and sedimentary rocks that underlie the mountainous regions of the HR. Because many of the bedrock regions of the HR consist of mineralized metamorphic rock containing ores of copper, gold, silver, lead, mercury, zinc, and other metals, potential impacts to groundwater are anticipated to predominantly derive from these natural sources. Only a very minor cumulative contribution is expected from the historic mining and milling operations, including those sites evaluated in this PA (ECM 2014).

Seventy-six groundwater basins are delineated in the South Lahontan HR, including the Langford Valley Groundwater Basin, which is divided into two sub-basins. The groundwater basins underlie about 11.6 million acres (18,100 square miles) or about 55 percent of the HR. In most of the smaller basins, groundwater is found in unconfined alluvial aquifers; however, in some of

the larger basins, or near dry lakes, aquifers may be separated by aquitards that cause confined groundwater conditions. Depths of the basins range from tens or hundreds of feet in smaller basins to thousands of feet in larger basins. The thickness of aquifers varies from tens to hundreds of feet. Well yields vary in this region depending on aquifer characteristics and well location, size, and use.

The chemical character of the groundwater varies throughout the region, but most often is calcium or sodium bicarbonate. Near and beneath dry lakes, sodium chloride and sodium sulfate-chloride water is common. In general, groundwater near the edges of valleys contains lower total dissolved solids content than water beneath the central part of the valleys or near dry lakes.

Additional details of the hydrology of the AML site regions are presented in the PA (ECM 2014).

1.5 Climate and Topography

Death Valley National Park covers over 3 million acres of Mojave and Great Basin Desert terrain, with elevations ranging from 282 feet below mean sea level at Badwater Basin to 11,049 feet on the summit of Telescope Peak. Temperatures in the valley range from over 120 degrees Fahrenheit (°F) in the summer to an average of 40°F in the winter but often dip below freezing. Annual precipitation varies from a 2.5-inch 30-year average on the valley floor to over 15 inches in the higher mountains.

NPS maintained a climate station at Furnace Creek in Death Valley until 2007. Although exact wind speeds were not archived, daily wind movement, which measures the total distance the wind moves each day, was recorded. According to these records, average daily wind movement is lowest during the winter and peaks during the early spring. Within DEVA, it not uncommon for fine-grained material to become airborne and re-distribute great distances from its source.

Prevalent wind direction is from the south; however, conditions vary greatly in specific locations. The PA (ECM 2014) presents an analysis of wind conditions at select locations. High winds (estimated in excess of 40 miles per hour) and wind-transport of fine-grained material were observed at Skidoo Mill during Site Inspection work.

1.6 Vegetation and Wildlife

Death Valley National Park contains a great diversity of plants. Vegetation zones include creosote bush, desert holly, and mesquite at the lower elevations. At the higher elevations, shad scale, black brush, Joshua tree, pinyon-juniper, to sub-alpine limber pine and bristlecone pine woodlands can be observed. The saltpan in the middle portion of the valley is devoid of vegetation and the slopes along the valley's alluvial fans have sparse cover.

Death Valley's range of elevations and habitats support a variety of wildlife species. The PA (ECM 2014) presents more detailed information on which species occur in the vicinity of each AML site.

1.7 Milling and Ore Processing

The mineral resources of the Death Valley area have been accessed and investigated since the days of the great California gold rush. From the 1850s to 1900, mining in Death Valley was sporadic and many mining endeavors were unsuccessful for a variety of reasons, including lack of finances, inefficient mining techniques, scarcity of water, and insufficient transportation. By the early 1900s, new technology enabled large-scale mining operations for gold, silver, and other metals and renewed interest in mining in the area.

Milled ore was most commonly processed using mercury amalgamation and/or cyanide leaching to extract gold. Amalgamation followed by cyanidation increased the amount of gold recovered from ore. These extraction methods generated piles of pulverized rock or mill tailings which could potentially contain hazardous materials such as cyanide, mercury, and other metals. An alternative extraction method used in DEVA silver mine sites was a flotation method.

The PA (ECM 2014) concluded that historical milling operations and ore processing practices used in Death Valley National Park have the potential to impact the environment. The following is a description of various ore processing methods used at the DEVA mill sites.

1.7.1 Milling and Ore Processing

Amalgamation is one of the oldest gold extraction processes and was commonly used in the early days of mining in Death Valley. The process is based on the fact that mercury forms a chemical bond with gold, called an amalgam. A saturated solution of mercury with gold contains 13.5 percent of gold. The process is inefficient because less than 30 percent of the available gold is recovered and 25 to 30 percent of the mercury used in the process is lost, potentially to the environment. More modern operations followed amalgamation with cyanidation or flotation.

The amalgamation process comprises several steps. First, ore is crushed, then milled, usually in water, to create fine size particles that will pass through a number 14 or 20 size mesh. The fine-grained ore was then entered into the recovery portion of the process. Several recovery processes were used to slowly pass the fine-grained ore over copperplates coated with mercury. The gold-mercury amalgam was then removed at regular intervals and the plates were re-dressed with mercury. Finally, the mercury was distilled from the amalgam to produce nearly pure gold. Mercury was an expensive commodity, and as much as possible it was recaptured for later use. Mercury lost during the process potentially ended up in the mill tailings.

Grinding ore for mercury amalgamation purposes started with crushing by a jaw crusher, then pulverized using large mechanical devices called stamp mills. The basic design of a stamp mill has been used for thousands of years for a variety of crushing applications, but is most commonly used for the processing of ore for mineral extraction. Typical stamp mill construction consisted of a series of heavy metal stamps arranged in a wooden frame called a battery. The stamp mills

used in DEVA during the gold rush era were usually powered by water, steam engines, or internal combustion engines. A system of belts, rotating shafts, and cams raised then dropped the stamps and crushed coarser grain ore into finer grain material for further processing.

1.7.2 Cyanide Leaching

Cyanide leaching originated around 1890 and was commonly used in conjunction with amalgamation to extract gold from ore. Cyanide leaching is more economical than amalgamation because approximately 90 percent of the gold that is present can be recovered. Early in its development, the process was used on the waste tailings from amalgamation. Because of the improved recovery, many of the tailing piles from other processes were reprocessed by cyanide leaching to extract gold. By 1925, cyanidation processing technology was applied to both gold and silver ores without using amalgamation first.

Gold is soluble in dilute solutions of potassium or sodium cyanide, and the dissolved gold can be precipitated from the cyanide solution using metallic zinc. The process typically comprises the following steps. The ore is ground or pulverized to a suitable size for use in a cyanide solution, or mixed with water to form a slurry or "pulp." Sodium cyanide and lime are added to the slurry to create and maintain a cyanide solution with an alkaline condition (pH near 11). The pulp is agitated through a series of tanks or stirred to cause dissolution of the gold from the pulverized ore. The gold is precipitated from the cyanide solution by passing it over zinc shavings, or agitating it with zinc dust. The gold-zinc precipitate is refined, producing gold bullion. If silver is present, the gold and silver are separated by dissolving the silver with sulfuric or nitric acid. The bullion could be melted and cast into bars for shipment.

Not all gold ores are suitable for cyanidation processes. Arsenic and antimony-rich ores, such as some ores in the Panamint district, are problematic. Gold ores that contain copper are more soluble in a cyanide solution and increased cyanide consumption makes the process economically impractical. The flotation process is a more economical alternative for extraction of gold from these ores.

Typically, cyanide does not persist in arid environments at the surface or in aerobic conditions. Under aerobic conditions, microbial activity can degrade cyanide to ammonia, which then oxidizes to nitrate. This process has been shown effective with cyanide concentrations of up to 200 parts per million. Although biological degradation also occurs under anaerobic conditions, cyanide concentrations greater than 2 parts per million are toxic to these microorganisms. Although cyanide reacts readily in the environment and degrades or forms complexes and salts of varying stabilities, it is toxic to many living organisms at very low concentrations.

1.7.3 Floatation Process

Flotation methods came into widespread use because they can recover almost all forms of gold, including fine, free gold, gold associated with any form of sulfides, and gold-oxidized lead and gold-copper ores. When gold or silver is recovered using flotation, the high grade concentrate contains the precious metal. The concentrate may be ground, with or without roasting, treated with cyanide solution, or shipped to a smelter for further processing.

Extraction using the floatation method was completed according to the following general steps. Ore was brought into a mill, and crushed. This milled ore was mixed with water to form a slurry and then passed through a ball and/or rod mill, which used cast iron balls or long iron rods to further crush the ore into a finer powder.

The different metals in the milled ore were then separated using flotation cells. A mix of reagents and flocculants were introduced to the ore slurry to cause the desired metals to float to the top of the tank solution while at the same time sinking the other metals. In these systems, lead, copper, and other precious metals could be recovered.

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2 Site Description, Previous Investigations, and Conceptual Site Model

This section summarizes the known environmental information and historical activities that have occurred at the six subject sites and presents this information in the form of a graphical Conceptual Site Model (CSM). The CSM was developed in the SAP (NOREAS 2016), and was revised as presented in this report, based on the findings of the SI field activities. Figure 9 is a graphical CSM that illustrates the potential exposure pathways relevant for the subject sites.

2.1 Key Site Features

The following sections describe the key site features of the six subject AML sites. Additional details for each mill site are included in the PA (ECM 2014).

2.1.1 Site Descriptions

Descriptions of the six subject sites are presented below, including general site operational background and geographic and environmental setting. No prior sampling for constituents of concern had been performed at any of the six subject sites.

2.1.2 Skidoo Mill

Skidoo Mill (Figure 2) is located near the top of a broad ridge in the Panamint Mountains (Latitude: 36.4368° North, Longitude: -117.1549° West). The site is currently fully open to the public and experiences low to moderate annual visitation. The mill and process areas are located on a steep canyon wall and cover approximately 5 acres. The mill is well preserved and displays many intact features. Tanks, mercury tables, and a large portion of the mill operations are well preserved and visible. To the northwest and down the canyon, the slope goes over a shear “dry falls.” To the east and west are steep to moderately sloped canyon walls. Both mercury amalgamation and cyanide-leaching operations took place in large scale. Tailings are found in many of the operations tanks at the mill and upstream/upslope to an area that is suspected to be an impoundment area. Based on operational history and information gathered during the PA (ECM 2014), the preliminary COCs identified were cyanide and metals, including mercury.

2.1.3 Homestake Mill

Homestake Mill (Figure 3) is located in the Bullfrog Hills, in the Nevada portion of DEVA (Latitude: 36.9395° North, Longitude: -116.8886° West) in an area known as the “Nevada Triangle.” The site sits at an elevation of approximately 4,950 feet above sea level and is located on a steep south-

sloping hillside overlooking broad deposits of alluvium. The mill site contains a series of five, reinforced-concrete foundations that are between 66 and 100 feet long, 3 feet thick at the base, and up to 16 feet high. Homestake Mill covers approximately 5 acres and experiences low annual visitation. The Homestake-King mine was one of the only mines (and the largest producer) in the famous Bullfrog Mining District that is contained within the park. Based on the operational history and results gathered during the PA (ECM 2014), the preliminary COCs identified at the site were cyanide and metals, including mercury.

2.1.4 Journigan's Mill

Journigan's Mill (Figure 4) is located in the Panamint Range, 1 mile south of Emigrant Springs and 13.5 miles south of Stovepipe Wells, California (Latitude: 36.4135º North, Longitude: -117.1822° West) at an elevation of 4,398 feet above sea level. The site is open to the public and is located on the west side of Emigrant Canyon/Wildrose Canyon Road. Although the ruins at the site are not substantial, the highly visible location on the west side of paved Emigrant Canyon Road attracts visitors, including many who are unfamiliar with mining, milling, and the associated hazards. Journigan's Mill experiences moderate annual visitation. Scattered mill tailings are found around the mill foundations on all of the levels and in most of the tanks. The site includes the largest ruin of an amalgamation and cyanide plant of the 1930s-1950s period left within the park. Based on operational history and results gathered during the PA (ECM 2014), the preliminary COCs identified were cyanide and metals.

2.1.5 Starr Mill

During initial SI activities it was determined, with USACE and NPS approval, that sampling of Starr Mill, located approximately a mile northwest of Journigan's Mill and sharing both the northern and the southern washes[2], would be included in the SI. Collection and analysis of data from Starr Mill was recommended to better evaluate the potential origin of mill tailing within these washes.

Starr Mill (Figure 5) is located at 4,009 feet above sea level and bound on the west by steep canyon walls and on the east by Emigrant Canyon Road and the eastern canyon wall. The wash slopes gently to the north and towards the city of Stovepipe Wells, California (13 miles south). The entire site covers an area of less than 0.5 acre. Access to the site is via paved road, which is open to the public. Starr Mill experiences low annual visitation. The site consists of four terraced, in-ground process "pools" and/or tank foundations with stacked rock walls or "dug-in" perimeters, and a concrete grout interior liner. Starr Mill was operated during the 1930s (ECM 2014). The site currently has concrete foundations from a few of the cyanide tanks and a mound

[2] Northern and southern washes were designated as Decision Units (DUs) 5 and 6. Decision Units are described in detail in Section 3.

of tailings on bedrock above the road. Based on operational history and information gathered during the PA, the preliminary COCs were identified as cyanide and metals.

2.1.6 Tucki Mine and Mill

Tucki Mill (Figure 6) is located on the southeast slope of the Tucki Mountains in the Panamint Range (Latitude: 36.4526° North, Longitude: -117.0906° West), east of the summit. The site is located 4 miles north-northeast of Skidoo and 10 miles by road from Emigrant Canyon via Telephone Canyon. Tucki Mine experiences low annual visitation. Steep peaks surround the Tucki process area, but the site is located on a gently sloping, steep-sided wash. The wash slopes to the east and then drops off a steep mountain edge approximately 0.5 mile from the site. The site operations covered approximately 3 acres. Cyanide processing operations were conducted on the southern side of the wash. Additionally, one "pool" foundation is at the eastern end of this row. The southern side of the wash is dominated by 2,000 to 3,000 cubic yards of ¾-inch crushed rock that the four former cyanide-leaching tanks reside on. The 100-cubic yard-capacity leach tanks are of steel-lined rectangular concrete block construction and ¾-full of ore. Several feet above and to the west of the leach tanks is a second "pool" foundation. At the bottom of the wash, to the west of the cyanide-leach tanks, is a small former pump pad. Based on operational history and information gathered during the PA (ECM 2014), the preliminary COCs identified were cyanide and metals.

2.1.7 Cashier Mill

Cashier Mill (Figure 7) is located 17 miles south of Stovepipe Wells, California, in the Panamint Mountains (Latitude: 36.3615°, Longitude: -117.1107°) at an elevation of 5,089 feet above sea level. The site is open to the public and can be reached via a 1.5-mile-long graded dirt road accessed east of Emigrant Canyon/Wildrose Canyon Road. This is one of the more heavily visited mine and mill sites in DEVA. Cashier Mill experiences moderate annual visitation. The mill site is located on the southeastern side of Providence Ridge, an east-west-trending hill standing approximately 200 feet above a wide valley. The alluvial plain surrounding Providence Ridge extends over 4 miles to the northwest and gently slopes to the north. Gold ore supplying the mill was taken from the Cashier and Eureka Mines, located in the extreme northeastern extent of the ridge. An entrance to the Eureka Mine is found upslope of the mill ruins. Approximately 100 cubic yards of medium-grained pink sand tailings occur in the vicinity and down slope of the mill foundation where cyanide and mercury processing took place. A separate tailing deposit is present up slope of the mill site. Mine waste is present on the hillside to the west and south of the mill ruins. Many foot paths intersect the tailing deposits in the mill and mine areas. Based on the operational history and information gathered during the PA (ECM 2014), the preliminary COCs for the site were cyanide and metals, including mercury.

2.1.8 Gold Hill Mill

Gold Hill Mill (Figure 8) is located 35 miles south of Furnace Creek, California, in Warm Spring Canyon (Latitude: 35.9687°, Longitude: -116.9317°) at an elevation of 2,360 feet above sea level. The Gold Hill Mining District is one of the oldest mining areas within DEVA, with prospecting and work dating from the 1870s. The Gold Hill region is located within DEVA in the southwest corner, in the Panamint Mountain Range, at the northeastern end of Butte Valley and north of Warm Spring. Gold Hill Mill is heavily visited due to its location next to the Warm Spring Mining Camp and along the road to Butte Valley. This site is accessed via 14 miles of infrequently graded dirt roads requiring high clearance four-wheel drive vehicles. Gold Hill Mill experiences moderate annual visitation. The site covers less than 1 acre and consists of a complete and well-preserved mill with evidence of mercury amalgamation. A spring and an abandoned mining camp are located south of the mill ruins. Minor mill tailings from the amalgamated mercury process used to extract the gold have accumulated in and around the mill workings, primarily on the east side, scattered in and around the equipment, and comingling with native rock. Based on operational history and information gathered during the PA (ECM 2014), the preliminary COCs for the site were identified as metals, including mercury.

2.2 Summary of Previous Investigations

Preliminary Assessments of the seven above-mentioned AML sites was conducted by ECM in February 2014 (ECM 2014a). The PAs described the historical uses of the sites, current state of the sites, and approximated by visual means-only the extent of various waste rock and mill tailings at each of the sites. No chemical sampling for COCs had previously been performed at the sites.

2.2.1 Contaminants of Potential Concern

Based on operational history and information gathered during the PA (ECM 2014), the preliminary COCs for the site are metals, including mercury, and cyanide.

2.2.2 Media of Potential Concern

Soils are the primary media of concern at the subject AML sites. At Gold Hill Mill, a stream is present that flows from Warm Spring (Figure 8). Therefore, surface water samples were collected from the stream at Gold Hill Mill. In addition, samples of surface water were collected at Skidoo Mill and Cashier Mill in areas where standing water was observed during sampling following recent rain events during the sampling period.

2.3 Current and Future Property Use Scenarios

As described in Section 2.1, the subject sites are visited by a low volume of DEVA visitors each year, with the more remote sites receiving fewer visitations. Visits by site workers are also infrequent. Land uses are unlikely to change in the future.

2.4 Graphical Conceptual Site Model

The potential human and ecological exposure routes are illustrated in the CSM presented on Figure 9. The principal human exposure pathways are through dermal contact and inhalation (wind-blown material).

The potential exposure pathways for aquatic receptors are assumed to be limited to sites with significant nearby standing or running waters. At this time, potential aquatic receptors are likely to be only present near Gold Hill Mill. Depth of occurrence of groundwater at the subject sites is unknown. The presence of Warm Springs near Gold Hill Mill suggest this site may support relatively shallow groundwater. The likelihood of realization of beneficial use of groundwater, if present, at the subject sites is very low due to the remoteness of the sites and protections from future site development.

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3. Field Activities and Analytical Protocols

This section summarizes the SI field activities performed at Skidoo, Homestake, Journigan's, Starr, Tucki, Cashier, and Gold Hill between February 16, 2016 and March 9, 2016. The goal of these SIs was to obtain and analyze environmental samples, to assess human and environmental exposure to hazardous substances, and to evaluate the basis for further actions, if needed (NOREAS 2016). Complete delineation of the extent of contaminants, if present, was not a goal of these SI activities. Figures 2 through 8 illustrates the information detailed in the following sections. Table 1 summarizes sample collection for all sites. Tables 2 through 8 summarize soil sampling analytical results at individual sites. Table 9 summarizes surface water analytical results. Table 10 summarizes soil leachability testing results.

Soil samples were labeled and preserved on ice in coolers during the sampling week, and submitted to TestAmerica Laboratories, Inc., Irvine, California facility at the end of each sampling week. The Irvine facility repackaged samples for shipping to the TestAmerica's Arvada, Colorado facility, which maintains the appropriate Department of Defense (DoD) laboratory certifications in accordance with the project Sampling and Analysis Plan (SAP), (NOREAS 2016). Acid-Base Accounting (ABA) analyses were subcontracted by TestAmerica to SVL Analytical, Inc.'s laboratory in Kellogg, Idaho.

3.1. Soil and Surface Water Sampling Procedures

The following sections summarize soil and surface water sampling procedures performed at each site as described in the SAP (NOREAS 2016). Samples collected consisted of ISM soil samples, discrete background soil samples, and surface water grab samples. Photographs of ISM sampling areas, discrete samples, surface water samples and general site areas are logged and presented in Appendix A, and GPS coordinates are documented in Appendix B. Samples were collected from each Decision Unit (DU) prior to moving to next DU. Soil and surface water sample collection was conducted in accordance with SAP requirements (NOREAS 2016). A DU refers to a specific soil area, such as mill tailing impoundment, cyanide processing area, mine waste stockpile, or background native soil area, designated for sampling.

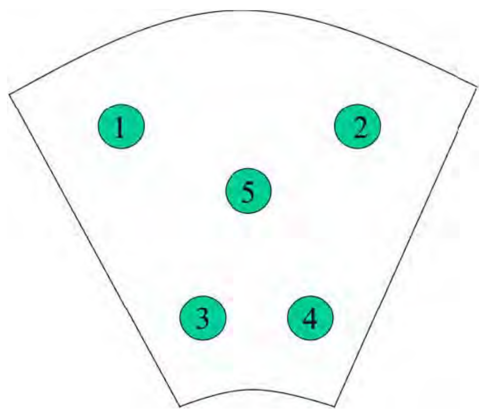
3.1.1. Soil Sampling

ISM provides representative samples of a DU by collecting numerous increments of soil (30 increments were used at DEVA) that are combined, processed, and subsampled according to specific protocols. Detailed procedures for ISM sampling are presented in Incremental Sampling Methodology (ITRC, 2012).

ISM sampling was implemented in two stages per the SAP (NOREAS 2016): 1) DU boundary and grid demarcation, and 2) sample collection. Once the DU boundaries were delineated and staked, each DU was then subdivided into 30 approximately equally sized sampling units (SUs). Survey "whiskers" were used to define the edges of each SU.

Once the ISM SU delineation was complete, a systematic random sampling approach was used to collect samples from each DU. ISM samples were collected using the following procedure:

- Five positions, one at each corner of the SU and one at the center of a SU were established and assigned a number as shown below;



- A single six-sided dice was rolled to determine the random sample locations. Sampling proceeded clockwise to the next position as each ISM sample was collected separately.

- The incremental sampling equipment was decontaminated prior to sampling and between each DU sample.

- Immediately before collecting soil samples and between each DU sample, a new pair of disposable nitrile gloves was donned.

- Approximately 35 grams of soil from between 0 and approximately 6 inches below ground surface was collected at each SU. Materials larger than 2 millimeters such as stones and roots were avoided. The soil was immediately placed into a clean plastic bag. Each ISM sample submitted to the laboratory consisted of approximately 1 kilogram of soil.

The ISM sampling tools were decontaminated between each DU sample using a triple-rinse method, and rinsate source blanks and equipment rinsate samples were collected and analyzed in accordance with the SAP (NOREAS 2016).

3.1.2. Background Soil Samples

To obtain defensible background results for each site, the background area at each site was delineated and sampled in the same manner as a DU. The background areas were located upgradient and outside but adjacent to the area potentially affected by the milling operations. The areal extent of the background sampling area was of similar scale to the DUs at each site. In addition to the ISM samples, discrete background samples were collected from randomly selected locations within the background ISM grid from Skidoo Mill and Journigan's Mill sites. These discrete sample results are compared to ISM sampling results in Section 4. Skidoo Mill was selected for this purpose due to the prevalence of metal ores in the vicinity of the mill site, which may impact the distribution of metals concentrations in native soils. Journigan's Mill was also selected for background discrete sampling because it is known that Journigan's Mill received ore metals from other mining sites in the general area; therefore, ISM results alone may not appropriately capture the range of background metals concentrations present in the mining region.

3.1.3. Surface Water Sampling

When encountered, surface water samples were collected using a grab sampling technique and filtered manually on site using a dedicated syringe, tubing, and a 0.45 micrometer capsule filter into lab provided bottles (NOREAS 2016). Following filtering, the samples were acidified with nitric acid to a pH of <2, double-bagged and iced immediately per SAP requirements (NOREAS 2016).

Surface waters were also tested for pH using a field-calibrated pH meter. The pH meter was calibrated or calibration-checked prior to sampling, on the day of sampling. Documentation of pH readings were recorded in field book

3.2. Skidoo Mill

SI field activities at Skidoo Mill were performed beginning on February 16 and through February 19, 2016. Information presented in the PA and defined in the SAP (NOREAS 2016) identified five DUs present at Skidoo Mill: DU-1 cyanide processing area, DU-2 mercury amalgamation area, DU-3 mill tailing impoundment, DU-4 mill tailings in wash, and DU-5 background native soils (Figure 2). Soil sampling results discussed in Section 4.1 and are presented in Table 2; sample summary information is summarized in Table 1.

Initial SI activities involved establishing the DU-5 background native soil sampling area. Two areas were identified as representative background native soils (Figure 2): an area located at the top of the ridge southeast and up slope from the mill, and an area upgradient within the wash east

the mill. Once the two background areas were identified and delineated, the ISM sampling grids were delineated. The DU was then subdivided into 30 approximately equally sized sampling units (SUs), with each area divided into 15 SUs. The ridge background sampling area and the upgradient wash background sampling area have a combined area of approximately 28, 000 ft^2 [Appendix A (Skidoo - Photo 41-48)]. A total of 3 ISM samples (SKID-05-001 thru SKID-05-003) and 15 discrete samples [7 discrete samples from the ridge background sampling area and 8 discrete samples from the upgradient wash background area (SKID-BG-001 thru SKID-BG-015)] were collected from DU-5.

The cyanide processing area (DU-1) ISM area is approximately 13,000 square feet and consists of the cyanide processing tanks and foundations, and extends approximately 75 feet below the tank area along the slope (Figure 2). A total of four ISM samples (SKID-01-001 thru SKID-01-004) were collected from DU-1 [Appendix A (Skidoo - Photo 5-10)].

The mercury amalgamation area (DU-2) ISM area is approximately 1,500 square feet and consists of the mercury amalgamation tables and areas in and around the mill foundations in the vicinity of the tables (behind and beneath) (Figure 2). The ISM grids were evenly distributed throughout this area [Appendix A (Skidoo - Photo 11-17)]. A total of four ISM samples (SKID-02-001 thru SKID-02-004) were collected from DU-2.

The mill tailings impoundment area (DU-3) ISM area is approximately 22,000 square feet and consists of the area at the bottom of the slope beneath the mill and within the wash bounded by a rock dam to the west and extends approximately 500 feet to the east (Figure 2) [Appendix A (Skidoo - Photo 18-22)]. A total of four ISM samples (SKID-03-001 thru SKID-03-004) were collected from DU-3.

Discrete samples of the eroded tailings in the wash (DU-4) extended from the top of the dry fall to approximately 2,000 feet west down the wash (Figure 2). A total of 15 discrete samples (SKID-04-001 thru SKID-04-015) were collected from DU-4 [Appendix A (Skidoo - Photo 23-40)]. Thick sections of eroded mill tailings were observed in the wash (Skidoo - Photo 23-40)]. Discrete samples, photos, and GPS coordinate information was collected from each sample location prior to moving to next location and per SAP requirements (NOREAS 2016).

Surface water was observed in DU-2 mercury amalgamation area and DU-3 mill tailing impoundment, the result of an overnight rain storm (Figure 2). DU-2 surface water sample was collected from the mercury amalgamation table trough (SKID-02-SW1) and the DU-3 surface water sample was collected from a low lying area within the tailings impoundment (SKID-03-SW1) [Appendix A (Skidoo - Photos 50-54)].

3.3. Homestake Mill

SI field activities at Homestake Mill were performed beginning March 7 through March 9, 2016. Information presented in the PA and defined in the SAP (NOREAS 2016) identified five DUs present at Homestake Mill: DU-1 mill foundations, DU-2 mill tailings stockpile, DU-3 mine waste stockpile, DU-4 downgradient mill tailings, and DU-5 background native soils (Figure 3). Sampling results are discussed in Section 4.2 and presented in Table 3. Sample summary information is summarized in Table 1.

Initial SI activities involved establishing the DU-5 background native soil sampling area. The area identified as representative background native soils is located approximately 500 feet northwest of the mill is a wash (Figure 3) with a total area of 11,500 square feet. Once the background area was identified and delineated, the ISM sampling girds were delineated. The DU was then subdivided into 30 approximately equally sized SUs [Appendix A (Homestake - Photos 47-48)]. A total of 3 ISM samples (HOME-05-001 thru HOME-05-003) were collected from DU-5.

The mill foundations (DU-1) consist of five, reinforced concrete foundations that are between 66 and 100 feet long (Figure 3). Four of the five foundations were identified as representative and delineated for ISM sampling. The mill foundations ISM area is approximately 11,000 square feet. A total of four ISM samples (HOME-01-001 thru HOME-01-004) were collected from DU-1 [Appendix A (Homestake - Photos 4-10)].

The mill tailings stockpile (DU-2) ISM area is approximately 240 feet downslope beneath the mill foundations to the east and has an area of approximately 8,200 square feet (Figure 3) [Appendix A (Homestake - Photos 11-12)]. A total of four ISM samples (HOME-02-001 thru HOME-02-004) were collected from DU-2.

During delineation of DU-3 mine waste stockpiles, it was observed that the mine waste stockpiles were more extensive than what was originally described in the PA (Figure 3). Mine waste stockpiles (DU-3) are located on the north and south sides of the mill foundations with a total area of approximately 17,500 square feet (Figure 3). A total of 15 discrete samples (HOME-03-001 thru HOME-03-015) were collected from DU-3 [Appendix A (Homestake - Photos 13-28]. Only fine-grained material within the mine waste stockpile was sampled.

During delineation of DU-4 eroded downgradient mill tailings, it was observed that the eroded mill tailings were more extensive than what was originally described in the PA. Thick sections of tailings were observed in the wash for approximately 0.75 miles or 3,900 feet from the mill and that thin out and continue across the access road onto BLM land (Figure 3) [Appendix A (Homestake - Photos 29-30]. Discrete samples of the eroded downgradient mill tailings (DU-4)

extended from approximately 500 feet downslope from the mill to approximately 0.75 miles where the wash meets the access road and are spaced approximately 300 feet apart (Figure 3). A total of 15 discrete samples (HOME-04-001 thru HOME-04-015) were collected from DU-4 [Appendix A (Homestake - Photos 32-46)].

3.4. Journigan's Mill

SI field activities at Journigan's Mill were performed beginning March 1 through March 3, 2016. Information presented in the PA and defined in the SAP (NOREAS 2016) identified seven DUs present at Journigan's Mill: DU-1 cyanide processing area, DU-2 mill foundations, DU-3 mill tailings large bermed stockpile, DU-4 southern mine waste stockpile, DU-5 eroded mill tailings in northern wash, DU-6 eroded mill tailings in southern wash, and DU-7 background soils (Figure 4). During initial SI activities it was determined, with USACE and NPS approval, that sampling of Starr Mill, located approximately a mile west of Journigan's Mill and sharing both the northern (DU-5) and the southern (DU-6) washes, would be included in the SI. Collection and analysis of data from Starr Mill was recommended to better evaluate the potential origin of mill tailing within these washes. Sample results are discussed in Section 4.3 and presented in Table 4; sample information is summarized in Table 1.

Initial SI activities involved establishing the DU-7 background native soil sampling area. Two areas south of the mill were identified as representative background native soils (Figure 4): an area located along a slope and an area upgradient within a wash south of the mill. Once the two background areas were identified and delineated, the ISM sampling grids were delineated. The DU was then subdivided into 30 approximately equally sized sampling units, with each area divided into 15 SUs. The sloped background sampling area and the upgradient wash background area have a combined area of approximately 11,600 square feet [Appendix A (Journigan's - Photo 58-63)]. A total of 3 ISM samples (JOUR-07-001 thru JOUR-07-003) and 19 discrete samples [7 discrete samples from the slope background sampling area and 7 discrete samples from the upgradient wash background area (JOUR-07-004 thru JOUR-07-017)] were collected from DU-5. To further evaluate the background native soils, two additional discrete background samples were collected from the northern (JOUR-07-018) and southern (JOUR-07-019) washes upgradient and east of the mill (Figure 4).

The cyanide processing area (DU-1) ISM area is approximately 7,600 square feet and consists of the cyanide processing tanks and foundations, and extends approximately 30 feet below the tank area to the toe of the slope (Figure 4). A total of four ISM samples (JOUR-01-001 thru JOUR-01-004) were collected from DU-1 [Appendix A (Journigan's - Photo 5-9)].

The mill foundations (DU-2) ISM area consists of two areas of foundations with a combined area of approximately 3,800 square feet (Figure 4) [Appendix A (Journigan's - Photo 10-13)]. A total of four ISM samples (JOUR-02-001 thru JOUR-02-004) were collected from DU-2.

The mill tailings large bermed stockpile (DU-3) ISM area consists of three areas and has a total combined area of approximately 11,300 square feet (Figure 4). The DU-3 area begins at the base of the mill foundations and extends northwest down slope toward Emigrant Canyon Road (Figure 4). The DU was subdivided into 30 approximately equally sized sampling units, with each of the three areas divided into 10 SUs [Appendix A (Journigan's - Photo 14-18)]. A total of four ISM samples (JOUR-03-001 thru JOUR-03-004) were collected from DU-3.

The southern mine waste stockpile (DU-4) ISM area is located at the top of the hill where the former mills ore chute was located (Figure 4). DU-4 extends down the western slope approximately 20 feet and is approximately 400 square feet [Appendix A (Journigan's - Photos 19-22)]. Only the fine grained material within the mine waste pile was sampled. A total of four ISM samples (JOUR-04-001 thru JOUR-04-004) were collected from DU-4.

Discrete samples of possible eroded mill tailings (based on visual characteristics) in the northern wash (DU-5) were identified extended from approximately 500 feet east of the mill along the northern shoulder of Emigrant Canyon Road to approximately 1.5 miles northwest of the mill (Figure 4). To further evaluate the fine grained material within the wash, two additional samples were collecting from the northern wash at the intersection of Emigrant Canyon Road and Highway 190 (Figure 4) approximately 4.7 miles from the site. A total of 20 discrete samples (JOUR-05-001 thru JOUR-05-020) were collected from DU-5 [Appendix A (Journigan's - Photos 23-42)]. Thick sections of eroded mill tailings were observed in the wash approximately 400 feet northwest of the mill within the northern wash (Journigan's - Photos 27-28)].

Discrete samples of the suspected eroded mill tailings in the southern wash (DU-6) extended from approximately 500 feet east of the mill along the southern shoulder of Emigrant Canyon Road to approximately 2.1 miles west of the mill (Figure 4). A total of 14 discrete samples (JOUR-06-001 thru JOUR-06-014) were collected from DU-6 [Appendix A (Journigan's - Photos 43-57)].

3.4.1. Starr Mill

As discussed in Section 3.1, Starr Mill was added to SI activities due to the mills proximity to the northern and southern washes of Journigan's Mill (Figure 5). SI field activities at Starr Mill were performed on March 3, 2016. Information presented in the PA identified two areas of concern at Starr Mill: tailings stockpiled at the mill foundation/cyanide processing area and eroded tailings

in the washes (Figure 5). Sample results are discussed in Section 4.4 and presented in Table 5; sample information is summarized in Table 1.

The mill foundations / cyanide process area (DU-1) ISM area consists of three areas with a combined area of approximately 800 square feet and includes the mill tailings stockpile and processing tanks (Figure 5) [Appendix A (Starr - Photos 1-7)]. A total of four ISM samples (STAR-01-001 thru STAR-01-004) were collected from DU-1.

A total of 3 discrete samples (STAR-01-001 thru STAR-01-003) were collected from an area where eroded mill tailings appeared to have settled/ponded, located approximately ¾ of a mile north of the mill on the west side of Emigrant Canyon Road at the 5-Mile marker [Appendix A (Starr - Photos 8-12)]. The settlement/ponded area was approximately 5,000 square feet.

3.5. Tucki Mill

SI field activities at Tucki Mill were performed on February 22 and February 23, 2016. Information presented in the PA and defined in the SAP (NOREAS 2016) identified three DUs present at Tucki Mill: DU-1 cyanide processing area, DU-2 fine-grained mine waste, and DU-3 background native soils (Figure 6). Sample results are discussed in Section 4.5 and presented in Table 6; sample information is summarized in Table 1.

Initial SI activities involved establishing the DU-3 background native soil sampling area. An area approximately 1,000 feet west of the mill on the south side of the access road was identified as representative background native soils and consists of an area of approximately 300 square feet (Figure 6) [Appendix A (Tucki - Photos 10-11)]. A total of 3 ISM samples (TUCK-03-001 thru TUCK-01-003) were collected from DU-3.

The cyanide processing area (DU-1) ISM area is approximately 11,300 square feet and consists of the cyanide processing tanks, the crushed ore/ mill foundation, and slope area (Figure 6) [Appendix A (Tucki - Photos 1, 2, 5, & 6)]. Only fine-grained material within the crushed rock pile was sampled. A total of four ISM samples (TUCK-01-001 thru TUCK-01-004) were collected from DU-1.

The fine-grained mine waste (DU-2) ISM area consists of three separate stockpiles [Appendix A (Tucki - Photos 7-9)]. The three areas have a total combined area of approximately 1,500 square feet, with one stockpile located 20 feet north and two stockpiles located approximately 45 feet east of DU-1 (Figure 6). Only the fine grained material within the mine waste piles was sampled. A total of four ISM samples (TUCK-02-001 thru TUCK-02-004) were collected from DU-2.

3.6. Cashier Mill

SI field activities at Cashier Mill were performed beginning February 23 through February 25, 2016. Information presented in the PA and defined in the SAP (NOREAS 2016) identified five DUs present at Cashier Mill: DU-1 mill foundations, DU-2 mill tailings in eastern wash, DU-3 mill tailing in western wash, DU-4 mine waste on northern slope, and DU-5 background native soils (Figure 7). Sample results are discussed in Section 4.6 and presented in Table 7; sample information is summarized in Table 1.

Initial SI activities involved establishing the DU-5 background native soil sampling area. Two areas were identified as representative background native soils (Figure 7): an area located along the top of the ridge approximately 350 feet northwest of the mill and an area within a wash approximately 250 feet south of the mill. Once the two background areas were identified and delineated, the ISM sampling girds were delineated. The DU was then subdivided into 30 approximately equally sized sampling units (SUs), with each area divided into 15 SUs. The ridge background sampling area is and the wash background sampling area have a combined area of 530 square feet [Appendix A (Cashier - Photos 27-28)]. A total of 3 ISM samples (CASH-05-001 thru CASH-05-003) were collected from DU-5.

The mill foundations (DU-1) ISM area is approximately 3,200 square feet and consists of the cyanide and mercury processing area and foundations (Figure 7). A total of four ISM samples (CASH-01-001 thru CASH-01-004) were collected from DU-1 [Appendix A (Cashier - Photos 1-3)].

The mill tailings in the eastern drainage (DU-2) ISM area is approximately 250 square feet and is located approximately 450 feet northeast of the mill (Figure 7). A total of four ISM samples (CASH-02-001 thru CASH-02-004) were collected from DU-2 [Appendix A (Cashier - Photos 4-5)].

The mill tailings in the western drainage (DU-3) ISM area is approximately 600 square feet and is located approximately 45 feet southwest of the mill (Figure 7). A total of four ISM samples (CASH-03-001 thru CASH-03-004) were collected from DU-3 [Appendix A (Cashier - Photos 6-9)].

Discrete samples of the mine waste on the northern slope (DU-4) were collected from stockpile from the toe of the slope to the top of the ridge (Figure 7). A total of 15 discrete samples (CASH-04-001 thru CASH-04-015) were collected from DU-4 [Appendix A (Cashier – Photos 10-26)]. Only fine-grained material within the mine waste stockpiles was sampled.

Surface water was observed in DU-1 mill foundation area (Figure 7), the result of an overnight rain storm. DU-1 surface water sample was collected from a depression in one of the concrete mill foundations (CASH-01-SW1).

3.7. Gold Hill Mill

SI field activities at Gold Hill Mill were performed on February 26 and February 29, 2016. Information presented in the PA and defined in the SAP (NOREAS 2016) identified three DUs present at Gold Hill Mill: DU-1 mill foundations, DU-2 eroded mill tailings in wash along road, and DU-3 background native soils (Figure 8). Warm Spring is located approximately 850 feet upslope and south of the mill. The spring actively discharges water at a rate of 50 gallons per minute, providing a stream that infiltrates approximately 500 feet downstream (ECM 2014). Sample results are discussed in Section 4.7 and presented in Table 8; sample information is summarized in Table 1.

The mill foundations (DU-1) ISM area is approximately 2,800 square feet and includes the ore crushing area and the ramp (Figure 8) [Appendix A (Gold Hill - Photos 1, & 4-9)]. A total of four ISM samples (GOLD-01-001 thru GOLD-01-004) were collected from DU-1.

Discrete samples of the mill tailings in the wash along the road (DU-2) were collected just north of the mill foundations and approximately 300 feet downgradient from the mill (Figure 8). A total of 7 discrete samples (GOLD-02-001 thru GOLD-02-007) were collected from DU-2 [Appendix A (Gold Hill - Photos 10-11)].

An area approximately 140 feet west of the mill on the north side of the road within a wash was identified as representative background native soils (DU-3) (Figure 8). The background native soil (DU-3) ISM area is approximately 3,000 square feet [Appendix A (Gold Hill - Photo 12-15)]. A total of 3 ISM samples (GOLD-03-001 thru GOLD-01-003) were collected from DU-3.

Two surface water samples were collected from the stream that flows from Warm Spring (Figure 8). The first sample was collected from the stream just at the foot of the slope located approximately 330 feet south of the mill (GOLD-SW1) and a second sample (and duplicate sample) was collected downgradient approximately 1,000 east of the mill next to Warm Springs Road (GOLD-SW2 and GOLD-SW3) [Appendix A (GOLD - Photos 16-18)].

4. Sampling Results

The following sections summarize the results of soil and, where applicable, surface water sampling at the subject mill sites.

Methods

Applicable for all sites, determination of 95-percent (%) upper confidence limit (UCL) concentration of soil sample results was performed for each DU, using USEPA ProUCL 5.1.002 software. The UCLs for each metal of potential concern is listed in the respective tables for each site, and 95% UCL for each DU are shown on the respective site figures. In cases where an analyte was not detected in a sample, a result equal to one-half of the analyte reporting limit was assumed for 95% UCL determination. The 95% UCL for all ISM samples was determined using the Chebyshev method, which is recommended for use in ISM-based samples, as this method provides a conservative estimate of the UCL (ITRC 2012). The Chebyshev method is based on non-parametric (no distributional) assumptions of the data set.

For discrete sampling performed within DUs, the ProUCL software was used to determine the data set properties (i.e., normal, gamma, non-parametric) and an appropriate UCL-determination method was selected based on the observed data set. In most cases, a normal distribution was assumed and a Student's-t 95% UCL was used. The respective site data tables (Tables 2 through 8) are notated regarding the method used for determining 95% UCL concentrations for each data set.

For Tier 1 risk screening purposes, sample results (95% UCL concentrations) in Tables 2 through 9 are compared with site screening values established in the SAP (NOREAS 2016), including USEPA Region 9 Regional Screening Levels (RSLs) (residential use assumption), NPS Ecological Screening Levels (ESVs) and California Regional Water Quality Control Board (Water Board) Environmental Screening Levels (ESLs). It should be noted that these screening levels represent conservative assumptions regarding human and ecological risk exposures. Due to their remote locations and short-term recreational visitor site uses, actual exposure duration at the subject sites is significantly less than the exposure time assumed for Tier 1 human health risk screening values used in this SI Report.

Acid-base accounting (ABA) was performed at selected DUs. ABA results measure the acid generating potential (AGP) and acid neutralization potential (ANP) of the soil. When the ratio of

ANP/AGP is greater than 1.2:1, the soil is considered to have minimal acid mine waste generation potential. In all cases described below, acid mine waste generation potential was very low.

4.1. Skidoo Mill

The following sections summarize the evaluation of the SI sampling results for Skidoo Mill. Results for Skidoo Mill are tabulated in Table 2 and summarized on Figure 2.

4.1.1. Background Soil Sampling

Background soil samples were collected using both ISM and discrete sampling methods at Skidoo Mill. Comparison of the results of 95% UCL concentrations between discrete and ISM sampling methods yielded excellent correlation (R^2=0.998), with the 95% UCL concentration from ISM samples yielding a higher result than discrete samples for all analytes except thallium. This apparent bias for higher 95% UCL concentrations from ISM results is consistent with the use of the conservative Chebyshev method for determination of the UCL.

For all metals except cadmium (Cd), cobalt (Co), selenium (Se), and silver (Ag), the background soil concentrations exceeded the NPS ESV (based on Screening Level Environmental Risk Assessment (SLERA) Chemicals of Potential Ecological Concern (COPEC) (NPS 2014b). Other Skidoo Mill DUs also exceed NPS ESVs for most metals analyzed.

USEPA Region 9 RSLs and Water Board ESLs were exceeded for arsenic in background soils. Arsenic (As) concentrations in California soils are commonly elevated above these screening levels, and the background (95% UCL) concentration of approximately 12 milligrams per kilogram (mg/kg) arsenic is consistent with values observed in many areas of California.

4.1.2. Mill Area (Mercury and Cyanide Processing Areas)

Elevated concentrations (above background) of antimony (Sb), As, lead (Pb), mercury (Hg), molybdenum (Mo), Ag, and zinc (Zn) were reported in soils collected from DU-1 (cyanide processing area) and DU-2 (mercury amalgamation area) samples. Notably, Pb is 1,359 mg/kg (95% UCL) in DU-2, which exceeds corresponding RSL (400 mg/kg) by a factor of 4, ESV (0.94 mg/kg) by approximately three orders of magnitude, and ESL (80 mg/kg) by approximately two orders of magnitude.

4.1.3. Mill Tailings Impoundment

The mill tailings impoundment area (DU-3) soils contain elevated (above background) concentrations of Sb, As, copper (Cu), Pb, Hg, Mo, Ag and Zn. Notably, the 95% UCL concentration of Pb in DU-3 is 1,477 mg/kg.

DU-3 soils have cyanide concentration (95% UCL) of 12.1 mg/kg, above the NPS ESV (0.1 mg/kg), Water Board ESL (0.0036 mg/kg) and USEPA RSL (2.7 mg/kg).

Mill tailings soils were reported to have slightly basic pH of approximately 9.4 (standard units). Results of ABA tests on mill tailing impoundment samples indicates that soils in this DU do not have net acid-generating potential [AGP; AGP<acid neutralization potential (ANP)].

4.1.4. Downgradient Wash

Discrete soil samples (15) were collected in the wash area downgradient of Skidoo Mill (DU-4). The 95% UCL concentrations of the DU-4 samples exceeded background concentrations for Sb, As, Cu, Pb, Hg, Mo, Se, Ag and Zn. Notably, the 95% UCL concentration of Pb in DU-4 is 2,083 mg/kg; the range of Pb in DU-5 discrete soil samples is from 1,150 mg/kg to 2,640 mg/kg.

4.1.5. Surface Water Samples

Surface water sample results are summarized in Table 9. Sample DEVA-SKID-02-SW1 was collected from the Hg-amalgamation tables (DU-2) within the mill structure. This sample exceeded the NPS ESV for surface waters for barium (Ba), Cu, Pb, Hg, Ag and Zn. The surface water sample collected from the Hg amalgamation tables contained Pb [10.5 micrograms per liter (μg/L)] and Hg (0.27 μg/L) at approximately an order of magnitude above their NPS ESVs (0.92 μg/L and 0.026 μg/L, respectively). Sample DEVA-SKID-03-SW1 was collected from a small area of ponded water within the mill tailings (DU-3) impoundment. The DU-3 surface water sample reported concentrations of As, Ba, Cu, Pb, Hg, Ag and Zn above NPS ESVs, including Pb at 891 μg/L and Hg at 1.02 μg/L. The presence of water at both of these sample locations was highly ephemeral, having accumulated the night before during a rain event, and largely dried by the end of the day of collection.

4.1.6. Soil Leaching Analyses

One Skidoo Mill soil sample, DEVA-SKID-01-003 (684 mg/kg Pb) was analyzed for leachability using the Toxicity Characteristic Leaching Procedure (TCLP) for Pb. The resulting leachate was reported with a concentration of 9.25 milligrams per liter (mg/L) Pb.

4.1.7. Data Quality Assessment

This section describes the quality and usability of analytical data collected during the February 2016 site inspection sampling conducted at Skidoo Mill. General data quality assessment

procedures used were the same for all sites. Field sampling and laboratory analytical activities for all SI sites were performed in accordance with the Sampling and Analysis Plan (NOREAS 2016).

At Skidoo Mill, a total of 29 discrete soil, 2 surface water, 2 source blank, and 2 equipment blank samples were collected on February 17 through 19, 2016. In addition, 15 grab soil samples were collected using ISM. Environmental samples were analyzed for Title 22 metals (California Administrative Manual [CAM] 17 metals (EPA Method 6020A and 7470A/7471), cyanide (EPA 9012A), soil pH (EPA 9045D) and ABA (Modified Sobek Method). All samples were received in good condition and technical holding time requirements were met.

Analysis of groundwater and soil samples from all SI sites were performed by Test America Denver Laboratory, Inc. located in Arvada, Colorado. Test America is an approved laboratory facility in accordance with California Department of Health Services Environmental Laboratory Accreditation Program (ELAP), State of Nevada Department of Conservation and Natural Resources, and Department of Defense (DoD) ELAP. A third-party validation firm, Laboratory Data Consultants, Inc. (LDC), performed data validation on the chemical analyses for the project samples.

The overall data quality was determined based on the analytical results generated for field and laboratory quality assurance/quality control (QA/QC) samples during this project. QA/QC for field activities was ensured through standardized sampling methods, rigorous documentation, and the collection of field QC samples as described in the project SAP (NOREAS 2016). Additionally, laboratory performed QC analyses to assess precision and accuracy of the analytical processes as determined by method-required laboratory QC samples, calibration and verification standards, instrument and method blanks. Results from field blanks and method blanks were evaluated to assess the possibility of contamination of environmental samples that may have been introduced during sampling and laboratory activities. Field duplicates could not be collected at this site due to insufficient surface water available during sampling at Skidoo Mill site.

Field Blanks

In accordance with the SAP, two equipment blanks, identified as DEVA-SKID-EB-021816 and DEVA-SKID-EB-021916, were collected to assess if non-disposable equipment decontamination procedure was effective and if cross-contamination of soil samples occurred during soil sampling activities. No target analytes were detected in the equipment blanks with the exception of thallium, beryllium, chromium, cobalt, and/or molybdenum. Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater (>5X) than the concentrations found in the associated

field blanks except for three soil (DEVA-SKID-01-001, DEVA-SKID-01-002, and DEVA-SKID-03-001) and two surface water samples (DEVA-SKID-02-SW1 and DEVA-SKID-03-SW1), for which the detected concentrations were adjusted to "not detected (ND)" at the reported concentrations.

An equipment rinsate source blank identified as DEVA-SB-021816 was also collected. No target analytes were detected in the source blank except for antimony at a trace concentration. The sample concentrations were either not detected or were significantly greater (>5X) than the concentration found in the source blank. No data qualification was required.

Laboratory Quality Control Analyses

Laboratory QC samples for all SI sites were prepared and analyzed by the laboratory to monitor the analytical process. The laboratory QC samples for this event included method blanks, initial and continuing calibration blanks, laboratory control samples (LCSs), instrument tune and calibration verifications (ICVs and CCVs), interference check, and matrix spike (MS) and matrix spike duplicate (MSD) samples. The laboratory analyzed all instrument tune, calibration, and QC samples at the method-required frequency. The analyses were performed within all specifications of the methods. The QC criteria were met and are considered acceptable. The following samples were qualified as estimated due to QC exceedances:

No contaminants were found in the laboratory blanks except for molybdenum in DEVA-SKID-EB-021816 and/or antimony in DEVA-SKID-02-SW1 and DEVA-SKID-03-SW1. Accordingly, the detection was adjusted to ND at the reported concentration.

Select metals (arsenic, beryllium, cadmium, chromium, cobalt, copper, lead, molybdenum, nickel, selenium, thallium, vanadium, and/or zinc) exceeded MS, MSD or post spike % recovery criteria. Spiked samples (DEVA-SKID-BG-014, DEVA-SKID-03-001, and DEVA-SKID-04-015) were qualified using "UJ" for not detected and "J" for detected results.

Data Validation Results

Analytical data collected during SI activities (at all sites) were reviewed and validated by LDC in Carlsbad, California. Data validation was performed in accordance with USEPA SW-846 Test Methods (EPA 1986 and final updates), DoD Quality Systems Manual (QSM) for Environmental Laboratories, version 5.0 (July 2013), modified USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review (January 2010), and QA/QC criteria specified in the project-specific SAP (NOREAS 2016).

Data were subjected to approximately 10 percent Level IV and 90 percent Level III validation. Data validation included a review of sample preservation/condition, cooler temperature, and technical holding times; detection limits/sensitivity; instrument tune, calibration and verifications; laboratory blanks; LCS and MS/MSD; and field QC sample data (as applicable), including a review of chromatograms and quantitation reports. In addition, chain-of-custody records were reviewed to assess the potential for any field conditions that adversely impact data quality. Relevant data validation qualifiers are defined as follows:

U – (Not detected): The compound or analyte was analyzed for and positively identified by the laboratory; however, the compound or analyte should be considered non-detected at the reported concentration due to presence of contaminants detected in the associated blank(s).

J – (Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however, the reported concentrations is estimated due to nonconformances discovered during data validation.

UJ – (Not-detected estimated): The compound or analyte was reported as not detected by the laboratory; however, the reported detection limit is estimated due to nonconformances discovered during data validation.

Third-party validation reports indicate that data associated with samples collected during the SI sampling in February 2016 are usable and acceptable. No results were rejected in this report. All technical holding time requirements were met. Overall precision and accuracy goals were met. Copies of the analytical laboratory reports, including COC forms are provided in Appendix C. Data validation reports are provided in Appendix D.

4.2. Homestake Mill

The following sections summarize sampling results for the SI performed at Homestake Mill. Table 2 presents results of soil analyses from Homestake Mill, and results are summarized on Figure 3.

4.2.1. Background Soil Sampling

Background soil samples were collected using ISM sampling methods at Homestake Mill. For all metals except Co, Cu, nickel (Ni), Se and silver (Ag), the background soil concentrations exceeded the NPS ESV. Other site DUs also exceed NPS ESVs for most metals analyzed.

USEPA Region 9 RSLs and Water Board ESLs were exceeded for arsenic in background soils. Arsenic (As) concentrations in California soils are commonly elevated above these screening levels, and the background (95% UCL) concentration of approximately 10 mg/kg arsenic is consistent with values observed in many areas of California.

4.2.2. Mill Area (Mercury and Cyanide Processing Areas)

The mill foundation area (DU-1) soils contain elevated (above background) concentrations of Sb, beryllium (Be), Cd, Cu, Pb, Hg, Se, Ag, thallium (Th) and Zn. The 95% UCL concentration of Pb in DU-1 is 725 mg/kg.

DU-3 soils have cyanide concentration (95% UCL) of 61.4 mg/kg (ISM sample range of 10.7 to 48.6 mg/kg), above the NPS ESV, Water Board ESL, and USEPA RSL (2.7 mg/kg).

Mill tailings soils were reported to have slightly basic pH of approximately 9.4 (standard units). Results of ABA tests on mill tailing impoundment samples indicates that soils in DU-3 do not have net acid-generating potential (AGP< ANP).

4.2.3. Mill Tailings Stockpile

The mill tailings stockpile (DU-2) soils contain elevated (above background) concentrations of Sb, Be, Cd, Cu, Hg, Se, Ag, vanadium (V) and Zn, based on comparison to 95% UCL concentrations. Notably, lead concentrations in DU-2 soils are only 18.1 mg/kg (95% UCL).

4.2.4. Mine Waste Stockpile

Mine waste stockpile (DU-3) soils were analyzed using 15 discrete soil samples. The 95% UCL concentrations of Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Se, Ag, V and Zn in DU-3 are above background (DU-5) concentrations.

4.2.5. Downgradient Mill Tailings

Downgradient mill tailings (DU-4) soils were evaluated from 15 discrete soil sample locations in the wash areas downgradient from the site. Comparison of 95% UCL concentrations from DU-4 soils to background soils (DU-5) indicates the Be, Cu, Hg, Se, Ag and Zn are above background in DU-4.

4.2.6. Soil Leaching Analyses

Soil leaching assessment via TCLP was performed for Pb in soil samples DEVA-HOME-01-003 (566 mg/kg pb) (and DEVA-HOME-01-004 (168 mg/kg Pb) (mill foundation area). The TCLP results for these samples were 0.448 J and 0.0564 J, respectively, indicating low leaching potential from these soils. Samples DEVA-HOME-03-002 (4.3 mg/kg Hg) and DEVA-HOME-04-012 (6.28 mg/kg Hg) were analyzed for Hg leachability using TCLP. Both TCLP results were for only trace (estimated values) of Hg, indicating very low leaching potential for Hg from these soils.

4.2.7. Data Quality Assessment

This section describes the quality and usability of analytical data collected during the March 2016 site inspection (SI) sampling conducted at the Homestake Mill.

A total of 11 grab samples of soils were collected using ISM. In addition, 31 discrete soils, 2 source blanks, 2 equipment blanks, and 7 sets of MS/MSD samples were collected on March 7 through 9, 2016 at this site. Environmental samples were analyzed for metals, cyanide, soil pH ABA. All samples were received in good condition and technical holding time requirements were met.

Results from field blanks and method blanks were evaluated to assess the possibility of contamination of environmental samples that may have been introduced during sampling and laboratory activities.

Field Blanks

In accordance with the SAP, two equipment blanks, identified as DEVA-HOME-EB-030716 and DEVA-HOME-EB-030816, were collected to assess the effectiveness of the non-disposable equipment decontamination procedure and if cross-contamination of samples occurred during sampling activities. Two source blanks identified as DEVA-SB-021816 and DEVA-SB-031116 were also collected. No target analytes were detected in the equipment or source blanks with the exception of trace concentrations of barium, silver, thallium, mercury, manganese, and antimony. Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater (>5X) than the

concentrations found in the associated field blanks. No data qualification was necessary for any of the samples.

Laboratory Quality Control Analyses

The analyses were performed within all specifications of the methods. The QC criteria were met and are considered acceptable. The following samples were qualified as estimated due to QC exceedances:

- Laboratory blanks for metals analysis were free of contaminants except for detections of antimony, silver, thallium, mercury, and manganese. As a result, these detections were adjusted to ND at the reported concentrations in seven associated samples.
- Arsenic, antimony, barium, beryllium, lead, mercury, and/or silver exceeded MS/MSD and post spike % recovery criteria. Spiked samples were qualified using "J" for detected results for these analytes. This condition may be attributed to matrix interference.
- Cyanide exceeded MS/MSD % recovery criteria. Spiked sample DEVA-HOME-02-004 was qualified using "J" for detected results for cyanide. This condition may be attributed to matrix interference.
- Technical holding time (28 days) was exceeded for TCLP analysis of mercury in two samples identified as DEVA-HOME-03-002 and DEVA-HOME-04-012 for which mercury results are qualified as estimated using "J."

Data Validation Results

Third-party validation reports indicate that data associated with samples collected at Journigan's Mill during the SI sampling on March 7 through 9, 2016 are usable and acceptable. No results were rejected in this report. All technical holding time requirements were met with the exception of mercury in two samples, which were qualified as estimated. Copies of the analytical laboratory reports, including COC forms are provided in Appendix C. Data validation reports are provided in Appendix D.

4.3. Journigan's Mill

The following sections summarize sampling results for the SI performed at Journigan's Mill. Table 3 presents results of soil analyses from Journigan's Mill, and results are summarized on Figure 4.

4.3.1. Background Soil Sampling

Background soil samples were collected using both ISM and discrete sampling methods at Journigan's Mill. Comparison of the results of 95% UCL concentrations between discrete and ISM sampling methods yielded excellent correlation, with the 95% UCL concentration from ISM samples generally yielding similar or higher result than the 95% UCL concentration determined for discrete samples, except for arsenic. This apparent bias for higher 95% UCL concentrations from ISM results is consistent with the use of the conservative Chebyshev method for determination of the UCL. The higher arsenic concentration reported in the discrete background samples appears to be biased due results from 2 of 15 background samples, DEVA-JOUR-07-018 and DEVA-JOUR-07-019, with 53.4 and 29.0 mg/kg arsenic reported, respectively.

For all metals except Cd, Se and silver (Ag), the background soil concentrations exceeded the NPS ESV (based on Screening Level Environmental Risk Assessment (SLERA) Chemicals of Potential Ecological Concern (COPEC) (NPS 2014b). Other Skidoo Mill DUs also exceed NPS ESVs for most metals analyzed.

USEPA Region 9 RSLs and Water Board ESLs were exceeded for arsenic in background soils. Arsenic (As) concentrations in California soils are commonly elevated above these screening levels, and the background (95% UCL) concentration of approximately 4 mg/kg arsenic in the ISM samples is consistent with values observed in many areas of California. The 95% UCL concentration of 20.8 mg/kg arsenic derived from the discrete background sample data is on the upper end of normal background concentrations; however, given the types of naturally-occurring minerals in this area, elevated localized arsenic concentrations are not unexpected.

4.3.2. Cyanide Processing Area

The cyanide processing area (DU-1) soils contain elevated (above background) concentrations of Sb, As, Ba, Cd, Pb, Hg, Mo, Ag and Zn. The 95% UCL concentration of Pb in DU-1 is 776 mg/kg.

DU-1 soils have cyanide concentration (95% UCL) of 25.3 mg/kg, above the NPS ESV, Water Board ESL, and USEPA RSL (2.7 mg/kg).

Cyanide processing area soils were reported to have slightly basic pH of approximately 8.4.

4.3.3. Mill Foundation Area

The mill foundation area (DU-2) soils contain elevated (above background) concentrations of Sb, As, Ba, Cd, Cr, Cu, Pb, Hg, Mo, Se, Ag and Zn. The 95% UCL concentration of Pb in DU-2 is 348 mg/kg.

DU-2 soils have cyanide concentration (95% UCL) of 9.48 mg/kg, above the NPS ESV, Water Board ESL, and USEPA RSL (2.7 mg/kg).

Mill foundation soils were reported to have slightly basic pH of approximately 8.4. Results of ABA tests on mill tailing impoundment samples indicates that soils in DU-2 do not have net acid-generating potential (AGP< ANP).

4.3.4. Mill Tailings Stockpile

Soils from the mill tailings stockpile (DU-3) at Journigan's contained the following metals above background soils (95% UCL concentration comparison): Sb, Cd, Pb, Hg, Mo, Ag, Th and Zn. The 95% UCL concentration of Pb in DU-3 soils was 472 mg/kg.

Cyanide concentrations in DU-3 (95% UCL) is 29.6 mg/kg, above the NPS ESV, Water Board ESL, and USEPA RSL (2.7 mg/kg).

Mill tailings soils were reported to have slightly basic pH of approximately 8.6. Results of ABA tests on mill tailing impoundment samples indicates that soils in DU-3 do not have net acid-generating potential (AGP< ANP).

4.3.5. Mine Waste Stockpile

Mine waste stockpiles (DU-4) contain the following metals above background concentrations (95% UCL concentration comparison): Sb, Be, Cd, Cr, Cu, Pb, Hg, Ag, Th,V and Zn. The 95% UCL concentration of Pb in DU-4 is 503 mg/kg.

4.3.6. Mill Tailings in North (DU-5) and South Washes (DU-6)

Mill tailings in the north wash area (DU-5) contain the following metals above background concentrations (95% UCL concentration comparison): Sb, As, Ba, Be, Cd, Cr, Pb, Hg, Mo, Ag, Th and Zn. The 95% UCL concentration of Pb in DU-5 is 703 mg/kg; however, this result is skewed by the results of a single discrete sample, DEVA-JOUR-05-003, which reported Pb at 2,540 mg/kg. This sample is located close to mill site (Figure 4) and based on the results of the 14 other discrete

samples in the north wash area, widespread Pb contamination throughout the north wash area does not appear to have occurred.

Mill tailings in the south wash area (DU-6) contain the following metals above background concentrations (95% UCL concentration comparison): Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Hg, Mo, Ni, Ag, Th and Zn. The 95% UCL concentration of Pb in DU-6 is 381 mg/kg; however, similar to DU-5, this result is skewed by the results of a single discrete sample, DEVA-JOUR-06-002, which reported Pb at 890 (J) mg/kg. This sample is located close to mill site (Figure 4) and based on the results of the 14 other discrete samples in the south wash area, widespread Pb contamination throughout the south wash area does not appear to have occurred.

4.3.7. Soil Leaching Analyses

Soil leaching analyses by TCLP were performed on five (5) samples from Journigan's Mill.

- Sample DEVA-JOUR-02-002 (309 mg/kg Pb) was tested for TCLP Pb, with a result of 0.184 J mg/L, indicating low leaching potential.
- Sample DEVA-JOUR-01-002 (656 mg/kg Pb) was tested for TCLP Pb with a result of 0.618 mg/L, indicating low leaching potential.
- Sample DEVA-JOUR-03-003 (445 mg/kg Pb) was tested for TCLP Pb with a result of 0.247 J mg/L, indicating low leaching potential.
- Sample DEVA-JOUR-04-001 (482 mg/kg Pb) was tested for TCLP Pb with a result of 0.0251 J mg/L, indicating low leaching potential.
- Sample DEVA-JOUR-06-002 (890 mg/kg Pb) was tested for TCLP Pb with a result of 13 mg/L, indicating a high leaching potential.
- Sample DEVA-JOUR-05-003 (7.99 mg/kg Hg) was tested for TCLP Hg with a reported result of 0.000738 J mg/L, indicating a low leaching potential for Hg from this sample. It should be noted that the Pb concentration of 2,540 mg/kg in this sample is likely to exhibit similar leaching characteristic for lead as determined for sample DEVA-JOUR-06-002.

4.3.8. Data Quality Assessment

This section describes the quality and usability of analytical data collected during the March 2016 SI sampling conducted at the Journigan's Mill.

A total of 19 grab samples of soils were collected using ISM. In addition, 38 discrete soils, 1 source blank, 2 equipment blanks, and 5 sets of MS/MSD samples were collected on March 1 through 3,

2016 at this site. Environmental samples were analyzed for metals, cyanide, , soil pH and ABA. All samples were received in good condition and technical holding time requirements were met.

Results from field blanks and method blanks were evaluated to assess the possibility of contamination of environmental samples that may have been introduced during sampling and laboratory activities.

Field Blanks

In accordance with the SAP, two equipment blanks, identified as DEVA-JOUR-EB-030116 and DEVA-JOUR-EB-030216, were collected to assess the effectiveness of the non-disposable equipment decontamination procedure and if cross-contamination of samples occurred during sampling activities. A source blank identified as DEVA-SB-030116 was also collected. No target analytes were detected in the equipment or source blanks with the exception of trace concentrations of lead, barium, manganese, zinc, and antimony. Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater (>5X) than the concentrations found in the associated field blanks. No data qualification was necessary for any of the samples.

Laboratory Quality Control Analyses

Laboratory QC samples were prepared and analyzed by the laboratory to monitor the analytical process. The analyses were performed within all specifications of the methods. The QC criteria were met and are considered acceptable. The following samples were qualified as estimated due to QC exceedances:

- Laboratory blanks for metals analysis were free of contaminants except for detections of silver, thallium, molybdenum, and manganese. As a result, these detections were adjusted to ND at the reported concentrations in 16 affected samples.
- Arsenic, chromium, copper, lead, mercury, molybdenum, nickel, selenium, and/or vanadium exceeded MS/MSD and post spike % recovery criteria. Spiked samples DEVA-JOUR-07-007, DEVA-JOUR-04-002, DEVA-JOUR-05-014, and DEVA-JOUR-06-002 were qualified using “J” for detected results for these analytes. This condition may be attributed to matrix interference.
- Cyanide exceeded MS/MSD % recovery criteria. Spiked sample DEVA-JOUR-02-001 and DEVA-JOUR-01-001 were qualified using “J” for detected results for these analytes. This condition may be attributed to matrix interference.

Data Validation Results

Third-party validation reports indicate that data associated with samples collected at Journigan's Mill during the SI sampling on March 1 through 3, 2016 are usable and acceptable. No results were rejected in this report. All technical holding time requirements were met. Copies of the analytical laboratory reports, including COC forms are provided in Appendix C. Data validation reports are provided in Appendix D.

4.4. Starr Mill

The following sections summarize sampling results for the SI performed at Starr Mill. Table 4 presents results of soil analyses from Starr Mill, and results are summarized on Figure 5.

4.4.1. Background Soil Sampling

Site-specific background samples for Starr Mill were not collected. Based on proximity to Journigan's Mill, it is assumed that background concentrations at Starr Mill are similar to those reported at Journigan's Mill. Table 4 contains DU-7 ISM background sample concentrations from Journigan's Mill sampling for reference in the evaluation of Starr Mill results.

4.4.2. Mill Area (Mill Foundation and Cyanide Processing Areas)

Soils from the mill foundation and cyanide processing areas (DU-1, sample -001 through 004) at Starr Mill contained the following metals above (Journigan's Mill DU-7) background soils (95% UCL concentration comparison): Sb, As, Be, Cd, Cu, Pb, Hg, Mo, Se, Ag, Th and Zn. The 95% UCL concentration of Pb in Starr Mill foundation/cyanide processing area soils was 199 mg/kg.

The mill foundation/cyanide processing area soils at Starr Mill have cyanide concentration (95% UCL) of 2.9 mg/kg, above the NPS ESV, Water Board ESL, and USEPA RSL (2.7 mg/kg).

Mill foundation/cyanide processing area soils were reported to have slightly basic pH of approximately 9.4. Results of ABA tests on mill tailing impoundment samples indicates that soils in DU-1 do not have net acid-generating potential (AGP< ANP).

4.4.3. Downgradient Discrete Samples

Three (3) discrete soils collected from Starr Mill, close to and downgradient from the mill site (DU-1, sample -005 through 007) at Starr Mill contained the following metals above (Journigan's Mill DU-7) background soils (95% UCL concentration comparison): Sb, As, Be, Cr, Co, Cu, Pb, Mn, Hg, Mo, Ni, Ag, Th and Zn. The 95% UCL concentration of Pb in Starr Mill foundation/cyanide processing area soils was 23 mg/kg. These results are comparable to those found for the north and south wash discrete samples for Journigan's Mill, except for the noted elevated concentrations samples at Journigan's Mill discussed in Section 4.36.

4.4.4. Soil Leaching Analyses

One sample, DEVA-STAR-01-003, reporting 177 (J) mg/kg Pb and 6.61 (J) mg/kg Hg was analyzed for TCLP Pb, with a result of 0.0581 J mg/L and TCLP Hg, with a result of 0.000112 J mg/L. Both of these results indicate a low leaching potential for this sample.

4.4.5. Data Quality Assessment

A total of 3 discrete soil, 1 source blank, and 1 equipment blank samples were collected on March 3, 2016 at Starr Mill. In addition, four grab samples of soils were collected using ISM. Environmental samples were analyzed for metals, cyanide, soil pH and ABA. All samples were received in good condition and technical holding time requirements were met.

Results from field blanks and method blanks were evaluated to assess the possibility of contamination of environmental samples that may have been introduced during sampling and laboratory activities.

Field Blanks

In accordance with the SAP, one equipment blank, identified as DEVA-STAR-EB-030316, was collected to assess the effectiveness of the non-disposable equipment decontamination procedure and if cross-contamination of samples occurred during sampling activities. A source blank identified as DEVA-SB-021816 was also collected. No target analytes were detected in the equipment blank or source blank with the exception of antimony. Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater (>5X) than the concentrations found in the associated field blank except for the equipment blank DEVA-STAR-EB-030316 for which the detected concentration for antimony was adjusted to “not detected (ND)” at the reported concentration.

Laboratory Quality Control Analyses

The analyses were performed within all specifications of the methods. The QC criteria were met and are considered acceptable. The following samples were qualified as estimated due to QC exceedances:

- Laboratory blank was free of contaminants except for detections of antimony and molybdenum in DEVA-STAR-EB-030316. As a result, these detections were adjusted to ND at the reported concentrations.

- Antimony and molybdenum exceeded MS and MSD % recovery and RPD criteria. Spiked sample DEVA-STAR-01-003 were qualified using "J" for detected results. This condition may be attributed to matrix interference.
- MSMSD % recovery criteria for total cyanide exceeded acceptance limits. Cyanide result was qualified using "J" in DEVA-STAR-01-003. This condition may be attributed to matrix interference.

Data Validation Results

Third-party validation reports indicate that data associated with samples collected at Starr Mill during the SI sampling on March 3, 2016 are usable and acceptable. No results were rejected in this report. All technical holding time requirements were met. Overall precision and accuracy goals were met. Copies of the analytical laboratory reports, including COC forms are provided in Appendix C. Data validation reports are provided in Appendix D.

4.5. Tucki Mill

The following sections summarize sampling results for the SI performed at Tucki Mill. Table 5 presents results of soil analyses from Tucki Mill, and results are summarized on Figure 6.

4.5.1. Background Soil Sampling

Background soil samples were collected using ISM sampling methods at Tucki Mill. For all metals except Co, Se and silver (Ag), the background soil concentrations exceeded the NPS ESV. Other site DUs also exceed NPS ESVs for most metals analyzed.

USEPA Region 9 RSLs and Water Board ESLs were exceeded for arsenic in background soils. Arsenic (As) concentrations in California soils are commonly elevated above these screening levels, and the background (95% UCL) concentration of 15.9 mg/kg arsenic is consistent with values observed in many areas of California.

4.5.2. Cyanide Processing Area

Results from the DU-1 cyanide processing area at Tucki Mill indicates that the 95% UCL concentrations of Sb, As, Pb, manganese (Mn), Hg, Se, Ag and Zn are above the background 95% UCL concentrations of these constituents in soil. Notably, the As concentration (95% UCL) is 230 mg/kg in DU-1. Only low concentrations of cyanide were detected in DU-1 soils (ranging from 0.158 to 0.257 mg/kg). Soil pH was slightly basic at approximately 9.2.

4.5.3. Fine-Grained Mine Waste

The DU-2 Mine waste piles 95% UCL concentrations exceed background (DU-3) concentrations for the following metals: Sb, As, Ba, Cd, Cu, Pb, Mn, Hg, Se, Ag and Zn. Notably, the As concentration (95% UCL) is 111 mg/kg in DU-2. Results of ABA testing of DU-2 soils indicates no net potential for acid generation (ANP> AGP). Soil pH in DU-2 was slightly basic at approximately 9.0. Low concentrations of cyanide were reported in DU-2 soils (ranging from 0.113 to 0.197 mg/kg).

4.5.4. Soil Leaching Analyses

Sample DEVA-TUCK-02-001, reporting 89.2 mg/kg As and 0.404 mg/kg Hg was analyzed using TCLP for these two metals, with results of As at 0.0574 J mg/L and Hg not detected. Based on these results, these soils are considered to have a low leaching potential.

4.5.5. Data Quality Assessment

A total of 11 grab samples of soils were collected using the ISM. In addition, 1 source blank and 1 equipment blank were collected on February 22-23, 2016 at this site. Environmental samples were analyzed for Title 22 metals, cyanide, soil pH and ABA. All samples were received in good condition and technical holding time requirements were met.

Field Blanks

In accordance with the SAP, one equipment blank, identified as DEVA-TUCK-EB-022216, was collected to assess the effectiveness of the non-disposable equipment decontamination procedure and if cross-contamination of samples occurred during sampling activities. A source blank identified as DEVA-SB-021816 was also collected. No target analytes were detected in the equipment or source blank samples with the exception of antimony. Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater (>5X) than the concentrations found in the associated field blanks except for the equipment blank DEVA-TUCK-EB-022216 for which the detected concentration for antimony was adjusted to "not detected (ND)" at the reported concentration. The background contamination is believed to have resulted from the rinsate water.

Laboratory Quality Control Analyses

The analyses were performed within all specifications of the methods. The QC criteria were met and are considered acceptable. The following samples were qualified as estimated due to QC exceedances:

- Due to ICPMS tune (mass calibration), data for all metals except for mercury and manganese were qualified as estimated in sample DEVA-TUCK-EB-022216.
- Laboratory blank was free of contaminants except for detections of lead, manganese, molybdenum, thallium, and mercury in DEVA-TUCK-EB-022216. As a result, these detections were adjusted to ND at the reported concentrations.
- Antimony, copper, molybdenum, selenium, and vanadium exceeded MS/MSD % recovery criteria. Spiked sample DEVA-TUCK-02-002 was qualified using "J" for detected results. This condition may be attributed to matrix interference.
- Technical holding time (14 days) was exceeded by one day for total cyanide in DEVA-TUCK-02-001, DEVA-TUCK-02-002, DEVA-TUCK-02-003, and DEVA-TUCK-02-04. Cyanide results for these four samples are qualified as estimated using "J."

- MS/MSD % recovery criteria for total cyanide exceeded acceptance limits in DEVA-TUCK-02-002. Cyanide result for this sample was qualified using “J.” This condition may be attributed to matrix interference.

Data Validation Results

Third-party validation reports indicate that data associated with samples collected at Tucki Mill during the SI sampling on February 22-23, 2016 are usable and acceptable. No results were rejected in this report. All technical holding time requirements were met except for total cyanide in four samples which exceeded by one day. Cyanide results for these samples were qualified as estimated. Overall precision and accuracy goals were met. Copies of the analytical laboratory reports, including COC forms are provided in Appendix C. Data validation reports are provided in Appendix D.

4.6. Cashier Mill

The following sections summarize sampling results for the SI performed at Cashier Mill. Table 6 presents results of soil analyses from Cashier Mill, and results are summarized on Figure 7.

4.6.1. Background Soil Sampling

Background soil samples were collected using ISM sampling methods at Cashier Mill. For all metals except Cd, Co, Se and silver (Ag), the background soil concentrations exceeded the NPS ESV. Other site DUs also exceed NPS ESVs for most metals analyzed.

USEPA Region 9 RSLs and Water Board ESLs were exceeded for arsenic in background soils. Arsenic (As) concentrations in California soils are commonly elevated above these screening levels, and the background (95% UCL) concentration of 24.4 mg/kg arsenic is consistent with the upper end of background values observed in California. Given the types of naturally-occurring minerals in this area, elevated localized arsenic concentrations are not unexpected.

4.6.2. Mill Foundation Area

Soils from the mill foundation area (DU-1) at Cashier Mill contained the following metals above background soils (95% UCL concentration comparison): Sb, As, Ba, Be, Cd, Cu, Pb, Mn, Hg, Mo, Ag and Zn. The 95% UCL concentration of Pb in Starr Mill foundation/cyanide processing area soils was 1,326 mg/kg.

The mill foundation/cyanide processing area soils at Cashier Mill have cyanide concentration (95% UCL) of 1.62 mg/kg, above the NPS ESV and Water Board ESL but below the USEPA RSL (2.7 mg/kg).

Mill foundation/cyanide processing area soils were reported to have slightly basic pH of approximately 9.0. Results of ABA tests on mill tailing impoundment samples indicates that soils in DU-1 do not have net acid-generating potential (AGP< ANP).

4.6.3. Mill Tailings in Eastern and Western Drainages

Mill tailings soils from the east drainage area (DU-2) at Cashier Mill contained the following metals above background soils (95% UCL concentration comparison): Sb, As, Be, Cd, Cu, Pb, Mn, Hg, Mo, Ag and Zn. The 95% UCL concentration of Pb in Cashier Mill DU-2 was 333 mg/kg. The 95% UCL concentration of As in Cashier Mill DU-2 was 274 mg/kg.

Mill tailings soils from the west drainage area (DU-3) at Cashier Mill contained the following metals above background soils (95% UCL concentration comparison): Sb, As, Ba, Be, Cd, Cu, Pb, Mn, Hg, Mo, Ag and Zn. The 95% UCL concentration of Pb in Cashier Mill DU-3 soils was 953 mg/kg. The 95% UCL concentration of As in Cashier Mill DU-2 was 298 mg/kg.

4.6.4. Mine Waste on Northern Slope

It is noted that several areas of mine waste were identified in the PA (ECM 2014) at Cashier Mill. Sample locations (Figure 6) were collected in areas along the north slope representative of the largest volumes of mine waste observed at the site.

Mine waste piles (DU-4) at Cashier Mill were sampled using 15 discrete soil sampling points, and contained the following metals above background soils (95% UCL concentration comparison): Sb, As, Ba, Be, Cd, Co, Cu, Pb, Mn, Hg, Mo, Ni, Ag and Zn. The 95% UCL concentration of Pb in Cashier Mill DU-3 soils was 1,098 mg/kg. The 95% UCL concentration of As in Cashier Mill DU-2 was 10,960 mg/kg. Highly elevated As concentrations in the DU-4 soils were reported in 5 of the 15 DU-4 discrete soil samples, DEVA-CASH-04-011, -012, -013, -014 and -015.

4.6.5. Surface Water Analysis

A surface water sample was collected from accumulated water in a depression within the Cashier Mill foundation area (Table 9). This sample reported As, Ba, Cu, Pb, Hg and Ag above NPS ESVs. Results for notable COPECs include As (78.0 J μg/L; NPS ESV 3.1 μg/L), Cu (20.9 μg/L; NPS ESV 0.23 μg/L); Pb (9.6 μg/L; NPS ESV 0.92 μg/L) and Hg (0.585 μg/L; NPS ESV 0.026 μg/L).

4.6.6. Soil Leaching Analyses

Soil leachability analyses using TCLP were performed on four (4) soil samples from Cashier Mill; DEVA-CASH-01-004 (TCLP As), DEVA-CASH-02-001 (TCLP As and Pb), DEVA-CASH-03-002 (TCLP As and Pb), DEVA-CASH-04-011 (TCLP As, Pb and Hg). As summarized on Table 11, all of the above soil samples indicated low leaching potential using TCLP.

4.6.7. Data Quality Assessment

This section describes the quality and usability of analytical data collected during the February 2016 site inspection (SI) sampling conducted at Cashier Mill.

A total of 15 discrete soil, 1 surface water, 1 source blank, and 1 equipment blank samples were collected on February 23 through 25, 2016 at this site. In addition, 15 grab samples of soils were

collected using ISM. Environmental samples were analyzed for metals, cyanide, soil pH and ABA. All samples were received in good condition and technical holding time requirements were met.

Results from field blanks and method blanks were evaluated to assess the possibility of contamination of environmental samples that may have been introduced during sampling and laboratory activities. Field duplicates could not be collected at this site due to insufficient surface water present during sampling.

Field Blanks

In accordance with the SAP, one equipment blank, identified as DEVA-CASH-EB-022416 was collected to assess if non-disposable equipment decontamination procedure was effective and if cross-contamination of samples occurred during soil sampling activities. No target analytes were detected in the equipment blank with the exception of trace concentrations of thallium, manganese, molybdenum, and vanadium. Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater (>5X) than the concentrations found in the associated field blank. Therefore, data qualifying was not required.

A source blank identified as DEVA-SB-021816 was also collected. No target analytes were detected in the source blank except for antimony at a trace concentration. The sample concentrations were either not detected or were significantly greater (>5X) than the concentration found in the source blank. Therefore, data qualifying was not required.

Laboratory Quality Control Analyses

The analyses were performed within all specifications of the methods. The QC criteria were met and are considered acceptable. The following samples were qualified as estimated due to QC exceedances:

- Due to mass calibration, data for affected metals were qualified as estimated in 18 samples.
- Laboratory blanks were free of contaminants except for detections of molybdenum in DEVA-CASH-01-SW1; manganese, molybdenum, thallium, and mercury in DEVA-CASH-EB-022416; and thallium in DEVA-CASH-04-011. As a result, these detections were adjusted to ND at the reported concentrations.
- Select metals (arsenic, antimony, barium, cadmium, chromium, cobalt, copper, lead, molybdenum, nickel, selenium, thallium, vanadium) exceeded MS and MSD % recovery criteria. This condition may be attributed to matrix interference. Spiked samples for these

analytes (DEVA-CASH-01-SW1, DEVA-CASH-01-003, DEVA-CASH-04-010) were qualified using "UJ" for not detected and "J" for detected results.

- MS/MSD % recovery and RPD criteria for total cyanide exceeded acceptance limits. Cyanide result was qualified using "J" in DEVA-CASH-01-003.
- Technical holding time for mercury in the TCLP sample run from DEVA-CASH-04-011 was exceeded; therefore, mercury result for this sample was qualified using "J."
- Percent recovery in LCS for lead was slightly outside the acceptance limit. Lead result in DEVA-CASH-02-001 was qualified using "J."

Data Validation Results

Third-party validation reports indicate that data associated with samples collected at Cashier Mill during the SI sampling in February 2016 are usable and acceptable. No results were rejected in this report. All technical holding time requirements were met except for mercury in the TCLP extraction for DEVA-CASH-04-011, which was qualified as estimated. Overall precision and accuracy goals were met. Copies of the analytical laboratory reports, including COC forms are provided in Appendix C. Data validation reports are provided in Appendix D.

4.7. Gold Hill Mill

The following sections summarize sampling results for the SI performed at Gold Hill Mill. Table 7 presents results of soil analyses from Cashier Mill, and results are summarized on Figure 8.

4.7.1. Background Soil Sampling

Background soil samples were collected using ISM sampling methods at Gold Hill Mill. For all metals except Cd, Co, Cu, Ni, Se and silver (Ag), the background soil concentrations exceeded the NPS ESV. Other site DUs also exceed NPS ESVs for most metals analyzed.

USEPA Region 9 RSLs and Water Board ESLs were exceeded for arsenic in background soils. Arsenic (As) concentrations in California soils are commonly elevated above these screening levels, and the background (95% UCL) concentration of 4.37 mg/kg arsenic is consistent with background values commonly observed in California.

4.7.2. Mill Foundation Area

Soils from the mill foundation area (DU-1) at Gold Hill Mill contained the following metals above background soils (95% UCL concentration comparison): Sb, As, Ba, Be, Cr, Cu, Pb, Mn, Hg, Mo, Ni, Se, Ag, Th, V and Zn. The 95% UCL concentration of Pb at the Gold Hill Mill foundation area soils was 14,661 mg/kg. Other metals, including Sb (1,124 mg/kg) , As (654 mg/kg) and Hg (28.4 mg/kg), reported high concentrations in the DU-1 soils, which are particularly notable as no clear evidence of high production volumes was observed at or near the mill site, and the milling mechanisms did not appear to be designed for high production volumes.

The mill foundation/cyanide processing area soils at Gold Hill Mill have cyanide concentration (95% UCL) of 0.618 mg/kg, above the NPS ESV and Water Board ESL but below the USEPA RSL (2.7 mg/kg).

Mill foundation/cyanide processing area soils were reported to have slightly basic pH of approximately 8.8. Results of ABA tests on mill tailing impoundment samples indicates that soils in DU-1 do not have net acid-generating potential (AGP< ANP).

4.7.3. Eroded Tailings in Wash (along Road)

Visually observable mill tailings in the wash (DU-2) were of limited extent. Only seven (7) discrete samples were collected in the wash due to the limited observable material. One discrete sample, DEVA-GOLD-02-007 was of uncertain origin, and was collected to determine if the soils that could not clearly be visually identified as mill tailings exhibited the chemical signature of mill tailings.

Based on the comparative results of this sample compared to samples DEVA-GOLD-02-001 through -006, sample -007 is considered to be downgradient background material, and was excluded from the determination of the 95% UCL concentrations for DU-2 discussed below, as inclusion in this data set would create a low-bias in the data set.

Mill tailings in the wash (DU-2) at Gold Hill Mill contained all CAM 17 metals above background soils (95% UCL concentration comparison). The 95% UCL concentration of Pb at the Gold Hill Mill foundation area soils was 12,579 mg/kg. Other metals, including Sb (1,540 mg/kg) , As (851 mg/kg) and Mn (12,447 mg/kg), reported high concentrations in the DU-1 soils, above the EPA Region 9 RSLs (Table 7).

4.7.4. Surface Water Analyses

Surface water samples were collected at two locations at Gold Hill Mill. Sample DEVA-GOLD-SW1 was collected as a background sample from near the source of Warm Spring. Samples DEVA-GOLD-SW2 and -SW3 were collected as a surface water sample and field duplicate sample from surface waters present in the stream bed downgradient from Gold Hill Mill. Results from near the spring source reported As, Ba, and Se above NPS ESVs (Table 10). Results from the downgradient surface water sample (SW-2 is the primary sample) reported As, Ba and Se above NPS ESVs. Surface water sampling does not indicate an influence of contaminants from Gold Hill Mill directly impacting surface waters downgradient of the site.

4.7.5. Data Quality Assessment

This section describes the quality and usability of analytical data collected during Gold Hill Mill.

A total of 7 grab samples of soils were collected using ISM. In addition, 7 discrete soils, 3 surface waters, 1 source blank, 1 equipment blank, 1 set of field duplicates, and 4 sets of MS/MSD samples were collected on February 26 and 29, 2016 at this site. Environmental samples were analyzed for metals, cyanide, soil pH and ABA. All samples were received in good condition and technical holding time requirements were met.

Results from field blanks and method blanks were evaluated to assess the possibility of contamination of environmental samples that may have been introduced during sampling and laboratory activities.

Field Duplicates

Field sampling precision is evaluated by analyzing field duplicate samples which are collected and analyzed at a frequency of 10 percent for surface water samples. Field duplicates consist of two

collocated samples of the same matrix collected at the same time and location, to the extent possible, using the same sampling techniques.

In accordance with the project SAP, a set of field duplicate samples identified as DEVA-GOLD-SW2 and DEVA-GOLD-SW3 were collected and analyzed for the constituents of concern during surface water sampling at this site. The field duplicate results met the SAP requirement of 30 relative percent difference (RPD) for the detected constituents of concern at concentrations approximately above 10 x limit of quantitation (LOQ). RPDs ranged from 1 to 22 percent indicating excellent agreement for the field duplicate samples. Higher RPDs 35 and 41 percent for were exhibited for low-level analytes nickel and copper, respectively. No data were qualified based on field duplicate results.

Field Blanks

In accordance with the SAP, one equipment blank, identified as DEVA-GOLD-EB-022916, was collected to assess the effectiveness of the non-disposable equipment decontamination procedure and if cross-contamination of samples occurred during sampling activities. A source blank identified as DEVA-SB-021816 was also collected. No target analytes were detected in the equipment blank. Source blank sample was reported having trace concentration of antimony. Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater (>5X) than the concentrations found in the associated field blanks. No data qualification was necessary.

Laboratory Quality Control Analyses

The analyses were performed within all specifications of the methods. The QC criteria were met and are considered acceptable. The following samples were qualified as estimated due to QC exceedances:

- Laboratory blanks for metals analysis were free of contaminants except for detections of antimony, molybdenum, and silver. As a result, these detections were adjusted to ND at the reported concentrations in the affected samples (DEVA-GOLD-03-001 through -003, DEVA-GOLD-SW1 through -SW3).

- Laboratory blank for cyanide analysis was free of contaminants except for trace detections of cyanide. As a result, detections of cyanide were adjusted to ND at the reported concentrations in the affected samples DEVA-GOLD-SW1 and DEVA-GOLD-SW3.

- Lead, vanadium, and zinc exceeded MS/MSD % recovery criteria. Spiked sample DEVA-GOLD-03-002 was qualified using "J" for detected results for these analytes. This condition may be attributed to matrix interference.

- All technical holding time requirements were met with the exception of mercury in sample DEVA-GOLD-02-004, which was prepared and analyzed two days outside of the holding time of 28 days. Mercury result for this sample is qualified as estimated using a "J."

Data Validation Results

Third-party validation reports indicate that data associated with samples collected at Gold Hill Mill during the SI sampling on February 26 and 29, 2016 are usable and acceptable. No results were rejected in this report. All technical holding time requirements were met with the exception of mercury in only one sample DEVA-GOLD-02-004 for which the result is qualified as estimated. Overall precision and accuracy goals were met. Copies of the analytical laboratory reports, including COC forms are provided in Appendix C. Data validation reports are provided in Appendix D.

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5. Summary and Recommendations

Site inspections were performed at seven (7) mill sites at DEVA, including Skidoo Mill, Homestake Mill, Journigan's Mill, Starr Mill, Tucki Mill, Cashier Mill and Gold Hill Mill. The results of the soil sampling indicate that all seven sites contain metals in soil above local background concentrations and above Tier 1 human and ecological risk screening criteria. A principal contaminant of concern at all sites is lead (Pb). In addition, arsenic was found at several sites at significantly elevated concentrations. Metals in ephemeral surface water at Skidoo Mill and Cashier Mill exceed NPS ESVs. Surface water impacts downgradient of Gold Hill Mill were not detected. Soil testing for acid-base accounting indicated that none of the site soils tested had potential for generation of acid-mine wastes.

The screening levels used in this report are not site-specific and do not consider the actual site conditions, site background concentrations and potential specific receptors. Therefore, the following further investigations are recommended for the sites:

- Perform additional sampling at the subject sites to document the extent and volume of impacted soils (mine waste rock and mill tailings);
- Complete site-specific Ecological Risk Assessments (ERA) and Human Health Risk Assessments (HHRA) for the subject DEVA AML sites, which include considering site-specific conditions, receptors, exposure durations, etc. The results of the ERA and HHRA will be used to evaluate risks and develop site-specific risk-based screening levels. These site specific screening levels and additional site data documenting impacted soil volumes and extent would be used to support the preparation of an Engineering Evaluation/Cost Analysis.

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6. References

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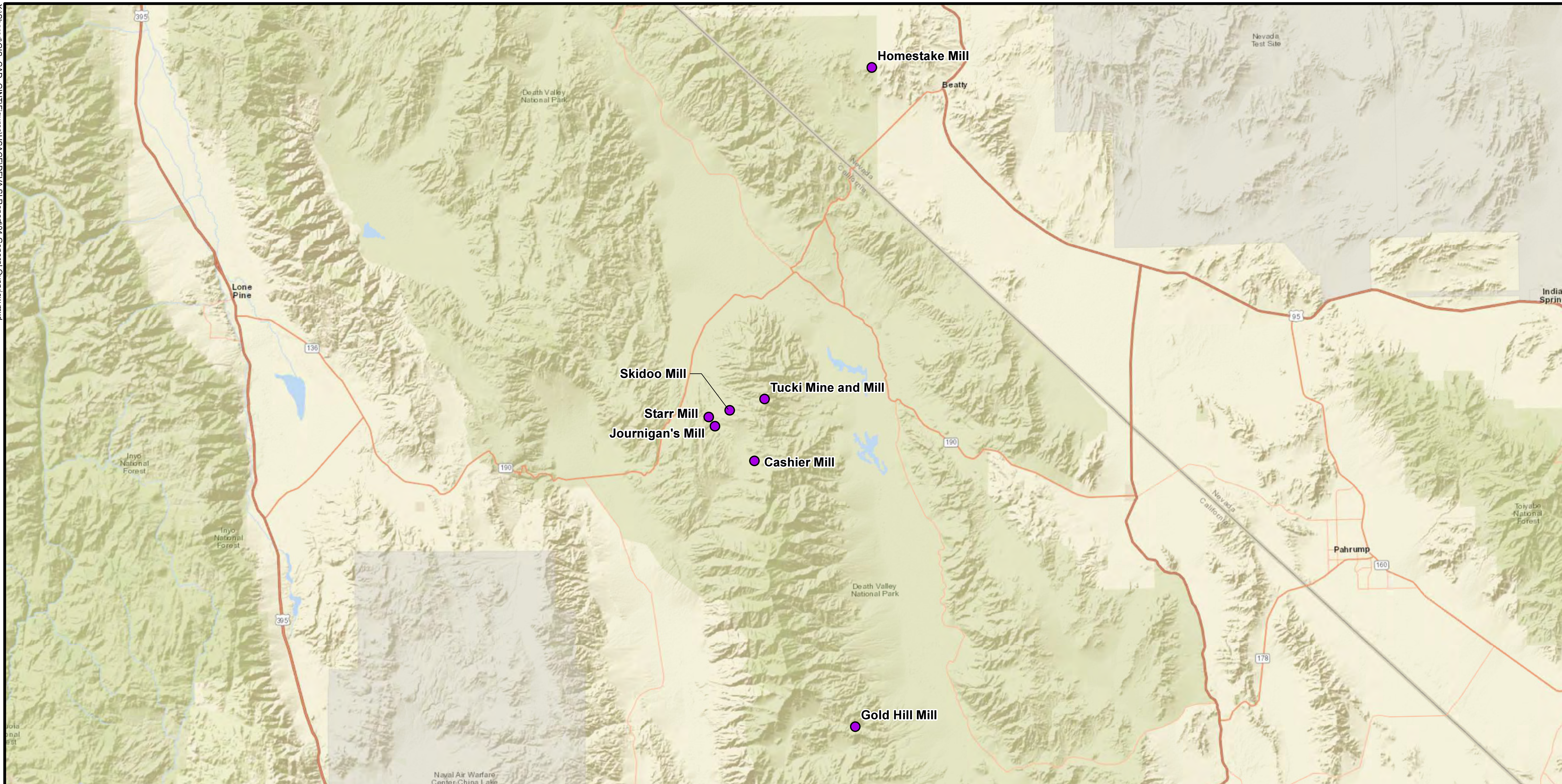
Figures



LEGEND

● 2016 Investigation Abandoned Mineral Lands Sites, Death Valley National Park

National Park Lands

N

0 5 10 20 Miles

UNITED STATES ARMY CORPS OF ENGINEERS

LOS ANGELES, CALIFORNIA

DEATH VALLEY NATIONAL PARK
CALIFORNIA AND NEVADA

FIGURE 1

GENERAL VICINITY MAP

NOREAS Environmental Engineering and Science

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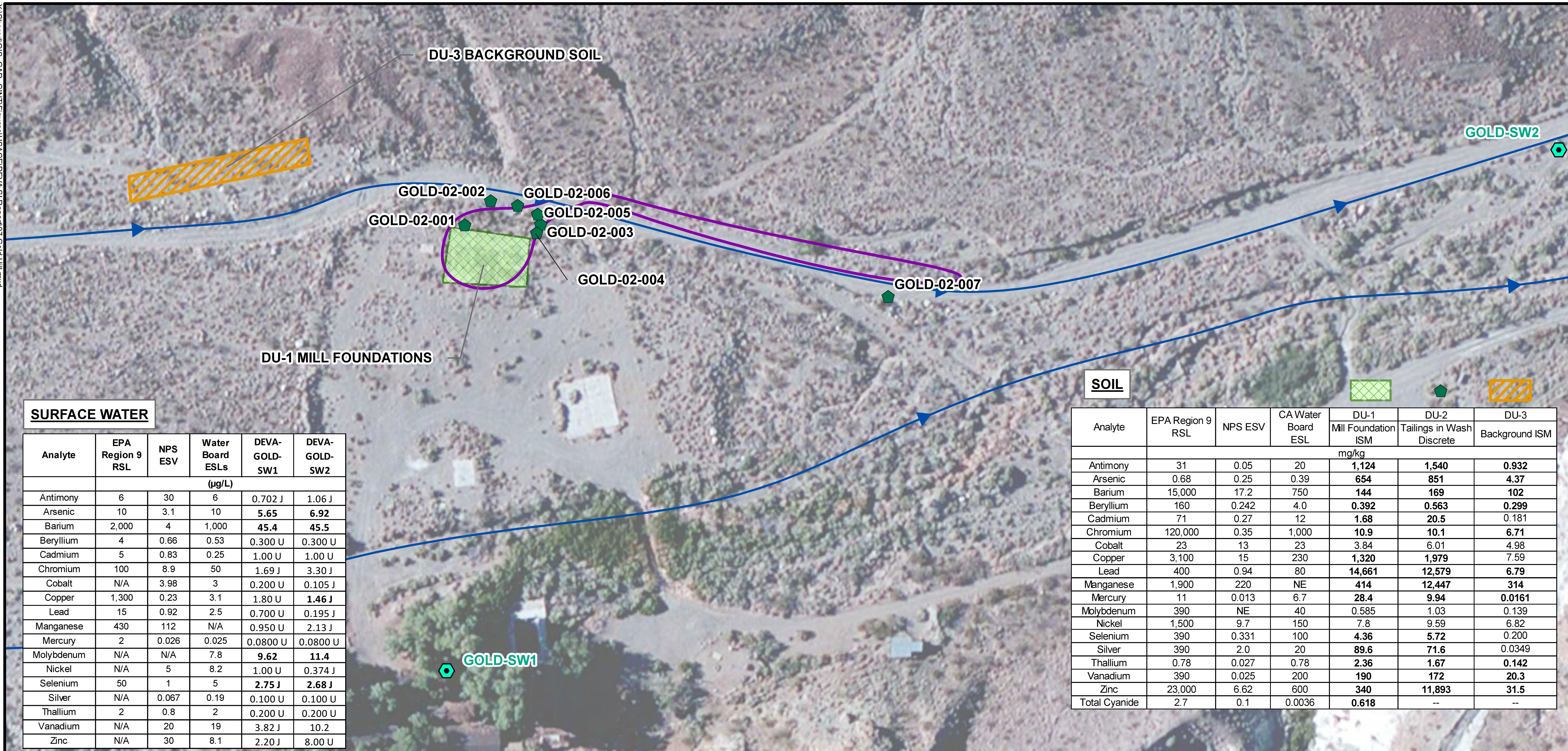


SURFACE WATER

Analyte	EPA Region 9 RSL	NPS ESV	Water Board ESLs	DEVA-GOLD-SW1	DEVA-GOLD-SW2
	(µg/L)				
Antimony	6	30	6	0.702 J	1.06 J
Arsenic	10	3.1	10	**5.65**	**6.92**
Barium	2,000	4	1,000	**45.4**	**45.5**
Beryllium	4	0.66	0.53	0.300 U	0.300 U
Cadmium	5	0.83	0.25	1.00 U	1.00 U
Chromium	100	8.9	50	1.69 J	3.30 J
Cobalt	N/A	3.98	3	0.200 U	0.105 J
Copper	1,300	0.23	3.1	1.80 U	**1.46 J**
Lead	15	0.92	2.5	0.700 U	0.195 J
Manganese	430	112	N/A	0.950 U	2.13 J
Mercury	2	0.026	0.025	0.0800 U	0.0800 U
Molybdenum	N/A	N/A	7.8	**9.62**	**11.4**
Nickel	N/A	5	8.2	1.00 U	0.374 J
Selenium	50	1	5	**2.75 J**	**2.68 J**
Silver	N/A	0.067	0.19	0.100 U	0.100 U
Thallium	2	0.8	2	0.200 U	0.200 U
Vanadium	N/A	20	19	3.82 J	10.2
Zinc	N/A	30	8.1	2.20 J	8.00 U

SOIL

Analyte	EPA Region 9 RSL	NPS ESV	CA Water Board ESL	DU-1 Mill Foundation ISM	DU-2 Tailings in Wash Discrete	DU-3 Background ISM
	mg/kg					
Antimony	31	0.05	20	**1,124**	**1,540**	**0.932**
Arsenic	0.68	0.25	0.39	**654**	**851**	**4.37**
Barium	15,000	17.2	750	**144**	**169**	**102**
Beryllium	160	0.242	4.0	**0.392**	**0.563**	**0.299**
Cadmium	71	0.27	12	**1.68**	**20.5**	0.181
Chromium	120,000	0.35	1,000	**10.9**	**10.1**	**6.71**
Cobalt	23	13	23	3.84	6.01	4.98
Copper	3,100	15	230	**1,320**	**1,979**	7.59
Lead	400	0.94	80	**14,661**	**12,579**	**6.79**
Manganese	1,900	220	NE	**414**	**12,447**	**314**
Mercury	11	0.013	6.7	**28.4**	**9.94**	**0.0161**
Molybdenum	390	NE	40	0.585	1.03	0.139
Nickel	1,500	9.7	150	7.8	9.59	6.82
Selenium	390	0.331	100	**4.36**	**5.72**	0.200
Silver	390	2.0	20	**89.6**	**71.6**	0.0349
Thallium	0.78	0.027	0.78	**2.36**	**1.67**	**0.142**
Vanadium	390	0.025	200	**190**	**172**	**20.3**
Zinc	23,000	6.62	600	**340**	**11,893**	**31.5**
Total Cyanide	2.7	0.1	0.0036	**0.618**	--	--

LEGEND

- SURFACE WATER SAMPLE
- DU-1 MILL FOUNDATIONS
- DU-2: TAILINGS IN WASH ALONG ROAD (DISCRETE SOIL SAMPLES)
- DU-3 BACKGROUND SOIL
- FLOW DIRECTION (ECM 2014)
- EXTENT OF MINE TAILINGS (ECM 2014)

ACRONYMS:
-- - NOT ANALYZED FOR
EPA - ENVIRONMENTAL PROTECTION AGENCY
ESL - ENVIRONMENTAL SCREENING LEVEL (TIER 1) (WATER BOARD, 2013)
ESV - ENVIRONMENTAL SCREENING LEVEL (NPS 2014)
ISM - INCREMENTAL SAMPLING METHOD
J - LABORATORY ESTIMATED VALUE
µg/L - MICROGRAMS PER LITER
mg/kg - MILLIGRAMS PER KILOGRAM
N/A - NOT APPLICABLE
NE - NOT ESTABLISHED
NPS ESV - NATIONAL PARK SERVICE ECOLOGICAL SCREENING VALUE
RSL - REGIONAL SCREENING LEVEL - MAXIMUM CONTAMINANT LEVEL
U - NOT DETECTED AT REPORTING LIMIT SHOWN

NOTE: FLOW DIRECTION AND EXTENT OF MINE TAILINGS FROM PRELIMINARY ASSESSMENT PREPARED BY ENVIRONMENTAL COST MANAGEMENT (ECM) IN 2014.

RESULTS IN **BOLD** EXCEED A SCREENING LEVEL.

N

0 40 80 160 Feet

UNITED STATES ARMY CORPS OF ENGINEERS

LOS ANGELES, CALIFORNIA

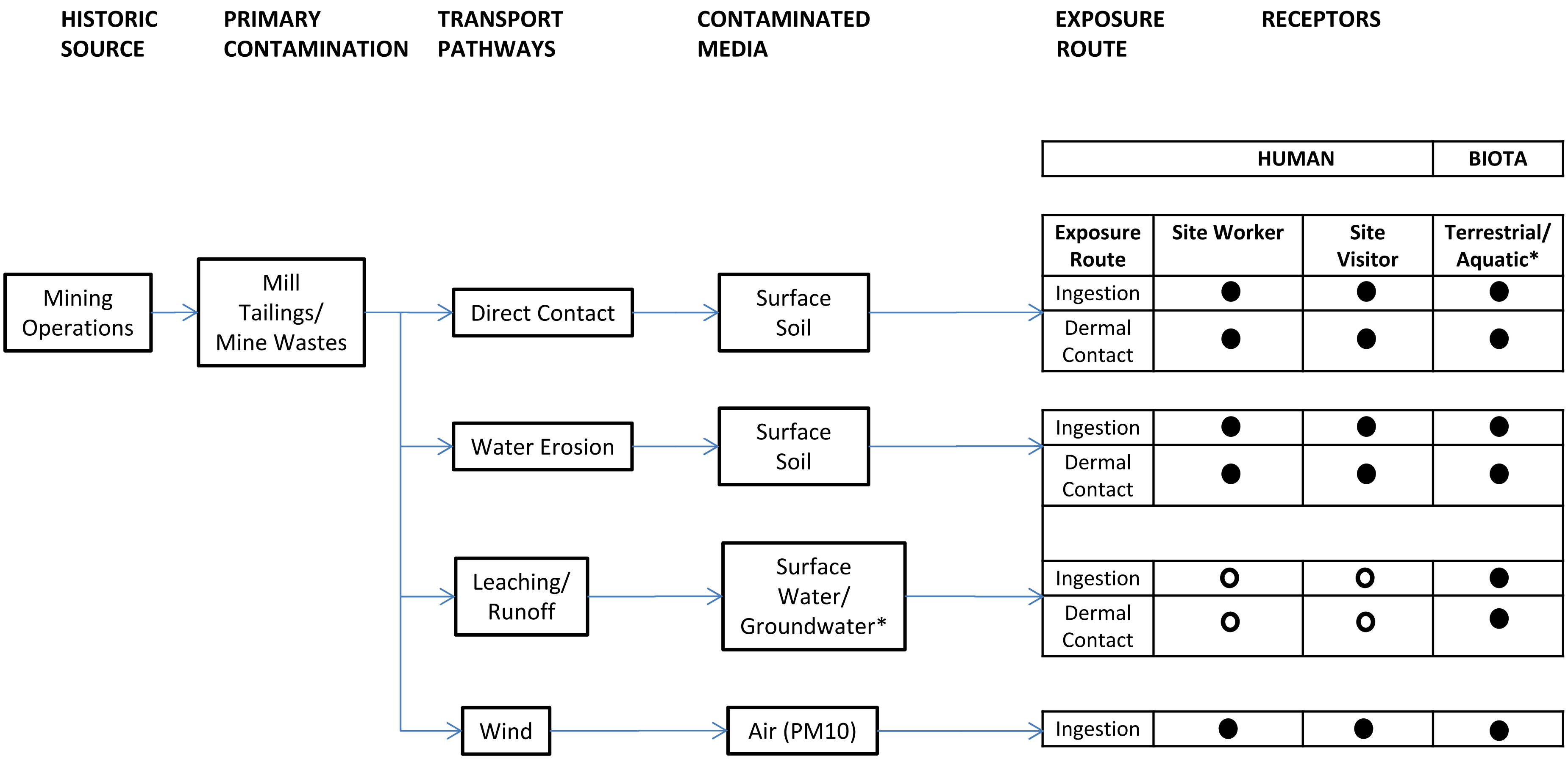
DEATH VALLEY NATIONAL PARK
CALIFORNIA AND NEVADA

FIGURE 8

GOLD HILL MILL

NOREAS
Environmental Engineering and Science

Figure 9. DEVA AML Sites Conceptual Site Model and Potential Exposure Pathways



* Surface water encountered in very limited volumes except at Gold Hill Mill; Groundwater occurrence unknown, unlikely to be used

● Pathway complete

○ Pathway incomplete or unlikely to be complete

Tables

Table 1. Sampling Summary Information

Gold Hill Mill Sampling Information	Soil						Water				ISM Grid Area	Sample Data	Sample IDs		
	Title 22 Metals	Hg	CN	ABA	TCLP	CAL-WET (STLC)	Title 22 Metals	Hg	CN	ISM Prep	Sq. Ft.		ISM	Discrete	Surface Water
DU-1 Mill Foundations	4	4	4	4						4	2,800	2/29/2016	GOLD-01-001 thru 004		
DU-2 Eroded Tailings in Wash Along Road	7	7										2/26/2016		GOLD-02-001 thru 007	
DU-3 Background Native Soils	3	3								3	3,000	2/29/2016	GOLD-03-001 thru 003		
Nearby Surface Water							3	3	3						GOLD-SW1 thru SW3
	14	14	4	4			3	3	3	7					

Table 8. Gold Hill Mill Laboratory Soil Analyses

Analyte	Units	EPA Region 9 RSL	NPS ESV	CA Water Board ESL	Background ISM Samples			**Background ISM 95% UCL**	Mill Foundations ISM Samples				**Mill Foundation ISM 95% UCL**
					280-80478-1 DEVA-GOLD-03-001 2/29/2016 9:20 AM	280-80478-2 DEVA-GOLD-03-002 2/29/2016 9:25 AM	280-80478-3 DEVA-GOLD-03-003 2/29/2016 10:20 AM		280-80478-4 DEVA-GOLD-01-001 2/29/2016 12:40 PM	280-80478-5 DEVA-GOLD-01-002 2/29/2016 12:50 PM	280-80478-6 DEVA-GOLD-01-003 2/29/2016 1:50 PM	280-80478-7 DEVA-GOLD-01-004 2/29/2016 2:00 PM	
Antimony	mg/kg	31	0.05	20	0.7	0.727	0.834	**0.932**	956	1,000	1,070	1,040	**1,124**
Arsenic	mg/kg	0.68	0.25	0.39	3.97	3.8	3.49 J	**4.37**	564	547	505	612	**654**
Barium	mg/kg	15,000	17.2	750	90.7	96.9 J	94.1	**102**	119	95.6	106	129	**144**
Beryllium	mg/kg	160	0.242	4.0	0.29	0.282	0.278	**0.299**	0.336	0.343	0.352	0.378	**0.392**
Cadmium	mg/kg	71	0.27	12	0.156	0.153	0.131	0.181	1.4	1.55	1.58	1.42	**1.68**
Chromium	mg/kg	120,000	0.35	1,000	5.77	6.23	5.57	**6.71**	10.0	8.08	8.03	9.2	**10.9**
Cobalt	mg/kg	23	13	23	4.41	4.68	4.68	4.98	3.5	3.62	3.46	3.73	3.84
Copper	mg/kg	3,100	15	230	6.99	7.08	6.55 J	7.59	1,110	1,080	1,080	1,260	**1,320**
Lead	mg/kg	400	0.94	80	6.21	6.38	5.89	**6.79**	12,600	11,700	12,100	13,900	**14,661**
Manganese	mg/kg	1,900	220	NE	274	287	254	**314**	364	377	367	401	**414**
Mercury	mg/kg	11	0.013	6.7	0.0102 J	0.0109 J	0.0136 J	**0.0161**	22.0	25.2	20.7	17.4	**28.4**
Molybdenum	mg/kg	390	NE	40	0.124 J	0.132 J	0.130 J	**0.139**	0.476	0.509	0.393	0.501	**0.585**
Nickel	mg/kg	1,500	9.7	150	6.13	6.44	5.92	6.82	7.37	6.33	6.5	6.92	7.8
Selenium	mg/kg	390	0.331	100	0.393 U	0.385 U	0.382 U	0.200	3.31	3.63	4.07	3.32	**4.36**
Silver	mg/kg	390	2.0	20	0.0216 J	0.0197 J	0.0285 J	0.0349	77.6	80.8	86.5	78.2	**89.6**
Thallium	mg/kg	0.78	0.027	0.78	0.136	0.139	0.139	**0.142**	1.23	1.4	2.07	1.21	**2.36**
Vanadium	mg/kg	390	0.025	200	18.6	19.5 J	18.4	**20.3**	157	165	178	175	**190**
Zinc	mg/kg	23,000	6.62	600	28.2	29.8 J	27.5	**31.5**	222	260	219	306	**340**
Cyanide, Total	mg/kg	2.7	0.1	0.0036					0.429 J	0.214 J	0.468 J	0.385 J	**0.618**
pH adj. to 25 deg C	SU				9.52	9.48	9.42		8.59	8.77	9.06	8.61	
ABA & Sulfur Forms													
ABA	TCaCO3/kT								143	147	139	148	
AGP	TCaCO3/kT								1.1	0.9	0.8	1.1	
ANP	TCaCO3/kT								144	148	140	149	
Non-extractable Sulfur	%								0.02	0.02	0.01	0.01	
Non-Sulfate Sulfur	%								0.05	0.05	0.04	0.05	
Pyritic Sulfur	%								0.03	0.03	0.03	0.04	
Sulfate Sulfur	%								0.04	0.05	0.05	0.04	
Total Sulfur	%								0.09	0.1	0.1	0.09	

J - Laboratory Estimated Value
U - Not Detected at stated reporting limit
ABA - Acid-Base Accounting
AGA - Acid Generating Potential
ANP - Acid Neutralization Potential
ISM - Incremental Sampling Method
mg/kg - milligrams per kilogram
NE - Not established
SU - Standard Unit
TCaCO3/kT - Tons of calcium carbonate equivalent per kiloton of soil.
Gray shaded cells - Not Analyzed
All 95% Upper Confidence Limits (UCLs) determined by Chebyshev method.
UCL results shown in bold exceed one or more screening levels
[a] - 95% UCL excludes results from sample DEVA-GOLD-002-007, as results are signficantly lower than other discrete samples in this DU
ESL - Environmental Screening Level (California Water Board)
NPS ESV - National Park Service Ecological Screening Value
RSL - Regional Screening Level (USEPA)

Table 8. Gold Hill Mill Laboratory Soil Analyses

Analyte	Units	EPA Region 9 RSL	NPS ESV	CA Water Board ESL	Eroded Tailings in Wash Along Road Discrete Samples							**Tailings in Wash Discrete[a] 95% UCL**
					280-80265-1 DEVA-GOLD-02-001 2/26/2016 11:25 AM	280-80265-2 DEVA-GOLD-02-002 2/26/2016 11:35 AM	280-80265-3 DEVA-GOLD-02-003 2/26/2016 11:40 AM	280-80265-4 DEVA-GOLD-02-004 2/26/2016 11:50 AM	280-80265-5 DEVA-GOLD-02-005 2/26/2016 11:55 AM	280-80265-6 DEVA-GOLD-02-006 2/26/2016 12:00 PM	280-80265-7 DEVA-GOLD-02-007 2/26/2016 12:10 PM	
Antimony	mg/kg	31	0.05	20	557 J	284	901	756	913	1,490	5.96	**1,540**
Arsenic	mg/kg	0.68	0.25	0.39	361	322	552	392	532	854	11.9	**851**
Barium	mg/kg	15,000	17.2	750	78.4	86.6	61.8	175	69.7	37.4	107 J	**169**
Beryllium	mg/kg	160	0.242	4.0	0.398	0.511	0.456	0.523	0.44	0.353	0.413 J	**0.563**
Cadmium	mg/kg	71	0.27	12	0.519	0.404	1.04	22.8	0.845	1.13	0.164 J	**20.5**
Chromium	mg/kg	120,000	0.35	1,000	6.47	9.94	4.99	7.48	7.38	5.23	7.29 J	**10.1**
Cobalt	mg/kg	23	13	23	3.68	5.7	2.82	4.46	3.44	1.91	5.3 J	6.01
Copper	mg/kg	3,100	15	230	693	688	1,440	635	951	1,920	16.5 J	**1,979**
Lead	mg/kg	400	0.94	80	4,740	3,870	7,920	5,230	8,870	12,000	71.2 J	**12,579**
Manganese	mg/kg	1,900	220	NE	318	309	350	13,900	249	264	325 J	**12,447**
Mercury	mg/kg	11	0.013	6.7	6.75 J	2.34	8.46	7.33	5.58	6.69	0.0388	**9.94**
Molybdenum	mg/kg	390	NE	40	0.473	0.943	0.402	0.845	0.654	0.601	0.182 J	**1.03**
Nickel	mg/kg	1,500	9.7	150	6.37	9.17	4.31	7.44	5.94	4.32	7.36 J	9.59
Selenium	mg/kg	390	0.331	100	2.54	3.54	4.43	3.84	3.99	5.51	0.270 UJ	**5.72**
Silver	mg/kg	390	2.0	20	45.6 J	11.1	41.0	36.8	47.3	63.6	0.161	**71.6**
Thallium	mg/kg	0.78	0.027	0.78	0.645	0.936	1.27	1.0	1.02	1.62	0.166 J	**1.67**
Vanadium	mg/kg	390	0.025	200	58.5	59.9	151	95.7	122	132	22.2 J	**172**
Zinc	mg/kg	23,000	6.62	600	102	109	163	13,300	118	177	33.0	**11,893**
Cyanide, Total	mg/kg	2.7	0.1	0.0036								
pH adj. to 25 deg C	SU				8.9	8.74	8.69	8.56	8.64	9.04	9.05	
ABA & Sulfur Forms												
ABA	TCaCO3/kT											
AGP	TCaCO3/kT											
ANP	TCaCO3/kT											
Non-extractable Sulfur	%											
Non-Sulfate Sulfur	%											
Pyritic Sulfur	%											
Sulfate Sulfur	%											
Total Sulfur	%											

J - Laboratory Estimated Value
U - Not Detected at stated reporting limit
ABA - Acid-Base Accounting
AGA - Acid Generating Potential
ANP - Acid Neutralization Potential
ISM - Incremental Sampling Method
mg/kg - milligrams per kilogram
NE - Not established
SU - Standard Unit
TCaCO3/kT - Tons of calcium carbonate equivalent per kiloton of soil.
Gray shaded cells - Not Analyzed
All 95% Upper Confidence Limits (UCLs) determined by Chebyshev method.
UCL results shown in bold exceed one or more screening levels
[a] - 95% UCL excludes results from sample DEVA-GOLD-002-007, as results are signficantly lower than other discrete samples in this DU
ESL - Environmental Screening Level (California Water Board)
NPS ESV - National Park Service Ecological Screening Value
RSL - Regional Screening Level (USEPA)

Table 9. Summary of Surface Water Analyses

Analyte	EPA Region 9 RSL (µg/L)	NPS ESV (µg/L)	Water Board ESLs (µg/L)	280-80267-1 DEVA-CASH-01-SW1 2/23/2016	280-80101-25 DEVA-SKID-02-SW1 2/18/2016	280-80101-26 DEVA-SKID-03-SW1 2/18/2016	280-80478-8 DEVA-GOLD-SW1 2/29/2016	280-80478-9 DEVA-GOLD-SW2 2/29/2016
Antimony	6	30	6	5.25 J	3.70 J	2.08 J	0.702 J	1.06 J
Arsenic	10	3.1	10	78.0 J	0.559 J	20.2	5.65	6.92
Barium	2,000	4	1,000	16	17	89.1	45.4	45.5
Beryllium	4	0.66	0.53	0.300 U	0.300 U	0.162 J	0.300 U	0.300 U
Cadmium	5	0.83	0.25	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
Chromium	100	8.9	50	1.80 U	0.511 J	1.98 J	1.69 J	3.30 J
Cobalt	N/A	3.98	3	1.4	0.547 J	2.64	0.200 U	0.105 J
Copper	1,300	0.23	3.1	20.9	12.2	25.7	1.80 U	1.46 J
Lead	15	0.92	2.5	9.6	10.5	891	0.700 U	0.195 J
Manganese	430	112	N/A	32.1 J	23.1	44.4	0.950 U	2.13 J
Mercury	2	0.026	0.025	0.585	0.27	1.02	0.0800 U	0.0800 U
Molybdenum	N/A	N/A	7.8	1.83 J	0.438 J	2.03	9.62	11.4
Nickel	N/A	5	8.2	3.66	1.96 J	2.76 J	1.00 U	0.374 J
Selenium	50	1	5	2.00 U	2.00 U	2.00 U	2.75 J	2.68 J
Silver	N/A	0.067	0.19	0.692 J	0.929 J	2.31 J	0.100 U	0.100 U
Thallium	2	0.8	2	0.200 U	0.200 U	0.0530 J	0.200 U	0.200 U
Vanadium	N/A	20	19	4.53 J	2.00 U	10.1	3.82 J	10.2
Zinc	N/A	30	8.1	12.6 J	41.9	375	2.20 J	8.00 U

ESL – Environmental Screening Level (Tier 1) (Water Board 2013)

ESV – Environmental Screening Level (NPS 2014); SLERA COPEC Selection ESV (Table 1a) listed

RSL – Regional Screening Level – Maximum Contaminant Level

SLERA – Screening Level Ecological Risk Assessment

J - Laboratory estimated value

U - not detected at reporting limit shown

ug/L - micrograms per liter

Table 10. Summary of Soil Leachability Analyses

TCLP Analyte	Units	280-80101-28 **DEVA-SKID-01-003** **2/19/2016**	280-80765-7 **DEVA-HOME-01-003** **3/8/2016**	280-80765-8 **DEVA-HOME-01-004** **3/8/2016**	280-80765-15 **DEVA-HOME-03-002** **3/9/2016**	280-80765-40 **DEVA-HOME-04-012** **3/8/2016**
Arsenic	mg/L					
Lead	mg/L	9.25	0.448 J	0.0564 J		
Mercury	mg/L				0.0000317 J H	0.000343 J H

TCLP Analyte	Units	280-80481-27 **DEVA-JOUR-01-002** **3/2/2016**	280-80481-22 **DEVA-JOUR-02-002** **3/1/2016**	280-80481-32 **DEVA-JOUR-03-003** **3/2/2016**	280-80481-34 **DEVA-JOUR-04-001** **3/2/2016**	280-80481-40 **DEVA-JOUR-05-003** **3/3/2016**	280-80481-53 **DEVA-JOUR-06-002** **3/3/2016**
Arsenic	mg/L						
Lead	mg/L	0.618	0.184 J	0.247 J	0.0251 J		13
Mercury	mg/L					0.000738 J	

TCLP Analyte	Units	280-80475-4 **DEVA-STAR-01-003** **3/3/2016**	280-80266-4 **DEVA-TUCK-02-001** **2/22/2016**	280-80267-9 **DEVA-CASH-01-004** **2/24/2016**	280-80267-14 **DEVA-CASH-02-001** **2/24/2016**	280-80267-11 **DEVA-CASH-03-002** **2/24/2016**	280-80267-28 **DEVA-CASH-04-011** **2/25/2016**
Arsenic	mg/L		0.0574 J	0.0837 J	0.0247 J	0.160 J	0.197 J
Lead	mg/L	0.0581 J			0.131 J	0.144 J	0.0579 J
Mercury	mg/L	0.000112 J J	0.0000800 U H				0.000113 J H

J - Laboratory estimated value, below reporting limit
H - Sample analyzed outside of hold time
U - Not detected at laboratory reporting limit shown
TCLP - Toxicity Characteristics Leaching Procedure
mg/L - milligrams per liter
Gray cell - not analyzed

Gold Hill Mill

Photo 1: View of Gold Hill Mill looking south.

Photo 2: View of wash/road next to mill looking west.

Gold Hill Mill

Photo 3: View of wash/ road next to mill looking east toward abandoned talc mine.

Photo 4: View of DU-1 Mill Foundations ISM grid looking west.

Gold Hill Mill

Photo 5: View of DU-1 Mill Foundations ISM grid looking west.

Photo 6: View of DU-1 Mill Foundations ISM grid looking east.

Gold Hill Mill

Photo 7: View of DU-1 Mill Foundations ISM grid looking south.

Photo 8: View of DU-1 Mill Foundations ISM grid looking south.

Gold Hill Mill

Photo 9: View of DU-1 Mill Foundations ISM grid looking east.

Photo 10: View of DU-2 Eroded Tailings in Wash Along Road looking west.

Gold Hill Mill

Photo 11: View of DU-2 Eroded Tailings in Wash Along Road looking southwest.

Photo 12: View of DU-3 Native Soils ISM grid setup in wash northwest of mill looking west.

Gold Hill Mill

Photo 13: View of DU-3 Native Soils ISM grid setup in wash northwest of mill looking southwest.

Photo 14: View of DU-3 Native Soils ISM grid setup in wash northwest of mill looking west.

Gold Hill Mill

Photo 15: View of DU-3 Native Soils ISM grid setup in wash northwest of mill looking east.

Photo 16: View of Warm Spring located south of Mill.

Gold Hill Mill

Photo 17: View of surface water runoff from Warm Spring and GOLD-SW1 sampling location.

Gold Hill Mill

Photo 18: View of surface water runoff from Warm Spring an d GOLD-SW2 sampling location east of Gold Hill Mill along wash/road.

Appendix B – Global Positioning System Survey Data

Appendix B
GPS Data - Site Inspection Report
DEVA AML Sites

Site	Comment	GPS_Date	GPS_Time	GNSS_Height	Point_ID	x (CA State Plane Zone 5)	y (CA State Plane Zone 5)
Cashier	DU-5 Background Native Soils (Wash)	2/23/2016 0:00	04:09:21pm	5088.195		6824490.426	2682987.828
Cashier	DU-5 Background Native Soils (Wash)	2/23/2016 0:00	04:10:52pm	5086.826		6824477.501	2683004.602
Cashier	DU-5 Background Native Soils (Wash)	2/24/2016 0:00	11:49:02am	5086.459		6824478.221	2683005.328
Cashier	DU-5 Background Native Soils (Wash)	2/24/2016 0:00	11:51:20am	5087.446		6824468.313	2683000.066
Cashier	DU-5 Background Native Soils (Wash)	2/24/2016 0:00	11:52:46am	5088.486		6824481.263	2682983.917
Cashier	DU-5 Background Native Soils (Wash)	2/24/2016 0:00	11:53:47am	5088.223		6824490.837	2682988.16
Gold Hill	DU-1 Mill Foundation	2/29/2016 0:00	01:24:47pm	2361.236	19	6877825.646	2540610.244
Gold Hill	DU-1 Mill Foundation	2/29/2016 0:00	01:27:59pm	2358.105	20	6877828.124	2540649.28
Gold Hill	DU-1 Mill Foundation	2/29/2016 0:00	01:29:53pm	2354.695	21	6877893.785	2540643.144
Gold Hill	DU-1 Mill Foundation	2/29/2016 0:00	01:31:21pm	2357.677	22	6877889.959	2540603.403
Gold Hill	DU-3 Background Native Soils	2/29/2016 0:00	12:19:55pm	2362.323	15	6877714.667	2540703.344
Gold Hill	DU-3 Background Native Soils	2/29/2016 0:00	12:21:34pm	2362.556	16	6877711.872	2540723.507
Gold Hill	DU-3 Background Native Soils	2/29/2016 0:00	12:23:41pm	2372.176	17	6877567.352	2540692.533
Gold Hill	DU-3 Background Native Soils	2/29/2016 0:00	12:25:03pm	2371.622	18	6877568.91	2540672.422
Gold Hill	GOLD-02-001	2/26/2016 0:00	12:22:55pm	2358.701	8	6877840.185	2540653.447
Gold Hill	GOLD-02-002	2/26/2016 0:00	12:34:44pm	2352.511	9	6877861.388	2540673.038
Gold Hill	GOLD-02-003	2/26/2016 0:00	12:42:20pm	2353.31	10	6877901.997	2540654.004
Gold Hill	GOLD-02-004	2/26/2016 0:00	12:50:59pm	2354.167	11	6877898.805	2540647.013
Gold Hill	GOLD-02-005	2/26/2016 0:00	12:54:09pm	2352.447	12	6877899.571	2540662.197
Gold Hill	GOLD-02-006	2/26/2016 0:00	01:01:44pm	2353.12	13	6877883.276	2540669.264
Gold Hill	GOLD-02-007	2/26/2016 0:00	01:09:33pm	2335.469	14	6878184.003	2540595.598
Gold Hill	GOLD-SW1 Upstream Surface Water Sample	2/26/2016 0:00	11:52:15am	2372.316	6	6877825.529	2540292.344
Gold Hill	GOLD-SW2 Downstream Surface Water Sample	2/26/2016 0:00	11:44:37am	2299.781	5	6878728.202	2540714.283
Homestake	DU-1 Mill Foundation	3/8/2016 0:00	02:51:02pm	4870.541	9	6886784.209	2894242.271
Homestake	DU-1 Mill Foundation	3/8/2016 0:00	02:53:05pm	4871.104	10	6886809.863	2894316.502
Homestake	DU-1 Mill Foundation	3/8/2016 0:00	03:04:32pm	4899.299	16	6886758.582	2894302.017
Homestake	DU-1 Mill Foundation	3/8/2016 0:00	03:07:07pm	4898.916	18	6886741.086	2894246.855
Homestake	DU-1 Mill Foundation	3/8/2016 0:00	03:10:45pm	4912.675	20	6886724.645	2894267.441
Homestake	DU-1 Mill Foundation	3/8/2016 0:00	03:13:10pm	4912.462	22	6886735.566	2894305.244
Homestake	DU-1 Mill Foundation	3/8/2016 0:00	03:15:40pm	4908.144	24	6886723.859	2894308.991
Homestake	DU-1 Mill Foundation	3/8/2016 0:00	03:16:52pm	4912.261	25	6886713.439	2894271.334
Homestake	DU-1 Mill Foundation	3/8/2016 0:00	03:21:37pm	4914.096	27	6886694.391	2894281.315
Homestake	DU-1 Mill Foundation	3/8/2016 0:00	03:22:45pm	4916.874	28	6886705.593	2894258.103
Homestake	DU-1 Mill Foundation	3/8/2016 0:00	03:24:22pm	4917.851	30	6886689.832	2894262.956
Homestake	DU-1 Mill Foundation	3/8/2016 0:00	03:26:51pm	4930.913	32	6886676.807	2894263.462
Homestake	DU-1 Mill Foundation	3/8/2016 0:00	03:27:31pm	4933.731	33	6886666.717	2894265.63
Homestake	DU-1 Mill Foundation	3/8/2016 0:00	03:28:49pm	4933.948	34	6886678.284	2894305.976
Homestake	DU-1 Mill Foundation	3/8/2016 0:00	03:29:31pm	4929.679	35	6886687.765	2894302.695
Homestake	DU-2 Mill Tailings Stockpile	3/8/2016 0:00	12:21:00pm	4738.924	4	6887175.029	2894186.218

Appendix C – Chain of Custody Records and Laboratory Reports (Provided on CD)

Appendix D – Data Validation Report
(Provided on CD)

Appendix B – Human Health Risk Assessment

APPENDIX B
BASELINE HUMAN HEALTH RISK ASSESSMENT
GOLD HILL MILL SITE

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Definitions and Terms

Chronic	Occurring over a long time. Chronic exposures are typically greater than 1 year.
Cancer	Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.
Cancer Risk	A theoretical probability for getting cancer if exposed to a substance over 70 years (a lifetime exposure). The true risk might be lower.
Carcinogen	A substance that causes cancer.
Exposure	Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term, of intermediate duration, or long-term
Non-carcinogen	A substance that has not shown to cause cancer

List of Abbreviations and Acronyms

AB	Assembly Bill
AML	Abandoned Mine Land
AMSL	Above Mean Sea Level
BHHRA	Baseline Human Health Risk Assessment
Cal EPA	California Environmental Protection Agency
CEM	Conceptual Exposure Model
CSF	Carcinogenic Slope Factor
COPC	Chemical of Potential Concern
DEVA	Death Valley National Park
DQO	Data Quality Objective
DTSC	Department of Toxic Substances Control
DTSC-SL	DTSC-Screening Level
DU	Decision Unit
EE/CA	Engineering Evaluation/Cost Analysis
EPC	Exposure Point Concentration
HI	Hazard Index
HQ	Hazard Quotient
hr/yr	hours per year
ISM	Integrated Sampling Methodology
mg/kg	milligrams per kilogram
NOREAS	NOREAS, Inc.
NPS	National Park Service
OEHHA	Office of Environmental Health Hazard Assessment
PEP	Potentially Exposed Population
PM	Particulate Matter
RfC	Noncarcinogenic Inhalation Reference Concentration
RfD	Noncacinogenic Oral Reference Dose
RML	USEPA Risk Management Level
RSL	USEPA Regional Screening Level
SAP	Sampling and Analysis Plan
SI	Site Inspection
SIR	Site Inspection Report
SOP	standard operating procedure
TCR	Toxicity Criteria Rule
UCL	upper confidence limit
$\mu g/m^3$	micrograms per cubic meter
URF	unit risk factor
USEPA	U.S. Environmental Protection Agency
USACE	United States Army Corps of Engineers
UTM	Universal Transverse Mercator
XRF	X-ray fluorescence

B.1 Introduction

Appendix B presents the results of a Baseline Human Health Risk Assessment (BHHRA) for Gold Hill Mill Site (Site). As a result of historic mining activities at the Site, located within the Death Valley National Park (DEVA), a redistribution and concentration of heavy metals has occurred from operations represented by identified Decision Units (DUs). Human exposures to these contaminants may result in potential health risks. To assess these risks, this BHHRA has been prepared for the Site. The results of the BHHRA are intended to support the Engineering Evaluation/Cost Analysis Report (EE/CA), to which this BHHRA is appended, and are used to determine if potential risks are unacceptable and, if so, to inform the selection of appropriate cleanup levels, if necessary, and help focus the risk management alternatives.

This BHHRA presents the methods and assumptions used to estimate health risks as well as the results and findings. Data sources and references are presented in attached tables, as well as all calculations. When appropriate, figures are referenced to those presented as part of the EE/CA.

The BHHRA includes the following components:

- Hazard identification
- Exposure assessment
- Toxicity assessment
- Risk characterization

The HHRA was prepared according to United States Environmental Protection Agency (USEPA) guidance on conducting HHRAs in support of the Superfund program, including, but not limited to, the following:

- USEPA 1989. Risk Assessment Guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response. EPA/540/1-89/002.

- USEPA 1991a. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals) Office of Emergency and Remedial Response. EPA/540/R-92/003. December 1991

- USEPA. 1996a. Soil Screening Guidance: User's Guide. Office of Emergency and Remedial Response. Washington, DB. OSWER No. 9355.4-23

- USEPA. 1996b. Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. Washington, DC. OSWER No. 9355.4-17A

B.2 Hazard Identification

Hazard identification is the process of identifying potential chemicals that may originate from the Site that could result in exposures to toxic contaminants. Based on an understanding of the contaminant sources, Contaminants of potential concern (COPCs) are identified by comparing maximum detected

concentrations in each media to the lowest appropriate risk-based screening levels. These screening levels are based on a target excess lifetime cancer risk of 1 in 1 million ($1x10^{-6}$) and a target non-cancer hazard quotient (HQ) of 0.1 based on exposure assumptions derived from a residential exposure scenario.

Contaminants detected above these screening levels were identified as COPCs and carried forward in the risk assessment.

B 2.1 Contaminant Sources

Gold Hill Mill is located approximately 35 miles south of Furnace Creek, California, in Warm Spring Canyon at an elevation of 2,360 feet above sea level. The Gold Hill Mining District is one of the oldest mining areas within DEVA, with prospecting and work dating from the 1870s. The Gold Hill region is located within DEVA in the southwest corner, in the Panamint Mountain Range, at the northeastern end of Butte Valley and north of Warm Spring. This site is accessed via 14 miles of infrequently graded dirt roads requiring high clearance four-wheel drive vehicles. Gold Hill Mill experiences moderate annual visitation. The site covers less than 1 acre and consists of a complete and well-preserved mill with evidence of mercury amalgamation. SI field activities at Gold Hill Mill were performed in February 2016. Three DUs are present at Gold Hill Mill that represent potential contaminant sources: DU-1 Mill Foundations, and DU-2 Eroded Mill Tailings in wash along road.

Image D-1 Gold Hill Mill

DU-1 – Mill Foundation

The mill foundations (DU-1) ISM area is approximately 2,800 square feet and includes the ore crushing area and the ramp. A total of four ISM samples (GOLD-01-001 thru GOLD-01-004) were collected from DU-1.

DU-2 – Tailings in Wash

> Discrete samples of the mill tailings in the wash along the road (DU-2) were collected just north of the mill foundations and approximately 300 feet downgradient from the mill. A total of 7 discrete samples (GOLD-02-001 thru GOLD-02-007) were collected from DU-2.

Figure B.1 shows the layout of the Gold Hill Mill Site and the associated DUs.

B 2.2 Results of Site Inspection

To assess the environmental concentrations at the DUs, extensive field and analytical activities occurred and are reported in the SIR (NOREAS 2016). Soils at DU-1 were assessed using an Integrated Sampling Methodology (ISM) at DU-1. The ISM provides representative samples of a DU by collecting numerous increments of soil (30 increments were used at DEVA) that are combined, processed, and subsampled according to specific protocols. Detailed procedures for ISM sampling are presented in Incremental Sampling Methodology (ITRC 2012), and further described in the SIR (NOREAS 2016).

Visually observable mill tailings in the wash (DU-2) were of limited extent, within approximately 50 feet of the mill site. Based on characterizing observable tailings, seven (7) discrete samples (GOLD-02-001 thru GOLD-02-007) were collected in the wash. One discrete sample, DEVA-GOLD-02-007, collected 300 feet downgradient of the mill, was of uncertain origin and was collected to determine if the soils that could not clearly be visually identified as mill tailings exhibited the chemical signature of mill tailings. Results from this sample did not report elevated concentrations of metals at that location indicating that the extent of tailings had been captured by the sampling.

An area approximately 140 feet west of the mill on the north side of the road within a wash was identified as representative background native soils (DU-3). A total of 3 ISM samples (GOLD-03-001 thru GOLD-01-003) were collected from DU-3.

The results of the site inspection are presented in Table B 2.1, and summary statistics for these data are presented in Table B 2.2.

B 2.3 Selection of COPCs

Contaminants of potential concern (COPCs) were identified by comparing maximum detected concentrations in ISM samples to the lowest appropriate risk-based screening levels, which were identified in the sampling and analysis plan (SAP). The SAP (NOREAS 2016) identified the USEPA Residential Regional Screening Levels (RSLs) (USEPA 2019a) as appropriate risk-based screening levels. For BHHRA purposes, these screening levels are based on a target excess lifetime cancer risk of 1 in 1 million (1E-06) and a target non-cancer hazard quotient (HQ) of 0.1 based on exposure assumptions derived from a residential exposure scenario. To supplement the RSLs, the California EPA Department of Toxic Substances Control (DTSC) Screening Levels (DTSC 2019a) were also used in the identification of COPCs. These conservative screening levels ensure that potential contaminants are not prematurely rejected and are carried through the BHHRA and remain consistent with both state and federal screening levels.

Contaminants detected above these screening levels were identified as COPCs and carried forward in the risk assessment. This comparison is presented in Table B 2.3, and identifies the following COPC for the BHHRA:

- Antimony
- Arsenic
- Cadmium
- Cobalt
- Copper
- Lead
- Mercury
- Silver
- Thallium
- Zinc

B.3 Exposure Assessment

The exposure assessment characterizes, estimates, and predicts exposures, and provides information for developing exposures requiring the assessment of potential health impacts. Through the exposure assessment process, the HRA identifies potentially exposed populations and under what conditions they may be exposed.

B 3.1 Exposure Setting

The site covers less than 1 acre and consists of a complete and well-preserved mill with evidence of mercury amalgamation. Minor mill tailings from the amalgamated mercury process used to extract the gold have accumulated in and around the mill workings, primarily on the east side, scattered in and around the equipment, and comingling with native rock. An abandoned mining camp (Warm Spring Camp) are located south approximately 200-300 feet upslope of the mill ruins and were not identified to be impacted by mining activities (ECM 2014). Warm Spring is located behind and south of the Warm Spring Camp cabins, cross gradient and upslope of the mill ruins. The workings of a former talc mine operation occur approximately 700 feet downgradient (approximately west-south-west of the mill), along the south site of the wash (ECM 2014).

B 3.1.1 Geologic Setting and Hydrogeology

Gold Hill Mill is located on the southwest portion of the Panamint Range immediately adjacent to Death Valley to the east. The Site is north of Owlshead Mountains and west of the Black Mountains. Panamint Valley is to the west.

Bedrock in the vicinity of the Site is pre-Cenozoic granitic and metamorphic rocks of the Cronese Mountains area. This undifferentiated unit includes assemblages of quartzite, marble, talc, schist, and meta-igneous rocks. The mill ruins rest in the bottom of an east-west trending, narrow mountain canyon wash that slopes eastward at a moderate rate toward Death Valley. The site resides on a flat-bottomed ledge of recent Quaternary sediments (ECM 2014).

DEVA is located in the South Lahontan Region (HR), which covers approximately 21 million acres in eastern California. The HR is bounded on the west by the crest of the Sierra Nevada, on the north by the watershed divide between Mono Lake and East Walker River drainages, on the easy by Nevada, and on the south by the crest of the San Gabriel and San Bernardino mountains and the divide between watersheds draining south toward the Colorado River and those draining northward. This HR includes the Owens, Mojave, and Amargosa river systems, the Mono Lake drainage system, and many other internally

drained basins. Runoff is about 1.3 million acre-feet per year. Areas within the South Lahontan HR where groundwater occurs outside alluvial groundwater basins are called groundwater source areas. These areas are associated with the igneous intrusive and extrusive, metamorphic, and sedimentary rocks that underlie the mountainous regions of the HR. Because many of the bedrock regions of the HR consist of mineralized metamorphic rock containing ores of copper, gold, silver, lead, mercury, zinc, and other metals, potential impacts to groundwater are anticipated to predominantly derive from these natural sources (ECM 2014).

A spring is located south 850 feet upslope of the mill ruins. Surface water sampling does not indicate an influence of contaminants from the Gold Hill Mill site (NOREAS 2016). There are no lakes or permanent ponds nearby the site (ECM 2014).

B 3.1.2 Climate

Death Valley National Park covers over 3 million acres of Mojave and Great Basin Desert terrain, with elevations ranging from 282 feet below mean sea level at Badwater Basin to 11,049 feet on the summit of Telescope Peak. Temperatures in the valley range from over 120 degrees Fahrenheit (°F) in the summer to an average of 40°F in the winter but often dip below freezing. Annual precipitation varies from a 2.5-inch 30-year average on the valley floor to over 15 inches in the higher mountains.

NPS maintained a climate station at Furnace Creek in Death Valley (approximately 35 miles north of Gold Hill) until 2007. Although exact wind speeds were not archived, daily wind movement, which measures the total distance the wind moves each day, was recorded. According to these records, average daily wind movement is lowest during the winter and peaks during the early spring. Within DEVA, it not uncommon for fine-grained material to become airborne and re-distribute great distances from its source.

Prevalent wind direction is from the south; however, conditions vary greatly in specific locations. The PA (ECM, 2014) presents an analysis of wind conditions at select locations. High winds gusts (estimated in excess of 40 miles per hour [mph]) and wind-transport of fine-grained material were observed at Gold Hill Mill during Site Inspection work. The highest average winds at Death Valley come from mid spring and early summer and average 11 mph (USA Today, 2018).

B 3.1.3 Vegetation

In general, Death Valley National Park contains a great diversity of plants. Vegetation zones include creosote bush, desert holly, and mesquite at the lower elevations. At the higher elevations, shad scale, black brush, Joshua tree, pinyon-juniper, to sub-alpine limber pine and bristlecone pine woodlands can be observed. The saltpan in the middle portion of the valley is devoid of vegetation and the slopes along the valley's alluvial fans have sparse cover (NOREAS 2016).

B 3.2 Potentially Exposed Populations

Access to the Gold Hill Mill site is a limited by the 14 miles of graded dirt roads requiring high clearance four-wheel drive vehicles. However, it is estimated that Gold Hill Mill receives 2,000 visitors yearly (NPS, 2019), who are also attracted to the Warm Spring Camp (abandoned) and talc mine (non-operational). Park staff and contractors may access the site to visit and work as well. Based on site visitation and usage, the following potentially exposed populations (PEPs) are identified:

Park Worker - Adult

The evaluation of this scenario will identify potential health impacts to NPS workers that actively visits the Gold Hill Mill Site.

Tourist Visitor – Adult and Child

The scenario is descriptive of the common tourist family that could visit the Site and is mostly trail bound. The results from this scenario will identify potential health impacts to the common site visitor.

Mining Enthusiast Visitor – Adult and Child

This scenario is descriptive of the Mining Enthusiast family that is off the trail, physically handles rocks/soil/tailings. In general, more involved in exploring the mill/mine sites than the typical tourist. This scenario represents the potential upper-bound exposures to the site visitors (adult and child).

B 3.3 Potential Exposure Media

Exposure media represents contaminated environmental media that the PEPs may encounter. The following sections discuss the potential exposure media considered in the BHHRA.

B 3.3.1 Soil

As identified by in the SI, soils at the Gold Hill Mill site contain heavy metals associated with mining activities and waste. Surface soil represents complete and potentially significant exposures to the identified PEPs due to the potential for tailings to impact site soil and dust.

B 3.3.2 Air

Exposures related to inhalation of windborne particulates are considered likely due to the arid climate, high wind speeds and extended wind movement at the site. Airborne concentrations of contaminants originating from site soils represent complete and potentially significant exposures to the identified PEPs.

B 3.3.3 Surface Water

A spring and an abandoned mining camp are located south 850 feet upslope of the mill ruins and does not appear to have been impacted by mining activities. Surface water samples were collected from Warm Spring. Surface water sampling does not indicate an influence of contaminants from Gold Hill Mill directly impacting surface waters downgradient of the site.

B 3.3.4 Groundwater

No potable water wells are nearby the site. No residences are nearby, and groundwater is not used as a drinking water source (ECM, 2014), therefore there are no exposures to site groundwater.

B 3.4 Potential Routes of Exposure

Potential routes of exposure represent how the PEPs may be exposed to the identified exposure media and are discussed in the following sections.

B 3.4.1 Soil Ingestion

Inadvertent and incidental soil ingestion may occur as the PEPs visit and explore the Gold Hill Mill site. Soil and dust may adhere to hands and may be inadvertently ingested.

B 3.4.2 Dermal absorption

Dermal exposure results when soil containing contaminants contacts and adheres to the skin. Of the COPCs evaluated, the USEPA (2019a) identifies that arsenic is a COPC that has dermal absorption potential.

B 3.4.3 Inhalation Exposure

Exposure to substances in ambient air may occurs through the inhalation of particulate matter originating from site related material, consequently inhalation exposures can occur. This exposure is likely because of the fine-grained nature of the tailings. The canyon-like setting can also focus the winds such that wind-blown tailings would be common.

B 3.5 Potential Exposure Scenarios

The identified PEPs may be exposed to site contaminants based on the following exposure scenarios.

> **Tourist Visitor Scenario**: Assumes periodic visits to the Gold Hill Mill Site. Activities are mostly trail bound, with little off trail exploration. The Tourist Visitor may include both adults and children. There is a road that leads to the Gold Hill Mill site. Additionally, all of the remaining structures would be attractive to tourists.
>
> **Mining Enthusiast Visitor Scenario**: Assumes frequent and longer visit to the Gold Hill Mill site than the Tourist Scenario. The enthusiast explores the Gold Hill Mill site, inspecting relics and artifacts. Off trail exploration is expected by both adult and child enthusiasts.
>
> **NPS Worker Scenario:** The Gold Hill Mill site is frequently visited by NPS staff with 1-2 visits per month. This scenario depicts their frequent visits to the site.

B 3.6 Conceptual Exposure Model

A conceptual exposure model (CEM) is a graphical representation of potential exposures to be evaluated. The CEM is presented as Table B 3.1

B 3.7 Exposure Point Concentrations

The estimation of the concentration of a chemical in the environment is termed the exposure point concentration (EPC) and is a conservative estimate of the average concentration. The EPCs are determined for each DU. The USEPA recommends using the average concentration likely to be contacted over time (USEPA. 1989). For the datasets represented by ISM sampling, the arithmetic mean of ISM

samples were selected as the EPC and are presented in Table B 3.2For DU-2, where discrete samples were analyzed, the 95 percent upper confidence limit (UCL) of the arithmetic mean was selected for the EPC. The SI has estimated the 95% UCL for the detected chemicals and are presented in Table B 3.2. If the 95%UCL exceeds the maximum concentrations, the maximum concentration was selected as the EPC.

B 3.7.1 Particulates in Air

To estimate particulate concentrations in air, the particulate emission factor (EF_{part}) methodology was used. The EF_{part} is representative of the relationship between soil concentrations and particulate concentrations as follows:

$$C_{soil}/EF_{part} = C_{air}$$

Where:

C_{soil} = Concentration in soil (mg/kg)

EF_{part} = Particulate emission factor (cubic meters per kilogram [m^3/kg])

C_{air} = Concentration in air (mg/m^3)

To estimate the EFpart, the following equation was used:

$$EF_{part} = \frac{Q}{C_{wind}} \times \frac{3600\ seconds\ per\ hour}{0.036 \times (1-V) \times \left(\frac{U_m}{U_t}\right)^3 \times F(x)}$$

Variable	Variable Definition	Value
EF_{part}	Particulate Emission Factor (m^3/kg)	5.28E+08
Q/Cwind	Inverse of the ratio of the geometric mean air concentration to the emission flux at the center of the source or at the boundary of the source (g/m^2-s per kg/m^2)	83.09653
V	Fraction of vegetative cover	0.01
U_m	Mean annual windspeed (m/s). Based on highest average winds of 11 mph at Death Valley (USA Today 2018).	4.917
U_t	Equivalent threshold value of windspeed at 7m (m/s)	11.32

Variable	Variable Definition	Value
F(x)	Function dependent on U /U derived using Cowherd et al. (1985) (unitless)	0.194

And:

$$Q/C_{wind} = A \text{ x } \exp[(\ln A_{site} - B)^2/C]$$

Variable	Variable Definition	Value
Q/C	Inverse of the ratio of the geometric mean air concentration to the emission flux at the center of the source or at the boundary of the source (g/m^2-s per kg/m^2)	83.09653
A	Constants based on air dispersion modeling for specific climate zones. Climate based on Las Vegas.	13.3093
B		19.8387
C		230.1652
A_{site}	Areal extent of the site or contamination (acres)	0.5
$\ln A_{site}$		-0.6931472

The resulting EFpart value of 5.28×10^8 is integrated into the daily and lifetime inhalation exposure factors (Table B 3.3) which are then used to estimate COPC intakes from air in Attachment B 1.

B 3.7.2 Volatiles in Air

Of the identified COPC, only mercury is considered volatile. To assess mercury concentrations in air resulting from volatilization, the USEPA derived volatility factor (VF) for mercury of 3.4×10^4 m^3/kg was identified. The concentration in air due to volatile mercury is estimated as:

$$C_{soil}/VF = C_{air}$$

Where:

C_{soil} = Concentration in soil (mg/kg)

EF_{part} = Volatility Factor (m^3/kg)

C_{air} = Concentration in air (mg/m^3)

The application of the VF for mercury is integrated to the estimation of intakes in Attachment B 1.

B 3.8 Exposure Factors

Identification of relevant exposure factors is necessary to quantify potential exposures, Exposure factors define variables that, for example, depict how long a PEP may be exposed, and the intake quantity of exposure media. A summary of the exposure factors used in the BHHRA are presented in Table B 3.3, and are discussed below.

B 3.8.1 Tourist Visitor

The Tourist Visitor scenario assumes a visit to the Gold Hill Mill site once a year, representing an Exposure Frequency (EF) of 1 day per year, for a total of 12 years (6 as a child, and 6 as an adult) (USEPA, 2011), which correspond to the USEPA mean residential occupancy period (i.e., how long a person lives at a given location). This exposure duration (ED) assumes that frequent visitors will live within a practical distance from the Site, and upon moving will cease visits. Potential health impacts are evaluated for childhood and adult exposures. Based on information provided by the NPS, the average exposure time (ET) at the Gold Hill Mill site is assumed to be 30 minutes (NPS 2019).

Additional exposure factors are as follows:

Ingestion Rate (IR): Considering the dusty/dry environment of the mill sites at DEVA, for the Tourist, the IR for child and adult are 200 mg/day and 100 mg/day, respectively. These are typical USEPA RME assumptions (USEPA 2019a).

Soil Adherence Factor (AF): For the Tourist, the AF for child and adult are 0.2 mg/cm^2 and 0.07 mg/cm^2, respectively. These are typical USEPA RME assumptions (USEPA 2019a).

Skin Surface Area (SA): This represents how much skin is exposed and available for contact with soil. For the child tourist, the SA was 2,373 cm^2, and the adult 6,032 cm^2. These are typical USEPA RME assumptions (USEPA, 2019a).

B 3.8.2 Mining Enthusiast Visitor

The Mining Enthusiast Visitor scenario, like the Tourist Visitor scenario, assumes a total exposure duration (ED) of 12 years (6 as a child, and 6 as an adult). As previously noted, this scenario is descriptive of the Mining Enthusiast family that is off the trail, physically handles rocks/soil/tailings. In general, more involved in exploring the mill/mine sites than the typical tourist. This PEP has been observed at DEVA and their enthusiastic interest in abandoned mine sites are expected to continue in the future.

To determine exposure time (ET) and exposure frequency (EF) an assessment based on the "Activity Features" present at the Gold Hill Mill site and an assumption of time spent at each feature was made. Activity Features are physical features at a site that encourage exploration and activities that could result in exposure to chemicals of concern detected in site soils.

For the Gold Hill Mill site, the following activity features are identified:

- Miscellaneous Artifacts – This refers to the presence of artifacts such as old cans and bottles, evidence of past activities.
- Miscellaneous Relics and Structures – This refers to old structures and ancillary equipment (e.g., rail tracks, pipelines remnants) scattered around the site.
- Mill Tailings

The time spent exploring each Activity Feature is assumed to take an hour. In some cases, the size of a feature may require a “multiplier” to account for a higher interest level. At Gold Hill, three Activity Features are identified.

It is assumed that 4-hours per day is the maximum hours at a mill site due to travel time and weather exposure (desert heat). For simplicity, each exposure day is 4 hours and if more than 4 hours of exposure are anticipated, an additional day of exposure is assumed. Using these assumptions, the following Table Ban be used to identify ET and EF based on the number of site features, and identifies at the Gold Hill Mill site , and ET of 4 hours per day and an EF of 1 days per year.

Number of Features	Number of Hours per Day at Site – Mining Enthusiast(ET)	Number of Days per Year at Site – Mining Enthusiast (EF)
1-4	4 hours per day	1
5-8	4 hours per day	2
9+	4 hours per day	3

Additional exposure factors are as follows:

Ingestion Rate (IR): The Mining Enthusiast is assumed to have greater soil contact rates (soil ingestion, dermal exposures) than the tourist, as their visits may involve the more extensive exploration of site features and artifacts. Potential health impacts are evaluated for child and adult exposures.

For the Mining Enthusiast, the child and adult IRs are represented by 400 mg/day and 330 mg/day, respectively. The 400 mg/day for the Enthusiast child is the USEPA upper bound value (USEPA 2011) and is also a value derived to depict a subsistence lifestyle by native Americans, which is descriptive of a variety of outdoor activities, inclusive of hunting and gathering activities (CTUIR 2004). This value is greater than the USEPA camping scenario value of 300 mg/day (van Wijnen, et al. 1990). The adult Enthusiast value of 330 mg/day is consistent with the Cal/EPA-DTSC (2019b) assumption for an adult construction worker.

Soil Adherence Factor (AF): For the child Enthusiast, the soil AF of 1 mg/cm^2 is used. This value is derived to depict a subsistence lifestyle by native Americans (CTUIR 2004). The adult Enthusiast value of 0.8 mg/cm^2 is consistent with the Cal/EPA-DTSC (2019b) assumption for an adult construction worker.

B 3.8.3 NPS Worker

Based on information provided by the NPS, the NPS Worker scenario assumes that the Gold Hill Mill site is visited 20 days per year (EF), for 0.5-hour each visit[1] (ET) (NPS 2019). It is also assumed that the NPS Worker has an exposure duration (ED) of 25 years, which is the standard assumption for occupational exposures (USEPA 2019a).

Additional exposure factors are as follows:

Ingestion Rate (IR): The NPS Worker is assumed to have a soil ingestion rate of 100 mg/day, which is the USEPA default assumption for an outdoor worker (USEPA 2019a).

Soil Adherence Factor (AF): For the NPS Worker the selected AF was 0.12 mg/cm^2, identified by the USEPA as appropriate for an outdoor worker (USEPA, 2019a, 2011).

Skin Surface Area (SA): This represents how much skin is exposed and available for contact with soil. For the NPS Worker, the SA was 3,527 cm^2, identified by the USEPA as appropriate for an outdoor worker USEPA 2019a, 2011).

B 3.9 Estimation of Intakes

The exposure factors in Table B 3.3 are used to develop integrated daily and lifetime exposure factors by exposure media (i.e., soil or air) and exposure route (i.e., oral, dermal or inhalation). When multiplied by media exposure point concentrations, route specific chemical exposures are estimated. These integrated exposure factors are calculated in Table B 3.3.

To assess contaminant intakes, additional absorption factors are used. For the oral pathway, relative bioavailability factors (RBA) are used, and for the dermal pathway, dermal absorption factors (ABS_d) are used. Per the USEPA (2012), the RBA for arsenic is 60%. For all other compounds, the RBA was 100%. For dermal ABS_d values were obtained from the USEPA (2004, 2019) and identifies the ABS_d for arsenic to be 3%. The USEPA does not identify ABS_d values for the other COPC metals.

B.4 Toxicity Assessment

The purpose of the toxicity assessment is to identify current and relevant toxicity criteria and information for the identified COPCs. In 2018, Title 22, California Code of Regulations Sections 69021-29022 Toxicity Criteria for Human Health Risk Assessments, Screening levels, and Remediation Goals rule {Toxicity Criteria Rule, aka TCR) was adopted. The rule provides a list of required toxicity criteria for specific chemicals to be used in human health risk assessments. Toxicity criteria are used to assess potential health impacts characterized as carcinogenic and noncarcinogenic. Some COPCs may be characterized as both carcinogens (either known or potential), and noncarcinogens. Toxicity criteria compliant with the TCR are available from the DTSC (2019b). When not available by the DTSC TCR, the USEPA Integrated Risk Information System (USEPA 2020) is referenced. The USEPA IRIS program

[1] The NPS (2019) identified an average visit of 15 minutes. To assess potential upper-bound exposure, this value was doubled to 30 minutes per visit.

identifies and characterizes the health hazards of chemicals found in the environment. The IRIS assessments are the preferred source of toxicity information used by USEPA.

A summary of the toxicity criteria used in the BHHRA are presented in Table B 4.1.

B 4.1 Carcinogens

Carcinogenic COPCs are those that are known or suspected of causing cancer. Cancer effects were evaluated based on the assumption that any level of exposure to a carcinogenic compound can cause an effect. The USEPA extrapolated from observed laboratory animal data using a mathematical model known as the linear multi-stage model. This model plots a line back toward the origin, adjusting the background cancer rate in the control (unexposed) animal populations. For oral exposures, the cancer slope factor (CSF) is the 95 percent upper bound on the slope of the dose-response curve in the low dose region and has dimensions of risk of cancer per unit dose. For inhalation exposures, cancer risk is characterized by an inhalation unit risk (IUR) value, which represents the upper-bound excess lifetime cancer risk estimated to result from continuous lifetime exposure to a chemical at a concentration of 1 $\mu g/m^3$ in air.

Chemicals are classified as known, probable, or possible human carcinogens based on a USEPA weight-of-evidence scheme in which chemicals are systematically evaluated for their ability to cause cancer in humans or laboratory animals with the following descriptors: (1) carcinogenic to humans, (2) likely to be carcinogenic to humans, (3) suggestive evidence of carcinogenic potential, (4) inadequate information to assess carcinogenic potential, and (5) not likely to be carcinogenic to humans.

B 4.2 Noncarcinogens

Noncarcinogenic COPCs are those that may result in deleterious health effects, other than cancer, during acute or chronic time frames. The potential for non-cancer effects was estimated by comparing a calculated exposure to a reference dose (RfD) for oral exposures or a reference concentration (RfC) for inhalation exposures for each individual chemical. The RfD and RfC represent a daily exposure that is designed to be protective of human health, even for sensitive individuals or subpopulations, over a lifetime of exposure.

B 4.3 Toxicity Information for COPC

The following summarized the toxicity information for the identified COPC. This information provides a general identification of potential health impacts posed by the COPC and their associated toxicity criteria.

Antimony

Antimony is a silvery-white metal that is found in the earth's crust (ATSDR 1995). Although exposure to antimony at high levels can result in a variety of adverse health effects, antimony can have beneficial effects when used for medical reasons[2]. Antimony is not classified as a

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[2] Antimony has been used as a medicine to treat people infected with parasites (ATSD 1995).

carcinogen. Based on longevity, blood and cholesterol indicators in laboratory rat bioassays, the EPA has identified an oral RfD of 4E-4 mg/kg-day (EPA 1987).

Arsenic

Arsenic is a naturally occurring element in the earth's crust and is very widely distributed in the environment. In certain geographical areas, natural mineral deposits may contain large quantities of arsenic (OEHHA 2004). Arsenic is a known human carcinogen and consumption of arsenic may cause short-term and/or long-term health effects, depending on the dose and the time period of exposure. The California EPA has identified an oral CSF of 9.5 mg/kg-day, based on potential skin cancer occurrences (OEHHA, 2004). The EPA has identified an inhalation unit risk value of 4.3E-3 $(\mu g/m^3)^{-1}$, based on potential lung cancer occurrences (EPA 2002a).

To characterize noncarcinogenic effects, the California EPA Office of Environmental Health Hazard Assessment (OEHHA) has identified and oral RfD of 3.5E-6 mg/kg-day, and an inhalation RfC 1.5E-2 µg/m3, based on a *decrease in intellectual function and adverse effects on neurobehavioral development* in 10-year-old children (OEHHA 2008).

Cadmium

Cadmium is a naturally occurring heavy-metal trace element found in processed mine tailings and soil at the Gold Hill site. In occupational studies, cadmium exposure has been linked to higher levels of lung cancer. As a noncarcinogen, cadmium exposure can result in kidney, lung, and intestinal damage. Based on human occupation lung cancer data, the OEHHA has estimated an inhalation URF of 4.2E-3 $(\mu g/m^3)^{-1}$. Cancer risk values for the ingestion of cadmium are not available from either the DTSC or the USEPA. To assess noncarcinogenic health risks, the potential, the USEPA has derived a RfD of 1×10^{-3} mg/kg-day, based on the potential for *significant proteinuria* (increased protein in urine, an indicator of kidney disorder). To asses inhalation health impacts, the DTSC recognizes a level of 1×10^{-2} $\mu g/m^3$ derived by the Agency for Toxic Substances Disease Registry (ATSDR 2012a) as an RfC.

Cobalt

Cobalt is a naturally occurring element that has properties similar to those of iron and nickel. Small amounts of cobalt are naturally found in most rocks, soil, water, plants, and animals. Cobalt is usually found in the environment combined with other elements such as oxygen, sulfur, and arsenic (ATSDR 2004a). Cobalt is likely to be carcinogenic to humans by the inhalation route of exposure (EPA 2008), and an IUR of 9E-3 $(\mu g/m^3)^{-1}$ has been identified (EPA 2008). Based on the potential for decreased iodine uptake in humans, a RfD of 3E-4 mg/kg-day has been identified (EPA 2008) Decreased pulmonary function and respiratory tract irritation were identified as the co-critical effects for derivation of the-RfC of 6E-3 $\mu g/m^3$ (EPA 2008).

Copper

Copper is a reddish metal that occurs naturally in rock, soil, water and sediment. Copper also occurs naturally in all plants and animals. It is an essential element for all known living organisms including humans and other animals at low levels of intake (ATSDR 2004b). Copper is not considered a carcinogen by either the DTSC or the USEPA. To assess noncaracinogenic effects, the DTSC recognize a provisional RfD of $1x10^{-2}$ mg/kg-day, which is protective of gastrointestinal system irritation (USEPA 1997). The derivation of this RfD is highly uncertain and is not currently recognized by the USEPA under the IRIS program.

Mercury

Mercury is a naturally occurring element. At the Gold Hill Mill site, mercury was used in the mercury amalgamation gold extraction process. Mercury is considered a possible human carcinogen, but the carcinogenicity of inorganic mercury compounds is judged to be rather weak, as compared with the potential for renal (kidney related) toxicity (OEHHA 1999). To assess potential renal effects, the OEHHA has identified a RfD of 1.6E-4 mg/kg-day. Based on potential neurotoxicity, the OEHHA identified an RfC of 3E-3 $\mu g/m^3$ (OEHHA 2008).

Silver

Silver is a rare element naturally occurring in the environment. Silver is not considered a carcinogen by either the DTSC or the USEPA. To assess noncaracinogenic effects, the USEPA has derived an RfD of $1x10^{-1}$ mg/kg-day, which is protective of argyria, which a is medically benign but permanent bluish-gray discoloration of the skin, resulting from the deposition of silver in the dermis and also from silver-induced production of melanin (USEPA 1991 – Silver Iris).. The USEPA RfD is recognized for use in risk assessment by the DTSC. Neither the DTSC nor U.S.EPA identify an RfC for silver.

Thallium

Thallium occurs naturally in the earth’s crust and measurable concentrations of thallium are also found in marine water, freshwater, and air (USEPA 2009). Thallium is not considered a carcinogen by the DTSC or USEPA. To assess noncarcinogenic effects, the DTSC utilizes the RfD for thallium derived by the USEPA. of 1×10^{-5} mg/kg-day (protective of hair follicle atrophy). Neither the DTSC nor U.S.EPA identify an RfC for thallium.

Vanadium

Vanadium is a naturally occurring element. It is widely distributed in the earth’s crust and present in soil, water, and air. Vanadium is not considered a carcinogen by either the DTSC or the USEPA. To assess noncaracinogenic effects, the USEPA has derived an RfD of $5x10^{-3}$ mg/kg-day, which is protective of decreased hair cystine. Cystine plays an important role in maintaining the health life cycle of hair. The USEPA RfD is recognized for use in risk assessment by the DTSC. Both the DTSC and U.S.EPA recognized the chronic inhalation minimal risk levels

(MRL) (equivalent to the RfC) of 0.1 μg/m^3 derived by the ATSDR (2012b), which is protective of respiratory symptoms.

Zinc

Zinc is ubiquitous in the environment and occurs in the earth's crust and is an essential trace element that is crucial to survival and health maintenance, as well as growth, development, and maturation of developing organisms of all animal species (USEPA 2005). Zinc metal is not found freely in nature; rather it is found as various minerals such as sphalerite (zinc sulfide), smithsonite (zinc carbonate), and zincite (zinc oxide). Zinc is not considered a carcinogen by either the DTSC or the USEPA. To assess noncarcinogenic effects, the DTSC utilizes the RfD for zinc derived by the USEPA. of 3×10^{-1} mg/kg-day (reduced copper status has been associated with increased zinc intake). Neither the DTSC nor U.S.EPA identify an RfC for zinc.

B 4.4 Assessment of Lead Exposures

Environmental exposure to lead can affect multiple organs in the human body, however the nervous system is the mostly affected by lead toxicity. Childhood exposures to lead are of greater impact than adults because of tissue development and a decrease in cognitive performance and functions of the nervous system. To assess potential lead exposures, blood lead levels (BLLs) (i.e., concentration of lead in blood) are considered an indicator. The USEPA identifies a BLL of 10 micrograms of lead per deciliter of blood (μg/dl) as a level of concern, and the DTSC identifies a BLL of 1 μg/dl as a level if concern. In 2012, the Center for Disease Control and Prevention identified a level of concern of 5 μg/dl in children 1-5 years of age (CDC 2012).

The evaluation and assessment of lead exposures is dependent upon long-term exposures (more than 90 days) resulting in quasi-steady state BLLs. Under the child Tourist Visitor and Mining Enthusiast scenarios, exposures are assumed to be short term (up to 2 days per year). Recognizing the uncertainties associated with the current lead evaluation tools, quantified lead evaluations are not presented for the Tourist and Mining Enthusiasts. In lieu of a quantitative assessment for the Tourist Visitor and Mining Enthusiast scenarios, a qualitative assessment based on a comparison to the USEPA DTSC residential and commercial/industrial screening levels. can be made.

USEPA selected a residential 400 mg/kg standard because that is the level at which a child has a 1% to 5% risk of having a blood lead level of 10 micrograms per deciliter. However, USEPA applied the 400 mg/kg standard only to the areas in which a child might play (Frisman, 2006). The USEPA defines a 1,200 mg/kg standard for the *non-play area* of a residential site (USEPA 2001).

According to the USEPA, the 800 mg/kg screening level is protective of all adult subpopulations (USEPA 2019a). It is recognized that the USEPA screening levels are not representative of site conditions. That is, the USEPA levels assume daily residential and industrial exposures to lead in soil, while exposures at the Gold Hill Mill site are significantly less. Additionally, the Cal-EPA-DTSC screening value of 80 mg/kg is also used for comparison (DTSC 2019a). The Cal-EPA value reflects exposures to a residential toddler who plays on bare soil, exhibits hand-to-mouth behavior, and therefore ingests higher- than-average amounts of soil (OEHHA 2015). The Cal-EPA DTSC also identify an industrial exposure concentration 320 mg/kg. A summary of current lead screening levels in soil is presented in Table B 4.2.

Table B 4.2

Summary of Lead Comparison Values

Agency	**Cal-EPA-DTSC**	**Cal-EPA-DTSC**	**USEPA**	**USEPA**	**USEPA**
Screening Concentration (mg/kg)	80	320	400	800	1200
Scenario	High exposure residential children (350 days per year)	Industrial adult exposures (250 days/year)	Residential child exposures play area soil (350 days per year)	Industrial adult exposures (250 days/year)	Residential Yard, Non Play Area
Target Blood Lead Level (µg/dl) of Concern	1	1	10	10	10[3]

To evaluate the NPS Worker scenario , the USEPA Adult Lead Model (ALM), which has been modified and distributed by the DTSC in California as part of the LeadSpread Excel worksheet, was used. The DTSC-modified ALM addresses exposure to lead from soil and soil derived indoor dust based on the ingestion pathway only. Per the USEPA (2003) infrequent exposures (i.e., less than 1 day per week) over a minimum duration of 90 days would be expected to produce oscillations in blood lead concentrations associated with the absorption and subsequent clearance of lead from the blood between each exposure event. Based on the above assumptions about the elimination half-time lead in blood, the USEPA recommends that this methodology should not be applied to scenarios in which EF is less than 1 day/week. Accordingly, the ALM worksheets reflect the minimum EF of 52 days per year, which is over twice the identified EF for the NPS Worker scenario, to conservatively assess potential lead impacts to the NPS PEP.

B.5 Risk Characterization

Risk characterization is the risk assessment process where risks and hazards are calculated on a COPC basis for each exposure scenario at each DU. The quantitative estimates are expressed in terms of a probability statement for the potential excess lifetime cancer risk and an HQ for the likelihood of adverse non-cancer health effects. When there are multiple COPCs that cause non-cancer effects, the cumulative hazard index (HI) is calculated as the sum of HQs. Cancer risks and noncarcinogenic hazard are further discussed in the following sections.

A summary of risk characterization results is presented in Table B 5.1 and risk characterization calculations are provided in Attachment B 1, with sample calculations provided as Attachment B 2.

[3] At 1,200 ppm in soil, the IEUBK model estimates a mean blood lead level in the range of 8 to 11 µg/dL (USEPA 2001).

B 5.1 Carcinogenic Risk Estimating Process

The BHHRA results are expressed as carcinogenic risk and noncarcinogenic hazard. Carcinogenic risks are expressed in terms of probabilities. That is, a probabilistic expression is calculated to indicate the number of cancers that can be expected within a population (the lower the number the lower the probability). For example, the probability expressed as 1×10^{-5} can be read as a probability of cancer of one in 100,000. As a point of reference, the USEPA considers carcinogenic risk probabilities ranging from 10^{-4} to 10^{-6} as "safe."

In general, risks are estimated by multiplying lifetime average intakes and CSF. That is:

Lifetime Average Intake x Carcinogenic Slope Factor = Carcinogenic Risk

Risks are estimated for each COPC identified as being carcinogenic via each route of exposure for each exposure media.

B 5.2 Noncarcinogenic Risk Estimating Process

For noncarcinogens, the indicator calculated is a noncarcinogenic hazard. The hazard is the ratio of the estimated intake divided by the COPC specific RfD, which is a level believed to be without deleterious health impacts to sensitive subpopulations. A total hazard less than unity, or one, is believed to be without adverse health effects to the most sensitive subpopulations.

In general, hazards are estimated by daily average intake by the RfD. That is:

Average Daily Intake ÷ Reference Dose = Noncarcinogenic Hazard

Risks are estimated for each COPC identified as being noncarcinogenic via each route of exposure for each exposure media.

B 5.3 Lead Assessment

As previously identified, lead is assessed by comparison of site concentrations to current lead standards. To evaluate the NPS Worker scenario, the USEPA Adult Lead Model (ALM), which has been modified and distributed by the DTSC (2011) in California as part of the LeadSpread Excel worksheet, was used. The ALM modeling sheets are provided as Attachment B 3.

B 5.4 Risk Characterization Results

Potential health risks are characterized for each DU. The results are not additive but should be evaluated on a DU by DU basis to assist in the risk evaluation process of the EE/CA. Figure C 2.1 identified the site layout and DU locations. A summary of all estimated health risks is presented in Table B 5.1.

B 5.4.1 DU-1 (Mill Foundations)

The risk results for DU-1, the Cyanide Processing Area, are presented in Table B 5.2 These results are discussed in the following sections.

Tourist Visitor Scenario DU-1

The total carcinogenic risk for this scenario was estimated to be $2x10^{-6}$ ($2x10^{-6}$ child, and $3x10^{-7}$ adult). The risk driver was identified as arsenic, contributing a majority of the carcinogenic risk. The other carcinogenic COPCs evaluated were cadmium and cobalt, which contributed a total risk of $7x10^{-13}$. The primary pathway of concern was dermal exposures, contributing 67% of the total risk, followed by the oral pathway, contributing 33% of the total risk.

The total child hazard was < 1 (0.6), with arsenic contributing a majority of the hazard. For adults, the total hazard was < 1 (0.09) with arsenic contributing a majority of the hazard. Under both childhood and adult exposures, dermal and oral exposures contributed to a majority of the hazard.

Risk are at the low end of the risk range (10^{-4} to 10^{-6}) and acceptable for the non-cancer hazards, under the Tourist exposure scenario.

Mining Enthusiast Scenario DU-1

The total carcinogenic risk for this scenario was estimated to be approximately $2x10^{-5}$ ($2x10^{-5}$ child, and $4x10^{-6}$ adult). The risk driver was identified as arsenic, contributing a majority of the carcinogenic risk. The other carcinogenic COPCs evaluated were cadmium and cobalt, which contributed a total risk of $1x10^{-11}$. The primary pathway of concern was oral exposures, contributing 58% of the total risk, followed by the dermal pathway, contributing 42% of the total risk.

The total child hazard was > 1 (6), with arsenic contributing a majority of the hazard. For adults, the total hazard was also equal to 1, with arsenic contributing a majority of the hazard. Under both childhood and adult exposures, dermal and oral exposures contributed to a majority of the hazard.

Risk for the Mining Enthusiast are within the acceptable risk range (10^{-4} to 10^{-6}) and exceed the generally acceptable non-cancer hazard of unity under the child exposure assumptions.

NPS Worker Scenario DU-1

The total carcinogenic risk for this scenario was estimated to be $2x10^{-5}$. The risk driver was identified as arsenic, contributing a majority of the carcinogenic risk. The other carcinogenic COPCs evaluated were cadmium and cobalt, which contributed a total risk of $2x10^{-11}$.. The primary pathway of concern was dermal exposure, contributing 77% of the total risk, followed by the oral pathway, contributing 23% of the total risk.

The total hazard was > 1 (2), with arsenic contributing a majority of the hazard. Under the MPS Worker scenario, dermal and oral exposures contributed to a majority of the hazard.

Risk for the NPS Worker are within the acceptable risk range (10^{-4} to 10^{-6}) and exceed the generally acceptable non-cancer hazard of unity.

Lead Assessment DU-1

The EPC for lead at DU-1 is 12,575 mg/kg. This concentration is greater than the USEPA 1200 mg/kg non-play area residential concentration and the USEPA 800 mg/kg for daily industrial exposures . Assessing the NPS Worker scenario using the USEPA Adult Lead Model, the EPC resulted in an adult BLL of 0.5 and fetal 90th percentile BLL of 1.0 µg/dl.

B 5.4.2 DU-2 (Eroded Tailings in the Wash)

The risk results for DU-2, the Eroded Tailings in the Wash, are presented in Table B 5.3 These results are discussed in the following sections.

Tourist Visitor Scenario DU-2

The total carcinogenic risk for this scenario was estimated to be $2x10^{-6}$ ($2x10^{-6}$ child, and $3x10^{-7}$ adult). The risk driver was identified as arsenic, contributing a majority of the carcinogenic risk. The other carcinogenic COPCs evaluated were cadmium and cobalt, which combined a total risk of $3x10^{-12}$. The primary pathway of concern was dermal exposures, contributing 67% of the total risk, followed by the oral pathway, contributing 33% of the total risk.

The total child hazard was < 1 (0.7), with arsenic contributing a majority of the hazard. For adults, the total hazard was < 1 (0.1) with arsenic contributing a majority of the hazard. Under both childhood and adult exposures, dermal and oral exposures contributed to a majority of the hazard.

Risk are at the low end of the risk range (10^{-4} to 10^{-6}) and acceptable for the non-cancer hazards, under the Tourist exposure scenario.

Mining Enthusiast Scenario DU-2

The total carcinogenic risk for this scenario was estimated to be $2x10^{-5}$ ($2x10^{-5}$ child, and $4x10^{-6}$ adult). The risk driver was identified as arsenic, contributing a majority of the carcinogenic risk. The other carcinogenic COPCs evaluated contributed a risk of $2x10^{-11}$. The primary pathway of concern was oral exposures, contributing 58% of the total risk, followed by the dermal pathway, contributing 42% of the total risk.

The total child hazard was >1 (6), with arsenic contributing a majority of the hazard. For adults, the total hazard was >1 (2), with arsenic contributing a majority of the hazard. Under both childhood and adult exposures, dermal and oral exposures contributed to a majority of the hazard.

Risk for the Mining Enthusiast are within the acceptable risk range (10^{-4} to 10^{-6}) and exceed the generally acceptable non-cancer hazard of unity.

NPS Worker Scenario DU-2

The total carcinogenic risk for this scenario was estimated to be $2x10^{-5}$. The risk driver was identified as arsenic, contributing a majority of the carcinogenic risk. The other carcinogenic COPCa contributed a risk

of $1x10^{-10}$. The primary pathway of concern was dermal exposures, contributing 77% of the total risk, followed by the oral pathway, contributing 23% of the total risk.

The total hazard was >1 (2), with arsenic contributing most of the hazard. Under the NPS Worker scenario, dermal and oral exposures contributed to a majority of the hazard.

Risk for the NPS Worker are within the acceptable risk range (10^{-4} to 10^{-6}) and exceed the generally acceptable non-cancer hazard of unity.

Lead Assessment DU-2

The EPC for lead at DU-2 is 8,940 mg/kg. This concentration is above the USEPA 1200 mg/kg non-play area residential concentration and the USEPA 800 mg/kg industrial exposure screening level. Using the USEPA Adult Lead Model, the EPC resulted in an increase to adult BLL of 0.4 and fetal 90th percentile BLL of 0.7 µg/dl.

B 5.5 Preliminary Human Health-Based Removal Goals

Based on the currently selected exposure factors for the Gold Hill Mill site, preliminary removal goals (PRGs) are calculated for COPC that present significant risks and or hazards. These PRGs represent a back calculation to derive acceptable concentrations in soil based on the assumed amount of exposure.

Tables 5.2 and 5.3 identify that arsenic is the only COPC contributing to a risk estimate greater than 1 x 10-6, and also contributes to hazard greater than 1.

As calculated, the PRGs are based on a carcinogenic risk of $1x10^{-6}$, and a hazard quotient of 1.0. The PRGs for all three scenarios (Tourist Visitor, Mining Enthusiast, NPS Worker), as presented in Table B 5.4.

The PRG for lead is based on a consideration of currently available values considered acceptable, as well as the review of the EPA Adult Lead Model. As discussed, blood lead level modeling is inappropriate for the exposure scenarios anticipated at the Gold Hill Mill site. That is, anticipated exposures at the Gold Hill Mill site are short in both duration and frequency, which precludes the ability for exposure models to depict a quasi-steady state BLL. Currently the DTSC and U.S.EPA recognize concentrations in soil that are protective of residential and industrial/commercial exposures. Neither of these scenarios are appropriate for consideration at the Gold Hill Mill site. To assess potential exposures to the NPS worker, the U. S. EPA Adult Lead Model (ALM), which was conservatively[4] used to estimate a lead in soil PRG of 12,000 mg/kg.

In 2001, the U S. EPA published TSCA §403 Soil Hazard Rule, which establishes a soil-lead hazard of 400 mg/kg for bare soil in play areas and 1,200 mg/kg for bare soil in non-play areas of the yard. These

[4] The minimum exposure frequency for the ALM is 52 days, representing one day per week exposure. The exposure evaluation for Gold Hill Mill identified a potential exposure frequency of 20 days per year. The BLL was estimated based on a fetal BLL of 1 µg/dl.

concentrations are based on a BLL of 10 µg/dl. In addition to the TSCA §403 Soil Hazard Rule, this BHHRA also identified the USEPA RSLs for lead of 400 mg/kg and 800 mg/kg for residential and industrial exposures, respectively. Also, the DTSC has published DTSC-SLs of 80 µg/dl and 320 µg/dl for residential and industrial exposures, respectively. The Gold Hill Mill Site is neither a residential nor industrial exposure environment, therefore none of these available criteria are directly appropriate.

Recognizing the need to protect public health, the TSCA §403 Soil Hazard Rule concentration of 1,200 mg/kg is selected as the PRG. This value is below the 6,000 mg/kg level considered protective of the NPS Worker and is protective of non-play residential soil. Table B 5.5 summarizes the PRGs calculated for each of the exposure scenarios and also identifies the EPCs for comparison.

B.6 Uncertainties

A summary of the uncertainties inherent to each component of the BHHRA process and how they may affect the quantitative risk estimates and conclusions of the risk analysis is provided here.

Informational uncertainty stems from assumptions related to estimates of exposure and chemical toxicity. For example, in the HHRA, to account for uncertainties in the development of exposure assumptions, conservative assumptions are made to ensure estimated risks are protective of sensitive subpopulations or the maximum exposed individuals, resulting in a bias toward over-predicting both cancer and non-cancer risks.

The list below represents a summary of the uncertainties and assumptions made:

- Exposure zones – DU Exposures
- Quantitative Site Characterization
- Toxicity Criteria
- Assessment of Lead
- Exposure Factors

B 6.1 Exposure Zones

The BHHRA for each DU assumes that exposures occur exclusively at the DU evaluated. It is likely that visitors and workers may experience a "composite" of exposures consisting of both DUs and background concentrations.

B 6.2 Quantitative Site Characterization

The BHHRA is dependent upon the quantitative characterization of the DUs presented in the SIR. Soil sampling and analysis designs were structured to characterize impacted areas and identified features at the Gold Hill mill site, and the overall sampling design may not represent overall exposure areas. The focus on characterizing site features may overestimate site exposures, as visitors to the site will likely have random exposures throughout the mill site and not solely on the site feature.

To reduce variability within each sampled feature, potential health impacts are based on the mean of the reported ISM sample concentrations as representative EPCs. ISM is designed to provide an unbiased,

statistically valid estimate of the mean value of an analyte within the site feature. By design, ISM provides complete spatial coverage within the site feature (ITRC 2012). A limitation of ISM is that is does not provide information on the spatial distribution of contaminants within the site feature and generates a distribution of means that approaches normality (ITRC 2012). As the EPC is represented as a mean calculation, all detected concentrations are weighted equally, and theoretically (as a normal distribution) the mean represents that maximum detected concentrations will be encountered as frequently as the minimum concentration.

To assess ISM concentration variation and potential uncertainties to the BHHRA, the standard deviation (SD) was calculated using the EPA ProUCL program. The SD represents a measure of dispersion, or spread, of the data. A high SD identifies a data distribution considered to be more spread out, meaning it has more variability, whereas a low SD identifies data that revolves more tightly around the mean. Based on the SD, a Z-Score can be calculated to predict, using standardized Z-tables, the distribution percentile of the maximum concentration, which represents the upper end of the data coverage by the ISM samples.

The COPC arsenic was determined to be the primary carcinogenic COPC. At DU-1the maximum arsenic concentration Z-Score is 1.24. This would indicate that calculated means incorporate data from the 89 percentile of observed data. The variability suggests that the maximum concentration for arsenic is spread from the true mean. This would suggest a wide range of concentrations for lead are incorporated to estimate the ISM mean value used to represent the EPC.

The COPC lead was determined to be the primary carcinogenic COPC based on its prevalence and generally high detected concentrations. At DU-1the maximum lead concentration Z-Score is 1.38. This would indicate that calculated means incorporate data from the 92 percentile of observed data. Similar to arsenic, the variability of lead suggests that concentrations are spread and that the maximum concentration of lead at DU-1 is not close to the true mean. This would suggest a wide range of concentrations for lead are incorporated to estimate the ISM mean value used to represent the EPC.

B 6.3 Toxicity Criteria

The assessment of potential health impacts is reliant upon the derivation of toxicity criteria by governmental agencies. Typically, these criteria are available from the federal USEPA or the California EPA-DTSC (2019a). In the BHHRA, the toxicity criteria were based on those available from the Cal EPA-DTSC, as the evaluation of the Gold Hill Mill site is within the state of California, and per California Title 22, California Code of Regulations Sections 69021-29022 *Toxicity Criteria for Human Health Risk Assessments, Screening levels, and Remediation Goals* (Toxicity Criteria Rule), there is a specific list of required toxicity criteria to be used in human health risk assessments.

In the case of arsenic, the primary COPC, the Cal EPA-DTSC carcinogenic oral slope factor is 9.5 mg/kg-day, whereas the USEPA value is 1.5 mg/kg-day, representing a carcinogenic potential which is approximately 6 times *less* than identified by the Cal EPA-DTSC. Using the USEPA arsenic criteria, the potential health risks are presented in Table B 6.1 and identifies that all risk under all scenarios are at area proportionally less than those estimated using DTSC values.

Also, the noncarcinogenic potential of arsenic is evaluated differently between the USEPA and the DTSC. The DTSC RfD for arsenic is 3.5E-6 mg/kg-day, and the USEPA RfD is 3E-4 mg/kg-day. The lower the RfD indicates the lower implied threshold for toxic effects. A comparison between the two values shows the DTSC RfD has a threshold 85 times *less* than the USEPA value. The results of using the USEPA value is shown on Table B 6.1 and indicate all hazards under all scenarios to be less than 1.

The USEPA RfD (USEPA, 1991b) is based on the critical effect of *hyperpigmentation keratosis and possible vascular complication* due to the ingestion of arsenic. The DTSC RfD (OEHHA 2008) is based on a *decrease in intellectual function and adverse effects on neurobehavioral development* in 10-year-old children continuously exposed to arsenic in drinking water for 9.5 to 10 years. While the target population represented by the DTSC RfD is similar to children that may be exposed at the Gold Hill Mill site, the long-term continuous exposures evaluated in the RfD derivation are unlike the exposure conditions at the site.

While the appropriateness and usability of toxicity criteria is debatable, the technical derivation of these values in not within the scope of this BHHRA. However, the difference in toxicity criteria between the USEPA and the DTSC are highlighted and represents a source of uncertainty.

B 6.4 Assessment of Lead

As previously discussed, the assessment of lead typically requires long-term exposures to model a quasi-steady state blood lead levels (BLLs). In the case of the Gold Hill Mill PEPs, exposures are short-term and the associated exposure factors do not coincide with the long-term assumptions used in current BLL models.

To assess the NPS Worker, the EPA Adult Lead Model was used. Although a quantified result was estimated using the minimum exposure frequency recommended with the ALM, the scenario specific exposure frequency is less than what is recommended to establish a quasi steady state BLL, and therefore the results from the ALM are uncertain, and may be overstated.

To provide a comparative perspective on the lead concentrations at Gold Hill Mill site, concentrations were compared to USEPA and Cal EPA-DTSC screening levels. In all cases, the established screening levels do not represent exposure conditions at the Gold Hill Mill site. The comparison is therefore for perspective only and represents a highly uncertain evaluation of potential health impacts.

B 6.5 Exposure Assumptions

Exposure assumptions were selected to be descriptive of three distinct PEPs. Although these assumptions were based on risk assessment guidance and NPS provided exposure information, the nature of individual variability and activity proclivity make it difficult to specifically assess individuals. To account for potential exposure variations, the BHHRA selected exposure factors that are conservative and are likely to overestimate exposures and subsequent health impacts. This health-protective approach is taken to guard against underestimating exposures and health impacts.

B.7 Conclusions

The results of the BHHRA are dependent upon the assumptions regarding site conditions and potential exposure scenarios. As such, the information developed by the BHHRA represents a health-protective "baseline" condition and portray health risks that may occur if 1) exposure conditions portrayed in the BHHRA are met, and 2) site conditions are unchanged. As the risk management process at the Gold Hill Mill site proceeds, the evaluation of these baseline human health risk will serve as a criterion for identifying potential risk management alternatives.

Potential health risks for the Gold Hill Mill site have been evaluated in this BHHRA. Using conservative and health protective screening criteria, the following COPCs were identified:

- Antimony
- Arsenic
- Cadmium
- Cobalt
- Copper
- Lead
- Mercury
- Silver
- Thallium
- Zinc

Of these COPCs, arsenic, cadmium and cobalt were evaluated for their carcinogenic potential. All COPCs, except for lead, were evaluated for noncarcinogenic health impacts.

Three exposure scenarios were considered: Tourist Visitor, Mining Enthusiast Visitor, NPS Worker. The highest contact rates to impacted media are associated with the Mining Enthusiast Visitor scenario, and as a result, the highest carcinogenic risks and noncarcinogenic hazards are associated with that scenario.

The highest estimated health risks were associated with DU-1 and DU-2 with a $2x10^{-5}$ risk estimate (Mining Enthusiast – sum of child and adult exposures). *De minimis* risks were also exceeded under all scenarios at both DUs. In all cases, arsenic was the COPC resulting in the highest risks and hazards.

The noncarcinogenic hazard was found to be above the generally regarded threshold value of 1 at both DUs under the Mining Enthusiasts and NPS Worker scenarios.

The most prominent routes of exposure were found to be oral (soil ingestion) and dermal absorption. The inhalation of particulates was found not to contribute significantly to risks and hazards.

To assess lead, concentrations were compared to values provided by the USEPA that are used to characterize daily residential and industrial exposures of 400 mg/kg and 800 mg/kg, respectively. These values are exceeded at all DUs. Exceedance of these values, however, are not indicative of potential health impacts, as the values are not representative of the exposures at the Gold Hill Mill site[5]. That is, exposures at the site are short-term, and do not reflect daily residential or industrial exposures. A more appropriate non-industrial screening level may be 1,200 mg/kg, defined under the TSCA §403 Soil Hazard Rule. To further characterize potential health impacts under the NPS Worker scenario, the USEPA Adult Lead Model was used and identified BLLs resulting from exposure to both DUs to be less than USEPA 10 micrograms of lead per deciliter of blood (μg/dl) level of concern (adult BLL of 0.5 and

[5] The USEPA values for lead are based long-term lead exposures (more than 90 days), resulting in quasi-steady state blood lead levels.

fetal 90th percentile BLL of 1.0 at DU-1, and adult BLL of 0.4 and fetal 90th percentile BLL of 0.7 at DU-2), but near the DTSC level of concern of 1 µg/dl. The use of this model to assess short-term exposures is uncertain, since the limited time exposure times may not allow for quasi-state blood lead levels.

The results of the BHHRA are dependent upon the assumptions regarding site conditions and potential exposure scenarios. As such, the information developed by the BHHRA represents a health-protective "baseline" condition and portray health risks that may occur if 1) exposure conditions portrayed in the BHHRA are met, and 2) site conditions are unchanged. As the risk evaluation process at the Gold Hill Mill site proceeds, the evaluation of these baseline human health risk will serve as a criterion for identifying potential risk management alternatives.

As previously identified, a total carcinogenic risk less than $1x10^{-6}$ (one in a million) and noncarcinogenic hazards less than 1 are generally considered *de minimis* and below a level of regulatory concern. Risks found to be within the range of $1x10^{-4}$ and $1x10^{-6}$ are considered acceptable by the USEPA, as well as a cumulative noncancer hazard (sum of noncarcinogenic hazards) of less than one. As identified in Table B 5.1, all identified carcinogenic health risks are he acceptable range. For noncarcinogenic hazard, the Mining Enthusiasts child had a total hazard in exceedance of 1 at both DUs.

There are several uncertainties that need to be recognized in the interpretation of the BHHRA results. In particular, the use of the Cal/EPA-DTSC toxicity criteria for arsenic may overestimate potential health risks under the assumed scenarios.

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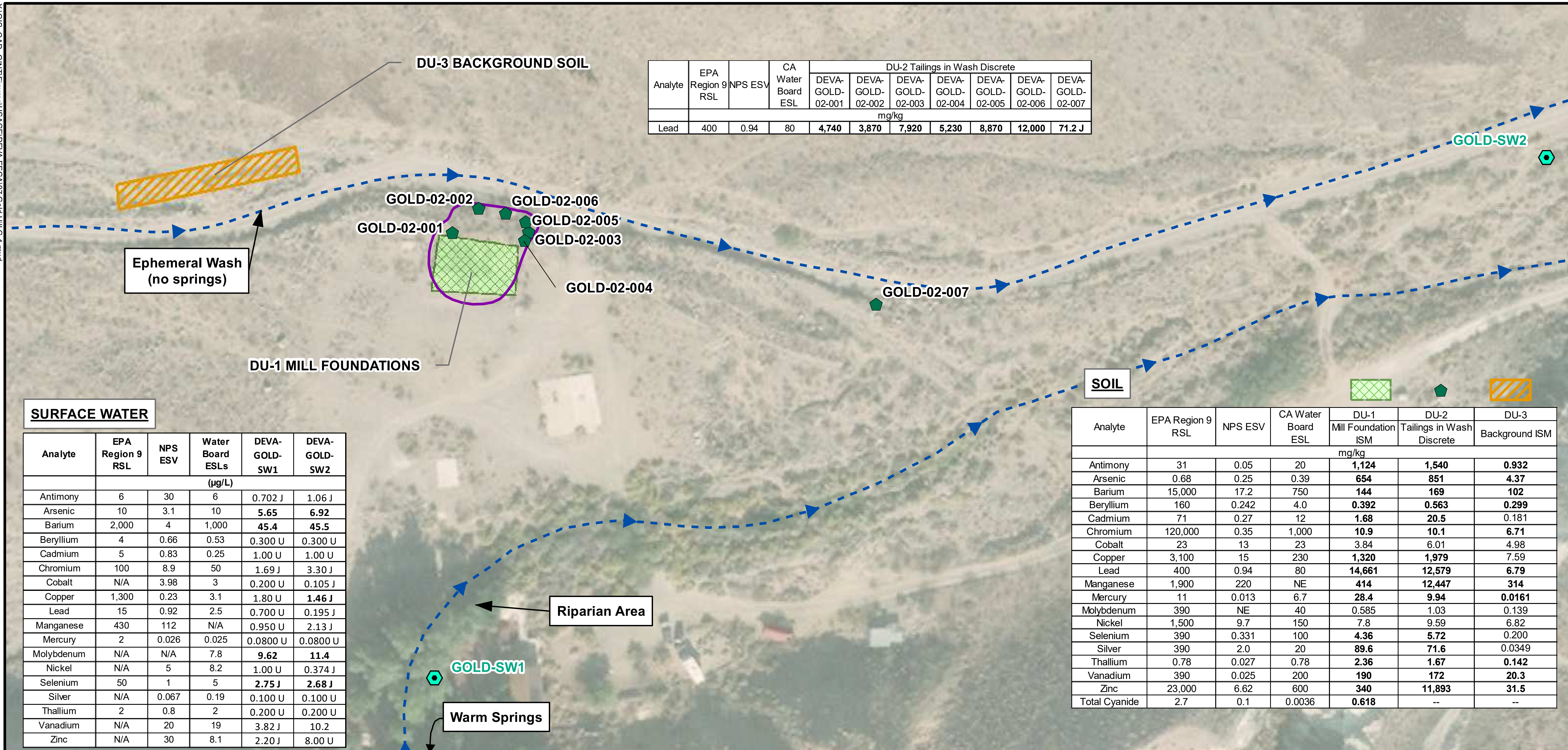
FIGURES



Analyte	EPA Region 9 RSL	NPS ESV	CA Water Board ESL	DU-2 Tailings in Wash Discrete						
				DEVA-GOLD-02-001	DEVA-GOLD-02-002	DEVA-GOLD-02-003	DEVA-GOLD-02-004	DEVA-GOLD-02-005	DEVA-GOLD-02-006	DEVA-GOLD-02-007
	mg/kg									
Lead	400	0.94	80	**4,740**	**3,870**	**7,920**	**5,230**	**8,870**	**12,000**	71.2 J

SURFACE WATER

Analyte	EPA Region 9 RSL	NPS ESV	Water Board ESLs	DEVA-GOLD-SW1	DEVA-GOLD-SW2
	(µg/L)				
Antimony	6	30	6	0.702 J	1.06 J
Arsenic	10	3.1	10	**5.65**	**6.92**
Barium	2,000	4	1,000	**45.4**	**45.5**
Beryllium	4	0.66	0.53	0.300 U	0.300 U
Cadmium	5	0.83	0.25	1.00 U	1.00 U
Chromium	100	8.9	50	1.69 J	3.30 J
Cobalt	N/A	3.98	3	0.200 U	0.105 J
Copper	1,300	0.23	3.1	1.80 U	**1.46 J**
Lead	15	0.92	2.5	0.700 U	0.195 J
Manganese	430	112	N/A	0.950 U	2.13 J
Mercury	2	0.026	0.025	0.0800 U	0.0800 U
Molybdenum	N/A	N/A	7.8	**9.62**	**11.4**
Nickel	N/A	5	8.2	1.00 U	0.374 J
Selenium	50	1	5	**2.75 J**	**2.68 J**
Silver	N/A	0.067	0.19	0.100 U	0.100 U
Thallium	2	0.8	2	0.200 U	0.200 U
Vanadium	N/A	20	19	3.82 J	10.2
Zinc	N/A	30	8.1	2.20 J	8.00 U

SOIL

Analyte	EPA Region 9 RSL	NPS ESV	CA Water Board ESL	DU-1 Mill Foundation ISM	DU-2 Tailings in Wash Discrete	DU-3 Background ISM
	mg/kg					
Antimony	31	0.05	20	**1,124**	**1,540**	**0.932**
Arsenic	0.68	0.25	0.39	**654**	**851**	**4.37**
Barium	15,000	17.2	750	**144**	**169**	**102**
Beryllium	160	0.242	4.0	**0.392**	**0.563**	**0.299**
Cadmium	71	0.27	12	**1.68**	**20.5**	0.181
Chromium	120,000	0.35	1,000	**10.9**	**10.1**	**6.71**
Cobalt	23	13	23	3.84	6.01	4.98
Copper	3,100	15	230	**1,320**	**1,979**	7.59
Lead	400	0.94	80	**14,661**	**12,579**	**6.79**
Manganese	1,900	220	NE	**414**	**12,447**	**314**
Mercury	11	0.013	6.7	**28.4**	**9.94**	**0.0161**
Molybdenum	390	NE	40	0.585	1.03	0.139
Nickel	1,500	9.7	150	7.8	9.59	6.82
Selenium	390	0.331	100	**4.36**	**5.72**	0.200
Silver	390	2.0	20	**89.6**	**71.6**	0.0349
Thallium	0.78	0.027	0.78	**2.36**	**1.67**	**0.142**
Vanadium	390	0.025	200	**190**	**172**	**20.3**
Zinc	23,000	6.62	600	**340**	**11,893**	**31.5**
Total Cyanide	2.7	0.1	0.0036	**0.618**	--	--

LEGEND

- SURFACE WATER SAMPLE
- DU-1 MILL FOUNDATIONS
- DU-2: TAILINGS IN WASH ALONG ROAD (DISCRETE SOIL SAMPLES)
- DU-3 BACKGROUND SOIL
- FLOW DIRECTION, EPHEMERAL
- EXTENT OF MINE TAILINGS

ACRONYMS:
-- - NOT ANALYZED FOR
EPA - ENVIRONMENTAL PROTECTION AGENCY
ESL - ENVIRONMENTAL SCREENING LEVEL (TIER 1) (WATER BOARD, 2013)
ESV - ENVIRONMENTAL SCREENING LEVEL (NPS 2014)
ISM - INCREMENTAL SAMPLING METHOD
J - LABORATORY ESTIMATED VALUE
µg/L - MICROGRAMS PER LITER
mg/kg - MILLIGRAMS PER KILOGRAM
N/A - NOT APPLICABLE
NE - NOT ESTABLISHED
NPS ESV - NATIONAL PARK SERVICE ECOLOGICAL SCREENING VALUE
RSL - REGIONAL SCREENING LEVEL - MAXIMUM CONTAMINANT LEVEL
U - NOT DETECTED AT REPORTING LIMIT SHOWN

NOTE:
RESULTS IN **BOLD** EXCEED A SCREENING LEVEL.

LEAD RESULTS FOR DU-2 ARE SHOWN AS AN INDICATOR OF THE PRESENCE/ABSENCE OF MILL TAILINGS. SEE APPENDIX A, TABLE 8, FOR ADDITIONAL DISCRETE METAL RESULTS.

N

0 40 80 160 Feet

UNITED STATES ARMY CORPS OF ENGINEERS

LOS ANGELES, CALIFORNIA

DEATH VALLEY NATIONAL PARK
CALIFORNIA AND NEVADA

FIGURE B.1

GOLD HILL MILL SITE MAP

NOREAS
Environmental Engineering and Science

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TABLES

Table B 2.1
Soil Data
Gold Hill Mill Site

Analyte	Units	Background ISM Samples			Mill Foundations ISM Samples			
		280-80478-1	280-80478-2	280-80478-3	280-80478-4	280-80478-5	280-80478-6	280-80478-7
		DEVA-GOLD-03-001	DEVA-GOLD-03-002	DEVA-GOLD-03-003	DEVA-GOLD-01-001	DEVA-GOLD-01-002	DEVA-GOLD-01-003	DEVA-GOLD-01-004
Antimony	mg/kg	0.7	0.727	0.834	956	1,000	1,070	1,040
Arsenic	mg/kg	3.97	3.8	3.49	564	547	505	612
Barium	mg/kg	90.7	96.9 J	94.1	119	95.6	106	129
Beryllium	mg/kg	0.29	0.282	0.278	0.336	0.343	0.352	0.378
Cadmium	mg/kg	0.156	0.153	0.131	1.4	1.55	1.58	1.42
Chromium	mg/kg	5.77	Attachment B	5.57	10.0	8.08	8.03	9.2
Cobalt	mg/kg	4.41	4.68	4.68	3.5	3.62	3.46	3.73
Copper	mg/kg	6.99	7.08	6.55	1,110	1,080	1,080	1,260
Lead	mg/kg	6.21	6.38	5.89	12,600	11,700	12,100	13,900
Mercury	mg/kg	0.0102	0.0109	0.0136	22.0	25.2	20.7	17.4
Molybdenum	mg/kg	0.124	0.132	0.13	0.476	0.509	0.393	0.501
Nickel	mg/kg	6.13	6.44	5.92	7.37	6.33	6.5	6.92
Selenium	mg/kg	0.393 U	0.385 U	0.382 U	3.31	3.63	4.07	3.32
Silver	mg/kg	0.0216	0.0197	0.0285	77.6	80.8	86.5	78.2
Thallium	mg/kg	0.136	0.139	0.139	1.23	1.4	2.07	1.21
Vanadium	mg/kg	18.6	19.5 J	18.4	157	165	178	175
Zinc	mg/kg	28.2	29.8 J	27.5	222	260	219	306
Cyanide, Total	mg/kg				0.429	0.214	0.468	0.385

J - Laboratory Estimated Value
U - Not Detected at stated reporting limit
ISM - Incremental Sampling Method
mg/kg - milligrams per kilogram
Gray shaded cells - Not Analyzed

Table B 2.1
Soil Data
Gold Hill Mill Site

Analyte	Units	Eroded Tailings in Wash Along Road Discrete Samples						
		280-80265-1 DEVA-GOLD-02-001	280-80265-2 DEVA-GOLD-02-002	280-80265-3 DEVA-GOLD-02-003	280-80265-4 DEVA-GOLD-02-004	280-80265-5 DEVA-GOLD-02-005	280-80265-6 DEVA-GOLD-02-006	280-80265-7 DEVA-GOLD-02-007
Antimony	mg/kg	557	284	901	756	913	1,490	5.96
Arsenic	mg/kg	361	322	552	392	532	854	11.9
Barium	mg/kg	78.4	86.6	61.8	175	69.7	37.4	107
Beryllium	mg/kg	0.398	0.511	0.456	0.523	0.44	0.353	0.413
Cadmium	mg/kg	0.519	0.404	1.04	22.8	0.845	1.13	0.164
Chromium	mg/kg	6.47	9.94	4.99	7.48	7.38	5.23	7.29
Cobalt	mg/kg	3.68	5.7	2.82	4.46	3.44	1.91	5.3
Copper	mg/kg	693	688	1,440	635	951	1,920	16.5
Lead	mg/kg	4,740	3,870	7,920	5,230	8,870	12,000	71.2
Mercury	mg/kg	6.75	2.34	8.46	7.33	5.58	6.69	0.0388
Molybdenum	mg/kg	0.473	0.943	0.402	0.845	0.654	0.601	0.182
Nickel	mg/kg	6.37	9.17	4.31	7.44	5.94	4.32	7.36
Selenium	mg/kg	2.54	3.54	4.43	3.84	3.99	5.51	0.27
Silver	mg/kg	45.6	11.1	41.0	36.8	47.3	63.6	0.161
Thallium	mg/kg	0.645	0.936	1.27	1.0	1.02	1.62	0.166
Vanadium	mg/kg	58.5	59.9	151	95.7	122	132	22.2
Zinc	mg/kg	102	109	163	13,300	118	177	33.0
Cyanide, Total	mg/kg							

J - Laboratory Estimated Value
U - Not Detected at stated reporting limit
ISM - Incremental Sampling Method
mg/kg - milligrams per kilogram
Gray shaded cells - Not Analyzed

Table B 2.2
General Statistics for Site Inspection Data at Each Decision Units
Gold Hill Mill Site

DU-1 Mill Foundation ISM Data							
Variable	Number of ISM Samples	Number Detected	% Detected	Minimum Dected	Maximum Detected	Mean	Standard Deviation
Antimony	4	4	100%	956	1070	1017	49.49
Arsenic	4	4	100%	505	612	557	44.26
Barium	4	4	100%	95.6	129	112.4	14.63
Beryllium	4	4	100%	0.336	0.378	0.352	0.0184
Cadmium	4	4	100%	1.4	1.58	1.488	0.0907
Chromium	4	4	100%	8.03	10	8.828	0.95
Cobalt	4	4	100%	3.46	3.73	3.578	0.122
Copper	4	4	100%	1080	1260	1133	86.17
Lead	4	4	100%	11700	13900	12575	957
Mercury	4	4	100%	17.4	25.2	21.33	3.228
Molybdenum	4	4	100%	0.393	0.509	0.47	0.0531
Nickel	4	4	100%	6.33	7.37	6.78	0.465
Selenium	4	4	100%	3.31	4.07	3.583	0.357
Silver	4	4	100%	77.6	86.5	80.78	4.062
Thallium	4	4	100%	1.21	2.07	1.478	0.404
Vanadium	4	4	100%	157	178	168.8	9.605
Zinc	4	4	100%	219	306	251.8	40.7
Cyanide	4	4	100%	0.214	0.468	0.374	0.112

DU-2 Mill Tailings Discrete Data							
Variable	Number of Discrete Samples	Number Detected	% Detected	Minimum Dected	Maximum Detected	Mean	Standard Deviation
Antimony	7	7	100%	5.96	1490	701	481
Arsenic	7	7	100%	11.9	854	432.1	257.5
Barium	7	7	100%	37.4	175	87.99	43.98
Beryllium	7	7	100%	0.353	0.523	0.442	0.0609
Cadmium	7	7	100%	0.164	22.8	3.843	8.366
Chromium	7	7	100%	4.99	9.94	6.969	1.661
Cobalt	7	7	100%	1.91	5.7	3.901	1.348
Copper	7	7	100%	16.5	1920	906.2	615.5
Lead	7	7	100%	71.2	12000	6100	3867
Mercury	7	7	100%	0.0388	8.46	5.313	3.018
Molybdenum	7	7	100%	0.182	0.943	0.586	0.261
Nickel	7	7	100%	4.31	9.17	6.416	1.76
Selenium	7	7	100%	0.27	5.51	3.446	1.663
Silver	7	7	100%	0.161	63.6	35.08	22.01
Thallium	7	7	100%	0.166	1.62	0.951	0.459
Vanadium	7	7	100%	22.2	151	91.61	46.58
Zinc	7	7	100%	33	13300	2000	4983

Table B 2.2
General Statistics for Site Inspection Data at Each Decision Units
Gold Hill Mill Site

DU-3 ISM Background							
Variable	Number of ISM Samples	Number Detected	% Detected	Minimum Dected	Maximum Detected	Mean	Standard Deviation
Antimony	3	3	100%	0.7	0.834	0.754	0.0709
Arsenic	3	3	100%	3.49	3.97	3.753	0.243
Barium	3	3	100%	90.7	96.9	93.9	3.105
Beryllium	3	3	100%	0.278	0.29	0.283	0.00611
Cadmium	3	3	100%	0.131	0.156	0.147	0.0137
Chromium	3	3	100%	5.57	6.23	5.857	0.338
Cobalt	3	3	100%	4.41	4.68	4.59	0.156
Copper	3	3	100%	6.55	7.08	6.873	0.284
Lead	3	3	100%	5.89	6.38	6.16	0.249
Mercury	3	3	100%	0.0102	0.0136	0.0116	0.0018
Molybdenum	3	3	100%	0.124	0.132	0.129	0.00416
Nickel	3	3	100%	5.92	6.44	6.163	0.262
Selenium	3	0	0%	N/A	N/A	N/A	N/A
Silver	3	3	100%	0.0197	0.0285	0.0233	0.00463
Thallium	3	3	100%	0.136	0.139	0.138	0.00173
Vanadium	3	3	100%	18.4	19.5	18.83	0.586
Zinc	3	3	100%	27.5	29.8	28.5	1.179

TABLE B 2.3
Identification of COPCs
Gold Hill Mill Site

Analyte	Units	DTSC Screening Levls (2019)*	EPA Region 9 RSL (2019)*	Maximum ISM Concentration DU-1	Is Max Graeter than DTSC-SL?	Is Max Graeter than RSL?	Maximum Discrete Concentration DU-2	Is Max Graeter than DTSC-SL?	Is Max Graeter than RSL?	Selected as COPC?
Antimony	mg/kg	NA	3.1	1070	No	Yes	1490	No	Yes	**Yes**
Arsenic	mg/kg	0.011	0.68	612	Yes	Yes	854	Yes	Yes	**Yes**
Barium	mg/kg	NA	1,500	129	No	No	175	No	No	**No**
Beryllium	mg/kg	1.6	16	0.378	No	No	0.523	No	No	**No**
Cadmium	mg/kg	7.1	7.1	1.58	No	No	22.8	Yes	Yes	**Yes**
Chromium	mg/kg	NA	12,000	10	No	No	9.94	No	No	**No**
Cobalt	mg/kg	NA	2.3	3.73	No	Yes	5.7	No	Yes	**Yes**
Copper	mg/kg	NA	310	1260	No	Yes	1920	No	Yes	**Yes**
Lead**	mg/kg	80	400	13900	Yes	Yes	12000	Yes	Yes	**Yes**
Mercury	mg/kg	0.1	1.1	25.2	Yes	Yes	8.46	Yes	Yes	**Yes**
Molybdenum	mg/kg	NA	39	0.509	No	No	0.943	No	No	**No**
Nickel	mg/kg	82	150	7.37	No	No	9.17	No	No	**No**
Selenium	mg/kg	NA	39	4.07	No	No	5.51	No	No	**No**
Silver	mg/kg	NA	39	86.5	No	Yes	63.6	No	Yes	**Yes**
Thallium	mg/kg	NA	0.078	2.07	No	Yes	1.62	No	Yes	**Yes**
Vanadium	mg/kg	NA	39	178	No	Yes	151	No	Yes	**Yes**
Zinc	mg/kg	NA	2,300	306	No	No	13300	No	Yes	**Yes**
Cyanide	mg/kg	NA	2.3	0.468	No	No	not analyzed at this DU			**No**

ISM - Incremental Sampling Method
mg/kg - milligrams per kilogram
U - Not Detected at stated reporting limit
DTSC-SL - Department of Toxic Substances Control Screening Levels
RSL - Regional Screening Level (USEPA)
* Screening levels for carcinogenic effects at 1 x 10-6, and noncarcinogenic effects at a hazard of 0.1.
** Screening levels for lead are based on blood lead level concentrations derived from either DTSC or EPA biokinetic modeling.

Table B 3.1
Conceptual Exposure Model

Impacted Media	Transport Pathways	Exposure Media	Expsoure Routes	Potentially Exposed Populations		
				Tourist Visitor	**Mining Enthusiast Visitor**	**NPS Worker**
Soil	*Leaching*	Groundwater*	Ingestion Dermal Contact Inhalation	○	○	○
				No potable use of groundwater		
		Soil	Ingestion	●	●	●
			Dermal Contact	●	●	●
	Fugitive Dust Emissions	Outdoor Air	Inhalation	●	●	●
	Erosion	Surface Water	Ingestion	○	○	○
			Dermal Contact	○	○	○
				No surface water bodies onsite		

Notes

* Groundwater impacts are currently unknown
○ Incomplete pathway.
● Potentially complete pathway.

TABLE B 3.2
Exposure Point Cocentrations (units in mg/kg)
Gold Hill Mill Site

COPC	CAS Number	DU-1	DU-2
		Mean ISM Concentration	Discrete UCL
Antimony	7440-36-0	1,017	1,054
Arsenic	7440-38-2	557	621
Cadmium	7440-43-9	1.488	22.8
Cobalt	7440-48-4	3.578	4.891
Copper	7440-50-8	1,133	1,358
Lead	7439-92-1	12,575	8,940
Mercury	7439-97-6	21.33	7.529
Silver	7440-22-4	80.78	51.24
Thallium	7440-28-0	1.478	1.288
Vanadium	7440-62-2	169	126
Zinc	7440-66-6	252	13,300

ISM - Incremental Sampling Method
mg/kg - milligrams per kilogram

Table B 3.3
Exposure Factors and Calculation of Integrated Daily and Lifetime Exposure Factors
Gold Hill Mill Site

		Non-Cancer				
		NPS Worker	Tourist		Mining Enthusiast	
Exposure Parameter	**Units**	**Adult**	**Child**	**Adult**	**Child**	**Adult**
Ingestion of Soil						
Ingestion Rate of Soil (IR_s)	mg/day	100	200	100	400	330
Exposure Frequency (EF)	days/year	20	1	1	1	1
Exposure Time Fraction (ET)	hours	0.50	0.50	0.50	4.00	4.00
Exposure Duration (ED)	years	25	6	6	6	6
Body Weight (BW)	kg	80	15	80	15	80
Averaging Time (AT)	days	9,125	2,190	2,190	2,190	2,190
Active Exposed Hours (EH)	Hours	8.00	8.00	8.00	8.00	8.00
Daily Average Exposure Factor, Oral ($DAEF_o$)						
$\frac{IRs \times EF \times ET \times ED}{BW \times AT \times EH}$	mg/kg-day	0.004280822	0.002283105	0.000214041	0.03652968	0.005650685
Dermal Contact with Soil						
Skin Surface Area (SA)	cm^2	3,527	2,373	6,032	2,373	6,032
Adherence Factor (AF)	mg/cm^2-event	0.12	0.2	0.07	1	0.8
Assumed events (E)	event/day	1	1	1	1	1
Exposure Frequency (EF)	days/year	20	1	1	1	1
Exposure Duration (ED)	years	25	6	6	6	6
Body Weight (BW)	kg	80	15	80	15	80
Averaging Time (AT)	days	9,125	2,190	2,190	2,190	2,190
Daily Average Exposue Factor, Dermal ($DAEF_d$)						
$\frac{SA \times AF \times E \times EF \times ED}{BW \times AT}$	mg-event/kg-day	0.289890411	0.086684932	0.014460274	0.433424658	0.165260274
Inhalation of Outdoor Particulates						
Exposure Frequency (EF)	days/year	20	1	1	1	1
Exposure Time (ET)	hrs/day	0.50	0.50	0.50	4.00	4.00
Exposure Duration (ED)	years	25	6	6	6	6
Averaging Time (AT)	days	9,125	2,190	2,190	2,190	2,190
Hours per Day (H)	hours	24	24	24	24	24
Particulate Emission Factor (PEF)	m^3/kg	5.28E+08	5.28E+08	5.28E+08	5.28E+08	5.28E+08
Daily Average Exposure Factor, Air ($DAEF_{air}$)						
$\frac{EF \times ET \times ED \times \left(\frac{1}{PEF} + \frac{1}{VF^*}\right)}{AT \times H}$ * the VF term is only applicbale to the assessment of mercury and is not integrated here. See Attachment D 1.	$1/(m^3/kg)$	2.16E-12	1.08E-13	1.08E-13	8.65E-13	8.65E-13

Table B 3.3
Exposure Factors and Calculation of Integrated Daily and Lifetime Exposure Factors
Gold Hill Mill Site

		Cancer				
		NPS Worker	Tourist		Mining Enthusiast	
Exposure Parameter	**Units**	**Adult**	**Child**	**Adult**	**Child**	**Adult**
Ingestion of Soil						
Ingestion Rate of Soil (IR-S)	mg/day	100	200	100	400	330
Exposure Frequency (EF)	days/year	20	1	1	1	1
Exposure Time Fraction (ET)	hours	0.50	0.50	0.50	4.00	4.00
Exposure Duration (ED)	years	25	6	6	6	6
Body Weight (BW)	kg	80	15	80	15	80
Averaging Time (AT)	days	25,550	25,550	25,550	25,550	25,550
Active Exposed Hours (EH)	Hours	8.00	8.00	8.00	8.00	8.00
Lifetime Average Exposure Factor, Oral ($LAEF_o$) $\frac{IRs \times EF \times ET \times ED}{BW \times AT \times EH}$	mg/kg-day	0.001528865	0.000195695	1.83464E-05	0.003131115	0.000484344
Dermal Contact with Soil						
Skin Surface Area (SA)	cm^2	3,527	2,373	6,032	2,373	6,032
Adherence Factor (AF)	mg/cm^2-event	0.12	0.2	0.07	1	0.8
Assumed events (E)	event/day	1	1	1	1	1
Exposure Frequency (EF)	days/year	20	1	1	1	1
Exposure Duration (ED)	years	25	6	6	6	6
Body Weight (BW)	kg	80	15	80	15	80
Averaging Time (AT)	days	25,550	25,550	25,550	25,550	25,550
Lifetime Average Exposue Factor, Dermal ($LAEF_d$) $\frac{SA \times AF \times E \times EF \times ED}{BW \times AT}$	mg-event/kg-day	0.10353229	0.007430137	0.001239452	0.037150685	0.014165166
Inhalation of Outdoor Particulates						
Exposure Frequency (EF)	days/year	20	1	1	1	1
Exposure Time (ET)	hrs/day	0.50	0.50	0.50	4.00	4.00
Exposure Duration (ED)	years	25	6	6	6	6
Particulate Emission Factor (PEF)	m^3/kg	5.28E+08	5.28E+08	5.28E+08	5.28E+08	5.28E+08
Averaging Time (AT)	hours	25,550	25,550	25,550	25,550	25,550
Hours per Day	hrs/day	24	24	24	24	24
Lifetime Average Exposure Factor, Air ($LAEF_{air}$) $\frac{EF \times ET \times ED \times \left(\frac{1}{PEF} + \frac{1}{VF^*}\right)}{AT \times H}$ * the VF term is only applicbale to the assessment of mercury and is not integrated here. See Attachment D 1.	$1/m^3$/kg-day	7.72E-13	9.27E-15	9.27E-15	7.41E-14	7.41E-14

Table B 4.1
Toxicity Criteria
Gold Hill Mill Site

Contaminant of Potential Concern	Chemical Abstract Service Registration Number	Chemical Specific Parameters#				Cancer Risk Values*		Noncancer Risk Values*	
		GI Absorption (dermal pathway)	Dermal Absorption	Relative Bioavailability (oral pathway)	Fraction Absorbed (dermal pathway)	Oral Slope Factor	Inhlalation Unit Risk	Reference Dose Oral	Reference Concentration
COPC	CASRN	GIABS	ABSd	RBA	FA	SFo $(mg/kg\text{-}d)^{-1}$	IUR $(\mu g/m^3)^{-1}$	RfD_o (mg/kg-d)	RfC $(\mu g/m^3)$
Antimony	7440-36-0	0.15		1	1	--	--	4.00E-04	--
Arsenic	7440-38-2	1	0.03	0.6	1	9.5	4.30E-03	3.50E-06	0.015
Cadmium	7440-43-9	0.025	0.001	1	1	--	4.20E-03	1.00E-03	1.00E-02
Cobalt	7440-48-4	1		1	1	--	9.00E-03	3.00E-04	6.00E-03
Copper	7440-50-8	1		1	1	--	--	4.00E-02	--
Lead	7439-92-1					--	--	--	--
Mercury	7439-97-6	1		1	1	--	--	1.60E-04	3.00E-02
Silver	7440-22-4	0.04		1	1	--	--	5.00E-03	--
Thallium	7440-28-0	1		1	1	--	--	1.00E-05	--
Vanadium	7440-62-2	0.026		1	1	--	--	5.00E-03	0.1
Zinc	7440-66-6	1		1	1	--	--	3.00E-01	--

#https://www.epa.gov/risk/regional-screening-levels-rsls
* DTSC. 2019. Human Health Risk Assessment Note 10. Toxicity Criteria by Rule and DTSC-Recommended

Table B 5.1
Summary of Estimated Health Impacts by Decision Unit
Gold Hill Mill Site

DU1	Risk				Hazard			
Tourist	Ingestion	Dermal	Inhalation	Totals	Ingestion	Dermal	Inhalation	Totals
Child	6E-07	1E-06	2E-11	2E-06	< 1	< 1	< 1	< 1
Adult	6E-08	2E-07	2E-11	3E-07	< 1	< 1	< 1	< 1
Totals	7E-07	1E-06	5E-11	2E-06	*Non Additive*			
Enthusiasts								
Child	1E-05	6E-06	2E-10	2E-05	4	2	< 1	6
Adult	2E-06	2E-06	2E-10	4E-06	< 1	< 1	< 1	1
Totals	1E-05	8E-06	4E-10	2E-05	*Non Additive*			
NPS Worker	5E-06	2E-05	2E-09	2E-05	< 1	1	< 1	2

DU2	Risk				Hazard			
Tourist	Ingestion	Dermal	Inhalation	Totals	Ingestion	Dermal	Inhalation	Totals
Child	7E-07	1E-06	3E-11	2E-06	< 1	< 1	< 1	< 1
Adult	6E-08	2E-07	3E-11	3E-07	< 1	< 1	< 1	< 1
Totals	8E-07	2E-06	5E-11	2E-06	*Non Additive*			
Enthusiasts								
Child	1E-05	7E-06	2E-10	2E-05	4	2	< 1	6
Adult	2E-06	3E-06	2E-10	4E-06	< 1	< 1	< 1	2
Totals	1E-05	9E-06	4E-10	2E-05	*Non Additive*			
NPS Worker	5E-06	2E-05	2E-09	2E-05	< 1	2	< 1	2

Table B 5.2
DU1 Summaries by Chemical and Route of Exposure

	Child Tourist, Total Hazard								Adult Tourist , Total Hazard							
	Oral		Dermal		Inhalation		Total		Oral		Dermal		Inhalation		Total	
	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total
Antimony	6E-03	0.91%	--		--		6E-03	0.91%	5E-04	0.60%	--		--		5E-04	0.60%
Arsenic	2E-01	34.08%	4E-01	64.70%	4E-06	0.00%	6E-01	98.78%	2E-02	22.39%	7E-02	75.64%	4E-06	0.00%	9E-02	98.03%
Cadmium	3E-06	0.00%	3E-09		2E-08	0.00%	3E-06	0.00%	3E-07	0.00%	5E-10	0.00%	2E-08	0.00%	3E-07	0.00%
Cobalt	3E-05	0.00%	--		6E-08	0.00%	3E-05	0.00%	3E-06	0.00%	--		6E-08	0.00%	3E-06	0.00%
Copper	6E-05	0.01%	--		--		6E-05	0.01%	6E-06	0.01%	--		--		6E-06	0.01%
Lead																
Mercury	3E-04	0.05%	--		1E-03	0.18%	1E-03	0.23%	3E-05	0.03%	--		1E-03	1.28%	1E-03	1.31%
Silver	4E-05	0.01%	--		--		4E-05	0.01%	3E-06	0.00%	--		--		3E-06	0.00%
Thallium	3E-04	0.05%	--		--		3E-04	0.05%	3E-05	0.03%	--		--		3E-05	0.03%
Vanadium	8E-05	0.01%	--		2E-07	0.00%	8E-05	0.01%	7E-06	0.01%	--		2E-07	0.00%	7E-06	0.01%
Zinc	2E-06	0.00%	--		--		2E-06	0.00%	2E-07	0.00%	--		--		2E-07	0.00%
Totals	2E-01	35.12%	4E-01	64.70%	1E-03	0.18%	6E-01	100.00%	2E-02	23.08%	7E-02	75.64%	1E-03	1.29%	9E-02	100.00%

Table B 5.2
DU1 Summaries by Chemical and Route of Exposure

	Child Tourist, Total Risk								Adult Tourist , Total Risk							
	Oral		Dermal		Inhalation		Total		Oral		Dermal		Inhalation		Total	
	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total
Antimony	--		--		--		--		--		--		--		--	
Arsenic	6E-07	34.50%	1E-06	65.50%	2E-11	0.00%	2E-06	100.00%	6E-08	22.84%	2E-07	77.15%	2E-11	0.01%	3E-07	100.00%
Cadmium	--		--		6E-14	0.00%	6E-14	0.00%	--		--		6E-14	0.00%	6E-14	0.00%
Cobalt	--		--		3E-13	0.00%	3E-13	0.00%	--		--		3E-13	0.00%	3E-13	0.00%
Copper	--		--		--		--		--		--		--		--	
Lead																
Mercury	--		--		--		--		--		--		--		--	
Silver	--		--		--		--		--		--		--		--	
Thallium	--		--		--		--		--		--		--		--	
Vanadium	--		--		--		--		--		--		--		--	
Zinc	--		--		--		--		--		--		--		--	
Totals	6E-07	34.50%	1E-06	65.50%	2E-11	0.00%	2E-06	100.00%	6E-08	22.84%	2E-07	77.15%	2E-11	0.01%	3E-07	100.00%

	Child + Adult Tourist, Total Risk							
	Oral		Dermal		Inhalation		Total	
	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total
Antimony	--		--		--		--	
Arsenic	7E-07	33.05%	1E-06	66.94%	4E-11	0.00%	2E-06	100.00%
Cadmium	--		--		1E-13	0.00%	1E-13	0.00%
Cobalt	--		--		6E-13	0.00%	6E-13	0.00%
Copper	--		--		--		--	
Lead								
Mercury	--		--		--		--	
Silver	--		--		--		--	
Thallium	--		--		--		--	
Vanadium	--		--		--		--	
Zinc	--		--		--		--	
Totals	7E-07	33.05%	1E-06	66.94%	5E-11	0.00%	2E-06	100.00%

Table B 5.2
DU1 Summaries by Chemical and Route of Exposure

	Child Enthusiast, Total Hazard								**Adult Enthusiast , Total Hazard**							
	Oral		Dermal		Inhalation		Total		Oral		Dermal		Inhalation		Total	
	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total
Antimony	9E-02	1.64%	--		--		9E-02	1.64%	1E-02	1.06%	--		--		1E-02	1.06%
Arsenic	3E+00	61.48%	2E+00	36.47%	3E-05	0.00%	6E+00	97.96%	5E-01	39.84%	8E-01	58.25%	3E-05	0.00%	1E+00	98.09%
Cadmium	5E-05	0.00%	2E-08	0.00%	1E-07	0.00%	5E-05	0.00%	8E-06	0.00%	6E-09		1E-07	0.00%	9E-06	0.00%
Chromium	0E+00	0.00%	--		--		--		0E+00	0.00%	--		--		--	
Cobalt	4E-04	0.01%	--		5E-07	0.00%	4E-04	0.01%	7E-05	0.00%	--		5E-07	0.00%	7E-05	0.01%
Copper	1E-03		--		--		1E-03	0.02%	2E-04		--		--		2E-04	0.01%
Lead																
Mercury	5E-03	0.09%	--		9E-03	0.16%	1E-02	0.25%	8E-04	0.06%	--		9E-03	0.69%	1E-02	0.75%
Silver	6E-04	0.01%	--		--		6E-04	0.01%	9E-05	0.01%	--		--		9E-05	0.01%
Thallium	5E-03	0.10%	--		--		5E-03	0.10%	8E-04	0.06%	--		--		8E-04	0.06%
Vanadium	1E-03	0.02%	--		1E-06	0.00%	1E-03	0.02%	2E-04	0.01%	--		1E-06	0.00%	2E-04	0.01%
Zinc	3E-05	0.00%	--		--		3E-05	0.00%	5E-06	0.00%	--		--		5E-06	0.00%
Totals	4E+00	63.36%	2E+00	36.47%	9E-03	0.17%	6E+00	100.00%	6E-01	41.05%	8E-01	58.25%	9E-03	0.69%	1E+00	100.00%

Table B 5.2
DU1 Summaries by Chemical and Route of Exposure

	Child Enthusiast, Total Risk							
	Oral		Dermal		Inhalation		Total	
	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total
Antimony	--		--		--		--	
Arsenic	1E-05	62.76%	6E-06	37.23%	2E-10	0.00%	2E-05	100.00%
Cadmium	--		--		5E-13	0.00%	5E-13	0.00%
Cobalt	--		--		2E-12	0.00%	2E-12	0.00%
Copper	--		--				--	
Lead								
Mercury	--		--		--		--	
Silver	--		--		--		--	
Thallium	--		--		--		--	
Vanadium	--		--		--		--	
Zinc	--		--		--		--	
Totals	1E-05	62.76%	6E-06	37.23%	2E-10	0.00%	2E-05	100.00%

	Adult Enthusiast , Total Risk							
	Oral		Dermal		Inhalation		Total	
	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total
Antimony	--		--		--		--	
Arsenic	2E-06	40.61%	2E-06	59.38%	2E-10	0.00%	4E-06	100.00%
Cadmium	--		--		5E-13	0.00%	5E-13	0.00%
Cobalt	--		--		2E-12	0.00%	2E-12	0.00%
Copper	--		--		--		--	
Lead								
Mercury	--		--		--		--	
Silver	--		--		--		--	
Thallium	--		--		--		--	
Vanadium	--		--		--		--	
Zinc	--		--		--		--	
Totals	2E-06	40.61%	2E-06	59.38%	2E-10	0.00%	4E-06	100.00%

	Child + Adult Enthusiast, Total Risk							
	Oral		Dermal		Inhalation		Total	
	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total
Antimony	--		--		--		--	
Arsenic	1E-05	58.49%	8E-06	41.51%	4E-10	0.00%	2E-05	100.00%
Cadmium	--		--		9E-13	0.00%	9E-13	0.00%
Cobalt	--		--		5E-12	0.00%	5E-12	0.00%
Copper	--		--		--		--	
Lead								
Mercury	--		--		--		--	
Silver	--		--		--		--	
Thallium	--		--		--		--	
Vanadium	--		--		--		--	
Zinc	--		--		--		--	
Totals	1E-05	58.49%	8E-06	41.51%	4E-10	0.00%	2E-05	100.00%

Table B 5.2
DU1 Summaries by Chemical and Route of Exposure

NPS Worker Total Risks and Hazards																
	Cacinogenic Risk								Noncarcinogenic Hazard							
	Oral		Dermal		Inhalation		Total		Oral		Dermal		Inhalation		Total	
	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total
Antimony	--		--		--		--		1E-02	1%	--		--		1E-02	1%
Arsenic	5E-06	23%	2E-05	77%	2E-09	0%	2E-05	100%	4E-01	22%	1.4E+00	76%	8E-05	0%	2E+00	98%
Cadmium	--		--		5E-12	0%	5E-12	0%	6E-06	0%	1.1E-08	0%	3E-07	0%	7E-06	0%
Cobalt	--		--		2E-11	0%	2E-11	0%	5E-05	0%	--		1E-06	0%	5E-05	0%
Copper	--		--		--		--		1E-04	0%	--		--		1E-04	0%
Lead																
Mercury	--		--		--		--		6E-04	0%	--		2E-02	1%	2E-02	1%
Silver	--		--		--		--		7E-05	0%	--		--		7E-05	0%
Thallium	--		--		--		--		6E-04	0%	--		--		6E-04	0%
Vanadium	--		--		--		--		1E-04	0%	--		4E-06	0%	1E-04	0%
Zinc	--		--		--		--		4E-06	0%	--		--		4E-06	0%
Totals	5E-06	23%	2E-05	77%	2E-09	0%	2E-05	100%	4E-01	23%	1.4E+00	76%	2E-02	1%	2E+00	100%

Table B 5.3
DU2 Summaries by Chemical and Route of Exposure

	Child Tourist, Total Hazard								Adult Tourist , Total Hazard							
	Oral		Dermal		Inhalation		Total		Oral		Dermal		Inhalation		Total	
	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total
Antimony	6E-03	0.85%	--		--		6E-03	0.85%	6E-04	0.54%	--		--		6E-04	0.54%
Arsenic	2E-01	34.15%	5E-01	64.84%	4E-06	0.00%	7E-01	98.99%	2E-02	21.82%	8E-02	73.69%	4E-06	0.00%	1E-01	95.51%
Cadmium	5E-05	0.01%	5E-08		2E-07	0.00%	5E-05	0.01%	5E-06	0.00%	8E-09	0.00%	2E-07	0.00%	5E-06	0.00%
Cobalt	4E-05	0.01%	--		9E-08	0.00%	4E-05	0.01%	3E-06	0.00%	--		9E-08	0.00%	4E-06	0.00%
Copper	8E-05	0.01%	--		--		8E-05	0.01%	7E-06	0.01%	--		--		7E-06	0.01%
Lead																
Mercury	1E-04	0.02%	--		4E-04	0.06%	5E-04	0.07%	1E-05	0.01%	--		4E-03	3.88%	4E-03	3.89%
Silver	2E-05	0.00%	--		--		2E-05	0.00%	2E-06	0.00%	--		--		2E-06	0.00%
Thallium	3E-04	0.04%	--		--		3E-04	0.04%	3E-05	0.03%	--		--		3E-05	0.03%
Vanadium	6E-05	0.01%	--		1E-07	0.00%	6E-05	0.01%	5E-06	0.01%	--		1E-07	0.00%	6E-06	0.01%
Zinc	1E-04	0.01%	--		--		1E-04	0.01%	9E-06	0.01%	--		--		9E-06	0.01%
Totals	2E-01	35.10%	5E-01	64.84%	4E-04	0.06%	7E-01	100.00%	2E-02	22.42%	8E-02	73.69%	4E-03	3.89%	1E-01	100.00%

Table B 5.3
DU2 Summaries by Chemical and Route of Exposure

	Child Tourist, Total Risk								**Adult Tourist , Total Risk**							
	Oral		Dermal		Inhalation		Total		Oral		Dermal		Inhalation		Total	
	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total
Antimony	--		--		--		--		--		--		--		--	
Arsenic	7E-07	34.50%	1E-06	65.50%	2E-11	0.00%	2E-06	100.00%	6E-08	22.84%	2E-07	77.15%	2E-11	0.01%	3E-07	100.00%
Cadmium	--		--		9E-13	0.00%	9E-13	0.00%	--		--		9E-13	0.00%	9E-13	0.00%
Cobalt	--		--		4E-13	0.00%	4E-13	0.00%	--		--		4E-13	0.00%	4E-13	0.00%
Copper	--		--		--		--		--		--		--		--	
Lead																
Mercury	--		--		--		--		--		--		--		--	
Silver	--		--		--		--		--		--		--		--	
Thallium	--		--		--		--		--		--		--		--	
Vanadium	--		--		--		--		--		--		--		--	
Zinc	--		--		--		--		--		--		--		--	
Totals	7E-07	34.50%	1E-06	65.50%	3E-11	0.00%	2E-06	100.00%	6E-08	22.84%	2E-07	77.15%	3E-11	0.01%	3E-07	100.00%

	Child + Adult Tourist, Total Risk							
	Oral		Dermal		Inhalation		Total	
	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total
Antimony	--		--		--		--	
Arsenic	8E-07	33.05%	2E-06	66.94%	5E-11	0.00%	2E-06	100.00%
Cadmium	--		--		2E-12	0.00%	2E-12	0.00%
Cobalt	--		--		8E-13	0.00%	8E-13	0.00%
Copper	--		--		--		--	
Lead								
Mercury	--		--		--		--	
Silver	--		--		--		--	
Thallium	--		--		--		--	
Vanadium	--		--		--		--	
Zinc	--		--		--		--	
Totals	8E-07	33.05%	2E-06	66.94%	5E-11	0.00%	2E-06	100.00%

Table B 5.3
DU2 Summaries by Chemical and Route of Exposure

	Child Enthusiast, Total Hazard								Adult Enthusiast , Total Hazard							
	Oral		Dermal		Inhalation		Total		Oral		Dermal		Inhalation		Total	
	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total
Antimony	1E-01	1.53%	--		--		1E-01	1.53%	1E-02	0.99%	--		--		1E-02	0.99%
Arsenic	4E+00	61.65%	2E+00	36.58%	4E-05	0.00%	6E+00	98.23%	6E-01	40.07%	9E-01	58.59%	4E-05	0.00%	1E+00	98.66%
Cadmium	8E-04	0.01%	2E-07	0.00%	2E-06	0.00%	8E-04	0.01%	1E-04	0.01%	9E-08		2E-06	0.00%	1E-04	0.01%
Cobalt	6E-04	0.01%	--		7E-07	0.00%	6E-04	0.01%	9E-05	0.01%	--		7E-07	0.00%	9E-05	0.01%
Copper	1E-03		--		--		1E-03	0.02%	2E-04	0.01%	--		--		2E-04	0.01%
Lead																
Mercury	2E-03	0.03%	--		3E-03	0.05%	5E-03	0.08%	3E-04	0.02%	--		3E-03	0.22%	4E-03	0.24%
Silver	4E-04	0.01%	--		--		4E-04	0.01%	6E-05	0.00%	--		--		6E-05	0.00%
Thallium	5E-03	0.07%	--		--		5E-03	0.07%	7E-04	0.05%	--		--		7E-04	0.05%
Vanadium	9E-04	0.01%	--		1E-06	0.00%	9E-04	0.01%	1E-04	0.01%	--		1E-06	0.00%	1E-04	0.01%
Zinc	2E-03	0.03%	--		--		2E-03	0.03%	3E-04	0.02%	--		--		3E-04	0.02%
Totals	4E+00	63.37%	2E+00	36.58%	3E-03	0.05%	6E+00	100.00%	6E-01	41.18%	9E-01	58.59%	3E-03	0.22%	2E+00	100.00%

Table B 5.3
DU2 Summaries by Chemical and Route of Exposure

	Child Enthusiast, Total Risk								**Adult Enthusiast , Total Risk**							
	Oral		Dermal		Inhalation		Total		Oral		Dermal		Inhalation		Total	
	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total
Antimony	--		--		--		--		--		--		--		--	
Arsenic	1E-05	62.76%	7E-06	37.23%	2E-10	0.00%	2E-05	100.00%	2E-06	40.61%	2E-06	59.38%	2E-10	0.00%	4E-06	100.00%
Cadmium	--		--		7E-12	0.00%	7E-12	0.00%	--		--		5E-13	0.00%	5E-13	0.00%
Cobalt	--		--		3E-12	0.00%	3E-12	0.00%	--		--		2E-12	0.00%	2E-12	0.00%
Copper	--		--		--		--		--		--		--		--	
Lead																
Mercury	--		--		--		--		--		--		--		--	
Silver	--		--		--		--		--		--		--		--	
Thallium	--		--		--		--		--		--		--		--	
Vanadium	--		--		--		--		--		--		--		--	
Zinc	--		--		--		--		--		--		--		--	
Totals	1E-05	62.76%	7E-06	37.23%	2E-10	0.00%	2E-05	100.00%	2E-06	40.61%	2E-06	59.38%	2E-10	0.00%	4E-06	100.00%

	Child + Adult Enthusiast, Total Risk							
	Oral		Dermal		Inhalation		Total	
	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total
Antimony	--		--		--		--	
Arsenic	1E-05	58.49%	9E-06	41.51%	4E-10	0.00%	2E-05	100.00%
Cadmium	--		--		1E-11	0.00%	1E-11	0.00%
Cobalt	--		--		7E-12	0.00%	7E-12	0.00%
Copper	--		--		--		--	
Lead								
Mercury	--		--		--		--	
Silver	--		--		--		--	
Thallium	--		--		--		--	
Vanadium	--		--		--		--	
Zinc	--		--		--		--	
Totals	1E-05	58.49%	9E-06	41.51%	4E-10	0.00%	2E-05	100.00%

Table B 5.3
DU2 Summaries by Chemical and Route of Exposure

NPS Worker Total Risks and Hazards																
	Cacinogenic Risk								Noncarcinogenic Hazard							
	Oral		Dermal		Inhalation		Total		Oral		Dermal		Inhalation		Total	
	Risk	% of Total	Risk	% of Total	Risk	% of Total	Risk	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total	Hazard	% of Total
Antimony	--		--		--		--		1E-02	1%	--		--		1E-02	1%
Arsenic	5E-06	23%	2E-05	77%	2E-09	0%	2E-05	100%	5E-01	23%	1.5E+00	76%	9E-05	0%	2E+00	99%
Cadmium	--		--		7E-11	0%	7E-11	0%	1E-04	0%	1.7E-07	0%	5E-06	0%	1E-04	0%
Cobalt	--		--		3E-11	0%	3E-11	0%	7E-05	0%	--		2E-06	0%	7E-05	0%
Copper	--		--		--		--		1E-04	0%	--		--		1E-04	0%
Lead																
Mercury	--		--		--		--		2E-04	0%	--		8E-03	0%	8E-03	0%
Silver	--		--		--		--		4E-05	0%	--		--		4E-05	0%
Thallium	--		--		--		--		6E-04	0%	--		--		6E-04	0%
Vanadium	--		--		--		--		1E-04	0%	--		3E-06	0%	1E-04	0%
Zinc	--		--		--		--		2E-04	0%	--		--		2E-04	0%
Totals	5E-06	23%	2E-05	77%	2E-09	0%	2E-05	100%	5E-01	23%	1.5E+00	76%	8E-03	0%	2E+00	100%

Table B 5.4
Gold Hill Mill Specific Preliminary Removal Goals
(Based on a Hazard of 1.0 and Carcinogenic Risk of $1x10^{-6}$)

Target HQ 1.0E+00	**GOLD HILL MILL SPECIFIC SCREENING LEVELS - NONCANCER (mg/kg)**							
	Tourist (Assumes 1 visit per year for 12 years [6 as child, 6 as adult], for 0.5 hour at Gold Hill Mill Site)							
COPC	**Child**				**Adult**			
	Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Arsenic	2.6E+03	1.3E+03	1.4E+08	8.8E+02	2.7E+04	8.1E+03	1.4E+08	6.2E+03

Target HQ 1.0E+00	**GOLD HILL MILL SPECIFIC SCREENING LEVELS - NONCANCER (mg/kg)**							
	Enthusiast (Assumes 1 visit per year for 12 years [6 as child, 6 as adult], for 4 hours per day at Gold Hill Mill Site)							
COPC	**Child**				**Adult**			
	Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Arsenic	1.6E+02	2.7E+02	1.7E+07	1.0E+02	1.0E+03	7.1E+02	1.7E+07	4.2E+02

Target HQ 1.0E+00	**GOLD HILL MILL SPECIFIC SCREENING LEVELS - NONCANCER (mg/kg)**			
	NPS Worker (Assumes 20 days per year, for 25 years, 0.5 hour per visit)			
COPC	**Adult**			
	Ingestion	Dermal	Inhalation	Total
Arsenic	1.4E+03	4.0E+02	6.9E+06	3.1E+02

Target Risk 1.0E-06	**GOLD HILL MILL SPECIFIC SCREENING LEVELS - CANCER (mg/kg)**								
	Tourist (Assumes 1 visit per year for 12 years [6 as child, 6 as adult], for 0.5 hour at Skidoo Mill Site)								
COPC	**Child**				**Adult**				**Child + Adult**
	Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total	Total
Arsenic	9.0E+02	4.7E+02	2.5E+07	3.1E+02	9.6E+03	2.8E+03	2.5E+07	2.2E+03	2.7E+02

Target Risk 1.0E-06	**GOLD HILL SPECIFIC SCREENING LEVELS - CANCER (mg/kg)**								
	Enthusiast (Assumes 1 visit per year for 12 years [6 as child, 6 as adult], for 1 hour at Skidoo Mill Site)								
	Child				**Adult**				**Child + Adult**
	Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total	
Arsenic	5.6E+01	9.4E+01	3.1E+06	3.5E+01	3.6E+02	2.5E+02	3.1E+06	1.5E+02	2.8E+01

Target Risk 1.0E-06	**GOLD HILL MILL SPECIFIC SCREENING LEVELS - CANCER (mg/kg)**			
	NPS Worker (Assumes 20 days per year, for 25 years, 1 hour per visit)			
COPC	**Adult**			
	Ingestion	Dermal	Inhalation	Total
Arsenic	1.1E+02	3.4E+01	3.0E+05	2.6E+01

Table B 5.5
Gold Hill Mill Specific Summary of Human Health Based Preliminary Removal Goals
(Noncarcinogenic Hazard of 1 and Carcinogenic Risk of $1x10^{-6}$)

COPC	Gold Hill Mill Concentrations (mg/kg)			Minimum Receptor Specific PRG	Receptors Specific PRGs (mg/kg)					
					Noncacinogenic			Carcinogenic		
	DU-1 Mill Foundation (ISM Mean)	DU-2 Tailings in the Wash (UCL of Discrete Sample Data)	Background Concentration (ISM Mean)		Tourist	Enthusiast	NPS Worker	Tourist	Enthusiast	NPS Worker
Arsenic	557	621	3.75	26	882	100	311	271	28	26
Lead	12,575	8,940	6.16	1,200	1,200	1,200	12,000	--	--	--

Table B 6.1
Estimation of Z-Statistic for ISM Data, DU-1
Gold Hill Mill Site

Mill Foundation ISM Data									
Variable	Number of ISM Samples	Number Detected	% Detected	Minimum Dected	Maximum Detected	Mean	Standard Deviation	Z Score (Maximum-Mean)	Z Table Percentile
Antimony	4	4	100%	956	1070	1017	49.49	1.07	85.8%
Arsenic	4	4	100%	505	612	557	44.26	1.24	89.3%
Cadmium	4	4	100%	1.4	1.58	1.488	0.0907	1.01	84.4%
Cobalt	4	4	100%	3.46	3.73	3.578	0.122	1.25	89.4%
Copper	4	4	100%	1080	1260	1133	86.17	1.47	92.9%
Lead	4	4	100%	11700	13900	12575	957	1.38	91.6%
Mercury	4	4	100%	17.4	25.2	21.33	3.228	1.20	88.5%
Silver	4	4	100%	77.6	86.5	80.78	4.062	1.41	92.1%
Thallium	4	4	100%	1.21	2.07	1.478	0.404	1.47	92.9%
Vanadium	4	4	100%	157	178	168.8	9.605	0.96	83.0%
Zinc	4	4	100%	219	306	251.8	40.7	1.33	90.8%

Table B 6.2
Summary of Estimated Health Impacts by Decision Unit
Using U.S. EPA Toxicity Criteria for Arsenic
Gold Hill Mill Site

DU1	Risk				Hazard			
Tourist	Ingestion	Dermal	Inhalation	Totals	Ingestion	Dermal	Inhalation	Totals
Child	1E-07	2E-07	2E-11	3E-07	< 1	< 1	< 1	< 1
Adult	9E-09	3E-08	2E-11	4E-08	< 1	< 1	< 1	< 1
Totals	1E-07	2E-07	5E-11	3E-07	*Non Additive*			
Enthusiasts								
Child	2E-06	9E-07	2E-10	3E-06	< 1	< 1	< 1	< 1
Adult	2E-07	4E-07	2E-10	6E-07	< 1	< 1	< 1	< 1
Totals	2E-06	1E-06	4E-10	3E-06	*Non Additive*			
NPS Worker	8E-07	3E-06	2E-09	3E-06	< 1	< 1	< 1	< 1

DU2	Risk				Hazard			
Tourist	Ingestion	Dermal	Inhalation	Totals	Ingestion	Dermal	Inhalation	Totals
Child	1E-07	2E-07	3E-11	3E-07	< 1	< 1	< 1	< 1
Adult	1E-08	3E-08	3E-11	4E-08	< 1	< 1	< 1	< 1
Totals	1E-07	2E-07	5E-11	4E-07	*Non Additive*			
Enthusiasts								
Child	2E-06	1E-06	2E-10	3E-06	< 1	< 1	< 1	< 1
Adult	3E-07	4E-07	2E-10	7E-07	< 1	< 1	< 1	< 1
Totals	2E-06	1E-06	4E-10	3E-06	*Non Additive*			
NPS Worker	9E-07	3E-06	2E-09	4E-06	< 1	< 1	< 1	< 1

ATTACHMENT B 1

RISK CALCULATIONS

Site/Area: Gold Hill Mill DU1
ISM Mean
Scenario: Tourist Visitor

	Child Tourist Soil, ORAL					Adult Tourist Soil, ORAL			
		Lifetime Average Exposure Factor ($LAEF_{tco}$) 1.96E-04	Daily Average Exposure Factor ($DAEF_{tco}$) 2.28E-03			Lifetime Average Exposure Factor ($LAEF_{tao}$) 1.83E-05	Daily Average Exposure Factor ($DAEF_{tao}$) 2.14E-04		
	Exposure Point Concentration EPC	Lifetime Average Intake (LAI_{tco}) $LAEF_{tco}$ x EPC x RBA x CF	Daily Average Intake (DAI_{tco}) $DAEF_{tco}$ x EPC x RBA X CF	Risk LAI_{tco} x SF	Hazard DAI_{tco}/RfD	Lifetime Average Intake (LAI_{tao}) $LAEF_{tao}$ x EPC x RBA x CF	Daily Average Intake (DAI_{tao}) $DAEF_{tao}$ x EPC x RBA X CF	Risk LAI_{tao} x SF	Hazard DAI_{tao}/RfD
	mg/kg	mg/kg-day	mg/kg-day			mg/kg-day	mg/kg-day		
Antimony	1017	1.99E-07	2.32E-06	--	5.80E-03	1.87E-08	2.18E-07	--	5.44E-04
Arsenic	557	6.54E-08	7.63E-07	6.21E-07	2.18E-01	6.13E-09	7.15E-08	5.82E-08	2.04E-02
Cadmium	1.488	2.91E-10	3.40E-09	--	3.40E-06	2.73E-11	3.18E-10	--	3.18E-07
Cobalt	3.578	7.00E-10	8.17E-09	--	2.72E-05	6.56E-11	7.66E-10	--	2.55E-06
Copper	1133	2.22E-07	2.59E-06	--	6.47E-05	2.08E-08	2.43E-07	--	6.06E-06
Lead	12575								
Mercury	21.33	4.17E-09	4.87E-08	--	3.04E-04	3.91E-10	4.57E-09	--	2.85E-05
Silver	80.78	1.58E-08	1.84E-07	--	3.69E-05	1.48E-09	1.73E-08	--	3.46E-06
Thallium	1.478	2.89E-10	3.37E-09	--	3.37E-04	2.71E-11	3.16E-10	--	3.16E-05
Vanadium	168.8	3.30E-08	3.85E-07	--	7.71E-05	3.10E-09	3.61E-08	--	7.23E-06
Zinc	251.8	4.93E-08	5.75E-07	--	1.92E-06	4.62E-09	5.39E-08	--	1.80E-07
			Totals	6.21E-07	2.25E-01		Totals	5.82E-08	2.11E-02

Site/Area: Gold Hill Mill DU1
ISM Mean
Scenario: Tourist Visitor

		Child Tourist Soil, DERMAL				Adult Tourist Soil, DERMAL			
		Lifetime Average Exposure Factor ($LAEF_{tcd}$) 7.43E-03	Daily Average Exposure Factor ($DAEF_{tcd}$) 8.67E-02			Lifetime Average Exposure Factor ($LAEF_{tad}$) 1.24E-03	Daily Average Exposure Factor ($DAEF_{tad}$) 1.45E-02		
	Exposure Point Concentration EPC	Lifetime Average Intake (LAI_{tcd}) $LAEF_{tcd}$ x EPC x ABSd x FA x CF	Daily Average Intake (DAI_{tcd}) $DAEF_{tcd}$ x EPC x ABSd x FA x CF	Risk LAI x SF x GIABS	Hazard DAI x GIABS/RfD	Lifetime Average Intake (LAI_{tad}) $LAEF_{tad}$ x EPC x ABSd x FA x CF	Daily Average Intake (DAI_{tad}) $DAEF_{tad}$ x EPC x ABSd x FA x CF	Risk LAI x SF x GIABS	Hazard DAI x GIABS/RfD
	mg/kg	mg/kg-day	mg/kg-day			mg/kg-day	mg/kg-day		
Antimony	1017	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Arsenic	557	1.24E-07	1.45E-06	1.18E-06	4.14E-01	2.07E-08	2.42E-07	1.97E-07	6.90E-02
Cadmium	1.488	1.11E-11	1.29E-10	--	3.22E-09	1.84E-12	2.15E-11	--	5.38E-10
Cobalt	3.578	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Copper	1133	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Lead	12575								
Mercury	21.33	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Silver	80.78	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Thallium	1.478	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Vanadium	168.8	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Zinc	251.8	no ABS	no ABS	--	--	no ABS	no ABS	--	--
			Totals	1.18E-06	4.14E-01		Totals	1.97E-07	6.90E-02

Site/Area: Gold Hill Mill DU1
ISM Mean
Scenario: Tourist Visitor

	Child Tourist Soil, INHALATION					Adult Tourist Soil, INHALATION			
		Lifetime Average Exposure Factor ($LAEF_{tci}$)	Daily Average Exposure Factor ($DAEF_{tci}$)			Lifetime Average Exposure Factor ($LAEF_{tai}$)	Daily Average Exposure Factor ($DAEF_{tai}$)		
		9.27E-15	1.08E-13			9.27E-15	1.08E-13		
	Exposure Point Concentration EPC	Lifetime Average Exposure Concentration ($LAEC_{tci}$) $LAEF_{tci}$ x EPC	Daily Average Exposure Concentration ($DAEC_{tci}$) $DAEF_{tci}$ x EPC	Risk $LAEC_{tci}$ x 1000 x IUR	Hazard $DAECtc_i$ x 1000/RfC	Lifetime Average Exposure Concentration ($LAEC_{tai}$) $LAEF_{tai}$ x EPC	Daily Average Exposure Concentration ($DAEC_{tai}$) $DAEF_{tai}$ x EPC	Risk $LAEC_{tai}$ x 1000 x IUR	Hazard $DAECtc_i$ x 1000/RfC
	mg/kg	mg/m^3	mg/m^3			mg/m^3	mg/m^3		
Antimony	1017	9.42E-12	1.10E-10	--	--	9.42E-12	1.10E-10	--	--
Arsenic	557	5.16E-12	6.02E-11	2.22E-11	4.01E-06	5.16E-12	6.02E-11	2.22E-11	4.01E-06
Cadmium	1.488	1.38E-14	1.61E-13	5.79E-14	1.61E-08	1.38E-14	1.61E-13	5.79E-14	1.61E-08
Cobalt	3.578	3.32E-14	3.87E-13	2.98E-13	6.45E-08	3.32E-14	3.87E-13	2.98E-13	6.45E-08
Copper	1133	1.05E-11	1.22E-10	--	--	1.05E-11	1.22E-10	--	--
Lead	12575				--				--
Mercury	21.33	1.98E-13	3.51E-08	--	1.17E-03	2.13E+01	3.51E-08	--	1.17E-03
Silver	80.78	7.48E-13	8.73E-12	--	--	7.48E-13	8.73E-12	--	--
Thallium	1.478	1.37E-14	1.60E-13	--	--	1.37E-14	1.60E-13	--	--
Vanadium	168.8	1.56E-12	1.82E-11	--	1.82E-07	1.56E-12	1.82E-11	--	1.82E-07
Zinc	251.8	2.33E-12	2.72E-11	--	--	2.33E-12	2.72E-11	--	--
			Totals	2.25E-11	1.17E-03		Totals	2.25E-11	1.17E-03

Site/Area: Gold Hill Mill DU1
ISM Mean
Scenario: Tourist Visitor

	Child Tourist, Total Hazard				Adult Tourist , Total Hazard			
	Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
Antimony	5.80E-03	--	--	5.80E-03	5.44E-04	--	--	5.44E-04
Arsenic	2.18E-01	4.14E-01	4.01E-06	6.32E-01	2.04E-02	6.90E-02	4.01E-06	8.95E-02
Cadmium	3.40E-06	3.22E-09	1.61E-08	3.42E-06	3.18E-07	5.38E-10	1.61E-08	3.35E-07
Cobalt	2.72E-05	--	6.45E-08	2.73E-05	2.55E-06	--	6.45E-08	2.62E-06
Copper	6.47E-05	--	--	6.47E-05	6.06E-06	--	--	6.06E-06
Lead								
Mercury	3.04E-04	--	1.17E-03	1.47E-03	2.85E-05	--	1.17E-03	1.20E-03
Silver	3.69E-05	--	--	3.69E-05	3.46E-06	--	--	3.46E-06
Thallium	3.37E-04	--	--	3.37E-04	3.16E-05	--	--	3.16E-05
Vanadium	7.71E-05	--	1.82E-07	7.73E-05	7.23E-06	--	1.82E-07	7.41E-06
Zinc	1.92E-06	--	--	1.92E-06	1.80E-07	--	--	1.80E-07
Totals	2.25E-01	4.14E-01	1.17E-03	6.40E-01	2.11E-02	6.90E-02	1.17E-03	9.13E-02

	Child Tourist, Total Risk				Adult Tourist , Total Risk			
	Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
Antimony	--	--	--	--	--	--	--	--
Arsenic	6.21E-07	1.18E-06	2.22E-11	1.80E-06	5.82E-08	1.97E-07	2.22E-11	2.55E-07
Cadmium	--	--	5.79E-14	5.79E-14	--	--	5.79E-14	5.79E-14
Cobalt	--	--	2.98E-13	2.98E-13	--	--	2.98E-13	2.98E-13
Copper	--	--	--	--	--	--	--	--
Lead								
Mercury	--	--	--	--	--	--	--	--
Silver	--	--	--	--	--	--	--	--
Thallium	--	--	--	--	--	--	--	--
Vanadium	--	--	--	--	--	--	--	--
Zinc	--	--	--	--	--	--	--	--
Totals	6.21E-07	1.18E-06	2.25E-11	1.80E-06	5.82E-08	1.97E-07	2.25E-11	2.55E-07

	Child + Adult Tourist, Total Risk			
	Oral	Dermal	Inhalation	Total

Site/Area: Gold Hill Mill DU1
ISM Mean
Scenario: Tourist Visitor

Antimony	--	--	--	--
Arsenic	6.80E-07	1.38E-06	4.44E-11	2.06E-06
Cadmium	--	--	1.16E-13	1.16E-13
Cobalt	--	--	5.97E-13	5.97E-13
Copper	--	--	--	--
Lead				
Mercury	--	--	--	--
Silver	--	--	--	--
Thallium	--	--	--	--
Vanadium	--	--	--	--
Zinc	--	--	--	--
Totals	6.80E-07	1.38E-06	4.51E-11	2.06E-06

Site/Area: Gold Hill Mill DU1
ISM Mean
Scenario: Mining Enthusiast Visitor

	Child Enthusiast Soil, ORAL					Adult Enthusiast Soil, ORAL			
		Lifetime Average Exposure Factor ($LAEF_{eco}$) 3.13E-03	Daily Average Exposure Factor ($DAEF_{eco}$) 3.65E-02			Lifetime Average Exposure Factor ($LAEF_{eao}$) 4.84E-04	Daily Average Exposure Factor ($DAEF_{eao}$) 5.65E-03		
	Exposure Point Concentration EPC	Lifetime Average Intake (LAI_{eco}) $LAEF_{eco}$ x EPC x RBA x CF	Daily Average Intake (DAIeco) $DAEF_{eco}$ x EPC x RBA X CF	Risk LAI_{eco} x SF	Hazard DAI_{eco}/RfD	Lifetime Average Intake (LAI_{eao}) $LAEF_{eao}$ x EPC x RBA x CF	Daily Average Intake (DAI_{eao}) $DAEF_{eao}$ x EPC x RBA X CF	Risk LAI_{eao} x SF	Hazard DAI_{eao}/RfD
	mg/kg	mg/kg-day	mg/kg-day			mg/kg-day	mg/kg-day		
Antimony	1017	3.18E-06	3.72E-05	--	9.29E-02	4.93E-07	5.75E-06	--	1.44E-02
Arsenic	557	1.05E-06	1.22E-05	9.94E-06	3.49E+00	1.62E-07	1.89E-06	1.54E-06	5.40E-01
Cadmium	1.488	4.66E-09	5.44E-08	--	5.44E-05	7.21E-10	8.41E-09	--	8.41E-06
Cobalt	3.578	1.12E-08	1.31E-07	--	4.36E-04	1.73E-09	2.02E-08	--	6.74E-05
Copper	1133	3.55E-06	4.14E-05	--	1.03E-03	5.49E-07	6.40E-06	--	1.60E-04
Lead	12575								
Mercury	21.33	6.68E-08	7.79E-07	--	4.87E-03	1.03E-08	1.21E-07	--	7.53E-04
Silver	80.78	2.53E-07	2.95E-06	--	5.90E-04	3.91E-08	4.56E-07	--	9.13E-05
Thallium	1.478	4.63E-09	5.40E-08	--	5.40E-03	7.16E-10	8.35E-09	--	8.35E-04
Vanadium	168.8	5.29E-07	6.17E-06	--	1.23E-03	8.18E-08	9.54E-07	--	1.91E-04
Zinc	251.8	7.88E-07	9.20E-06	--	3.07E-05	1.22E-07	1.42E-06	--	4.74E-06
			Totals	9.94E-06	3.59E+00		Totals	1.54E-06	5.56E-01

Site/Area: Gold Hill Mill DU1
ISM Mean
Scenario: Mining Enthusiast Visitor

	Child Enthusiast Soil, DERMAL					Adult Enthusiast Soil, DERMAL			
		Lifetime Average Exposure Factor ($LAEFe_{cd}$)	Daily Average Exposure Factor ($DAEFe_{cd}$)			Lifetime Average Exposure Factor ($LAEF_{ead}$)	Daily Average Exposure Factor ($DAEF_{ead}$)		
		3.72E-02	4.33E-01			1.42E-02	1.65E-01		
	Exposure Point Concentration	Lifetime Average Intake (LAIecd)	Daily Average Intake (DAIecd)	Risk	Hazard	Lifetime Average Intake (LAIead)	Daily Average Intake (DAIead)	Risk	Hazard
	EPC	$LAEF_{ecd}$ x EPC x ABSd x FA x CF	$DAEF_{ecd}$ x EPC x ABSd x FA x CF	LAI_{ecd} x SF x GIABS	DAI_{ecd} x GIABS/RfD	$LAEFe_{ad}$ x EPC x ABSd x FA x CF	$DAEFe_{ad}$ x EPC x ABSd x FA x CF	LAI_{ead} x SF x GIABS	DAI_{ead} x GIABS/RfD
	mg/kg	mg/kg-day	mg/kg-day			mg/kg-day	mg/kg-day		
Antimony	1017	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Arsenic	557	6.21E-07	7.24E-06	5.90E-06	2.07E+00	2.37E-07	2.76E-06	2.25E-06	7.89E-01
Cadmium	1.488	5.53E-11	6.45E-10	--	1.61E-08	2.11E-11	2.46E-10	--	6.15E-09
Cobalt	3.578	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Copper	1133	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Lead	12575								
Mercury	21.33	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Silver	80.78	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Thallium	1.478	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Vanadium	168.8	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Zinc	251.8	no ABS	no ABS	--	--	no ABS	no ABS	--	--
			Totals	5.90E-06	2.07E+00		Totals	2.25E-06	7.89E-01

Site/Area: Gold Hill Mill DU1
ISM Mean
Scenario: Mining Enthusiast Visitor

	Child Enthusiast Soil, INHALATION					Adult Enthusiast Soil, INHALATION			
		Lifetime Average Exposure Factor ($LAEF_{eci}$) 7.41E-14	Daily Average Exposure Factor ($DAEFe_{ci}$) 8.65E-13			Lifetime Average Exposure Factor ($LAEF_{eai}$) 7.41E-14	Daily Average Exposure Factor ($DAEF_{eai}$) 8.65E-13		
	Exposure Point Concentration EPC	Lifetime Average Exposure Concentration ($LAECe_{ci}$) $LAEF_{eci}$ x EPC	Daily Average Exposure Concentration ($DAECe_{ci}$) $DAEF_{eci}$ x EPC	Risk $LAEC_{eci}$ x 1000 x IUR	Hazard $DAECec_{i}$ x 1000/RfC	Lifetime Average Exposure Concentration ($LAEC_{eai}$) $LAEF_{eai}$ x EPC	Daily Average Exposure Concentration ($DAEC_{eai}$) $DAEF_{eai}$ x EPC	Risk $LAEC_{eai}$ x 1000 x IUR	Hazard $DAECea_{i}$ x 1000/RfC
	mg/kg	mg/m^3	mg/m^3			mg/m^3	mg/m^3		
Antimony	1017	7.54E-11	8.80E-10	--	--	7.54E-11	8.80E-10	--	--
Arsenic	557	4.13E-11	4.82E-10	1.78E-10	3.21E-05	4.13E-11	4.82E-10	1.78E-10	3.21E-05
Cadmium	1.488	1.10E-13	1.29E-12	4.63E-13	1.29E-07	1.10E-13	1.29E-12	4.63E-13	1.29E-07
Cobalt	3.578	2.65E-13	3.09E-12	2.39E-12	5.16E-07	2.65E-13	3.09E-12	2.39E-12	5.16E-07
Copper	1133	8.40E-11	9.80E-10	--	--	8.40E-11	9.80E-10	--	--
Lead	12575				--				--
Mercury	21.33	3.16E-12	2.81E-07	--	9.36E-03	3.16E-12	2.81E-07	--	9.36E-03
Silver	80.78	5.99E-12	6.99E-11	--	--	5.99E-12	6.99E-11	--	--
Thallium	1.478	1.10E-13	1.28E-12	--	--	1.10E-13	1.28E-12	--	--
Vanadium	168.8	1.25E-11	1.46E-10	--	1.46E-06	1.25E-11	1.46E-10	--	1.46E-06
Zinc	251.8	1.87E-11	2.18E-10	--	--	1.87E-11	2.18E-10	--	--
			Totals	1.80E-10	9.39E-03		Totals	1.80E-10	9.39E-03

Site/Area: Gold Hill Mill DU1
ISM Mean
Scenario: Mining Enthusiast Visitor

	Child Enthusiast, Total Hazard				Adult Enthusiast , Total Hazard			
	Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
Antimony	9.29E-02	--	--	9.29E-02	1.44E-02	--	--	1.44E-02
Arsenic	3.49E+00	2.07E+00	3.21E-05	5.56E+00	5.40E-01	7.89E-01	3.21E-05	1.33E+00
Cadmium	5.44E-05	1.61E-08	1.29E-07	5.45E-05	8.41E-06	6.15E-09	1.29E-07	8.54E-06
Cobalt	4.36E-04	--	5.16E-07	4.36E-04	6.74E-05	--	5.16E-07	6.79E-05
Copper	1.03E-03	--	--	1.03E-03	1.60E-04	--	--	1.60E-04
Lead								
Mercury	4.87E-03	--	9.36E-03	1.42E-02	7.53E-04	--	9.36E-03	1.01E-02
Silver	5.90E-04	--	--	5.90E-04	9.13E-05	--	--	9.13E-05
Thallium	5.40E-03	--	--	5.40E-03	8.35E-04	--	--	8.35E-04
Vanadium	1.23E-03	--	1.46E-06	1.23E-03	1.91E-04	--	1.46E-06	1.92E-04
Zinc	3.07E-05	--	--	3.07E-05	4.74E-06	--	--	4.74E-06
Totals	3.59E+00	2.07E+00	9.39E-03	5.67E+00	5.56E-01	7.89E-01	9.39E-03	1.35E+00

	Child Enthusiast, Total Risk				Adult Enthusiast , Total Risk			
	Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
Antimony	--	--	--	--	--	--	--	--
Arsenic	9.94E-06	5.90E-06	1.78E-10	1.58E-05	1.54E-06	2.25E-06	1.78E-10	3.79E-06
Cadmium	--	--	4.63E-13	4.63E-13	--	--	4.63E-13	4.63E-13
Cobalt	--	--	2.39E-12	2.39E-12	--	--	2.39E-12	2.39E-12
Copper	--	--	--	--	--	--	--	--
Lead								
Mercury	--	--	--	--	--	--	--	--
Silver	--	--	--	--	--	--	--	--
Thallium	--	--	--	--	--	--	--	--
Vanadium	--	--	--	--	--	--	--	--
Zinc	--	--	--	--	--	--	--	--
Totals	9.94E-06	5.90E-06	1.80E-10	1.58E-05	1.54E-06	2.25E-06	1.80E-10	3.79E-06

Site/Area: Gold Hill Mill DU1
ISM Mean
Scenario: Mining Enthusiast Visitor

	Child + Adult Enthusiast, Total Risk			
	Oral	Dermal	Inhalation	Total
Antimony	--	--	--	--
Arsenic	1.15E-05	8.15E-06	3.55E-10	1.96E-05
Cadmium	--	--	9.27E-13	9.27E-13
Cobalt	--	--	4.77E-12	4.77E-12
Copper	--	--	--	--
Lead				
Mercury	--	--	--	--
Silver	--	--	--	--
Thallium	--	--	--	--
Vanadium	--	--	--	--
Zinc	--	--	--	--
Totals	1.15E-05	8.15E-06	3.61E-10	1.96E-05

Site/Area: Gold Hill Mill DU1
ISM Mean
Scenario: NPS Worker

NPS Worker Soil, ORAL					
	Exposure Point Concentration EPC	Lifetime Average Exposure Factor ($LAEF_{wao}$) 1.53E-03 Lifetime Average Intake (LAI_{wao}) $LAEF_{wao}$ x EPC x RBA x CF	Daily Average Exposure Factor ($DAEF_{wao}$) 4.28E-03 Daily Average Intake (DAI_{wao}) $DAEF_{wao}$ x EPC x RBA X CF	Risk LAI_{wao} x SF	Hazard DAI_{wao}/RfD
	mg/kg	mg/kg-day	mg/kg-day		
Antimony	1017	1.55E-06	4.35E-06	--	1.09E-02
Arsenic	557	5.11E-07	1.43E-06	4.85E-06	4.09E-01
Cadmium	1.488	2.27E-09	6.37E-09	--	6.37E-06
Cobalt	3.578	5.47E-09	1.53E-08	--	5.11E-05
Copper	1133	1.73E-06	4.85E-06	--	1.21E-04
Lead	12575				
Mercury	21.33	3.26E-08	9.13E-08	--	5.71E-04
Silver	80.78	1.24E-07	3.46E-07	--	6.92E-05
Thallium	1.478	2.26E-09	6.33E-09	--	6.33E-04
Vanadium	168.8	2.58E-07	7.23E-07	--	1.45E-04
Zinc	251.8	3.85E-07	1.08E-06	--	3.59E-06
			Totals	4.85E-06	4.21E-01

Site/Area: Gold Hill Mill DU1
ISM Mean
Scenario: NPS Worker

NPS Worker Soil, DERMAL					
		Lifetime Average Exposure Factor ($LAEF_{wad}$) 1.04E-01	Daily Average Exposure Factor ($DAEF_{wad}$) 2.90E-01		
	Exposure Point Concentration	Lifetime Average Intake (LAI_{wad})	Daily Average Intake (DAI_{wad})	Risk	Hazard
	EPC	$LAEFw_{ad}$ x EPC x ABSd x FA x CF	$DAEF_{wad}$ x EPC x ABSd x FA x CF	LAI_{wad} x SF x GIABS	DAI_{wad} x GIABS/RfD
	mg/kg	mg/kg-day	mg/kg-day		
Antimony	1017	no ABS	no ABS	--	--
Arsenic	557	1.73E-06	4.84E-06	1.64E-05	1.38E+00
Cadmium	1.488	1.54E-10	4.31E-10	--	1.08E-08
Cobalt	3.578	no ABS	no ABS	--	--
Copper	1133	no ABS	no ABS	--	--
Lead	12575				
Mercury	21.33	no ABS	no ABS	--	--
Silver	80.78	no ABS	no ABS	--	--
Thallium	1.478	no ABS	no ABS	--	--
Vanadium	168.8	no ABS	no ABS	--	--
Zinc	251.8	no ABS	no ABS	--	--
			Totals	1.64E-05	1.38E+00

Site/Area: Gold Hill Mill DU1
ISM Mean
Scenario: NPS Worker

NPS Worker Soil, INHALATION					
		Lifetime Average Exposure Factor ($LAEF_{wai}$) 7.72E-13	Daily Average Exposure Factor ($DAEF_{wai}$) 2.16E-12		
	Exposure Point Concentration	Lifetime Average Exposure Concentration ($LAEC_{wai}$)	Daily Average Exposure Concentration ($DAEC_{wai}$)	Risk	Hazard
	EPC	$LAEF_{wai}$ x EPC	$DAEF_{wai}$ x EPC	$LAEC_{wai}$ x 1000 x IUR	$DAEC_{wai}$ x 1000/RfC
	mg/kg	mg/m^3	mg/m^3		
Antimony	1017	7.85E-10	2.20E-09	--	--
Arsenic	557	4.30E-10	1.20E-09	1.85E-09	8.03E-05
Cadmium	1.488	1.15E-12	3.22E-12	4.83E-12	3.22E-07
Cobalt	3.578	2.76E-12	7.74E-12	2.49E-11	1.29E-06
Copper	1133	8.75E-10	2.45E-09	--	--
Lead	12575				
Mercury	21.33	1.65E-11	7.02E-07	--	2.34E-02
Silver	80.78	6.24E-11	1.75E-10	--	--
Thallium	1.478	1.14E-12	3.20E-12	--	--
Vanadium	168.8	1.30E-10	3.65E-10	--	3.65E-06
Zinc	251.8	1.94E-10	5.44E-10	--	--
			Totals	1.88E-09	2.35E-02

Site/Area: Gold Hill Mill DU1
ISM Mean
Scenario: NPS Worker

NPS Worker Total Risks and Hazards								
	Cacinogenic Risk				**Noncarcinogenic Hazard**			
	Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
Antimony	--	--	--	--	1.09E-02	--	--	1.09E-02
Arsenic	4.85E-06	1.64E-05	1.85E-09	2.13E-05	4.09E-01	1.38E+00	8.03E-05	1.79E+00
Cadmium	--	--	4.83E-12	4.83E-12	6.37E-06	1.08E-08	3.22E-07	6.70E-06
Cobalt	--	--	2.49E-11	2.49E-11	5.11E-05	--	1.29E-06	5.23E-05
Copper	--	--	--	--	1.21E-04	--	--	1.21E-04
Lead								
Mercury	--	--	--	--	5.71E-04	--	2.34E-02	2.40E-02
Silver	--	--	--	--	6.92E-05	--	--	6.92E-05
Thallium	--	--	--	--	6.33E-04	--	--	6.33E-04
Vanadium	--	--	--	--	1.45E-04	--	3.65E-06	1.48E-04
Zinc	--	--	--	--	3.59E-06	--	--	3.59E-06
Totals	4.85E-06	1.64E-05	1.88E-09	2.13E-05	4.21E-01	1.38E+00	2.35E-02	1.83E+00

Site/Area: Gold Hill Mill DU2
Discrete
Scenario: Tourist Visitor

	Child Tourist Soil, ORAL					Adult Tourist Soil, ORAL			
		Lifetime Average Exposure Factor ($LAEF_{tco}$)	Daily Average Exposure Factor ($DAEF_{tco}$)			Lifetime Average Exposure Factor ($LAEF_{tao}$)	Daily Average Exposure Factor ($DAEF_{tao}$)		
		1.96E-04	2.28E-03			1.83E-05	2.14E-04		
	Exposure Point Concentration	Lifetime Average Intake (LAI_{tco})	Daily Average Intake (DAI_{tco})	Risk	Hazard	Lifetime Average Intake (LAI_{tao})	Daily Average Intake (DAI_{tao})	Risk	Hazard
	EPC	$LAEF_{tco}$ x EPC x RBA x CF	$DAEF_{tco}$ x EPC x RBA X CF	LAI_{tco} x SF	DAI_{tco}/RfD	$LAEF_{tao}$ x EPC x RBA x CF	$DAEF_{tao}$ x EPC x RBA X CF	LAI_{tao} x SF	DAI_{tao}/RfD
	mg/kg	mg/kg-day	mg/kg-day			mg/kg-day	mg/kg-day		
Antimony	1054	2.06E-07	2.41E-06	--	6.02E-03	1.93E-08	2.26E-07	--	5.64E-04
Arsenic	621.2	7.29E-08	8.51E-07	6.93E-07	2.43E-01	6.84E-09	7.98E-08	6.50E-08	2.28E-02
Cadmium	22.8	4.46E-09	5.21E-08	--	5.21E-05	4.18E-10	4.88E-09	--	4.88E-06
Cobalt	4.891	9.57E-10	1.12E-08	--	3.72E-05	8.97E-11	1.05E-09	--	3.49E-06
Copper	1358	2.66E-07	3.10E-06	--	7.75E-05	2.49E-08	2.91E-07	--	7.27E-06
Lead	8940								
Mercury	7.529	1.47E-09	1.72E-08	--	1.07E-04	1.38E-10	1.61E-09	--	1.01E-05
Silver	51.24	1.00E-08	1.17E-07	--	2.34E-05	9.40E-10	1.10E-08	--	2.19E-06
Thallium	1.288	2.52E-10	2.94E-09	--	2.94E-04	2.36E-11	2.76E-10	--	2.76E-05
Vanadium	125.8	2.46E-08	2.87E-07	--	5.74E-05	2.31E-09	2.69E-08	--	5.39E-06
Zinc	13300	2.60E-06	3.04E-05	--	1.01E-04	2.44E-07	2.85E-06	--	9.49E-06
			Totals	6.93E-07	2.50E-01		Totals	6.50E-08	2.34E-02

Site/Area: Gold Hill Mill DU2
Discrete
Scenario: Tourist Visitor

	Child Tourist Soil, DERMAL					Adult Tourist Soil, DERMAL			
		Lifetime Average Exposure Factor ($LAEF_{tcd}$)	Daily Average Exposure Factor ($DAEF_{tcd}$)			Lifetime Average Exposure Factor ($LAEF_{tad}$)	Daily Average Exposure Factor ($DAEF_{tad}$)		
		7.43E-03	8.67E-02			1.24E-03	1.45E-02		
	Exposure Point Concentration	Lifetime Average Intake (LAI_{tcd})	Daily Average Intake (DAI_{tcd})	Risk	Hazard	Lifetime Average Intake (LAI_{tad})	Daily Average Intake (DAI_{tad})	Risk	Hazard
	EPC	$LAEF_{tcd}$ x EPC x ABSd x FA x CF	$DAEF_{tcd}$ x EPC x ABSd x FA x CF	LAI x SF x GIABS	DAI x GIABS/RfD	$LAEF_{tad}$ x EPC x ABSd x FA x CF	$DAEF_{tad}$ x EPC x ABSd x FA x CF	LAI x SF x GIABS	DAI x GIABS/RfD
	mg/kg	mg/kg-day	mg/kg-day			mg/kg-day	mg/kg-day		
Antimony	1054	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Arsenic	621.2	1.38E-07	1.62E-06	1.32E-06	4.62E-01	2.31E-08	2.69E-07	2.19E-07	7.70E-02
Cadmium	22.8	1.69E-10	1.98E-09	--	4.94E-08	2.83E-11	3.30E-10	--	8.24E-09
Cobalt	4.891	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Copper	1358	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Lead	8940								
Mercury	7.529	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Silver	51.24	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Thallium	1.288	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Vanadium	125.8	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Zinc	13300	no ABS	no ABS	--	--	no ABS	no ABS	--	--
			Totals	1.32E-06	4.62E-01		Totals	2.19E-07	7.70E-02

Site/Area: Gold Hill Mill DU2

Discrete

Scenario: Tourist Visitor

	Child Tourist Soil, INHALATION					Adult Tourist Soil, INHALATION			
		Lifetime Average Exposure Factor ($LAEF_{tci}$) 9.27E-15	Daily Average Exposure Factor ($DAEF_{tci}$) 1.08E-13			Lifetime Average Exposure Factor ($LAEF_{tai}$) 9.27E-15	Daily Average Exposure Factor ($DAEF_{tai}$) 1.08E-13		
	Exposure Point Concentration	Lifetime Average Exposure Concentration ($LAEC_{tci}$)	Daily Average Exposure Concentration ($DAEC_{tci}$)	Risk	Hazard	Lifetime Average Exposure Concentration ($LAEC_{tai}$)	Daily Average Exposure Concentration ($DAEC_{tai}$)	Risk	Hazard
	EPC	$LAEF_{tci}$ x EPC	$DAEF_{tci}$ x EPC	$LAEC_{tci}$ x 1000 x IUR	$DAECtc_i$ x 1000/RfC	$LAEF_{tai}$ x EPC	$DAEF_{tai}$ x EPC	$LAEC_{tai}$ x 1000 x IUR	$DAECtc_i$ x 1000/RfC
	mg/kg	mg/m^3	mg/m^3			mg/m^3	mg/m^3		
Antimony	1054	9.77E-12	1.14E-10	--	--	9.77E-12	1.14E-10	--	--
Arsenic	621.2	5.76E-12	6.72E-11	2.48E-11	4.48E-06	5.76E-12	6.72E-11	2.48E-11	4.48E-06
Cadmium	22.8	2.11E-13	2.46E-12	8.87E-13	2.46E-07	2.11E-13	2.46E-12	8.87E-13	2.46E-07
Cobalt	4.891	4.53E-14	5.29E-13	4.08E-13	8.81E-08	4.53E-14	5.29E-13	4.08E-13	8.81E-08
Copper	1358	1.26E-11	1.47E-10	--	--	1.26E-11	1.47E-10	--	--
Lead	8940								
Mercury	7.529	6.98E-14	1.24E-08	--	4.13E-04	6.98E-14	1.22E-07	--	4.06E-03
Silver	51.24	4.75E-13	5.54E-12	--	--	4.75E-13	5.54E-12	--	--
Thallium	1.288	1.19E-14	1.39E-13	--	--	1.19E-14	1.39E-13	--	--
Vanadium	125.8	1.17E-12	1.36E-11	--	1.36E-07	1.17E-12	1.36E-11	--	1.36E-07
Zinc	13300	1.23E-10	1.44E-09	--	--	1.23E-10	1.44E-09	--	--
			Totals	2.60E-11	4.18E-04		Totals	2.60E-11	4.06E-03

Site/Area: Gold Hill Mill DU2
Discrete
Scenario: Tourist Visitor

	Child Tourist, Total Hazard				Adult Tourist , Total Hazard			
	Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
Antimony	6.02E-03	--	--	6.02E-03	5.64E-04	--	--	5.64E-04
Arsenic	2.43E-01	4.62E-01	4.48E-06	7.05E-01	2.28E-02	7.70E-02	4.48E-06	9.98E-02
Cadmium	5.21E-05	4.94E-08	2.46E-07	5.24E-05	4.88E-06	8.24E-09	2.46E-07	5.13E-06
Cobalt	3.72E-05	--	8.81E-08	3.73E-05	3.49E-06	--	8.81E-08	3.58E-06
Copper	7.75E-05	--	--	7.75E-05	7.27E-06	--	--	7.27E-06
Lead								
Mercury	1.07E-04	--	4.13E-04	5.20E-04	1.01E-05	--	4.06E-03	4.07E-03
Silver	2.34E-05	--	--	2.34E-05	2.19E-06	--	--	2.19E-06
Thallium	2.94E-04	--	--	2.94E-04	2.76E-05	--	--	2.76E-05
Vanadium	5.74E-05	--	1.36E-07	5.76E-05	5.39E-06	--	1.36E-07	5.52E-06
Zinc	1.01E-04	--	--	1.01E-04	9.49E-06	--	--	9.49E-06
Totals	2.50E-01	4.62E-01	4.18E-04	7.12E-01	2.34E-02	7.70E-02	4.06E-03	1.04E-01

	Child Tourist, Total Risk				Adult Tourist , Total Risk			
	Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
Antimony	--	--	--	--	--	--	--	--
Arsenic	6.93E-07	1.32E-06	2.48E-11	2.01E-06	6.50E-08	2.19E-07	2.48E-11	2.84E-07
Cadmium	--	--	8.87E-13	8.87E-13	--	--	8.87E-13	8.87E-13
Cobalt	--	--	4.08E-13	4.08E-13	--	--	4.08E-13	4.08E-13
Copper	--	--	--	--	--	--	--	--
Lead								
Mercury	--	--	--	--	--	--	--	--
Silver	--	--	--	--	--	--	--	--
Thallium	--	--	--	--	--	--	--	--
Vanadium	--	--	--	--	--	--	--	--
Zinc	--	--	--	--	--	--	--	--
Totals	6.93E-07	1.32E-06	2.60E-11	2.01E-06	6.50E-08	2.19E-07	2.60E-11	2.84E-07

Site/Area: Gold Hill Mill DU2
Discrete
Scenario: Tourist Visitor

	Child + Adult Tourist, Total Risk			
	Oral	Dermal	Inhalation	Total
Antimony	--	--	--	--
Arsenic	7.58E-07	1.53E-06	4.95E-11	2.29E-06
Cadmium	--	--	1.77E-12	1.77E-12
Cobalt	--	--	8.16E-13	8.16E-13
Copper	--	--	--	--
Lead				
Mercury	--	--	--	--
Silver	--	--	--	--
Thallium	--	--	--	--
Vanadium	--	--	--	--
Zinc	--	--	--	--
Totals	7.58E-07	1.53E-06	5.21E-11	2.29E-06

Site/Area: Gold Hill Mill DU2
Discrete
Scenario: Mining Enthusiast Visitor

	Child Enthusiast Soil, ORAL					Adult Enthusiast Soil, ORAL			
		Lifetime Average Exposure Factor ($LAEF_{eco}$) 3.13E-03	Daily Average Exposure Factor ($DAEF_{eco}$) 3.65E-02			Lifetime Average Exposure Factor ($LAEF_{eao}$) 4.84E-04	Daily Average Exposure Factor ($DAEF_{eao}$) 5.65E-03		
	Exposure Point Concentration	Lifetime Average Intake (LAI_{eco})	Daily Average Intake (DAIeco)	Risk	Hazard	Lifetime Average Intake (LAI_{eao})	Daily Average Intake (DAI_{eao})	Risk	Hazard
	EPC	$LAEF_{eco}$ x EPC x RBA x CF	$DAEF_{eco}$ x EPC x RBA X CF	LAI_{eco} x SF	DAI_{eco}/RfD	$LAEF_{eao}$ x EPC x RBA x CF	$DAEF_{eao}$ x EPC x RBA X CF	LAI_{eao} x SF	DAI_{eao}/RfD
	mg/kg	mg/kg-day	mg/kg-day			mg/kg-day	mg/kg-day		
Antimony	1054	3.30E-06	3.85E-05	--	9.63E-02	5.10E-07	5.96E-06	--	1.49E-02
Arsenic	621.2	1.17E-06	1.36E-05	1.11E-05	3.89E+00	1.81E-07	2.11E-06	1.71E-06	6.02E-01
Cadmium	22.8	7.14E-08	8.33E-07	--	8.33E-04	1.10E-08	1.29E-07	--	1.29E-04
Cobalt	4.891	1.53E-08	1.79E-07	--	5.96E-04	2.37E-09	2.76E-08	--	9.21E-05
Copper	1358	4.25E-06	4.96E-05	--	1.24E-03	6.58E-07	7.67E-06	--	1.92E-04
Lead	8940								
Mercury	7.529	2.36E-08	2.75E-07	--	1.72E-03	3.65E-09	4.25E-08	--	2.66E-04
Silver	51.24	1.60E-07	1.87E-06	--	3.74E-04	2.48E-08	2.90E-07	--	5.79E-05
Thallium	1.288	4.03E-09	4.71E-08	--	4.71E-03	6.24E-10	7.28E-09	--	7.28E-04
Vanadium	125.8	3.94E-07	4.60E-06	--	9.19E-04	6.09E-08	7.11E-07	--	1.42E-04
Zinc	13300	4.16E-05	4.86E-04	--	1.62E-03	6.44E-06	7.52E-05	--	2.51E-04
			Totals	1.11E-05	4.00E+00		Totals	1.71E-06	6.18E-01

Site/Area: Gold Hill Mill DU2
Discrete
Scenario: Mining Enthusiast Visitor

	Child Enthusiast Soil, DERMAL					Adult Enthusiast Soil, DERMAL			
		Lifetime Average Exposure Factor ($LAEFe_{cd}$) 3.72E-02	Daily Average Exposure Factor ($DAEFe_{cd}$) 4.33E-01			Lifetime Average Exposure Factor ($LAEF_{cad}$) 1.42E-02	Daily Average Exposure Factor ($DAEF_{cad}$) 1.65E-01		
	Exposure Point Concentration EPC	Lifetime Average Intake (LAIecd) $LAEF_{ecd}$ x EPC x ABSd x FA x CF	Daily Average Intake (DAIecd) $DAEF_{ecd}$ x EPC x ABSd x FA x CF	Risk LAI_{ecd} x SF x GIABS	Hazard DAI_{ecd} x GIABS/RfD	Lifetime Average Intake (LAIead) $LAEFe_{ad}$ x EPC x ABSd x FA x CF	Daily Average Intake (DAIead) $DAEFe_{ad}$ x EPC x ABSd x FA x CF	Risk LAI_{ead} x SF x GIABS	Hazard DAI_{ead} x GIABS/RfD
	mg/kg	mg/kg-day	mg/kg-day			mg/kg-day	mg/kg-day		
Antimony	1054	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Arsenic	621.2	6.92E-07	8.08E-06	6.58E-06	2.31E+00	2.64E-07	3.08E-06	2.51E-06	8.80E-01
Cadmium	22.8	8.47E-10	9.88E-09	--	2.47E-07	3.23E-10	3.77E-09	--	9.42E-08
Cobalt	4.891	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Copper	1358	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Lead	8940								
Mercury	7.529	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Silver	51.24	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Thallium	1.288	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Vanadium	125.8	no ABS	no ABS	--	--	no ABS	no ABS	--	--
Zinc	13300	no ABS	no ABS	--	--	no ABS	no ABS	--	--
			Totals	6.58E-06	2.31E+00		Totals	2.51E-06	8.80E-01

Site/Area: Gold Hill Mill DU2
Discrete
Scenario: Mining Enthusiast Visitor

	Child Enthusiast Soil, INHALATION					Adult Enthusiast Soil, INHALATION			
		Lifetime Average Exposure Factor ($LAEF_{eci}$) 7.41E-14	Daily Average Exposure Factor ($DAEFe_{ci}$) 8.65E-13			Lifetime Average Exposure Factor ($LAEF_{eai}$) 7.41E-14	Daily Average Exposure Factor ($DAEF_{eai}$) 8.65E-13		
	Exposure Point Concentration EPC	Lifetime Average Exposure Concentration ($LAECe_{ci}$) $LAEF_{eci}$ x EPC	Daily Average Exposure Concentration ($DAECe_{ci}$) $DAEF_{eci}$ x EPC	Risk $LAEC_{eci}$ x 1000 x IUR	Hazard $DAECec_i$ x 1000/RfC	Lifetime Average Exposure Concentration ($LAEC_{eai}$) $LAEF_{eai}$ x EPC	Daily Average Exposure Concentration ($DAEC_{eai}$) $DAEF_{eai}$ x EPC	Risk $LAEC_{eai}$ x 1000 x IUR	Hazard $DAECea_i$ x 1000/RfC
	mg/kg	mg/m^3	mg/m^3			mg/m^3	mg/m^3		
Antimony	1054	7.81E-11	9.12E-10	--	--	7.81E-11	9.12E-10	--	--
Arsenic	621.2	4.60E-11	5.37E-10	1.98E-10	3.58E-05	4.60E-11	5.37E-10	1.98E-10	3.58E-05
Cadmium	22.8	1.69E-12	1.97E-11	7.10E-12	1.97E-06	1.69E-12	1.97E-11	7.10E-12	1.97E-06
Cobalt	4.891	3.63E-13	4.23E-12	3.26E-12	7.05E-07	3.63E-13	4.23E-12	3.26E-12	7.05E-07
Copper	1358	1.01E-10	1.17E-09	--	--	1.01E-10	1.17E-09	--	--
Lead	8940								
Mercury	7.529	1.12E-12	9.91E-08	--	3.30E-03	1.12E-12	9.91E-08	--	3.30E-03
Silver	51.24	3.80E-12	4.43E-11	--	--	3.80E-12	4.43E-11	--	--
Thallium	1.288	9.55E-14	1.11E-12	--	--	9.55E-14	1.11E-12	--	--
Vanadium	125.8	9.33E-12	1.09E-10	--	1.09E-06	9.33E-12	1.09E-10	--	1.09E-06
Zinc	13300	9.86E-10	1.15E-08	--	--	9.86E-10	1.15E-08	--	--
			Totals	2.08E-10	3.34E-03		Totals	2.08E-10	3.34E-03

Site/Area: Gold Hill Mill DU2
Discrete
Scenario: Mining Enthusiast Visitor

	Child Enthusiast, Total Hazard				**Adult Enthusiast , Total Hazard**			
	Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
Antimony	9.63E-02	--	--	9.63E-02	1.49E-02	--	--	1.49E-02
Arsenic	3.89E+00	2.31E+00	3.58E-05	6.20E+00	6.02E-01	8.80E-01	3.58E-05	1.48E+00
Cadmium	8.33E-04	2.47E-07	1.97E-06	8.35E-04	1.29E-04	9.42E-08	1.97E-06	1.31E-04
Cobalt	5.96E-04	--	7.05E-07	5.96E-04	9.21E-05	--	7.05E-07	9.28E-05
Copper	1.24E-03	--	--	1.24E-03	1.92E-04	--	--	1.92E-04
Lead								
Mercury	1.72E-03	--	3.30E-03	5.02E-03	2.66E-04	--	3.30E-03	3.57E-03
Silver	3.74E-04	--	--	3.74E-04	5.79E-05	--	--	5.79E-05
Thallium	4.71E-03	--	--	4.71E-03	7.28E-04	--	--	7.28E-04
Vanadium	9.19E-04	--	1.09E-06	9.20E-04	1.42E-04	--	1.09E-06	1.43E-04
Zinc	1.62E-03	--	--	1.62E-03	2.51E-04	--	--	2.51E-04
Totals	4.00E+00	2.31E+00	3.34E-03	6.31E+00	6.18E-01	8.80E-01	3.34E-03	1.50E+00

	Child Enthusiast, Total Risk				**Adult Enthusiast , Total Risk**			
	Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
Antimony	--	--	--	--	--	--	--	--
Arsenic	1.11E-05	6.58E-06	1.98E-10	1.77E-05	1.71E-06	2.51E-06	1.98E-10	4.22E-06
Cadmium	--	--	7.10E-12	7.10E-12	--	--	7.10E-12	7.10E-12
Cobalt	--	--	3.26E-12	3.26E-12	--	--	3.26E-12	3.26E-12
Copper	--	--	--	--	--	--	--	--
Lead								
Mercury	--	--	--	--	--	--	--	--
Silver	--	--	--	--	--	--	--	--
Thallium	--	--	--	--	--	--	--	--
Vanadium	--	--	--	--	--	--	--	--
Zinc	--	--	--	--	--	--	--	--
Totals	1.11E-05	6.58E-06	2.08E-10	1.77E-05	1.71E-06	2.51E-06	2.08E-10	4.22E-06

Site/Area: Gold Hill Mill DU2
Discrete
Scenario: Mining Enthusiast Visitor

	Child + Adult Enthusiast, Total Risk			
	Oral	Dermal	Inhalation	Total
Antimony	--	--	--	--
Arsenic	1.28E-05	9.09E-06	3.96E-10	2.19E-05
Cadmium	--	--	1.42E-11	1.42E-11
Cobalt	--	--	6.53E-12	6.53E-12
Copper	--	--	--	--
Lead				
Mercury	--	--	--	--
Silver	--	--	--	--
Thallium	--	--	--	--
Vanadium	--	--	--	--
Zinc	--	--	--	--
Totals	1.28E-05	9.09E-06	4.17E-10	2.19E-05

Site/Area: Gold Hill Mill DU2
Discrete
Scenario: NPS Worker

NPS Worker Soil, ORAL					
		Lifetime Average Exposure Factor ($LAEF_{wao}$) 1.53E-03	Daily Average Exposure Factor ($DAEF_{wao}$) 4.28E-03		
	Exposure Point Concentration EPC	Lifetime Average Intake (LAI_{wao}) $LAEF_{wao}$ x EPC x RBA x CF	Daily Average Intake (DAI_{wao}) $DAEF_{wao}$ x EPC x RBA X CF	Risk LAI_{wao} x SF	Hazard DAI_{wao}/RfD
	mg/kg	mg/kg-day	mg/kg-day		
Antimony	1054	1.61E-06	4.51E-06	--	1.13E-02
Arsenic	621.2	5.70E-07	1.60E-06	5.41E-06	4.56E-01
Cadmium	22.8	3.49E-08	9.76E-08	--	9.76E-05
Cobalt	4.891	7.48E-09	2.09E-08	--	6.98E-05
Copper	1358	2.08E-06	5.81E-06	--	1.45E-04
Lead	8940				
Mercury	7.529	1.15E-08	3.22E-08	--	2.01E-04
Silver	51.24	7.83E-08	2.19E-07	--	4.39E-05
Thallium	1.288	1.97E-09	5.51E-09	--	5.51E-04
Vanadium	125.8	1.92E-07	5.39E-07	--	1.08E-04
Zinc	13300	2.03E-05	5.69E-05	--	1.90E-04
			Totals	5.41E-06	4.69E-01

Site/Area: Gold Hill Mill DU2
Discrete
Scenario: NPS Worker

NPS Worker Soil, DERMAL					
		Lifetime Average Exposure Factor ($LAEF_{wad}$) 1.04E-01	Daily Average Exposure Factor ($DAEF_{wad}$) 2.90E-01		
	Exposure Point Concentration	Lifetime Average Intake (LAI_{wad})	Daily Average Intake (DAI_{wad})	Risk	Hazard
	EPC	$LAEFw_{ad}$ x EPC x ABSd x FA x CF	$DAEF_{wad}$ x EPC x ABSd x FA x CF	LAI_{wad} x SF x GIABS	DAI_{wad} x GIABS/RfD
	mg/kg	mg/kg-day	mg/kg-day		
Antimony	1054	no ABS	no ABS	--	--
Arsenic	621.2	1.93E-06	5.40E-06	1.83E-05	1.54E+00
Cadmium	22.8	2.36E-09	6.61E-09	--	1.65E-07
Cobalt	4.891	no ABS	no ABS	--	--
Copper	1358	no ABS	no ABS	--	--
Lead	8940				
Mercury	7.529	no ABS	no ABS	--	--
Silver	51.24	no ABS	no ABS	--	--
Thallium	1.288	no ABS	no ABS	--	--
Vanadium	125.8	no ABS	no ABS	--	--
Zinc	13300	no ABS	no ABS	--	--
			Totals	1.83E-05	1.54E+00

Site/Area: Gold Hill Mill DU2
Discrete
Scenario: NPS Worker

NPS Worker Soil, INHALATION					
		Lifetime Average Exposure Factor ($LAEF_{wai}$) 7.72E-13	Daily Average Exposure Factor ($DAEF_{wai}$) 2.16E-12		
	Exposure Point Concentration EPC	Lifetime Average Exposure Concentration ($LAEC_{wai}$) $LAEF_{wai}$ x EPC	Daily Average Exposure Concentration ($DAEC_{wai}$) $DAEF_{wai}$ x EPC	Risk $LAEC_{wai}$ x 1000 x IUR	Hazard $DAEC_{wai}$ x 1000/RfC
	mg/kg	mg/m^3	mg/m^3		
Antimony	1054	8.14E-10	2.28E-09	--	--
Arsenic	621.2	4.80E-10	1.34E-09	2.06E-09	8.95E-05
Cadmium	22.8	1.76E-11	4.93E-11	7.39E-11	4.93E-06
Cobalt	4.891	3.78E-12	1.06E-11	3.40E-11	1.76E-06
Copper	1358	1.05E-09	2.94E-09	--	--
Lead	8940				
Mercury	7.529	5.82E-12	2.48E-07	--	8.26E-03
Silver	51.24	3.96E-11	1.11E-10	--	--
Thallium	1.288	9.95E-13	2.78E-12	--	--
Vanadium	125.8	9.71E-11	2.72E-10	--	2.72E-06
Zinc	13300	1.03E-08	2.88E-08	--	--
			Totals	2.17E-09	8.36E-03

Site/Area: Gold Hill Mill DU2
Discrete
Scenario: NPS Worker

NPS Worker Total Risks and Hazards								
	Cacinogenic Risk				**Noncarcinogenic Hazard**			
	Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
Antimony	--	--	--	--	1.13E-02	--	--	1.13E-02
Arsenic	5.41E-06	1.83E-05	2.06E-09	2.37E-05	4.56E-01	1.54E+00	8.95E-05	2.00E+00
Cadmium	--	--	7.39E-11	7.39E-11	9.76E-05	1.65E-07	4.93E-06	1.03E-04
Cobalt	--	--	3.40E-11	3.40E-11	6.98E-05	--	1.76E-06	7.16E-05
Copper	--	--	--	--	1.45E-04	--	--	1.45E-04
Lead								
Mercury	--	--	--	--	2.01E-04	--	8.26E-03	8.46E-03
Silver	--	--	--	--	4.39E-05	--	--	4.39E-05
Thallium	--	--	--	--	5.51E-04	--	--	5.51E-04
Vanadium	--	--	--	--	1.08E-04	--	2.72E-06	1.10E-04
Zinc	--	--	--	--	1.90E-04	--	--	1.90E-04
Totals	5.41E-06	1.83E-05	2.17E-09	2.37E-05	4.69E-01	1.54E+00	8.36E-03	2.02E+00

ATTACHMENT B 2

SAMPLE CALCULATION

Sample Calculations
Scenario: NPS Worker

Daily Average Exposure Factor, Oral ($DAEF_{wao}$), mg/kg-day (Equation 1)

Equation:

$$\frac{IRs \times \text{EF} \times ET \times \text{ED}}{BW \times AT \times EH}$$

Where

Notation	Parameter	Units	Value
IRs	Ingestion Rate of Soil (IR_s)	mg/day	100
EF	Exposure Frequency (EF)	days/year	20
ET	Exposure Time Fraction (ET)	hours	0.5
ED	Exposure Duration (ED)	years	25
BW	Body Weight (BW)	kg	80
AT	Averaging Time (AT)	days	9,125
EH	Active Exposed Hours (EH)	Hours	8.00

Value Replacement:

$$\frac{100\text{mg/day x 20 days/year x 0.5 hour x 25 years}}{\text{80 kg x 9125 days x 8 hours}}$$

Units check:

$$\frac{100\text{mg}/\cancel{\text{day}}\text{ x 20 }\cancel{\text{days/year}}\text{ x 0.5 }\cancel{\text{hour}}\text{ x 25 }\cancel{\text{years}}}{\text{80 kg x 9125 days x 8 }\cancel{\text{hours}}}$$

Solving:

$$\frac{\text{25,000 mg}}{\text{5,840,00 kg-day}}$$

= 0.00428 mg/kg-day

Sample Calculations

Scenario: NPS Worker

Daily Average Exposure Factor, Dermal ($DAEF_{wad}$), mg/kg-day (Equation 2)

Equation:

$$\frac{A \times AF \times E \times EF \times ED}{BW \times AT}$$

Where

Notation	Parameter	Units	Value
SA	Skin Surface Area (SA)	cm^2	3,527
AF	Adherence Factor (AF)	mg/cm^2-event	0.12
E	Assumed events (E)	1 event/day	1
EF	Exposure Frequency (EF)	days/year	20
ED	Exposure Duration (ED)	years	25
BW	Body Weight (BW)	kg	80
AT	Averaging Time (AT)	days	9,125

Value Replacement:

$$\frac{3527 cm^2 \times 0.12\ mg/cm^2\text{-event} \times 1\ event/day \times 20\ days/year \times 25\ years}{80\ kg \times 9125\ days}$$

Units check:

$$\frac{3527 \cancel{cm^2} \times 0.12\ mg/\cancel{cm^2\text{-event}} \times 1\ \cancel{event/day} \times 20\ \cancel{days/year} \times 25\ \cancel{years}}{80\ kg \times 9125\ days}$$

Solving:

$$\frac{211{,}620\ mg}{730{,}000\ kg\text{-day}}$$

= 0.2899 mg/kg-day

Sample Calculations

Scenario: NPS Worker

Daily Average Exposure Factor, Inhalation ($DAEF_{wai}$), 1/(m^3/kg) (Equation 3)

Equation:

$$\frac{EF \times ET \times ED}{E \quad \times AT \times H}$$

Where

Notation	Parameter	Units	Value
EF	Exposure Frequency (EF)	days/year	20
ET	Exposure Time (ET)	hrs/day	0.5
ED	Exposure Duration (ED)	years	25
AT	Averaging Time (AT)	days	9,125
H	Hours per Day (H)	hours	24
PEF	Particulate Emission Factor (PEF)	m^3/kg	5.28E+08

Value Replacement:

$$\frac{20 \text{ days/year} \times 0.5 \text{ hour/day} \times 25 \text{ years}}{5.28E{+}08 \text{ m}^3\text{/kg} \times 9125 \text{ days} \times 24 \text{ hours/day}}$$

Units check:

20 ~~days/year~~ x 0.5 ~~hour/day~~ x 25 ~~years~~

5.28E+08 m^3/kg x 9125 ~~days~~ x 24 ~~hours/day~~

Solving:

$$\frac{250}{1.16E{+}14 \text{ m}^3\text{/kg}}$$

= 2.16E-12 1/(m^3/kg)

Sample Calculations
Scenario: NPS Worker

Lifetime Average Exposure Factor, Oral ($LAEF_{wao}$) (Equation 4)

Equation:

$$\frac{IRs \times \mathrm{EF} \times ET \times \mathrm{ED}}{BW \times AT \times EH}$$

Where

Notation	Parameter	Units	Value
IRs	Ingestion Rate of Soil (IR_s)	mg/day	100
EF	Exposure Frequency (EF)	days/year	20
ET	Exposure Time Fraction (ET)	hours	0.5
ED	Exposure Duration (ED)	years	25
BW	Body Weight (BW)	kg	80
AT	Averaging Time (AT)	days	25,550
EH	Active Exposed Hours (EH)	Hours	8.00

Value Replacement:

$$\frac{100\text{mg/day} \times 20 \text{ days/year} \times 0.5 \text{ hour} \times 25 \text{ years}}{80 \text{ kg} \times 25{,}550 \text{ days} \times 8 \text{ hours}}$$

Units check:

$$\frac{100\text{mg}/\cancel{\text{day}} \times 20\ \cancel{\text{days/year}} \times 0.5\ \cancel{\text{hour}} \times 25\ \cancel{\text{years}}}{80\ \text{kg} \times 25{,}550\ \text{days} \times 8\ \cancel{\text{hours}}}$$

Solving:

$$\frac{25{,}000 \text{ mg}}{16{,}352{,}000 \text{ kg-day}}$$
$$= 0.00153 \text{ mg/kg-day}$$

Sample Calculations
Scenario: NPS Worker

Lifetime Average Exposure Factor, Dermal ($LAEF_{wad}$), mg/kg-day (Equation 5)

Equation:

$$\frac{A \times AF \times E \times EF \times ED}{BW \times AT}$$

Where

Notation	Parameter	Units	Value
SA	Skin Surface Area (SA)	cm^2	3,527
AF	Adherence Factor (AF)	mg/cm^2-event	0.12
E	Assumed events (E)	1 event/day	1
EF	Exposure Frequency (EF)	days/year	20
ED	Exposure Duration (ED)	years	25
BW	Body Weight (BW)	kg	80
AT	Averaging Time (AT)	days	25,550

Value Replacement:

$$\frac{3527cm^2 \text{ x } 0.12 \text{ mg/cm}^2\text{-event x 1 event/day x 20 days/year x 25 years}}{\text{80 kg x 25,550 days}}$$

Units check:

$$\frac{3527\cancel{cm^2} \text{ x } 0.12 \text{ mg/}\cancel{cm^2\text{-event}} \text{ x 1 } \cancel{\text{event/day}} \text{ x 20 } \cancel{\text{days/year}} \text{ x 25 } \cancel{\text{years}}}{\text{80 kg x 25,550 days}}$$

Solving:

$$\frac{\text{211,620 mg}}{\text{2,044,000 kg-day}}$$

= 0.1035 mg/kg-day

Sample Calculations
Scenario: NPS Worker

Lifetime Average Exposure Factor, Inhalation ($LAEF_{wai}$), $1/(m^3/kg)$ (Equation 6)

Equation:

$$\frac{EF \times ET \times ED}{E \times AT \times H}$$

Where

Notation	Parameter	Units	Value
EF	Exposure Frequency (EF)	days/year	20
ET	Exposure Time (ET)	hrs/day	0.5
ED	Exposure Duration (ED)	years	25
AT	Averaging Time (AT)	days	25,550
H	Hours per Day (H)	hours	24
PEF	Particulate Emission Factor (PEF)	m^3/kg	5.28E+08

Value Replacement:

$$\frac{20 \text{ days/year} \times 0.5 \text{ hour/day} \times 25 \text{ years}}{5.28E{+}08 \text{ } m^3/kg \times 25{,}550 \text{ days} \times 24 \text{ hours/day}}$$

Units check:

$$\frac{20 \text{ \sout{days/year}} \times 0.5 \text{ \sout{hour/day}} \times 25 \text{ \sout{years}}}{5.28E{+}08 \text{ } m^3/kg \times 25{,}550 \text{ \sout{days}} \times 24 \text{ \sout{hours/day}}}$$

Solving:

$$\frac{250}{3.23E{+}14 \text{ } m^3/kg}$$

$$= 7.72E{-}13 \text{ } 1/(m^3/kg)$$

Sample Calculation
Estimation of Intakes
Scenario: NPS Worker DU1, Evaluation of Arsenic

Daily Average Intake, Oral (DAI_{wao}) (Equation 7)

$DAEF_{wao}$ x EPC x RBA X CF

Notation	Parameter	Units	Value
$DAEF_{wao}$	Daily Average Exposure Factor (worker adult oral)	mg/kg-day	0.00428 (From Equation 1)
EPC	Exposure Point Concentration	mg/kg	557
RBA	Relative Bioavailability	unitless	0.6
CF	Conversion Factor	kg/mg	.000001

Value Replacement:

0.00428 mg/kg-day x 557 mg/kg x 0.6 x 0.000001 kg/mg

Units Check:

0.00428 mg/kg-day x 557 ~~mg~~/~~kg~~ x 0.6 x 0.000001 ~~kg~~/~~mg~~

Solving:

= 1.43E-6 mg/kg-day

Sample Calculation
Estimation of Intakes
Scenario: NPS Worker DU1, Evaluation of Arsenic

Daily Average Intake, Dermal (DAI_{wad}) (Equation 8)

$DAEF_{wad}$ x EPC x ABSd x FA x CF

Notation	Parameter	Units	Value
$DAEF_{wad}$	Daily Average Exposure Factor (worker adult dermal)	mg/kg-day	0.2899 (From Equation 2)
EPC	Exposure Point Concentration	mg/kg	557
ABSd	Dermal Absorption Factor	unitless	0.03
FA	Fraction Absorbed	unitless	1
CF	Conversion Factor	kg/mg	.000001

Value Replacement:

0.2899 mg /kg-day x 557 mg/kg x 0.03 x 1 x 0.000001 kg/mg

Units Check:

0.2899 mg/kg-day x 557 ~~mg~~/~~kg~~ x 0.03 x 1 x 0.000001 ~~kg~~/~~mg~~

Solving:

= 4.84E-6 mg/kg-day

Sample Calculation
Estimation of Intakes
Scenario: NPS Worker DU1, Evaluation of Arsenic

Daily Average Exposure Concentration ($DAEC_{wai}$) (Equation 9)

$$DAEF_{wai} \times EPC$$

Notation	Parameter	Units	Value
$DAEF_{wad}$	Daily Average Exposure Factor (worker adult inhalation)	$1/(m^3/kg)$	2.16E-12 (From Equation 3)
EPC	Exposure Point Concentration	mg/kg	557

Value Replacement:

$$2.16E\text{-}12\ 1/(m^3/kg) \times 557\ mg/kg$$

Units Check:

$$2.16E\text{-}12\ 1/(m^3/\cancel{kg}) \times 557\ mg/\cancel{kg}$$

Solving:

$$= 1.2E\text{-}9\ mg/m^3$$

Sample Calculation
Estimation of Intakes
Scenario: NPS Worker DU1, Evaluation of Arsenic

Lifetime Average Intake, Oral (LAI_{wao}) (Equation 10)

$DAEF_{wao}$ x EPC x RBA X CF

Notation	Parameter	Units	Value
$LAEF_{wao}$	Lifetime Average Exposure Factor (worker adult oral)	mg/kg-day	0.00153 (from Equation 4)
EPC	Exposure Point Concentration	mg/kg	557
RBA	Relative Bioavailability	unitless	0.6
CF	Conversion Factor	kg/mg	0.000001

Value Replacement:

0.00153 mg/kg-day x 557 mg/kg x 0.6 x 0.000001 kg/mg

Units Check:

0.00153 mg/kg-day x 557 ~~mg/kg~~ x 0.6 x 0.000001 ~~kg/mg~~

Solving:

= 5.11E-7 mg/kg-day

Sample Calculation
Estimation of Intakes
Scenario: NPS Worker DU1, Evaluation of Arsenic

Lifetime Average Intake, Dermal (LAI_{wad}) (Equation 11)

$$LAEF_{wad} \times EPC \times ABSd \times FA \times CF$$

Notation	Parameter	Units	Value
$LAEF_{wad}$	Lifetime Average Exposure Factor (worker adult dermal)	mg/kg-day	0.1035 (From Equation 5)
EPC	Exposure Point Concentration	mg/kg	557
ABSd	Dermal Absorption Factor	unitless	0.03
FA	Fraction Absorbed	unitless	1
CF	Conversion Factor	kg/mg	.000001

Value Replacement:

0.1035 mg/kg-day x 557 mg/kg x 0.03 x 1 x 0.000001 kg/mg

Units Check:

0.1035 mg/kg-day x 557 ~~mg~~/~~kg~~ x 0.03 x 1 x 0.000001 ~~kg~~/~~mg~~

Solving:

= 1.73E-6 mg/kg-day

Sample Calculation
Estimation of Intakes
Scenario: NPS Worker DU1, Evaluation of Arsenic

Lifetime Average Exposure Concentration ($LAEC_{wai}$) (Equation 12)

$$LAEF_{wai} \times EPC$$

Notation	Parameter	Units	Value
$LAEF_{wai}$	Lifetime Average Exposure Factor (worker adult inhalation)	$1/(m^3/kg)$	7.72E-12 (From Equation 6)
EPC	Exposure Point Concentration	mg/kg	557

Value Replacement:

$$7.72E\text{-}12\ 1/(m^3/kg) \times 557\ mg/kg$$

Units Check:

$$7.72E\text{-}12\ 1/(m^3/\sout{kg}) \times 557\ mg/\sout{kg}$$

Solving:

$$= 4.3E\text{-}10\ mg/m^3$$

Sample Calculation
Scenario: NPS Worker Gold Hill Mill Site DU1 Exposure to Arsenic
Estimation of Noncarcinogenic Hazards

Oral Hazard (Equation 13)

$$DAI_{wao}/RfD$$

Notation	Parameter	Units	Value
DAI_{wao}	Daily Average Intake (worker adult oral)	mg/kg-day	1.43E-6 (From Equation 7)
RfD	Reference Dose	mg/kg-day	3.5E-6

Value Replacement:

$$\frac{1.43E\text{-}6 \text{ mg/kg-day}}{3.5E\text{-}6 \text{ mg/kg-day}}$$

Units Check:

$$\frac{1.43E\text{-}6 \ \cancel{\text{mg/kg-day}}}{3.5E\text{-}6 \ \cancel{\text{mg/kg-day}}}$$

Solving

$$= 0.408$$

Sample Calculation
Scenario: NPS Worker Gold Hill Mill Site DU1 Exposure to Arsenic
Estimation of Noncarcinogenic Hazards

Dermal Hazard (Equation 14)

DAI_{wad} x GIABS/RfD

Notation	Parameter	Units	Value
DAI_{wad}	Daily Average Intake (worker adult dermal)	mg/kg-day	4.84E-6 (From Equation 8)
GIABS	GI Absorption from Dermal Exposure	unitless	1
RfD	Reference Dose	mg/kg-day	3.5E-6

Value Replacement:

$$\frac{4.84E\text{-}6 \text{ mg/kg-day} \times 1}{3.5E\text{-}6 \text{ mg/kg-day}}$$

Units Check:

$$\frac{4.84E\text{-}6 \ \cancel{\text{mg/kg-day}} \times 1}{3.5E\text{-}6 \ \cancel{\text{mg/kg-day}}}$$

Solving

= 1.38

Sample Calculation
Scenario: NPS Worker Gold Hill Mill Site DU1 Exposure to Arsenic
Estimation of Noncarcinogenic Hazards

Inhalation Hazard (Equation 15)

$$DAEC_{wai} \times 1000\mu g/mg/RfC$$

Notation	Parameter	Units	Value
$DAEC_{wai}$	Daily Average Exposure Concentrations (worker adult inhalation)	mg/m^3	1.2E-9 (From Equation 9)
RfC	Reference Concentration	$\mu g/m^3$	0.015

Value Replacement:

$$\frac{1.2E\text{-}9\ mg/m^3 \times 1000\mu g/mg}{0.015\mu g/m^3}$$

Units Check:

$$\frac{1.2E\text{-}9\ \cancel{mg/m^3} \times 1000\cancel{\mu g/mg}}{0.015\cancel{\mu g/m^3}}$$

Solving

$$= 8E\text{-}5$$

Sample Calculation
Scenario: NPS Worker Gold Hill Mill Site DU1 Exposure to Arsenic
Estimation of Carcinogenic Risks

Oral Risk (Equation 16)

$$LAI_{wao} \times SF$$

Notation	Parameter	Units	Value
LAI_{wao}	Lifetime Average Intake (worker adult oral)	mg/kg-day	5.11E-7 (From Equation 10)
SF	Carcinogenic Slope Factor	$(mg/kg\text{-}day)^{-1}$	9.5

Value Replacement:

$$5.11E\text{-}7 \text{ mg/kg-day} \times 9.5 \text{ (mg/kg-day)}^{-1}$$

Units Check:

$$5.11E\text{-}7 \text{ \sout{mg/kg-day}} \times 9.5 \text{ \sout{(mg/kg-day)}}^{-1}$$

Solving

$$= 4.85E\text{-}6$$

Sample Calculation
Scenario: NPS Worker Gold Hill Mill Site DU1 Exposure to Arsenic
Estimation of Carcinogenic Risks

Dermal Risk (Equation 17)

$$LAI_{wad} \times SF \times GIABS$$

Notation	Parameter	Units	Value
LAI_{wad}	Lifetime Average Intake (worker adult dermal)	mg /kg-day	1.73E-6 (From Equation 11)
GIABS	GI Absorption from Dermal Exposure	Unitless	1
SF	Carcinogenic Slope Factor	$(mg/kg\text{-}day)^{-1}$	9.5

Value Replacement:

$$1.73E\text{-}6 \text{ mg/kg-day} \times 1 \times 9.5 \text{ (mg/kg-day)}^{-1}$$

Units Check:

$$1.73E\text{-}6 \ \cancel{\text{mg/kg-day}} \times 1 \times 9.5 \ \cancel{\text{(mg/kg-day)}^{-1}}$$

Solving

$$= 1.6E\text{-}5$$

Sample Calculation
Scenario: NPS Worker Gold Hill Mill Site DU1 Exposure to Arsenic
Estimation of Carcinogenic Risks

Inhalation Risk (Equation 18)

$$LAEC_{wai} \text{ x } 1000\ \mu g/mg \text{ x } IUR$$

Notation	Parameter	Units	Value
$LAEC_{wai}$	Lifetime Average Exposure Concentrations (worker adult inhalation)	mg/m^3	4.3E-10 (From Equation 12)
IUR	Inhalation Unit Risk	$(\mu g/m^3)^{-1}$	4.3E-3

Value Replacement:

$$4.3E\text{-}10\ mg/m^3 \text{ x } 1000\ \mu g/mg \text{ x } 4.3E\text{-}3\ (\mu g/m^3)^{-1}$$

Units Check:

$$4.3E\text{-}10\ \cancel{mg/m^3} \text{ x } 1000\ \cancel{\mu g/mg} \text{ x } 4.3E\text{-}3\ (\cancel{\mu g/m^3})^{-1}$$

Solving

$$= 1.85E\text{-}9$$

Sample Calculation
Scenario: NPS Worker Gold Hill Mill Site DU1 Exposure to Arsenic
Estimation of Total Hazards and Total Carcinogenic Risks

Total Hazard (Equation 19)

Total Hazard = Oral Hazard + Dermal Hazard + Inhalation Hazard

Total Hazard = 0.4 + 1.38 + 8E-5

Total Hazard = 1.79

Total Risk (Equation 20)

Total Risk = Oral Risk + Dermal Risk + Inhalation Risk

Total Risk = 4.85E-6 + 1.64E-5 + 1.85E-9

Total Risk = 2.1E-5

CALCULATION OF SCREENING LEVELS

Scenario: NPS Worker Oral Exposure to Arsenic

Screening Level, worker, adult, oral Noncarcinogenic (Equation 21)

$$wao{-}nc = \frac{THQ \times AT\ days \times EH \quad s \qquad \times BW kg}{EF_{wao}\frac{days}{year} \times ED\ years \times ET hours \times \frac{RBA}{RfD\frac{mg}{kg}} \times \frac{IR_S mg}{kg} \times \frac{10^{-6}\ kg}{1\ mg}}$$

Where

Notation	Parameter	Units	Value
THQ	Target Hazard Quotient		1
IRs	Ingestion Rate of Soil	mg/day	100
EF	Exposure Frequency	days/year	20
ET	Exposure Time Fraction	hours	.5
ED	Exposure Duration	years	25
BW	Body Weight	kg	80
AT	Averaging Time	days	9,125
EH	Active Exposed Hours	Hours	8.00
RBA	Relative Bioavailability	unitless	0.6
RfD	Reference Dose	mg/kg-day	3.5E-6

Value Replacement:

$$\frac{1 \text{ x } 9125 \text{ days x } 8 \text{ hours x } 80 \text{ kg}}{20 \text{ days/year x } 25 \text{ years x } 0.5 \text{ hours x } 0.6/3.5\text{E-}6 \text{ mg/kg-day x } 100 \text{ mg/day x } 1\text{E-}6\text{kg/mg}}$$

Units check:

$$\frac{1 \text{ x } 9125 \text{ } \cancel{\text{days}} \text{ x } 8 \text{ } \cancel{\text{hours}} \text{ x } 80 \text{ } \cancel{\text{kg}}}{20 \text{ } \cancel{\text{days}}/\cancel{\text{year}} \text{ x } 25 \text{ } \cancel{\text{years}} \text{ x } 0.5 \text{ } \cancel{\text{hours}} \text{ x } \frac{0.6}{3.5\text{E}-6\frac{\cancel{\text{mg}}}{\text{kg}}\ \cancel{\text{d}}} \text{ x } 100 \text{ } \cancel{\text{mg}}/\cancel{\text{day}} \text{ x } 1\text{E-}6\cancel{\text{kg}}/\text{mg}}$$

Solving:

$$\frac{5{,}840{,}000}{4285.7 \text{ kg/mg}}$$

$$= 1362.7 \text{ mg/kg}$$

Scenario: NPS Worker Dermal Exposure to Arsenic

Screening Level, worker, adult, dermal Noncarcinogenic (Equation 22)

$$
{}_{wad-nc} = \frac{TH \times AT\ s \times BW}{E_{wad}\frac{s}{} \times E\ s \times \frac{1}{R\ \frac{}{} - \times IAB} \times A^{2} \times A\ \frac{}{2} \times AB \times \frac{10^{-6}}{1}}
$$

Where

Notation	Parameter	Units	Value
THQ	Target Hazard Quotient		1
IRs	Ingestion Rate of Soil	mg/day	100
EF	Exposure Frequency	days/year	20
ET	Exposure Time Fraction	hours	.5
ED	Exposure Duration	years	25
BW	Body Weight	kg	80
AT	Averaging Time	days	9,125
AF	Soil to Skin Adherence Factor	mg/cm2-day	0.12
SA	Skin Surface area Exposed	cm^2	3527
GIABS	GI Absorption	unitless	1
ABS	Dermal Absorption	unitless	0.03
RfD	Reference Dose	mg/kg-day	3.5E-6

Value Replacement:

$$\frac{1 \text{ x } 9125 \text{ days x } 80 \text{ kg}}{20 \text{ days/year x } 25 \text{ years x } \frac{1}{3.5E-6\frac{mg}{kg}-day \times 1} \text{ x } 3527 \text{ cm}^2 \text{ x } 0.12 \text{ mg/cm}^2 \text{ x } 0.03 \text{ x } 1E\text{-}6\text{kg/mg}}$$

Units check:

$$\frac{1 \text{ x } 9125 \text{ ~~days~~ x } 80 \text{ ~~kg~~}}{20 \text{ ~~days/year~~ x } 25 \text{ ~~years~~ x } \frac{1}{3.5E-6\frac{mg}{kg}-\text{~~day~~} \times 1} \text{ x } 3527 \text{ ~~cm}^2\text{~~ x } 0.12 \text{ ~~mg/cm}^2\text{-day~~ x } 0.03 \text{ x } 1E\text{-}6\text{~~kg/mg~~}}$$

Solving:

$$\frac{730000}{1814 \text{ kg/mg}}$$

$= 402.4$ mg/kg

Scenario: NPS Worker Inhalation Exposure to Arsenic

Screening Level, worker, adult, inhalation Noncarcinogenic (Equation 23)

$$= \frac{TH \quad \times AT \quad s}{E \; \frac{s}{\quad} \times E \quad s \quad \times ET\; h \;\; s \quad \frac{}{h} \times \frac{1}{R \quad \frac{}{3}} \times \frac{1}{E \quad \frac{3}{}}}$$

Where

Notation	Parameter	Units	Value
THQ	Target Hazard Quotient		1
EF	Exposure Frequency	days/year	20
ET	Exposure Time Fraction	hours	0.5
ED	Exposure Duration	years	25
AT	Averaging Time	days	9,125
RfC	Reference Concentration	µg/m^3	0.015
PEF	Particulate Emission Factor	m^3/kg	5.28E8

Value Replacement:

1 x 9125 days

20 days/year x 25 years x 0.5 hours/day x $\frac{1\,day}{24 \quad s}$ x $\frac{1}{0.015\,\frac{\mu g}{m^3} \times 0.001\,mg/\mu g}$ x $\frac{1}{5.28E8\,\frac{m^3}{kg}}$

Units check:

1 x 9125 ~~days~~

20 ~~days/year~~ x 25 ~~years~~ x 0.5 ~~hours/day~~ x $\frac{1\,\cancel{day}}{24 \;\cancel{s}}$ x $\frac{1}{0.015\,\frac{\cancel{\mu g}}{\cancel{m^3}} \times 0.001\,mg/\cancel{\mu g}}$ x $\frac{1}{5.28E8\,\frac{\cancel{m^3}}{kg}}$

Solving:

9125

0.00132

= 6.9E6 mg/kg

Scenario: NPS Worker Oral Exposure to Arsenic

Screening Level, worker, adult, oral Carcinogenic (Equation 24)

$$_{wao-c} = \frac{TR \times AT \quad s \quad \times EH\,h \quad s \quad \times BW}{E_{\;wao} \frac{s}{} \times E \quad s \quad \times ETh \quad s \quad \times \quad \times RBA \times IRs \frac{}{} \times \frac{10^{-6}}{1}}$$

Where

Notation	Parameter	Units	Value
TR	Target Risk		1E-6
IRs	Ingestion Rate of Soil (IR_s)	mg/day	100
EF	Exposure Frequency (EF)	days/year	20
ET	Exposure Time Fraction (ET)	hours	0.5
ED	Exposure Duration (ED)	years	25
BW	Body Weight (BW)	kg	80
AT	Averaging Time (AT)	days	25,550
EH	Active Exposed Hours (EH)	Hours	8.00
RBA	Relative Bioavailability	unitless	0.6
SF	Oral Slope Factor	$mg/kg\text{-}day^{-1}$	9.5

Value Replacement:

$$\frac{\text{1E-6 x 25,550 days x 8 hours x 80 kg}}{\text{20 days/year x 25 years x 0.5 hours x 9.5 (mg/kg-day)}^{-1}\text{ x 0.6 x 100 mg/day x 1E-6kg/mg}}$$

Units check:

$$\frac{\text{1E-6 x 25,550 days x 8 hours x 80 kg}}{\text{20 days/year x 25 years x 0.5 hours x 9.5 (mg/kg-day)}^{-1}\text{ x 100 mg/day x 1E-6kg/mg}}$$

Solving:

$$\frac{16.352}{\text{0.1425 kg/mg}}$$

$$= 114.75 \text{ mg/kg}$$

Scenario: NPS Worker Dermal Exposure to Arsenic

Screening Level, worker, adult, dermal Carcinogenic (Equation 25)

$$ {}_{wad-c} = \frac{TR \times AT \quad s \quad \times BW}{E_{\ wad} \frac{s}{\quad} \times E \quad s \quad \times \frac{(\text{—} - \quad)^{-1}}{IAB} \times A \quad {}^{2} \times A \ \frac{\quad}{2} \times AB \quad \times \frac{10^{-6}}{1}} $$

Where

Notation	Parameter	Units	Value
THQ	Target Hazard Quotient		1
IRs	Ingestion Rate of Soil (IR_s)	mg/day	100
EF	Exposure Frequency (EF)	days/year	20
ED	Exposure Duration (ED)	years	25
BW	Body Weight (BW)	kg	80
AT	Averaging Time (AT)	days	9,125
AF	Soil to Skin Adherence Factor	mg/cm2-day	0.12
SA	Skin Surface area Exposed	cm^2	3527
GIABS	GI Absorption	unitless	1
ABS	Dermal Absorption	unitless	0.03
SF	Slope Factor	$mg/kg\text{-}day^{-1}$	9.5

Value Replacement:

$$\frac{1E\text{-}6 \times 25550 \text{ days} \times 80 \text{ kg}}{20 \text{ days/year} \times 25 \text{ years} \times (9.5 \text{ mg/kg-day}^{-1}/1) \times 3527 \text{ cm}^2 \times 0.12 \text{ mg/cm}^2 \times 0.03 \times 1E\text{-}6\text{kg/mg}}$$

Units check:

$$\frac{1E\text{-}6 \times 25550 \text{ ~~days~~} \times 80 \text{ ~~kg~~}}{20 \text{ ~~days/year~~} \times 25 \text{ ~~years~~} \times (9.5 \text{ mg/kg-day}^{-1}/1) \times 3527 \text{ ~~cm}^2\text{~~} \times 0.12 \text{ ~~mg/cm}^2\text{~~} \times 0.03 \times 1E\text{-}6\text{~~kg/mg~~}}$$

Solving:

$$\frac{2.044}{0.06031}$$

$$= 34 \text{ mg/kg}$$

Scenario: NPS Worker Inhalation Exposure to Arsenic

Screening Level, worker, adult, inhalation Carcinogenic (Equation 26)

$$= \frac{TR \times AT \quad s}{E \; \frac{s}{\quad} \times E \quad s \quad \times ET\, h \; s \quad \frac{\quad}{h} \times \frac{1}{24\, h \; s} \times IR \; (\mu \; / \quad ^{3})^{-1} \times 1000 \; \frac{\mu}{\quad} \times \frac{1}{E \quad \frac{^{3}}{\quad}}}$$

Where

Notation	Parameter	Units	Value
TR	Target Risk	unitless	1E-6
EF	Exposure Frequency (EF)	days/year	20
ET	Exposure Time Fraction (ET)	hours	0.5
ED	Exposure Duration (ED)	years	25
AT	Averaging Time (AT)	days	25,550
IUR	Inhalation Unit Risk	$(\mu g/m^3)^{-1}$	4.3E-3
PEF	Particulate Emission Factor	m^3/kg	5.28E8

Value Replacement:

$$\frac{1E\text{-}6 \times 25550 \text{ days}}{20 \text{ days/year} \times 25 \text{ years} \times 0.5 \text{ hours/day} \times \frac{1\ day}{24\ \ s} \times 4.3E\text{-}3\ (\mu g/m^3)^{-1} \times 1000\ \mu g/mg \times \frac{1}{5.28E8 \frac{m^3}{kg}}}$$

Units check:

$$\frac{1E\text{-}6 \times 25550 \text{ days}}{20 \text{ days/year} \times 25 \text{ years} \times 0.5 \text{ hours/day} \times \frac{1\ day}{24\ \ s} \times 4.3E\text{-}3\ (\mu g/m^3)^{-1} \times 1000\ \mu g/mg \times \frac{1}{5.28E8 \frac{m^3}{kg}}}$$

Solving:

$$\frac{0.02555}{8.48E\text{-}8}$$

$$= 301{,}181 \text{ mg/kg}$$

Sample Calculation
Scenario: NPS Worker Gold Hill Mill Site DU1 Exposure to Arsenic
Estimation of Total Hazards and Total Carcinogenic Risks

Total Noncarcinogenic Screening Level worker adult (Equation 27)

$$_{nc}\left(\frac{}{}\right) = \frac{1}{\frac{1}{} + \frac{1}{} + \frac{1}{}}$$

Value Replacement:

$$\frac{1}{1/1{,}363 + 1/402 + 1/6.9E6}$$

Solving:

$$\frac{1}{0.00073 + 0.00249 + 1.44E\text{-}7}$$

= 311 mg/kg

Total Carcinogenic Screening Level worker adult (Equation 28)

$$_{c}\left(\frac{}{}\right) = \frac{1}{\frac{1}{} + \frac{1}{} + \frac{1}{}}$$

Value Replacement:

$$\frac{1}{1/110 + 1/34 + 1/301{,}181}$$

Solving:

$$\frac{1}{0.0091 + 0.0294 + 3.3E\text{-}6}$$

= 26 mg/kg

ATTACHMENT B 3

USEPA ADULT LEAD MODEL

Evaluation of DU-1 (Mill Foundation)

MODIFIED VERSION OF USEPA ADULT LEAD MODEL

CALCULATIONS OF BLOOD LEAD CONCENTRATIONS (PbBs) AND PRELMIINARY REMOVAL GOAL (PRG)

EDIT RED CELL

Variable	Description of Variable	Units	
PbS	Soil lead concentration	ug/g or ppm	12575
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	ug/dL	0.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.006
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	52
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**0.5**
$PbB_{fetal, 0.90}$	90th percentile PbB among fetuses of adult workers	ug/dL	1.0
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	**1.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**10.8%**

PRG90	**12237**

Click here for REFERENCES

Evaulation of DU-2 (Mill Tailings in the Wash)
MODIFIED VERSION OF USEPA ADULT LEAD MODEL

CALCULATIONS OF BLOOD LEAD CONCENTRATIONS (PbBs) AND PRELMIINARY REMOVAL GOAL (PRG)

EDIT RED CELL

Variable	Description of Variable	Units	
PbS	Soil lead concentration	ug/g or ppm	8940
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	ug/dL	0.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.006
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	52
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**0.4**
$PbB_{fetal, 0.90}$	90th percentile PbB among fetuses of adult workers	ug/dL	0.7
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	**1.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**3.5%**

PRG90	**12237**

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Appendix C – Ecological Risk Assessment

APPENDIX C

ECOLOGICAL RISK ASSESSMENT

GOLD HILL MILL SITE

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C.1 Ecological Risk Assessment

The ecological risk assessment (ERA) for the Gold Hill Mill Site includes a screening level ecological risk assessment (SLERA) that follows the protocol defined in the National Park Service (NPS) *Protocol for the Selection and Use of Ecological Screening Values for Non-Radiological Analytes* (NPS 2018). For the contaminants of potential ecological concern (COPECs) identified in the SLERA, a desktop baseline ecological risk assessment (BERA) was conducted that applies site-specific receptors and exposure assumptions to determine the risk for protection of one or more ecological receptors.

The SLERA comprises the first two steps in the ecological risk assessment process. The objective of the SLERA is to identify and document conditions that may warrant further evaluation (i.e., potential unacceptable risk). The goal is to eliminate insignificant hazards while identifying contaminants whose concentrations are sufficiently high to potentially pose unacceptable risks to ecological receptors. For a SLERA, it is important to minimize the chances of concluding that there is no risk when in fact a risk exists. Thus, selected exposure and toxicity values and assumptions are consistently biased toward overestimating risk. This ensures sites that might pose an ecological risk are studied further, i.e., a SLERA is deliberately designed to be protective in nature, not predictive of effects.

The SLERA includes the identification of COPECs, based on a comparison of maximum concentrations to lowest ecological screening levels. It is important to note the results of the COPEC selection are neither designed nor intended "to provide definitive estimates of actual risk or generate cleanup goals and, in general, are not based upon site-specific assumptions" (USEPA 2001).

If any potentially significant exposure pathways are indicated from the SLERA, then these pathways are further evaluated in a more refined BERA, which employs modified but conservative exposure and effect assessment methods to determine potential risks. The level of refinement and evaluation in the BERA depends upon the complexity of the Site. It can range from a "simple" BERA, which characterizes potential ecological risks based only on refined HQ estimates, to a "detailed" BERA, which employs multiple lines of evidence (e.g., refined HQs, toxicity tests, ecological community evaluations) to determine if the weight of evidence indicates the potential for unacceptable ecological risks.

An ecological risk assessment (both the SLERA and a BERA) includes the following components:

- Problem formulation
- Exposure and effects assessment
- Risk characterization (including an uncertainty analysis)

C.1.1 Problem Formulation

Gold Hill Mill is located 57 miles south of Furnace Creek, California, in Warm Spring Canyon at an elevation of 2,360 feet above sea level. The Gold Hill Mining District is one of the oldest mining areas within DEVA, with prospecting and work dating from the 1870s. The Gold Hill region is located within DEVA in the southwest corner, in the Panamint Mountain Range, at the northeastern end of Butte Valley and north of Warm Spring. This site is accessed via 14 miles of infrequently graded dirt roads requiring high clearance four-wheel drive vehicles. Gold Hill Mill experiences moderate annual visitation. The site covers less than 1 acre and consists of a complete and well-preserved mill with evidence of mercury amalgamation. A spring and an abandoned mining camp are located south 850 feet upslope of the mill ruins and does not appear to have been impacted by mining activities. Surface water samples were collected from Warm Spring. Minor mill tailings from the amalgamated mercury process used to extract the gold have accumulated in and around the mill workings, primarily on the east side, scattered in and around the equipment, and comingling with native rock. Based on operational history and information gathered during the PA (ECM 2014), the preliminary COCs for the site were identified as metals.

SI field activities at Gold Hill Mill were performed in February 2016. Three DUs are present at Gold Hill Mill: DU-1 mill foundations, DU-2 eroded mill tailings in wash along road, and DU-3 background native soils (Figure C-1). The spring actively discharges water at a rate of 50 gallons per minute, providing a stream that infiltrates approximately 500 feet downstream (ECM 2014). The presence of Warm Spring, a consistent fresh water source, would attract a variety of species to the area.

The mill foundations (DU-1) ISM area is approximately 2,800 square feet and includes the ore crushing area and the ramp. A total of four ISM samples (GOLD-01-001 thru GOLD-01-004) were collected from DU-1.

Image C-1 Gold Hill Mill

Discrete samples of the mill tailings in the wash along the road (DU-2) were collected just north of the mill foundations and approximately 300 feet downgradient from the mill. A total of 7 discrete samples (GOLD-02-001 thru GOLD-02-007) were collected from DU-2. Visually observable mill tailings in the wash (DU-2) were of limited extent, within approximately 50 feet of the mill site. Only seven (7) discrete samples were collected in the wash due to the limited observable material. One discrete sample, DEVA-GOLD-02-007, collected 300 feet downgradient of the mill, was of uncertain origin and was collected to determine if the soils that could not clearly be visually identified as mill tailings exhibited the chemical signature of mill tailings. Results from this sample did not report elevated concentrations of metals at that location indicating that the extent of tailings had been captured by the sampling.

An area approximately 140 feet west of the mill on the north side of the road within a wash was identified as representative background native soils (DU-3). A total of 3 ISM samples (GOLD-03-001 thru GOLD-01-003) were collected from DU-3.

Two surface water samples were collected from the stream that flows from Warm Spring. The first sample was collected from the stream just at the foot of the slope located approximately 330 feet south of the mill (GOLD-SW1) and a second sample (and duplicate sample) was collected downgradient approximately 1,000 feet east of the mill next to Warm Springs Road (GOLD-SW2 and GOLD-SW3). Surface water sampling does not indicate an influence of contaminants from Gold Hill Mill directly impacting surface waters downgradient of the site. The presence of Warm Spring, a consistent fresh water source, would attract a variety of species to the area.

The Creosote Bush scrub vegetation community was observed within the study area during the November 2019 site visit (Attachment 1). This vegetation community is dominated by widely-spaced creosote (*Larrea tridentata*) and white bursage (*Ambriosa dumosa*), with bare ground between them. Soils in this community are well drained, alluvial, and sandy. Other common flora present include white ratany (*Krameria bicolor*), jointfir (*Ephedra* sp.), pencil cholla (*Cylindropuntia ramosissima*), and wire-lettuce (*Stephanomeria pauciflora*).

Plant species observed during the surveys includes the following species: Creosote bush, Brittlebush (*Encelia farinosa*), white bursage, white ratany, jointfir, pencil cholla, wire-lettuce, beavertail cactus *(Opuntia basilaris),* rubber rabbitbrush *(Ericameria nauseosa),* cheesebush *(Ambrosia salsola),* sticky snakeweed *(Gutierrezia microcephala), cotton catclaw (Tetradymia axillaris),* sandbar willow *(Salix exigua),* honey mesquite *(Prosopis glandulosa),* and tamarisk *(Tamarix spp.).* Image C-2 shows the area near Gold Hill Mill.

Image C-2 Vegetation Around Gold Hill Mill

Wildlife species observed within the study area consisted of commonly-occurring species - including, but not limited to, European starling (*Sturnus vulgaris*), common raven (*Corvus corax*), red-tailed hawk (*Buteo jamaicensis*), and side-blotched lizard (*Uta stansburiana*). Other wildlife species known within the vicinity of the study area that were not observed during the survey include desert pocket mouse (*Chaetodipus penicillatus*), southern grasshopper mouse (*Onychomys torridus*), deer mouse (*Peromyscus maniculatus*), Panamint pocket gopher (*Thomymus umbrinus scapterus*) black-throated sparrow

(*Amphispiza bilineata*), Gambel's quail (*Callipepla gambelii*), desert side-blotched lizard (*Uta stansburiana*) and desert spiny lizard (*Sceloporus magister magister*).

For surface soil, it will be assumed that mammals, birds, reptiles, invertebrates, plants, and soil invertebrates could be exposed directly or indirectly to contaminated soil. Exposure to surface water at the Gold Hill Mill Site would be limited to Warm Springs which does not appear to have been impacted by mill activities; however, a consistent source of fresh water would attract a variety of wildlife to the general area.

Ecological receptor exposure pathways are outlined in the ecological pathway-receptor diagram (Figure C-2), and complete, incomplete, or not applicable pathways are identified. Direct exposure to surface water is considered potentially complete but insignificant. Direct exposures to soil and soil particulates are considered complete. Figure C-2 is the ecological pathway-receptor diagram that graphically shows these exposure pathways.

During the problem formulation, the goals, breadth, and focus of the ecological risk assessment are established through the selection and description of site-specific assessment endpoints. Assessment endpoints are explicit expressions of the environmental values (e.g., ecological resources) that are to be protected (USEPA, 1992). Valuable ecological resources include those without which ecosystem function would be significantly impaired, those providing critical resource and those perceived by valuable by humans (e.g., endangered species). Useful assessment endpoints define both the valued ecological entity at the site (e.g., species, ecological resource, or habitat type) and a characteristic(s) of the entity to protect (e.g., reproductive success) (USEPA 1997). The selected assessment endpoints are:

- Protection of birds, mammals, reptiles and invertebrates (e.g., tarantulas) with no unacceptable effects on species diversity and abundance (and viable reproduction) due to Site-related metals and cyanide in surface soils.
- Protection of general soil invertebrate and plant communities with no unacceptable effects on species diversity and abundance due to Site-related related metals and cyanide in the surface soils.

C.1.2 Screening-Level Ecological Risk Assessment

C.1.2.1 Identification of COPECs

In the SLERA, COPECs are determined by comparing the maximum concentrations of contaminants in environmental media (e.g., water, soil) to corresponding media-specific ecological screening values (ESVs) as provided in the *NPS Protocol for the Selection and Use of Ecological Screening Values for Non-Radiological Analytes* (NPS 2018). The COPEC Selection ESVs, which are the lowest ESVs across multiple NPS-approved toxicity value sources, are used to identify COPECs. The data comparisons are shown in Attachment 2. The COPECs based on the maximum ISM, discrete soil sample or surface water discrete sample compared to their respective conservative ESV are summarized in Table C-1.

Table C-1 COPECs Based on Maximum Detected Source Area DU Concentrations

Analyte	Soil COPEC	Surface Water COPEC
Antimony	X	--
Arsenic	X	--
Barium	--	X
Beryllium	--	--
Cadmium	X	Detection Limits > ESV
Chromium	X	--
Cobalt	--	--
Copper	X	X
Lead	X	--
Mercury	X	--
Molybdenum	X	--
Nickel	--	--
Selenium	X	--
Silver	X	--
Thallium	X	--
Vanadium	X	--
Zinc	X	--
Cyanide	X	Not Analyzed

C.1.2.2 Refined SLERA

In the refined SLERA, refined screening level Hazard Quotients (HQs) are calculated for each source DU at the Gold Hill Mill Site for the four receptor categories: plants, invertebrates, birds and mammals. To calculate the HQs, the maximum contaminant concentration for each DU (regardless of the type of sampling design[1]) was divided by the Refined SLERA ESV. The Refined SLERA ESVs are defined in

[1] The maximum detection from the individual ISM samples was used if the data were incremental.

the *NPS Protocol for the Selection and Use of Ecological Screening Values for Non-Radiological Analytes* (NPS 2018).

Contaminants with HQs equal to or below 1 are not evaluated further due to the conservative nature of the calculation, i.e., the maximum exposure concentration divided by a conservative screening value (at or below which no adverse effects would be expected). This step allows the confident removal of contaminants from further consideration.

Table C-2 below lists the COPECs for the Gold Hill Mill Site by receptor category based on the maximum detected concentrations in soil from the source DUs. This table summarizes the COPECs by exposure media for each receptor group. See Attachment 2 for the numeric comparison tables and HQs by receptor category and DU. Surface water exposure is not considered significant and although there are exceedances of the screening criteria for barium and copper.

Table C-2 COPECs by Receptor Category

Plants	**Invertebrates**	**Mammals**	**Birds**
Antimony	Antimony	Antimony	Antimony
Arsenic	Arsenic	Arsenic	Arsenic
Chromium	Chromium	Cadmium	Cadmium
Copper	Copper	Copper	Copper
Lead	Lead	Lead	Lead
Mercury	Mercury	Mercury	Mercury
Selenium	Silver	Molybdenum	Selenium
Thallium	Thallium	Selenium	Silver
Vanadium	Vanadium	Silver	Vanadium
Zinc	Zinc	Thallium	Zinc
Cyanide – No ESV	Cyanide – No ESV	Zinc	Cyanide

Based on the SLERA and Refined SLERA the following COPECs are eliminated from further consideration:

- Barium;
- Beryllium;
- Cobalt; and
- Nickel.

Based on the SI and Refined SLERA it was concluded that further investigation/sampling was required to understand the extent of the COPEC concentrations from the source DUs.

C.1.3 Baseline Ecological Risk Assessment

In the BERA, the risk from exposure to COPECs identified in the Refined SLERA to the four receptor groups (plants, invertebrates, birds and mammals) undergo further assessment. The BERA presented in this document uses a mean value for the EPC, modeling of COPECs into biological media (e.g., plants and insects), food web modeling using relevant wildlife receptors and toxicity reference values to

estimate risk. If this BERA shows one or more COPECs have the potential to result in unacceptable risks, a more detailed BERA using site-specific data obtained from the Gold Hill Mill Site (e.g., concentrations of COPECs in plants found at the site) may be performed to further refine the exposure and HQs.

C.1.3.1 BERA Exposure Assessment

Exposure areas for this assessment include the two DUs. The source DUs were previously defined in the SLERA and include:

- DU-1 – Mill Foundation (2,800 square feet or 0.06 acres)
- DU-2 – Mill Tailings in Wash along Road (300 linear feet)

The source DUs are small areas investigated in the SI as source areas (i.e., mill foundation) and were not designed to be representative of ecological habitats or ecological exposure areas. Based on observations during the site visits, the Mill Foundation (DU-1) presents limited ecological habitat. This small area associated with the processing of mining materials and contain structures. The areas could provide cover for small ranging receptors, but there would be minimal foraging. DU-2, Mill Tailings in Wash along Road, is a viable habitat in the Creosote Bush scrub vegetation community. Visually observable mill tailings in the wash (DU-2) were of limited extent.

C.1.3.1.1 Exposure Point Concentrations

The exposure point concentration (EPC) used in the SLERA and Refined SLERA was the maximum ISM or discrete sample concentration from both source DU. For the BERA, a more realistic EPC is applied which is the arithmetic average of ISM concentrations or the lower of the maximum and ProUCL recommended 95% upper confidence limit (UCL) of the arithmetic mean for discrete data sets such as for DU-2 (Mill Tailings in Wash along Road). The Uncertainty Analysis (Section D.1.4) discusses the data representativeness and variability.

C.1.3.1.2 BERA COPECs

The list of COPECs for analysis in the BERA was determined by comparing the geometric mean of the No Observed Effect Concentration (NOEC) and the lowest observed effect concentration (LOEC) from the Los Alamos National Laboratory Eco Database (2017) to the EPC for source DU-1 (Mill Foundation) and DU-2 (Mill Tailings in Wash along Road). Attachment 2 shows this comparison. The BERA COPECs are listed below in Table C-3.

Table C-3 BERA COPECs

Plants	Invertebrates	Mammals	Birds
Antimony	Antimony	Antimony	Antimony
Arsenic	Arsenic	Arsenic	Arsenic
Chromium	Chromium	Cadmium	Cadmium
Copper	Copper	Copper	Copper
Lead	Lead	Lead	Lead
Selenium	Mercury	Mercury	Mercury
Vanadium	Silver– No LOEC/NOEC	Selenium	Selenium
Zinc	Thallium– No LOEC/NOEC	Silver	Silver
Cyanide – No NOEC/LOEC	Vanadium– No LOEC/NOEC	Thallium	Vanadium
--	Zinc	Zinc	Zinc
--	Cyanide – No LOEC/NOEC	--	Cyanide

C.1.3.1.3 Wildlife Receptors

The following species were used for food web modeling in the BERA:

- Herbivorous mammals – Desert bighorn sheep
- Omnivorous mammal – White-tailed antelope squirrel
- Insectivorous mammal – Townsend's big-eared bat
- Insectivorous small rodent – Southern grasshopper mouse
- Omnivorous Bird – Common raven
- Omnivorous Bird – Black-throated sparrow
- Carnivorous Bird – Red-tailed hawk
- Reptile – Side-botched lizard

Birds and mammals were selected to represent wildlife species that may forage in and around the Gold Hill Mill Site. Dermal and inhalation exposure pathways for wildlife were not evaluated in this BERA. It is likely that species that utilize the burrows in the tailing material will be exposed through inhalation of particulates and dermal; however, ingestion is the only exposure pathway evaluated in this BERA.

Black-throated Sparrow – The black-throated sparrow (*Amphispiza bilineata*) is a medium-sized sparrow with a large, round head, conical seed-eating bill and a medium length tail. Black-throated Sparrows use semi-open areas with evenly spaced shrubs and trees that are 3–10 feet tall. They are common in canyons, desert washes, and desert scrub with creosote, ocotillo, cholla, acacia, sagebrush, mesquite, and rabbitbrush. In some parts of their range they occur as high as 7,000 feet elevation in pinyon-juniper forests (www.allaboutbirds.org/guide/Black-throated_Sparrow/lifehistory). Terres (1991) reports that these birds dwell in the driest, hottest parts of the desert uplands, rocky slopes and are

common in Death Valley, California, along the lower Colorado River and in southern Nevada where creosote bushes cholla cactuses, dwarf juniper, yucca, agave and sagebrush grow.

Black-throated sparrows are primarily ground foragers, foraging near or under shrubs and cacti. They also glean food from leaves and twigs in shrubs. They mainly eat insects during the breeding season and seeds during the nonbreeding season and include butterfly and moth larvae, mantids, robber flies, dragonflies, and walking sticks (www.allaboutbirds.org/guide/Black-throated_Sparrow/lifehistory). These sparrows feed on insects and their larvae during the breeding season when these prey are abundant and nestlings need ample food. At other seasons these birds eat grass seeds as well as the seeds of shrubs and cacti. Food items are gathered opportunistically from the ground or from plant stalks and stems (Johnson et al. 2002). The Black-throated sparrow can survive long periods without water, getting the moisture from food. Extra-efficient kidneys also help these birds retain water in their bodies. (https://abcbirds.org/bird/black-throated-sparrow/).

Black-throated sparrows are migratory, and the northern limit of their breeding range may change from year to year, occasionally extending farther northward. They winter in the southwestern United States and Mexico (http://birdweb.org/birdweb/bird/black-throated_sparrow). They breed in the southwest and central regions of North America, extending into the north-central mainland of Mexico. The summer range is much larger than the winter range in the United States. In the winters, they migrate to southern U.S. deserts (Clark 1999; Karl 2000).

Common Raven – The common raven (*Corvus corax*) is a large passerine bird that is known to be crafty, resourceful, quick to learn and profit from experience. It is largely a scavenger and competes with vultures in eating dead animals, but also eats insects and berries (Terres 1991). Common Ravens live in open and forest habitats across western and northern North America. This includes deciduous and evergreen forests up to tree line, as well as high desert, sea coast, sagebrush, tundra, and grasslands. They do well around people, particularly rural settlements but also some towns and cities (Cornell All About Birds https://www.allaboutbirds.org/guide/Common_Raven/id). They are omnivorous and feed on practically anything, but majority of their diet is animal matter. They feed on a wide variety of insects, including beetles, caterpillars, rodents, lizards, frogs, and eggs and young of other birds. Regularly eats carrion and garbage (www.audubon.org/field-guide/bird/common-raven). Home range and territories are highly variable and dependent upon the abundance of local resources. Because of the lack of food sources associated with the mill sites and DEVA in general, it is assumed that the home range of ravens at DEVA would be large with time concentrated around camp sites, restaurants and area vendors where garbage would be located.

Red-Tailed Hawk – The red-tailed hawk (*Buteo jamaicensis*) serves as a high trophic level predator in the terrestrial food web. It is a top carnivore in the ecosystem, preying on small mammals, birds, and large insects. It controls the populations of many of the lower trophic level prey species. The red-tailed hawk is widely distributed throughout the United States with home ranges reaching upwards of 1,500 hectares. Their habitats range from forests to prairie and can include urban areas (USEPA 1993; NGS 1987).

White-Tailed Antelope Squirrel – The white-tailed antelope squirrel (*Ammospermophilus leucurus*) has been noted at multiple mill sites in DEVA and is common to abundant in the deserts of California south to the Mexican border. Optimal habitats are desert scrub, sagebrush, bitterbrush, and pinyon-juniper. They are fairly common in desert riparian, desert succulent and desert wash habitats. Also occurs in mixed chaparral and annual grassland. During the year, different food sources make up the bulk of the diet. During the spring, greens are widely available, so they constitute the bulk of the diet, or approximately 60%. In the fall, when greens are not readily available, they only comprise about 20% of the diet. Seeds and fruits are the most important food source in the fall, making up about 60% of the diet, and are not as important in the spring, making up about 20% of the diet. Invertebrates, mainly insects, make up the rest of their diet during the year. The use of efficient kidneys keeps water loss low, but they must have some succulent plants or free water in their diet in order to survive. Foraging occurs in trees and shrubs or on the ground. White-tailed antelope squirrels have cheek pouches in which they can store food until they return to their burrows, where they will hoard the food, or put it into a cache, as do other squirrels. Common foods eaten include: seeds, green vegetation, including grasses, mesquite, acacia, yucca, ephedra Mormon tea, Joshua tree, evening primrose, storksbill, blackbrush and opuntia cactus, fruits, invertebrates, carrion. (Johnson and Harris 2001; Belk and Smith 1991; Tomich 1982).

Desert Bighorn Sheep – The desert bighorn sheep (*Ovis canadensis nelson*) is found at DEVA and is considered fully protected in California, a U.S. Bureau of Land Management Sensitive species and a U.S. Fish and Wildlife Service sensitive species (see Attachment 1). Desert bighorn sheep (*Ovis canadensis nelsoni*) range throughout the park, from salt flats to mountain ridges. Bighorn spend most of their time on steep slopes where they feel safe from their primary predator, mountain lions (https://www.nationalparkstraveler.org/2019/12/bighorn-sheep-study-underway-death-valley-national-park). Desert bighorn sheep are stocky, heavy-bodied sheep similar in size to mule deer. Weights of mature rams range from 115 to 280 pounds (52 to 127 kg), while ewes are somewhat smaller. Southern desert bighorn sheep are adapted to a desert mountain environment with little or no permanent water. Some may go without visiting water for weeks or months, sustaining their body moisture from food and from rainwater collected in temporary rock pools. They may have the ability to lose up to 30% of their body weight and still survive. After drinking water, they quickly recover from their dehydrated condition.

They graze and browse of a wide variety of plant species serve as food. Green grasses are preferred, but when this food is not available, as is the case for most of the year in DEVA, they feed on a variety of other plants, including cacti. Bighorns have a complex nine-stage digestive process that allows them to maximize removal of nutrients from their food (www.nps.gov/jotr/learn/nature/bighorn.htm).

Southern Grasshopper Mouse – The southern grasshopper mouse (*Onychomys torridus*) is an aggressive small mammal species which lives in burrows in the ground and occurs at relatively low densities. It is common in arid desert habitats of the Mojave Desert and southern Central Valley of California. Alkali desert scrub and desert scrub habitats are preferred, with somewhat lower densities expected in other desert habitats including succulent scrub, wash and riparian areas. It also occurs in coastal scrub, mixed chaparral, sagebrush, low sage and bitterbrush habitats. It feeds exclusively on arthropods, especially scorpions and orthopteran insects such as crickets and grasshoppers (Horner et al, 1964). Vertebrate (lizards and small mammals) and seeds are minor component of its diet (Bailey and Sperry, 1929; Horner et al., 1964).

As summarized by the CDFW (available at www.dfg.ca.gov/biogeodata/cwhr/cawildlife.aspx), the home range of southern grasshopper mice in New Mexico averaged 3.2 ha (7.8 ac) for males, and 2.4 ha (5.9 ac) for females (Blair 1943). In southeast Arizona, the average home range of adult mice equaled 11.45 ha (28 ac) (Chew and Chew 1970), whereas in Nevada desert scrub, the density averaged 1.83 mice/ha (0.74 mice per acre). It is active all year and does not migrate.

Townsend's Big-Eared Bat – The Townsend's big-eared bat (*Coryorhinus townsendii*) is found at all elevations in DEVA, it roots in abandoned mines (digital-desert.com/death-valley/wildlife/bats.html). It is considered a California species of special concern, a U.S. Bureau of Land Management Sensitive species and a U.S. Fish and Wildlife Service sensitive species (see Attachment 1). Townsend's big-eared bats are believed to feed entirely on moths. Foraging occurs near vegetation and other surfaces and prey is probably gleaned from these surfaces. Townsend's big-eared bats hibernate up to seven months of the year in caves often near the entrance in well-ventilated areas. They move to more stable parts of the cave if temperatures near the entrance become extreme. Hibernation occurs in cluster of a few bats to more than 100 (www.ndow.org/Species/Furbearer/Townsend's_Big-eared_Bat/). Mines are particularly important for bats like the Townsend's big-eared, which prefer broad, open surfaces on which to roost. They're poor crawlers, and won't creep into cracks and crevices after landing, like other species. They're also particularly sensitive to human disturbance: left alone, they'll use a roost site for years on end, but the entire colony will abandon a roost and relocate with even a seemingly minor disturbance. In California alone, the state's Department of Fish and Game found that in the late 1980s, the population had declined by an estimated 40 to 60 percent compared with the previous three decades, primarily as a result

of loss of roosting sites in mines and abandoned buildings. Only three maternity colonies, all located in national parks, increased in size during that period (Donahue 2017).

Side-Botched Lizard – The side botched lizard (*Uta stansburiana*) has been noted at multiple sites at DEVA including the Gold Hill Mill Site. It ranges from central Washington south to the tip of Baja, California, on the east side of the Cascades and Sierras, east to western Colorado and west Texas, and into central Mexico. The side-blotched lizard is one of the most abundant and commonly observed lizards in the West's drier regions. This lizard is one of the first to appear in the spring and last to hibernate in the late fall. Mostly ground dwellers, side-blotched lizards will climb boulders, logs or rock cairns (piles of rocks that are often used as trail markers) for vantage points, basking sites or to express their territoriality. These and other lizards do "push-ups" which can signify territorial or mating behavior. One lizard may chase another from its turf. One study determined the home range sizes for these lizards: males have a .06-acre home range, females have a .02-acre home range and juveniles have a .01-acre home range. In these home ranges, the territories of males often overlap, while those of the females rarely do. Side-blotched lizards' prey on a variety of creatures: ants, flies, mosquitoes, damselflies, dragonflies, beetles, bees, aphids, caterpillars, ticks, scorpions and spiders. The lizard tries to sneak up on its intended prey, then quickly dashes after its quarry and catches its prey in its mouth. These lizards, in turn, are preyed upon by larger lizards as wells as by snakes and birds (www.desertusa.com/reptiles/side-blotched-lizard.html).

C.1.3.1.4 Wildlife Modeling

The food ingestion rates, body weight and incidental soil ingestion rates used for each endpoint are presented in Attachment 2. The food ingestion rates are conservative estimates derived from the literature or are derived using allometric equations taken from the USEPA ***Wildlife Exposure Factors Handbook*** (USEPA 1993) and body weights.

Wildlife may ingest substantial amounts of soil while feeding, either deliberately or inadvertently. Concentrations of some elements and environmental contaminants in ingested soil may be so high in comparison with the concentrations in the animal's diet that the soil becomes an important means of exposure. Estimates of soil ingestion rates are required for risk assessments that attempt to include all sources of exposure to environmental contaminants. Soil ingestion also may be important to animals by supplying nutrients or by interfering with absorption of nutrients (Beyer et al. 1994). In contrast to food consumption rates, generalized models do not exist with which to estimate incidental soil ingestion rate by wildlife. Soil ingestion rates for the SLERA were taken from literature sources such as Beyer et al. (1994) and are listed in Attachment 2. For purposes of estimating the cumulative dose, the percent soil ingestion was in addition to, rather than a portion of, the food ingestion rate.

Food web ingestion-based modeling calculations were performed to characterize exposures to contaminants via the food web and to identify potential adverse effects for mammals, birds and reptiles. Ingestion modeling is based on species-specific exposure parameters and ingestion intake requirements based on standard allometric equations (USEPA 1993). The following general equation was used to estimate oral exposure for wildlife receptors:

$$Dose\ (mg/kg - day) = \left(\frac{(IRfood\ \times Cfood) + (IRsoil \times Csoil)EMF)}{BW}\right)$$

where:

Dose	=	Estimated dose from ingestion (mg COPEC/kg body weight/day)
IR_{food}	=	Ingestion rate of food (prey) (kg/day)
C_{food}	=	COPEC concentration in food (milligrams per kilogram [mg/kg])
IR_{soil}	=	Ingestion rate of soil (kg/day)
C_{soil}	=	COPEC concentration in soil (mg/kg)
EMF	=	Exposure modifying factor (unitless)
BW	=	Body weight of the receptor (kg)

C.1.3.1.5 Uptake Factors

Bioaccumulation is the chemical and biological processes that result in an increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment. Compounds accumulate in living things any time they are taken up and stored faster than they are broken down (metabolized) or excreted. In the context of ecological risk assessment, it is important to estimate the bioaccumulation of chemicals in biota because it could be a significant part of the exposure of ecological receptors to a chemical.

Uptake factors are a measure of the steady-state ratio between the concentration of a chemical in biota to the concentration in an abiotic medium (e.g., soil). The uptake factor is used to estimate concentrations of COPECs in specific items in an ecological receptor’s diet, such as plants, arthropods and mammals. Some receptors forage strictly on one type of food, in which case only one uptake factor is incorporated. For example, the soil-to-plant uptake factor would be incorporated to estimate exposure to an herbivorous mammal. However, many species feed on more than one type of food. In these cases, a COPEC concentration in food could be estimated by adding the products of (1) the soil concentration, (2) the uptake factor for that item and (3) the fraction of the total diet made up by that item. Uptake factors are

used to estimate the COPEC concentration from the soil to terrestrial plants, arthropods and mammals. Three types of uptake factors were used in this BERA:

- Soil to plant
- Soil to mammal and
- Soil to arthropod.

Soil to Plant - For inorganic COPECs, uptake factors were extracted from the post-validation dataset in Bechtel-Jacobs (1998). This dataset was developed using empirical field uptake factors available in the scientific literature and supplemented using measured concentrations in co-located soil and plant samples from two contaminated sites. The post-validation dataset is used since there are more uptake factors available in this dataset, and because they incorporate data from contaminated sites. USEPA relied on this dataset to estimate exposure in plants and derive Eco-SSLs. When uptake factors were not available from Bechtel-Jacobs (1998), the literature was reviewed for uptake factors and include sources such as USEPA (2007) and Diez-Ortiz et al (2010). The 90^{th} percentile is the preferred statistic chosen from the soil to plant uptake factor summary information provided by Bechtel-Jacobs (1998).

Soil to Mammal – Uptake factors for inorganic COPECs rely heavily on the Sample et al. (1998) dataset for small mammals due to the lack of data for other terrestrial vertebrate wildlife. The 90^{th} percentile is the preferred statistic chosen from the soil to mammal uptake factor summary information provided by Sample et al. (1998) based on general trophic group.

Soil to Arthropod - Soil-to-arthropod BAFs for inorganic compounds were extracted from USACHPPM (2004). This document presents data for the COPEC measured in a variety of insects such as beetles, caterpillars, grasshoppers, moths, butterflies, flies and hornets from contaminated sites. This data set better represents uptake for invertebrate species likely to be present at DEVA and not the overly conservative (and less likely present) earthworm. The 90^{th} percentile is the preferred statistic chosen from the soil to arthropod uptake factor.

If an uptake factor was not available from these primary sources, the uptake factor was taken from the TCEQ’s PCL Wildlife Database (2020). Original references for each uptake factor are presented in Attachment 2.

C.1.3.2 Toxicity Assessment

In the SLERA, COPEC selection was based on the lowest ESV across multiple NPS-approved toxicity value sources. However, in the BERA, risk estimates are revised using more species-specific

concentrations and/or dose-based toxicity reference values (TRVs). For the plant and invertebrate communities, the geometric mean of the NOEC and LOEC from the Los Alamos Ecological Database (2017) was used as the toxicity value for comparison in the BERA.

Mammal and bird TRVs were developed through a review of the open literature. The literature search covered several ecotoxicological databases in addition to scientific literature. Each COPEC has a TRV based on a lowest observed adverse effect level (LOAEL) and on a no observed adverse effect level (NOAEL). The toxicity values used to calculate HQs in this BERA for each receptor are shown in Attachment 2. The rationale for selection of a TRV for each ecological COPEC was based on several key factors:

- Preference for chronic (i.e., long-term) endpoints, especially those that include critical life stages;
- Preference for the use of the ecological receptor as a test organism;
- Preference for the highest NOAEL that did not exceed the lowest LOAEL;
- Preference for food studies over gavage or oral intubation studies; and
- Preference for ecologically significant effects, such as survival, growth, and/or reproduction.

The term "ecologically significant" is subjective. Toxicity data were chosen by weighing factors including species used in study, life stage, chemical form of the contaminant, route of exposure, length of study, and other measured endpoints. The relevant information about the available toxicity studies was evaluated and assessed for a constituent when choosing the toxicity data to be used in this BERA.

Toxicity data were taken primarily from the TCEQ PCL Wildlife Database (TCEQ 2020). The primary references of the toxicity values are listed in Attachment 2. The Database provides additional information on the chosen toxicity values. The avian lead TRV was taken from the open literature: *Revisiting the Avian Eco-SSL for Lead: Recommendations for Revision* (Sample et al., 2019). The researchers recommend an avian NOAEL of 4.4 mg/kg-day based on an ED10 (Effective Dose to10% of the study population). "The ED10 for egg production in chickens, although greater than the ED10 for egg production in Japanese Quail, was selected as the TRV for the revised Eco-SSL because of the uncertainty and high variability associated with the quail results." The Japanese quail study is the basis for the TRV of 1.63 mg/kg-day used in the EPA Eco SSL document (EPA, 2005a).

C.1.3.3 Risk Characterization

Predictions of the likelihood for adverse effects, if any, for the food web modeling studies are based on HQs (USEPA, 1997). The HQs were calculated by dividing the estimated ingestion intakes by the reference toxicity values for each of the COPECs for each of the species.

NOAEL – HQ = Exposure Dose/ NOAEL-TRV and

LOAEL – HQ = Exposure Dose/LOAEL-TRV

where:

- Exposure Dose = COPEC intake for exposure area (mg COPEC/kg BW per day)
- NOAEL – TRV = toxicity reference dose based on a NOAEL (mg COPEC/kg BW per day)
- LOAEL – TRV = toxicity reference dose based on a LOAEL (mg COPEC/kg BW per day)

The HQ value of 1 is considered the threshold for indicating that adverse effects may occur. An HQ less than or equal to a value of 1 (to one significant figure) indicates that adverse impacts to wildlife are considered unlikely. An HQ greater than 1 is an indication that further evaluation may be necessary to evaluate the potential for adverse impacts to wildlife. HQs equal to 1 using TRVs that are based on NOAELs should be considered protective of individuals and are commonly used in the evaluation of special-status species. HQs equal to 1 using TRVs that represent LOAELs may indicate a potential for low effects and are commonly used for evaluation of populations.

C.1.3.3.1 Risk Characterization – Terrestrial Plant Community

As described in Section D.1.1, the Creosote Bush scrub vegetation community was observed within the study area during the November 2019 site visit (Attachment 1). This vegetation community is dominated by widely-spaced creosote and white bursage, with bare ground between them. Soils in this community are well drained, alluvial, and sandy. Plant species observed during the survey includes the following species: creosote bush, brittlebush, white bursage, white ratany, jointfir, pencil cholla, wire-lettuce, beavertail cactus, rubber rabbitbrush, cheesebush, sticky snakeweed, cotton catclaw, sandbar willow, honey mesquite, and tamarisk.

The terrestrial plant COPECs are summarized in Table C-4 Terrestrial plant COPECs were determined from comparison of the DU EPCs to the geometric mean of the LANL NOEC and LOEC values for generic plants (LANL, 2017).

Table C-4 Summary of COPECs with Hazard Quotients Above 1 for Terrestrial Plants

DU-1			DU-2		
COPEC	**EPC (mg/kg)**	**HQ**	**COPEC**	**EPC (mg/kg)**	**HQ**
Antimony	1,017	40	Antimony	1,054	42
Arsenic	557	14	Arsenic	621	15
Chromium	8.83	7	Chromium	8.19	7
Copper	1,133	6	Copper	1,358	7
Lead	12,575	48	Lead	8,940	34
Selenium	3.58	3	Selenium	4.67	4
Vanadium	169	2	Vanadium	126	2
Cyanide	0.37	No LOEC/NOEC	Zinc	13,300	103
--	--	--	Cyanide	Not Sampled	--

Antimony - The EPCs for antimony are 1,017 mg/kg for DU-1 and 1,054 for DU-2. The refined SLERA ESV for protection of plants is 5 mg/kg and is based on “unspecified toxic effects on plants grown in a surface soil with the addition of 5 ppm antimony” (Kabata-Pendias and Pendias 1984). Efroymson et al (1997a) states that the confidence in the benchmark because it is based on a lone study. USEPA did not develop an Eco SSL for antimony because it could not locate studies that met the evaluation criteria (USEPA, 2005b). The Los Alamos National Lab Ecorisk Database (Release 4.1, September 2017) (LANL, 2017) lists a no observed effect concentration (NOEC) of 11 mg/kg and a lowest observed effect concentration (LOEC) of 58 mg/kg for generic plants (LANL 2017).

Arsenic – The EPCs for arsenic are 557 mg/kg for DU-1 and 621 for DU-2. The refined SLERA ESV for protection of terrestrial plants is 18 mg/kg and is the USEPA Eco SSL (USEPA 2005c). The Eco-SSL is the geometric mean of the maximum acceptable toxicant concentration (MATC) values reported for ryegrass (*Lolium perenne*), cotton (*Gossypium hirsutum Stoneville 7A*) and rice (*Oyza sativa L var. Nato*) under two separate test conditions (pH and percent organic matter). USEPA (2005c) also lists MATCs for other commonly consumed plants species that range from 6 mg/kg (radish, *Raphanus sativus*) to 97 mg/kg (potato, *Solanum tuberosum*). The LANL Ecorisk Database lists a NOEC of 18 mg/kg and a LOEC of 91 mg/kg for generic plants for arsenic (LANL 2017).

Chromium – The EPCs for total chromium are 8.83 mg/kg for DU-1 and 8.19 mg/kg for DU-2. The refined SLERA ESV for protection of terrestrial plants is 1 mg/kg and is based on studies of hexavalent chromium on soybean seedlings, lettuce, tomatoes and oats. The Effective Concentration on 50% of the test plants (EC50) was greater than 11 mg/kg for lettuce at a pH of 5.1 in humic sand soil and 1.8 mg/kg at pH 7.4 and lower organic matter. The same trend was true for both the tomato and oats (21 mg/kg and

31 mg/kg in humic, higher organic matter soil contrasted with 6.8 mg/kg and 7.4 mg/kg for lower organic matter soil, respectively). Efroymson et al (1997a) states that the confidence in the benchmark of 1 mg/kg is low because of the small number of studies on which it is based. The LANL Ecorisk Database lists a NOEC of 0.35 mg/kg and a LOEC of 4 mg/kg for generic plants for hexavalent chromium (LANL 2017). See the Uncertainty Section (Section D.1.4.5) on additional discussion of forms of chromium in soil and toxicity mechanisms to plants.

Copper – The EPCs for copper are 1,133 mg/kg for DU-1 and 1,358 mg/kg for DU-2. The refined SLERA ESV for protection of terrestrial plants is 70 mg/kg and is the USEPA Eco SSL (USEPA, 2007a). The Eco-SSL is the geometric mean of the MATC and EC10 values reported for alfalfa (*Medicago sativa*), black bindweed (*Polygonum convolvulus*), citrus cultivar (Cleopatra mandarin) and perennial ryegrass (*Lolium perenne L.*), under two separate test conditions (pH and percent organic matter). USEPA (2007a) also lists MATCs, No Observed Adverse Effect Concentrations (NOAECs), EC10, EC20, EC50, LC50 and Lowest Observed Adverse Effect Concentrations for other commonly consumed plants species that range from 0.74 mg/kg (barley, *Hordeum vulgare* var. Chapais*)* to 1,845 mg/kg (yellow bloodwood, *Eucalyptus eximia Schau.*). The variability of the data suggests toxicity to a plant community is difficult to assess based on studies using one plant species under controlled test conditions. The LANL Ecorisk Database lists a NOEC of 70 mg/kg and a LOEC of 490 mg/kg for generic plants for copper (LANL, 2017). There are no toxicity data listed for desert species found at the Gold Hill Mill Site.

Lead - The EPCs for lead are 12,575 mg/kg for DU-1 and 8,940 for DU-2. The refined SLERA ESV for protection of terrestrial plants is 120 mg/kg and is the USEPA Eco SSL (USEPA 2005a). The Eco-SSL is the geometric mean of the MATC values reported for loblolly pine (*Pinus taeda*), red maple (*Acer rubrum*), Berseem clover (*Trifolium alexandrium*) and ryegrass (*Lolium rigidum*), under two separate test conditions (pH and percent organic matter). USEPA (2005a) also lists MATCs and No Observed Adverse Effect Concentrations (NOAECs) for other commonly consumed plants species that range from 35 mg/kg (tomato, *Lycopersicum esculentum*) to 2,263 mg/kg (sow thistle, *Sonchous oleraceus L*.). The variability of the data suggests toxicity to a plant community is difficult to assess based on studies using one plant species under controlled test conditions. The LANL database lists a NOEC concentration of 120 mg/kg and a LOEC of 570 mg/kg for the generic plant (LANL 2017). There are no toxicity data listed for desert species found at the Gold Hill Mill Site.

Selenium - The EPCs for selenium are 3.58 mg/kg for DU-1 and 4.67 mg/kg for DU-2. The refined SLERA ESV for protection of terrestrial plants is 0.52 mg/kg and is the USEPA Eco SSL (USEPA 2007b). The Eco-SSL is the geometric mean of the MATC and EC20 values reported for alfalfa (*Medicago sativa*), barley (*Hordeum vilgare*), brassica (*Brassica rapa*), Raya (*Brassica juncea*), berseem (*Trilolium alexandrinum*) and cowpea (*Vigna sinensis*), under two separate test conditions (pH and

percent organic matter) that rand from 0.9 mg/kg to 1.6 mg/kg. USEPA (2007b) also lists MATCs and No Observed Adverse Effect Concentrations (NOAECs) and EC20s for other commonly consumed plants species that range from 0.5 mg/kg (alfalfa) to 3 mg/kg (alfalfa). The variability of the data suggests toxicity to a plant community is difficult to assess based on studies using one plant species under controlled test conditions. The LANL database lists a NOEC concentration of 0.52 mg/kg and a LOEC of 3 mg/kg for the generic plant for selenium (LANL, 2017). There are no toxicity data listed for desert species found at the Gold Hill Mill Site. There is uncertainty with the potential risk to the plant community from the selenium in the soils because of the plant species on which the ESV is based; however, the EPCs for both DU-1 and DU-2 are greater than all of the toxicity values listed in USEPA 2007b.

Vanadium - The EPCs for vanadium are 169 mg/kg for DU-1 and 126 mg/kg for DU-2. The refined SLERA ESV for protection of terrestrial plants is 2 mg/kg and is based on "unspecified toxic effects on plants grown in a surface soil with the addition of 50 ppm of vanadium" (Efroymson et al. 1997a). Efroymson et al (1997a) states that the confidence in the benchmark is low. The LANL database lists a NOEC concentration of 60 mg/kg and a LOEC of 80 mg/kg for the generic plant for vanadium. (LANL 2017).

Zinc - The EPCs for zinc are 252 mg/kg for DU-1 and 13,300 mg/kg for DU-2, The refined SLERA ESV for protection of terrestrial plants is 160 mg/kg and is the USEPA Eco SSL (USEPA 2007c). The Eco-SSL is the geometric mean of the MATC values reported for soybean (*Glycine max*), oats (*Avena sp.*) and lettuce (*Lactuca sativa*) under two separate test conditions (pH and percent organic matter). USEPA (2007c) also lists MATCs and NOAECs for other commonly consumed plants species that range from 20 mg/kg (spinach, *Spinacia oleracea*) to 440 mg/kg (oats, *Avena sp*.). There are no toxicity data listed for desert species. The LANL database lists a NOEC concentration of 160 mg/kg and a LOEC of 810 mg/kg for the generic plant (LANL, 2017). There is uncertainty with the potential risk to the plant community from the zinc in the soils because of the plant species on which the ESV is based; however, the concentrations detected in DU-1 and DU-2 are significantly elevated above published toxicity values.

Based on the EPCs from source DU-1 and DU-2 and an evaluation of the screening criteria, antimony, arsenic, chromium, copper, lead, selenium, vanadium and zinc are potentially ecological COPECs; however, this conclusion is highly uncertain. There are no toxicity levels derived using plant species relevant to DEVA. Cyanide is also considered a COPEC, but there are no screening values available for comparison.

C.1.3.3.2 Risk Characterization – Invertebrate/Arthropod Community

The invertebrate community COPECs are summarized in Table C-5. The soil invertebrate community at DEVA is likely limited from the lack of organic matter and moisture in the soils as well as the high temperatures during the summer months. Invertebrates likely found at DEVA include scorpions, spiders, centipedes, millipedes, walking sticks, termites, beetles, butterflies, moths, bees, wasps and ants (www.desertmuseum.org/books/nhsd_inverts.php). The LANL NOEC and LOEC values are based on earthworm species which may not be relevant to the invertebrate species at DEVA.

Table C-5 Summary of COPECs with Hazard Quotients Above 1 for Terrestrial Invertebrates

DU-1			DU-2		
COPEC	**EPC. (mg/kg)**	**HQ**	**COPEC**	**EPC. (mg/kg)**	**HQ**
Antimony	1,017	4	Antimony	1,054	4
Arsenic	557	26	Arsenic	621	29
Chromium	8.83	8	Chromium	8.19	8
Copper	1,133	6	Copper	1,358	7
Lead	12,575	3	Lead	8,940	2
Mercury	21	133	Mercury	8	47
Silver	80.78	No LOEC/NOEC	Silver	51.24	No LOEC/NOEC
Thallium	1.48	No LOEC/NOEC	Thallium	1.29	No LOEC/NOEC
Vanadium	169	No LOEC/NOEC	Vanadium	126	No LOEC/NOEC
Zinc	252	2	Zinc	13,300	40
Cyanide	0.374	No LOEC/NOEC	Not Sampled	--	

Antimony – The EPCs for antimony are 1,017 mg/kg for DU-1 and 1,054 for DU-2. The refined SLERA ESV for protection of terrestrial invertebrates is 78 mg/kg and is the USEPA Eco SSL (USEPA, 2005b). The Eco-SSL is the geometric mean of three EC20 values reported for the enchytraeid (*Enchytraeus crypticus*) (EC20 = 194 mg/kg), springtail (*Folsomia candida*) (EC20 = 81 mg/kg) and earthworm (*Eisenia fetida*) (EC20 = 30 mg/kg). The LANL database lists a NOEC concentration of 78 mg/kg and a LOEC of 780 mg/kg for the soil invertebrate - earthworm (LANL, 2017).

Arsenic – The EPCs for arsenic are 557 mg/kg for DU-1 and 621 for DU-2. The refined SLERA ESV is the benchmark of 60 mg/kg (Efroymson et al. 1997b). Fischer and Koszorus (1992) tested the effects of 68 ppm of arsenic (as potassium arsenate) on growth and reproduction of *Eisenia fetida* (average initial age of 5 weeks) when added to a combination of peaty marshland soil and horse manure (1:1). The number of survivors and their live mass and the number of cocoons produced were measured. The

number of cocoons produced per worm showed the highest sensitivity to arsenic with a 56% reduction at the test concentration. The benchmark of 60 ppm arsenic is based on this study only. Because of the lack of data, confidence in this benchmark is low (Efroymson et al. 1997b). The benchmark of 60 mg/kg is based on a toxicity study using an earthworm species, but given the dry conditions at DEVA, this species is not common at DEVA. The LANL database lists a NOEC concentration of 6.8 mg/kg and a LOEC of 68 mg/kg for the soil invertebrate - earthworm (LANL 2017).

Chromium – The EPCs for total chromium are 8.83 mg/kg for DU-1 and 8.19 mg/kg for DU-2The refined SLERA ESV for protection of terrestrial invertebrates is 0.4 mg/kg and is based on a study with the earthworm *Octochaetus pattoni* that were kept in concrete tanks containing a mixture of soil and animal dung for 60 days to assessment effect of hexavalent Cron survival and reproduction. Survival was the most sensitive measure with a 75% decrease resulting from 2 ppm Cr, the lowest concentration tested. The number of cocoons produced was not diminished until the concentration reached 20 ppm and the number of juveniles produced was not affected. Efroymson et al (1997b) states that the confidence in the benchmark of 0.4 mg/kg is low because of the small number of studies on which it is based. A safety factor of 5 was applied to the 2 ppm Lowest Observed Effect Concentration (LOEC). The LANL database lists a NOEC concentration of 0.34 mg/kg and a LOEC of 3.4 mg/kg for the soil invertebrate – earthworm for hexavalent chromium. The LANL does not present values for trivalent chromium (LANL 2017). See the Uncertainty Section (Section D.1.4.5) on additional discussion of forms of chromium in soil and toxicity mechanisms to earthworms.

Copper – The EPCs for copper are 1,133 mg/kg for DU-1 and 1,358 mg/kg for DU-2. The refined SLERA ESV for protection of terrestrial invertebrates is 80 mg/kg and is the USEPA Eco SSL (USEPA 2007a). The Eco-SSL is the geometric mean of toxicity values (EC10 and MATC) values reported for a nematode, springtail (*Folsomia fumetario*) and several species of earthworm (*Eisenia fetida*, *Lumbricus rubellus*, *Aporrectodea caliginosa*). The toxicity values ranged from 27 mg/kg to 188 mg/kg. The LANL database lists a NOEC concentration of 80 mg/kg and a LOEC of 305 mg/kg for the soil invertebrate – earthworm for copper (LANL, 2017).

Lead – The EPCs for lead are 12,575 mg/kg for DU-1 and 8,940 for DU-2. The refined SLERA ESV for protection of terrestrial invertebrates is 1,700 mg/kg and is the USEPA Eco SSL (USEPA, 2005a). The Eco-SSL is the geometric mean of four MATC values reported for a collembola (*Folsomia candida*). The toxicity values ranged from 894 mg/kg to 3,162 mg/kg. The LANL database lists a NOEC concentration of 1,700 mg/kg and a LOEC of 8,400 mg/kg for the soil invertebrate – earthworm for lead (LANL 2017).

Mercury – The EPCs for inorganic mercury are 21 for DU-1 and 8 mg/kg for DU-2. The refined SLERA ESV for protection of soil invertebrates is 0.1 mg/kg and is based on a study with *Octochaetus pattoni*. Survival and cocoon production were reduced 65 and 40% at 0.5 ppm mercury. The number of juveniles produced was not affected (Efroymson et al. 1997b). Efroymson et al (1997b) states that the confidence in the benchmark is low and a safety factor of 5 was applied to the LOEC. The LANL database lists a NOEC concentration of 0.05 mg/kg and a LOEC of 0.5 mg/kg for a soil dwelling invertebrate for inorganic mercury (LANL 2017).

Silver – The EPCs for silver are 80.78 mg/kg for DU-1 and 51.24 mg/kg for DU-2. NPS (2018) and LANL do not list any ESVs or NOEC/LOECs for the protection of the invertebrate community for silver.

Thallium – The EPCs for thallium are 1.48 mg/kg for DU-1 and 1.29 mg/kg for DU-2. NPS (2018) and LANL do not list any ESVs or NOEC/LOEC for the protection of the invertebrate community for thallium.

Vanadium – The EPCs for vanadium are 169 mg/kg for DU-1 and 126 mg/kg for DU-2. NPS (2018) and LANL do not list any ESVs or NOEC/LOEC for the protection of the invertebrate community for vanadium.

Zinc – The EPCs for zinc are 120 mg/kg for DU-1 and 13,300 mg/kg for DU-2. The refined SLERA ESV for protection of terrestrial invertebrates is 120 mg/kg and is the USEPA Eco SSL (USEPA, 2007c). The Eco-SSL is the geometric mean of the MATC and EC10 values reported for springtail (*Folsomia candida*) and nematode under different test conditions (pH and percent organic matter). USEPA (2007c) also lists MATCs, EC10 and NOAECs for other invertebrate species that range from 85 mg/kg (earthworm, *Eisenia fetida*) to 1,059 mg/kg (springtail, *Folsomia candida*.). The LANL database lists a NOEC concentration of 120 mg/kg and a LOEC of 930 mg/kg for a soil dwelling invertebrate for zinc (LANL 2017).

Based on the EPCs from source DU-1 and DU-2 as compared to the screening criteria, antimony, arsenic, chromium, copper, lead, mercury, and zinc are potentially ecological COPECs; however, this conclusion is highly uncertain. There are no toxicity levels derived using invertebrate species relevant to DEVA. Cyanide, silver, thallium and vanadium are also considered COPECs, but there are no screening values available for comparison.

C.1.3.3.3 Risk Characterization – Wildlife

The Gold Hill Mill Site and surrounding area potentially provide habitat for a variety of reptiles, birds, and mammals. Wildlife species observed within the study area consisted of commonly-occurring species -

including European starling, common raven, red-tailed hawk, and side-blotched lizard. Other wildlife species known within the vicinity of the study area that were not observed during the survey include several species of small rodents such as the southern grasshopper mouse. The Panamint pocket gopher, black-throated sparrow, Gambel's quail, and desert spiny lizard could also be present in the area. Several special-status species are potentially present on-site and include: desert bighorn sheep, Pallid bat and Townsend’s big-eared bat. Attachment 1 to this Appendix presents the biological resource habitat assessment conducted in 2019.

The site covers less than 1 acre and consists of a complete and well-preserved mill with evidence of mercury amalgamation. The proximity of Warm Springs could attract a variety of wildlife to the general area. An exposure area of 1 acre was applied in the BERA. This exposure area includes both the mill foundations (DU-1) ISM area (approximately 2,800 square feet) and the mill tailings in the wash along the road (DU-2) (approximately 300 feet downgradient from the mill). Visually observable mill tailings in the wash were of limited extent, within approximately 50 feet of the mill site. EPCs for the two DUs were based on the data collection method:

- DU-1 was assessed using ISM sampling and therefore a mean of the ISM sample data was used as the EPC.
- DU-2 as assessed with discrete sampling points and therefore the lower of the 95% UCL, recommended by the ProUCL program, and the maximum detection was the EPC.

Area use factors based on foraging area or migration were applied in the BERA. All exposure parameters are shown on Table 12 in Attachment 2.

A summary of the HQs greater than 1 are presented below in Table C-6. The HQs presented in Table C-6 were developed using the less conservative EPC (i.e., not the maximum concentration) and exposure modifications for wildlife receptors based on migration and foraging area. These HQs conservatively assume 100% bioavailability. HQs based on the no effect (NOAEL) and lowest effect (LOAEL) toxicity data are shown in Table C-6.

Table C-6 Hazard Quotients Above 1 for Wildlife (Adjusted by Exposure Modifying Factors)

Species	COPEC	NOAEL-HQ	LOAEL-HQ
DU-1 Mill Foundation			
Black-throated sparrow	Antimony	316	32
	Arsenic	26	3
	Copper	7	6
	Lead	130	13
	Mercury	19	9
	Selenium	2	1
	Vanadium	2	1
	Zinc	4	< 1
Common Raven	Antimony	3	< 1
Southern grasshopper mouse	Arsenic	3	< 1
	Lead	13	1
White-tailed antelope squirrel	Arsenic	16	4
	Lead	26	3
	Mercury	2	< 1
Side-botched lizard	Lead	6	< 1
DU-2 Eroded Tailings in Wash Along Road			
Black-throated sparrow	Antimony	327	33
	Arsenic	29	3
	Cadmium	8	3
	Copper	9	7
	Lead	92	9
	Mercury	7	3
	Selenium	3	2
	Vanadium	2	1
	Zinc	202	22
Common raven	Antimony	3	< 1
	Zinc	3	< 1
Southern grasshopper mouse	Arsenic	4	< 1
	Copper	2	1
	Lead	9	1
	Zinc	4	2
White-tailed antelope squirrel	Arsenic	18	4
	Cadmium	2	< 1
	Lead	19	2
	Zinc	4	2
Side-botched lizard	Lead	5	< 1

C.1.4 Uncertainty

A summary of the uncertainties inherent to each component of the ecological risk assessment process and how they may affect the quantitative risk estimates and conclusions of the risk analysis is provided here.

C.1.4.1 General Sources of Uncertainty

Due to the multiplicity of potential receptor species and general lack of detailed knowledge and/or variability surrounding their life cycles, feeding habits, and relative toxicological sensitivity, the uncertainty surrounding estimates of ecological hazard can be substantial. This BERA did not account for site-specific factors such as chemical bioavailability over time, adaptive tolerance, reproductive potential or recruitment from similar adjoining areas. Such factors would tend to mitigate the degree and ecological significance of loss or impairment of a portion of some ecological population(s) due to both chemical and physical stressors in the area. The criteria used in this assessment are all chemical-specific and as such, cannot address the additive, antagonistic, or synergistic effects of the mixtures of chemicals typically found in the environment.

C.1.4.2 Exposure Concentrations

Risk is most likely overestimated in the exposure assessment because the selected EPCs are maximum detected values in the SLERA phase and statistically based concentrations for the BERA. If the DU was sampled incrementally (e.g., DU-1), the mean of the ISM samples was used as the EPC in the BERA. If the DU was sampled using discrete techniques (e.g., DU-2), then the lower of the maximum detection or the 95 % UCL was used as the EPC. It is unlikely that most receptors would be consistently exposed to metals associated with one of the DUs because of the small size of the DUs. Use of this upper-end estimate of exposure, such as the 95% UCL or maximum, as the EPC is intentionally conservative for the BERA.

C.1.4.3 Water Exposure

There are two surface water samples collected during the SI, but were collected from a spring not associated with the site activities and not impacted by mill activities; however, the presence of the nearby water source would attract wildlife to the general area. Surface water exposure to wildlife receptors was not quantified in this BERA because this natural surface water feature was not impacted by the site activities or tailings. Table 9 in Attachment 2 shows the comparison of the detected and non-detected concentrations to the freshwater screening values listed in NPS (2018). Two concentrations of barium exceed and one concentration of copper exceed the screening values.

C.1.4.4 Reptiles

Currently, much less is known about the effects of COEPCs in reptiles than in any other vertebrate class, making prediction of COPC impacts on reptiles difficult. Reptiles may respond differently than birds and mammals to some environmental contaminants because their metabolic rates may slow the elimination and detoxification of toxic substances. A number of reptiles are predators or scavengers that occupy high positions in trophic food chains potentially resulting in an increased exposure to persistent contaminants as a result of biomagnification (Selcer 2006).

In general, past reptile studies have focused on measuring body burdens of various pollutants from samples collected in the field. While these data are useful for understanding historical exposures of given populations, the actual risks and population-level effects of pollution on reptiles is still largely unknown and generally understudied (Wier et al. 2010).

Relatively few laboratory studies have been conducted on the dose-response of toxicants and no standardized tests involving reptile models are in use (Talent et al. 2002). The lack of standard dose-response toxicity testing makes determining a toxicity reference virtually impossible or very imprecise. This BERA uses toxicity data for lead specific to the western fence lizard (Sceloporus occidentalis) as published by Salice et al., 2009. This study found statistically significant effects on body weight, cricket consumption, organ weight, hematological parameters and post-dose behavior. Of these, lead-induced changes in body weight are most useful for ecological risk assessment because it is linked to fitness in wild lizard populations (Salice et al. 2009). No other reptile TRVs are available.

The assessment of the side-botched lizard is highly uncertain. The model assumes a soil ingestion rate similar to the box turtle (Bayer et al. 1994). The food ingestion rate was modeled using Nagy (2001) for carnivorous reptiles. The concept of a kilogram per day ingestion rate may be incorrect for reptiles. In Hopkins (2005), the western fence lizard was fed 5% of their body mass, four days a week and on the fifth day, a ration equaling of 10% of its body mass. Thus, the feeding regime resulted in a weekly ration of 30% of each lizard’s body mass. The assumption of a daily intake is not applicable to many reptiles, but this impact of this uncertainty is unknown. Additionally, the reptilian metabolic processes during food digestion are different than the mammalian model and the effect on COPEC exposure is unknown.

C.1.4.5 Plant and Soil Invertebrate Media-Based Toxicity Levels

The selected ecological media-based toxicity levels protective of the plant and soil invertebrate communities are conservative threshold doses primarily extracted from the open literature and regulatory guidance documents. Numerous factors that may reduce the potential for effects are not considered at all or are assumed to operate at minimum levels in the derivation of these screening-level benchmarks (e.g.,

no consideration of detoxification or metabolic mechanisms). Therefore, given the inherent conservatism of the exposure estimation process, it is uncertain whether adverse effects would be observed if Site-related concentrations exceed one or more screening levels.

The media-based toxicity levels protective of the terrestrial plant and soil invertebrate communities are from a variety of published sources including Oak Ridge National Laboratory (ORNL), USEPA's Soil Screening Levels and Los Alamos National Laboratory (LANL). The ORNL values are based on individual studies with safety factors applied to address uncertainties. The USEPA SSLs for plants and soil invertebrates are generally geometric means of the maximum acceptable toxicant concentration values based on a variety of test species under various test conditions. The published values are generally based on earthworms and terrestrial plants which may or may not be applicable to species found at DEVA. COPEC-specific considerations are described below:

Chromium - Chromium is not an essential element in plants. The hexavalent form is more soluble and available to plants than the trivalent form and is considered the more toxic form (Smith et al. 1989). In soils within a normal Eh and pH range, hexavalent chromium, a strong oxidant, is likely to be reduced to the less available trivalent chromium form although the trivalent form may be oxidized to the hexavalent form in the presence of oxidized manganese (Bartlett and James 1979). Within the plant, hexavalent chromium may be reduced to the trivalent chromium form and complexed as an anion with organic molecules. Symptoms of toxicity include stunted growth, poorly developed roots, and leaf curling. Chromium may interfere with carbon, nitrogen, phosphorus, iron, and molybdenum metabolism, and enzyme reactions (Kabata-Pendias and Pendias 1984). It is difficult to set a benchmark concentration for toxicity of chromium to earthworms. Survival may be more sensitive than reproduction to the metal when it is added to the earthworm substrate as a soluble salt. The relative toxicity of trivalent chromium and hexavalent chromium is not clear from the studies presented in Efroymson et al. 1997b). Hexavalent chromium ions can pass through cell membranes with much greater ease than trivalent chromium ions. However, it is thought that hexavalent chromium is reduced to trivalent chromium inside the cell (Molnar et al., 1989); this latter may be the final active form. Without a better understanding of chromium transformations in the soil, transport across earthworm cell membranes, and reactions within the cell, it is difficult to separate the effects of the two different forms (Efryomson et al. 1997b).

C.1.4.6 Quantitative Site Characterization

The ecological risk assessment is dependent upon the quantitative characterization of the DUs presented in the SIR (NOREAS 2016). At DU 1, potential health impacts are based on the mean of the reported ISM sample concentrations as representative EPCs. ISM is designed to provide an unbiased, statistically valid estimate of the mean value of an analyte within the DU. By design, ISM provides complete spatial

coverage within the DU (ITRC, 2012) A limitation of ISM is that is does not provide information on the spatial distribution of contaminants within the DU, and generates a distribution of means that approaches normality (ITRC. 2012). As the EPC is represented as a mean calculation, all detected concentrations are weighted equally, and theoretically (as a normal distribution) the mean represents that maximum detected concentrations will be encountered as frequently as the minimum concentration.

The purpose of the sampling in the wash along the road (DU-2) was to determine the extent of the mill tailings transported away from the site. The most downstream sample (DEVA-GOLD-02-007) had concentrations much lower than the other samples indicating that the extent of the mill tailings in the wash had been defined. This sample was included in the development of the EPCs for DU-2. The EPC for DU-2 is based on the lower of the maximum detected concentration and the 95% UCL are may be an overly conservative EPC, especially for zinc. One sample (DEVA-GOLD-02-005) had an anomalously elevated zinc concentration (13,300 mg/kg) as compared to the other six samples which had concentration ranging from 33 mg/kg (DEVA-GOLD-02-007) to 163 mg/kg (DEVA-GOLD-2-003).

C.2 Development of Preliminary Risk-Based Removal Goals (PRGs)

The purpose of this section is to identify risk-based PRGs. PRGs generally establish what are the concentrations of contaminants for each exposure medium that will not present unacceptable risk to ecological receptors based on site-specific conditions.

C.2.1 Selection of Ecological Risk-Based Preliminary Removal Goals

Ecological risk-based PRGs were derived using the same exposure parameters and toxicity values used in the BERA but reversing the risk equation to solve for the EPC. Generally, PRGs are only developed for those chemicals that are identified as CECs in the risk assessment. CECs are defined as those chemicals for which the estimated HQ greater than 1 and the risks were derived with reasonable exposure assumptions and also taking into account the site conditions. Toxicity values used to derive the PRGs are based on the average between the no effect and lowest effect level. The PRGs for the Gold Hill Mill Site are summarized below in Table C-7.

Table C-7 Gold Hill Mill Site Ecological Preliminary Remediation Goals

CEC	Lowest Ecological PRG (mg/kg)	Receptor	Background Concentration (mg/kg)	Recommended PRG (mg/kg)	Rationale for PRG
Antimony	10	Black-throated sparrow	0.754	10	Lowest wildlife PRG
Arsenic	40.47	Plant Community	3.75	40.47	Geometric mean of NOEC and LOEC for Plant Community
Cadmium	5	Black-throated sparrow	0.15	5	Lowest wildlife PRG
Copper	175	Black-throated sparrow	6.87	175	Lowest wildlife PRG
Lead	262	Plant Community	6.16	262	Geometric mean of NOEC and LOEC for Plant Community
Mercury	0.16	Invertebrate Community	0.012	0.16	Geometric mean of NOEC and LOEC for Invertebrate Community
Selenium	1.25	Plant Community	Not Detected	1.25	Geometric mean of NOEC and LOEC for Plant Community

CEC	Lowest Ecological PRG (mg/kg)	Receptor	Background Concentration (mg/kg)	Recommended PRG (mg/kg)	Rationale for PRG
Vanadium	69.28	Plant Community	18.83	69.28	Geometric mean of NOEC and LOEC for Plant Community
Zinc	205	Black-throated sparrow	28.5	205	Lowest wildlife PRG

C.3 Summary and Conclusions

The Gold Hill Mill Site and surrounding area potentially provide habitat for a variety of reptiles, birds, and mammals. The site covers less than 1 acre and consists of a complete and well-preserved mill with evidence of mercury amalgamation. The proximity of Warm Springs located south 850 feet upslope of the mill ruins does not appear to have been impacted by mining activities. But likely attracts a variety of wildlife to the general area. Receptors evaluated in the BERA included

- General plant community- the mill site is within the creosote bush scrub vegetation community.
- General invertebrate community – invertebrates in this area would consist of species such as tarantulas, beetles, moths, butterflies, and ants.
- Black-throated sparrow which consumes arthropods and plants. This is a common small bird which is modeled to migrate out of the area for 3 months out of the year, but has a small foraging range of 2.1 acres.
- Common raven which consumes arthropods, plants and small mammals. This bird was observed at the site during the November 2019 site visit and is assumed to have an assumed foraging range of 50 acres.
- Red-tailed hawk which consumes small mammals. This upper trophic raptor has a large foraging range of over 500 acres.
- White-tailed antelope squirrel which consumes primarily plants, but also arthropods. This species is commonly found at mill sites burrowing into the fine tailings; however, no burrows were noted at the Gold Mill Site.
- Southern grasshopper mouse which consumes primarily arthropods, but also small amounts of plants and small mammals. This species is common in the area and has a small foraging range of 6.6 acres.
- Desert bighorn sheep as a protected species which consumes plants. This species has an assumed foraging range of 100 acres.
- Townsend's big-eared bat as a protected species which consumes arthropods. This species represents several bat species that roost in the mines throughout DEVA. The foraging range is assumed to be over 200 acres.
- Side-botched lizard which consumes arthropods. This species was commonly noted at multiple mill sites. The foraging range is assumed to be 3.4 acres.

An exposure area of 1 acre was applied in the BERA and includes both the mill foundations (DU-1) ISM area (approximately 2,800 square feet) and the mill tailings in the wash along the road (DU-2)

(approximately 300 feet downgradient from the mill). Visually observable mill tailings in the wash were of limited extent, within approximately 50 feet of the mill site.

EPCs for the two DUs were based on the data collection method:

- DU-1 was assessed using ISM sampling and therefore a mean of the four ISM sample data points were used as the EPC. The detected concentrations in the individual ISM samples were generally consistent. For example, the lead concentrations ranged from 11,700 mg/kg to 13,900 mg/kg.
- DU-2 as assessed with discrete sampling points and therefore the lower of the 95% UCL, recommended by the ProUCL program, and the maximum detection was the EPC. The wash area along the road was evaluated using 7 discrete samples. There is some variability within the 7 sample points, for example the maximum detection of zinc (13,300 mg/kg) is significantly elevated above the other 6 detections (range from 33 mg/kg to 163 mg/kg).

Ecological risks for the plant community, invertebrate community, birds, mammals and reptiles are presented in Attachment 2 and summarized in Section C.1.3.3. The development of PRGs was driven by the plant community, invertebrate community and the black-throated sparrow. A comparison of the PRGs with the EPCs by DU is presented in Table C-8. Development of PRGs is presented in Attachment 2 and a summary of all of the PRGs is presented on Table 29 in Attachment 2.

Table C-8 Gold Hill Mill PRGs Compared to DU EPCs

CEC	Recommended PRG (mg/kg)	Receptor	DU-1 Mill Foundation EPC (mg/kg)	DU-2 Eroded Tailings in Wash EPC (mg/kg)
Antimony	10	Black-throated sparrow	1,017	1,054
Arsenic	40.47	Plant Community	557	621
Cadmium	5	Black-throated sparrow	1.49	22.8
Copper	175	Black-throated sparrow	1,133	1,358
Lead	262	Plant Community	12,575	8,940
Mercury	0.16	Invertebrate Community	21	8
Selenium	1.25	Plant Community	3.58	4.67
Vanadium	69.28	Plant Community	169	126
Zinc	205	Black-throated sparrow	252	13,300

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ATTACHMENT 1

BIOLOGICAL RESOURCE HABITAT ASSESSMENT

Memorandum

To: Essi Esmaili – NOREAS Inc. (NOREAS)
From: Lincoln Hulse – NCBI
CC: Jeff Oslick – NOREAS, Lenny Malo – NOREAS, and Cody Glasbrenner – NOREAS.
Date: 12/19/2019
Subject: Biological Resources Habitat Assessment – Gold Hill Mine, Death Valley National Park (DEVA)

NOREAS (NOREAS) conducted a general biological resources habitat assessment for the Gold Hill Mine (hereafter referred to as the "Project"). The Project is located in Death Valley National Park, California (Figure 1). More specifically, the Project occurs in Inyo County on the Anvil Spring Canyon West United States Geological Survey (USGS) 7.5-minute quadrangle map - Mt. Diablo Base and Meridian, within Township 23 South, Range 47 East and Section 5. This memorandum (memo) documents the findings of baseline biological resources reconnaissance surveys and habitat assessments for the Project. The intended use of this document is to disclose and evaluate Project conditions, to determine the potential for occurrence of common and special-status species, and their habitats. For the purposes of this report, the "study area[1]" includes the Gold Hill Mine, and a buffer.

METHODS

Prior to beginning field surveys, commercially available information and relevant documents were reviewed to determine the locations and types of biological resources[2] that have the potential to exist within - and adjacent to the study area. Resources were evaluated within several miles of the Project. The materials reviewed included, but were not limited to, the following:

- 2019 United States Fish and Wildlife Service (USFWS) Critical Habitat Mapper and File Data;
- 2019 USFWS Species List for Inyo County;
- 2019 California Natural Diversity Database maintained by the California Department of Fish and Wildlife(CDFW) ;
- 2019 National Wetlands Inventory (NWI) maintained by the USFWS;
- 2019 California Native Plant Society (CNPS) Electronic Inventory; and
- Microsoft Corporation's 2019 Aerial Photographs.

To support the analysis detailed above, pedestrian-based field reconnaissance surveys were performed to assess general and dominant vegetation community types, community sizes, habitat types, and species present within communities. Community type descriptions were based on observed dominant vegetation composition and derived from the criteria and definitions of widely accepted vegetation classification systems (Holland 1986; Sawyer et al. 2009).

1 The "study area" includes the lands to be affected directly and indirectly by the Project, and is not merely the immediate locales involved in the action itself.

2 For the purposes of this analysis, "biological resources" refers to the plants, wildlife, and habitats that occur, or have the potential to occur, within the study area.

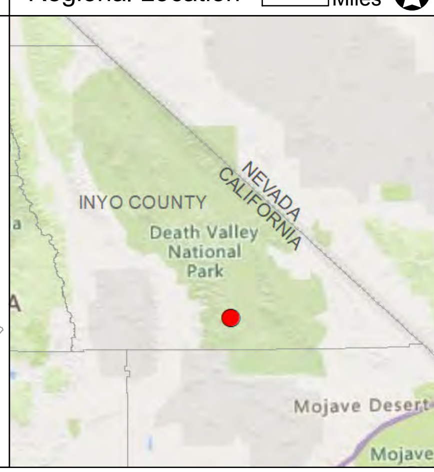
Study Area
Freeway (inset)
Forest or Park (inset)
Military Installation (inset)
Water Body (inset)

The site is located in Inyo County on the Anvil Spring Canyon West USGS 7.5-min quadrangle map. Mt. Diablo Base and Meridian, Township 23 South, Range 47 East, Section 5.

Center coordinates are:
Latitude 35.968451, Longitude -116.931219

Statewide Location

Regional Location 25 Miles



0 500 1,000 Feet
1 inch = 1,000 feet

Data Sources:
- Bing accessed Dec 2019
- BLM accessed Dec 2019
- ESRI US Topo Maps accessed Dec 2019

Map Prepared: 12-18-19

Prepared by:
NOREAS
Environmental Engineering and Science

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Figure 1. Gold Hill Mine Regional Location

Plants were identified to the lowest taxonomic level sufficient to determine whether the plant species observed were non-native, native, or special-status. Plants of uncertain identity were subsequently identified from taxonomic keys (Baldwin et al. 2012). Scientific and common species names were recorded according to Baldwin et al. (2012).

The presence of a wildlife species was based on direct observation and/or wildlife sign (e.g., tracks, burrows, nests, scat, or vocalization). Field data compiled for wildlife species included scientific name, and common name. Wildlife of uncertain identity was documented and subsequently identified from specialized field guides and related literature (Burt and Grossenheider 1980; Halfpenny 2000; Sibley 2000; Elbroch 2003, and Stebbins 2003).

The study area was also assessed for its potential to support special-status species[3] based on habitat[4] suitability comparisons with reported occupied habitats. The following potential for occurrence definitions were utilized within Appendix A:

- Absent [A] – Species distribution is restricted by substantive habitat requirements which do not occur within the study area, and no further survey or study is necessary to determine likely presence or absence of this species.
- Low [L] – Species distribution is restricted by substantive habitat requirements which are negligible within the study area, and no further survey or study is necessary to determine likely presence or absence of this species.
- Habitat Present [HP] – Species distribution is restricted by substantive habitat requirements which occur within the study area, and further study may be necessary to determine likely presence or absence of species.
- Present [P] – Species or species sign were observed within the study area or historically have been documented within the study area.
- Critical Habitat [CH] – The study area is located within a USFWS-designated critical habitat.

RESULTS

Weather conditions during the November 2019 field work included cloudy skies, temperatures ranging from 68–71 °F, and winds ranging from 0 to 5 miles per hour (mph).

Vegetation Community Documented within the Study Area

The Creosote Bush scrub vegetation community was observed within the study area. This vegetation community is dominated by widely-spaced creosote (*Larrea tridentata*) and white bursage (*Ambriosa dumosa*), with bare ground between them. Soils in this community are well drained, alluvial, and sandy. Other common flora present include white ratany (*Krameria bicolor*), jointfir (*Ephedra* sp.*),* pencil cholla (*Cylindropuntia ramosissima*), and wire-lettuce (*Stephanomeria pauciflora*).

Plants

Plant species observed during the surveys includes the following species: Creosote bush*,* Brittlebush (*Encelia farinosa*), white bursage*,* white ratany, jointfir, pencil cholla, wire-lettuce, beavertail cactus

[3] For the purposes of this analysis, "special-status species" refers to any species that has been afforded special protection by federal, state, or local resource agencies (e.g., U.S. Fish and Wildlife Service, California Department of Fish and Wildlife) or resource conservation organizations (e.g., California Native Plant Society). The term "special-status species" excludes those avian species solely identified under Section 10 of the Migratory Bird Treaty Act (MBTA) for federal protection. Nonetheless, MBTA Section 10 protected species are afforded avoidance and minimization measures per state and federal requirements.

[4] A "habitat" is defined as the place or type of locale where a plant or animal naturally or normally lives and grows.

(Opuntia basilaris), rubber rabbitbrush *(Ericameria nauseosa)*, cheesebush *(Ambrosia salsola)*, sticky snakeweed *(Gutierrezia microcephala), cotton catclaw (Tetradymia axillaris)*, sandbar willow *(Salix exigua),* honey mesquite *(Prosopis glandulosa),* and tamarisk *(Tamarix spp.).*

Wildlife

Wildlife species observed within the study area consisted of commonly-occurring species - including, but not limited to, Eurpean starling (*Sturnus vulgaris*), Common Raven (*Corvus corax*), Red-tailed hawk (*Buteo jamaicensis*), and side-blotched lizard (*Uta stansburiana*).

Special-Status Plants

No Federal or State listed plant species were observed within the study area during the 2019 field survey and habitat assessment. The study area includes no USFWS-designated critical habitat for plants. Nonetheless, several special status plants have been documented within 10 miles of the Project. That said, the study area includes the substantive habitat requirements necessary to support several special-status plants. Special-status species known to occur within 10 miles of the Project, and their potential for occurrence within the study area are detailed within Appendix A.

Special-Status Wildlife

No Federal or State listed wildlife species were observed within the study area during the 2019 field survey and habitat assessment. The study area includes no USFWS-designated critical habitat for wildlife. Nonetheless, several special status wildlife species have been documented within 10 miles of the Project. To that end, the study area includes the substantive habitat requirements necessary to support special-status wildlife species. Special-status species known to occur within 10 miles of the Project, and their potential for occurrence within the study area are detailed within Appendix A.

Wetland and Waterways

The study area includes mapped NWI records of riverine resources.

APPENDIX A

SPECIAL-STATUS SPECIES POTENTIAL FOR OCCURRENCE WITHIN THE STUDY AREA

Potential For Occurrence[5]	Common Name (Scientific Name)	Federal Listing Status	State Listing Status	CNPS List [6]	Other Status [7]	Distance From The Study Area (Miles)	Year(S) Sighted
HP	Townsend's big-eared bat (*Corynorhinus townsendii*)	None	None	-	SSC, BLM-S, USFS-S	Potentially Onsite	1992-1994
HP	Desert bighorn sheep (*Ovis canadensis nelsoni*)	None	None	-	FP, BLM-S, USFS-S	0.4	1986
HP	Limestone monkeyflower (*Erythranthe calcicola*)	None	None	1B.3	BLM-S	0.9	1978-2010
HP	Gray vireo (*Vireo vicinior*)	None	None	-	SSC, BLM-S, USFS-S, USFWS-BCC	1.0	1891
HP	Panamint Mountains bedstraw (*Galium hilendiae* ssp. *carneum*)	None	None	1B.3	-	1.9	1937-2011
HP	Death Valley round-leaved phacelia (*Phacelia mustelina*)	None	None	1B.3	BLM-S	2.5	1935-2011
HP	Greene's rabbitbrush (*Chrysothamnus greenei*)	None	None	2B.3	-	2.6	1938-1985
HP	Beaver Dam breadroot (*Pediomelum castoreum*)	None	None	1B.2	BLM-S	2.7	2016
HP	White bear poppy (*Arctomecon merriamii*)	None	None	2B.2	-	2.9	1931-2008
HP	Geyer's milk-vetch (*Astragalus geyeri* var. *geyeri*)	None	None	2B.2	-	2.9	1937

[5] Absent [A] – Species distribution is restricted by substantive habitat requirements, which do not occur within the study area, and no further survey or study is obligatory to determine likely presence or absence of this species; Low [L] – Species distribution is restricted by substantive habitat requirements, which are negligible within the study area, and no further survey or study is obligatory to determine likely presence or absence of this species; Habitat Present [HP] – Species distribution is restricted by substantive habitat requirements, which occur within the study area, and further survey or study may be necessary to determine likely presence or absence of species.; Present [P] – Species or species sign were observed within the study area, or historically has been documented within the study area; and Critical Habitat [CH] – The study area is located within a USFWS-designated critical habitat unit.

[6] List 1A: Plants presumed extinct in California; List 1B.1: Plants rare, threatened, or endangered in California and elsewhere; seriously threatened in California; List 1B.2: Plants rare, threatened, or endangered in California and elsewhere, fairly threatened in California; List 1B.3: Plants rare, threatened, or endangered in California and elsewhere, not very threatened in California; List 2.1: Plants rare, threatened, or endangered in California, but more common elsewhere; seriously threatened in California; and List 2.2: Plants rare, threatened, or endangered in California, but more common elsewhere; fairly threatened in California

[7] SSC = California Species of Special Concern; FP = Fully Protected in California; BLM-S = U.S. Bureau of Land Management Sensitive; CDF-S = California Department of Forestry and Fire Protection Sensitive; NMFS-SC = National Marine Fisheries Service Species of Concern; USFS-S = USDA Forest Service Sensitive; and USFWS-BCC = U.S. Fish and Wildlife Service: Birds of Conservation Concern

Potential For Occurrence[5]	Common Name (Scientific Name)	Federal Listing Status	State Listing Status	CNPS List[6]	Other Status[7]	Distance From The Study Area (Miles)	Year(S) Sighted
HP	Gilman's milk-vetch (*Astragalus gilmanii*)	None	None	1B.2	-	2.9	1935-2011
HP	Panamint dudleya (*Dudleya saxosa* ssp. *saxosa*)	None	None	1B.3	BLM-S	2.9	1906-1983
HP	Rusby's desert-mallow (*Sphaeralcea rusbyi* var. *eremicola*)	None	None	1B.2	BLM-S	3.4	Unknown-1938
A	King's eyelash grass (*Blepharidachne kingii*)	None	None	2B.3	-	3.6	1932-1983
HP	Jointed buckwheat (*Eriogonum intrafractum*)	None	None	1B.3	-	3.6	Unknown-1934
HP	Limestone beardtongue (*Penstemon calcareus*)	None	None	1B.3	-	3.6	1954-1983
A	Mormon needle grass (*Stipa arida*)	None	None	2B.3	-	3.6	1983-2011
HP	Holly-leaved tetracoccus (*Tetracoccus ilicifolius*)	None	None	1B.3	-	3.6	1938-2008
HP	Ripley's aliciella (*Aliciella ripleyi*)	None	None	2B.3	-	4.0	1940-1983
HP	Hoffmann's buckwheat (*Eriogonum hoffmannii* var. *hoffmannii*)	None	None	1B.3	BLM-S	4.5	1968-2011
HP	Pallid bat (*Antrozous pallidus*)	None	None	-	SSC, BLM-S, USFS-S	4.8	1970
HP	Panamint Mountains lupine (*Lupinus magnificus* var. *magnificus*)	None	None	1B.2	BLM-S	4.9	1940-2011
HP	American badger (*Taxidea taxus*)	None	None	-	SSC	6.3	1917
HP	Panamint daisy (*Enceliopsis covillei*)	None	None	1B.2	BLM-S	6.7	2005-2011
A	Panamint Mountains buckwheat (*Eriogonum microthecum* var. *panamintense*)	None	None	1B.3	BLM-S	6.7	1935-2011
A	Gilman's goldenbush (*Ericameria gilmanii*)	None	None	1B.3	BLM-S, USFS-S	6.9	1939-1956
A	Panamint rock-goldenrod (*Cuniculotinus gramineus*)	None	None	2B.3	-	7.0	1935
HP	Pinyon Mesa buckwheat (*Eriogonum mensicola*)	None	None	1B.3	BLM-S	7.4	1968-2011
A	Hanaupah rock daisy (*Perityle villosa*)	None	None	1B.3	BLM-S	7.4	1935-1940
HP	Inyo hulsea (*Hulsea vestita* ssp. *inyoensis*)	None	None	2B.2	-	7.5	1931-1935
HP	Amargosa beardtongue (*Penstemon fruticiformis* var. *amargosae*)	None	None	1B.3	BLM-S	7.5	1988
HP	Prairie falcon (*Falco mexicanus*)	None	None	-	USFWS-BCC	7.8	1977

Potential For Occurrence[5]	Common Name (Scientific Name)	Federal Listing Status	State Listing Status	CNPS List[6]	Other Status[7]	Distance From The Study Area (Miles)	Year(S) Sighted
HP	Polished blazing star (*Mentzelia polita*)	None	None	1B.2	BLM-S	8.4	2012
A	Wildrose Canyon buckwheat (*Eriogonum eremicola*)	None	None	1B.3	BLM-S	8.6	1968-2011
A	Knotted rush (*Juncus nodosus*)	None	None	2B.3	-	8.7	1931
HP	Reveal's buckwheat (*Eriogonum contiguum*)	None	None	2B.3	BLM-S	9.3	2010
HP	Limestone daisy (*Erigeron uncialis* var. *uncialis*)	None	None	1B.2	USFS-S	9.5	2001
HP	Pinyon rockcress (*Boechera dispar*)	None	None	2B.3	-	9.6	1897-1932

ATTACHMENT 2

ECOLOGICAL RISK ASSESSMENT SCREENING OUTPUT AND BERA HQ CALCULATIONS

Appendix C, Attachment 2 - Ecological Risk Assessment Screening Output and BERA HQ Calculations
Gold Hill Mill Site

DU-1 Mill Foundation
DU-2 Eroded Tailings in Wash Along Road

List of Tables

Table 1. Ecological Screening - Terrestrial Plants Using Maximum Concentration

Analyte	Units	SLERA COPEC Selection ESV (Plants and Invertebrates)	Refined SLERA ESVs (Terrestrial Plants)	Gold Hill DU-1 Mill Foundation	Gold Hill DU-2 Eroded Tailings in Wash along Road	Refined Hazard Quotient (HQ) based on Maximum Concentration		Retain for further assessment - Plants?
				Max	Max	DU-1	DU-2	
Antimony	mg/kg	5.0	5.0	**1,070**	**1,490**	**214**	**298**	**Yes**
Arsenic	mg/kg	6.8	18	**612**	**854**	**34**	**47**	**Yes**
Barium	mg/kg	110	500	**129**	**175**	0.3	0.4	No
Beryllium	mg/kg	2.5	10	0.38	0.52	0.04	0.05	No
Cadmium	mg/kg	4.0	32	1.58	**22.80**	0.05	0.7	No
Chromium	mg/kg	0.34	1.0	**10.00**	**9.94**	**10**	**10**	**Yes**
Cobalt	mg/kg	13	13	3.73	5.70	0.3	0.4	No
Copper	mg/kg	50	70	**1,260**	**1,920**	**18**	**27**	**Yes**
Lead	mg/kg	50	120	**13,900**	**12,000**	**116**	**100**	**Yes**
Mercury	mg/kg	0.05	0.3	**25**	**8**	**84**	**28**	**Yes**
Molybdenum	mg/kg	2.0	2.0	**0.51**	**0.94**	0.3	0.5	No
Nickel	mg/kg	30	38	7.37	9.17	0.2	0.2	No
Selenium	mg/kg	0.52	0.52	**4.07**	**5.51**	**8**	**11**	**Yes**
Silver	mg/kg	2.0	560	**86.50**	**63.60**	0.2	0.1	No
Thallium	mg/kg	0.05	1.0	**2.07**	**1.62**	**2**	**2**	**Yes**
Vanadium	mg/kg	2.0	2.0	**178**	**151**	**89**	**76**	**Yes**
Zinc	mg/kg	6.6	160	**306**	**13,300**	**2**	**83**	**Yes**
Cyanide, Total	mg/kg	No ESV	No ESV	**0.47**	NS	--	--	**No ESV**

ISM - Incremental Sampling Method
mg/kg - milligrams per kilogram
HQ - Hazard Quotient
ESV - ecological screening value
ESVs are from NPS Protocol for the Selection and Use of Ecological Screening Values for Non-radiological Analytes (November 2018)
Maximum detections are the from the individual ISM samples.
NS - not sampled.
Maximum detections greater than screening level are bolded. Refined HQs > 1 are bolded.
Analytes that are bolded have an HQ > 1 in at least one DU. HQ is based on refined ESV.

Table 2. Ecological Screening - Terrestrial Plants Using EPC

Analyte	Units	Geometeric Mean LANL NOEC and LOEC (mg/kg)	Gold Hill DU-1 Mill Foundation EPC	Gold Hill DU-2 Eroded Tailings in Wash along EPC	Refined Hazard Quotient (HQ) based on EPC DU-1	Refined Hazard Quotient (HQ) based on EPC DU-2	BERA COPEC - Plants?
Antimony	mg/kg	25.3	1,017	1,054	**40**	**42**	**Yes**
Arsenic	mg/kg	40.47	557	621	**14**	**15**	**Yes**
Barium	mg/kg	169	112	120	0.7	0.7	No
Beryllium	mg/kg	7.91	0.35	0.49	0.04	0.06	No
Cadmium	mg/kg	71.55	1.49	22.80	0.02	0.3	No
Chromium	mg/kg	1.2	8.83	8.19	**7**	**7**	**Yes**
Cobalt	mg/kg	41.11	3.58	4.89	0.1	0.1	No
Copper	mg/kg	185	1,133	1,358	**6**	**7**	**Yes**
Lead	mg/kg	261.53	12,575	8,940	**48**	**34**	**Yes**
Mercury	mg/kg	46.65	21	8	0.5	0.2	No
Molybdenum	mg/kg	2.0	0.47	0.78	0.2	0.4	No
Nickel	mg/kg	101	6.78	7.71	0.1	0.1	No
Selenium	mg/kg	1.25	3.58	4.67	**3**	**4**	**Yes**
Silver	mg/kg	1252.2	80.78	51.24	0.1	0.0	No
Thallium	mg/kg	1.00	1.48	1.29	1	1	No
Vanadium	mg/kg	69.3	169	126	**2**	**2**	**Yes**
Zinc	mg/kg	1,360	252	13,300	0.2	**10**	**Yes**
Cyanide, Total	mg/kg	No Value	0.37	NS	--	--	**No Value**

ISM - Incremental Sampling Method
mg/kg - milligrams per kilogram
HQ - Hazard Quotient
EPC - exposure point concentration
Geometric mean of No Observed Effect Concentration (NOEC) and Lowest Observed Effect Concentration (LOEC) values from LANL, 2018.
EPC is mean concentration if data are based on ISM data.
EPC is lower of maximum detections or 95% UCL if the data are based on discrete sample data.
NS - not sampled.
Analytes that are bolded have an HQ > 1 in at least one DU. HQ is based on geometric mean of LANL NOEC and LOEC.

Table 3. Ecological Screening - Soil Invertebrates Using Maximum Concentration

Analyte	Units	SLERA COPEC Selection ESV (Plants and Invertebrates)	Refined SLERA ESVs (Soil Invertebrate)	Gold Hill DU-1 Mill Foundation	Gold Hill DU-2 Eroded Tailings in Wash along Road	Refined Hazard Quotient (HQ) based on Maximum Concentration		Retain for further assessment - Invertebrates?
				Max	**Max**	**DU-1**	**DU-2**	
Antimony	mg/kg	5.0	78	**1,070**	**1,490**	**14**	**19**	**Yes**
Arsenic	mg/kg	6.8	60	**612**	**854**	**10**	**14**	**Yes**
Barium	mg/kg	110	330	**129**	**175**	0.4	0.5	No
Beryllium	mg/kg	2.5	40	0.38	0.52	0.01	0.01	No
Cadmium	mg/kg	4.0	140	1.58	**22.80**	0.01	0.2	No
Chromium	mg/kg	0.34	0.4	**10.00**	**9.94**	**25**	**25**	**Yes**
Cobalt	mg/kg	13	No ESV	3.73	5.70	0.3	0.4	No
Copper	mg/kg	50	80	**1260**	**1920**	**16**	**24**	**Yes**
Lead	mg/kg	50	1,700	**13,900**	**12,000**	**8**	**7**	**Yes**
Mercury	mg/kg	0.05	0.1	**25**	**8**	**252**	**85**	**Yes**
Molybdenum	mg/kg	2.0	No ESV	0.51	0.94	0.3	0.5	No
Nickel	mg/kg	30	280	7.37	9.17	0.03	0.03	No
Selenium	mg/kg	0.52	4.1	**4.07**	**5.51**	1	1	No
Silver	mg/kg	2.0	No ESV	**86.50**	**63.60**	--	--	**No ESV**
Thallium	mg/kg	0.05	No ESV	**2.07**	**1.62**	--	--	**No ESV**
Vanadium	mg/kg	2.0	No ESV	**178**	**151**	--	--	**No ESV**
Zinc	mg/kg	6.6	120	**306**	**13,300**	**3**	**111**	**Yes**
Cyanide, Total	mg/kg	No ESV	No ESV	**0.468**	NS	--	--	**No ESV**

ISM - Incremental Sampling Method
mg/kg - milligrams per kilogram
HQ - Hazard Quotient

ESVs are from NPS Protocol for the Selection and Use of Ecological Screening Values for Non-radiological Analytes (November 2018)

Maximum detections are the from the individual ISM samples.
NS - not sampled.
Maximum detections greater than screening level are bolded. Refined HQs > 1 are bolded.
Analytes that are bolded have an HQ > 1 in at least one DU. HQ is based on refined ESV.

Table 4. Ecological Screening - Soil Invertebrates Using EPC

Analyte	Units	Geometeric Mean LANL NOEC and LOEC (mg/kg)	Gold Hill DU-1 Mill Foundation	Gold Hill DU-2 Eroded Tailings in Wash along	Refined Hazard Quotient (HQ) based on EPC		BERA COPEC - Invertebrates?
			EPC	EPC	DU-1	DU-2	
Antimony	mg/kg	246.66	1,017	1,054	**4**	**4**	**Yes**
Arsenic	mg/kg	21.5	557	621	**26**	**29**	**Yes**
Barium	mg/kg	1,028	112	120	0.1	0.1	No
Beryllium	mg/kg	126.49	0.35	0.49	0.003	0.004	No
Cadmium	mg/kg	326.19	1.49	22.80	0.005	0.1	No
Chromium	mg/kg	1.1	8.83	8.19	**8**	**8**	**Yes**
Cobalt	mg/kg	No Value	3.58	4.89	--	--	No Value
Copper	mg/kg	206	1,133	1,358	**6**	**7**	**Yes**
Lead	mg/kg	3,779	12,575	8,940	**3**	**2**	**Yes**
Mercury	mg/kg	0.16	21	8	**133**	**47**	**Yes**
Molybdenum	mg/kg	No Value	0.47	0.78	--	--	No, ESV HQ < 1
Nickel	mg/kg	603	6.78	7.71	0.01	0.01	No
Selenium	mg/kg	12.97	3.58	4.67	0.3	0.4	No
Silver	mg/kg	No Value	80.78	51.24	--	--	No Value
Thallium	mg/kg	No Value	1.48	1.29	--	--	No Value
Vanadium	mg/kg	No Value	169	126	--	--	No Value
Zinc	mg/kg	334	252	13,300	0.8	**40**	**Yes**
Cyanide, Total	mg/kg	No Value	0.374	NS	--	--	No Value

Note: cobalt concentrations below SLERA screening values (See Table 3)
ISM - Incremental Sampling Method
mg/kg - milligrams per kilogram
HQ - Hazard Quotient
ESV - ecological screening value
EPC - exposure point concentration
Geometric mean of No Observed Effect Concentration (NOEC) and Lowest Observed Effect Concentration (LOEC) values from LANL, 2018.
EPC is mean concentration if data are based on ISM data.
EPC is lower of maximum detections or 95% UCL if the data are based on discrete sample data.
NS - not sampled.
Analytes that are bolded have an HQ > 1 in at least one DU. HQ is based on geometric mean of LANL NOEC and LOEC.

Table 5. Ecological Screening - Mammals Using Maximum Concentration

Analyte	Units	SLERA COPEC Selection ESV (Birds and Mammals)	Refined SLERA ESVs (Mammals)	Gold Hill DU-1 Mill Foundation	Gold Hill DU-2 Eroded Tailings in Wash along	Refined Hazard Quotient (HQ) based on Maximum Concentration		Retain for further assessment - Mammals?
				Max	Max	DU-1	DU-2	
Antimony	mg/kg	0.248	0.27	**1,070**	**1,490**	**3963**	**5519**	**Yes**
Arsenic	mg/kg	0.25	46	**612**	**854**	**13**	**19**	**Yes**
Barium	mg/kg	17.2	2,000	**129**	**175**	0.06	0.09	No
Beryllium	mg/kg	2.42	21	0.38	0.52	0.02	0.02	No
Cadmium	mg/kg	0.27	0.36	**1.58**	**22.80**	**4**	**63**	**Yes**
Chromium	mg/kg	23	63	10.00	9.94	0.2	0.16	No
Cobalt	mg/kg	76	230	3.73	5.70	0.02	0.02	No
Copper	mg/kg	14	49	**1,260**	**1,920**	**26**	**39**	**Yes**
Lead	mg/kg	0.94	56	**13,900**	**12,000**	**248**	**214**	**Yes**
Mercury	mg/kg	0.00035	1.7	**25**	**8**	**15**	**5**	**Yes**
Molybdenum	mg/kg	0.52	0.52	0.51	**0.94**	1	**2**	**Yes**
Nickel	mg/kg	10	130	7.37	9.17	0.06	0.07	No
Selenium	mg/kg	0.331	0.63	**4.07**	**5.51**	**6**	**8.7**	**Yes**
Silver	mg/kg	2.6	14	**86.50**	**63.60**	**6.2**	**4.5**	**Yes**
Thallium	mg/kg	0.027	0.42	**2.07**	**1.62**	**5**	**4**	**Yes**
Vanadium	mg/kg	0.714	280	**178**	**151**	0.6	0.5	No
Zinc	mg/kg	12	79	**306**	**13,300**	**4**	**168**	**Yes**
Cyanide, Total	mg/kg	0.098	330	**0.468**	NS	0.001	--	No

ISM - Incremental Sampling Method
mg/kg - milligrams per kilogram
HQ - Hazard Quotient

ESVs are from NPS Protocol for the Selection and Use of Ecological Screening Values for Non-radiological Analytes (November 2018)

Maximum detections are the from the individual ISM samples.
NS - not sampled.
Maximum detections greater than screening level are bolded. Refined HQs > 1 are bolded.
Analytes that are bolded have an HQ > 1 in at least one DU. HQ is based on refined ESV.

Table 6. Ecological Screening - Mammals Using EPC

Analyte	Units	Refined SLERA ESVs (Mammals)	Gold Hill DU-1 Mill Foundation EPC	Gold Hill DU-2 Eroded Tailings in Wash along EPC	Refined Hazard Quotient (HQ) based on EPC DU-1	Refined Hazard Quotient (HQ) based on EPC DU-2	BERA COPEC - Mammals?
Antimony	mg/kg	0.27	1,017	1,054	**3767**	**3904**	**Yes**
Arsenic	mg/kg	46	557	621	**12**	**14**	**Yes**
Barium	mg/kg	2,000	112	120	0.06	0.06	No
Beryllium	mg/kg	21	0.35	0.49	0.02	0.02	No
Cadmium	mg/kg	0.36	1.49	22.80	**4**	**63**	**Yes**
Chromium	mg/kg	63	8.83	8.19	0.14	0.13	No
Cobalt	mg/kg	230	3.58	4.89	0.02	0.02	No
Copper	mg/kg	49	1,133	1,358	**23**	**28**	**Yes**
Lead	mg/kg	56	12,575	8,940	**225**	**160**	**Yes**
Mercury	mg/kg	1.7	21	8	**13**	**4**	**Yes**
Molybdenum	mg/kg	0.52	0.47	0.78	1	1	No
Nickel	mg/kg	130	6.78	7.71	0.052	0.06	No
Selenium	mg/kg	0.63	3.58	4.67	**6**	**7**	**Yes**
Silver	mg/kg	14	80.78	51.24	**6**	**4**	**Yes**
Thallium	mg/kg	0.42	1.48	1.29	**4**	**3**	**Yes**
Vanadium	mg/kg	280	168.80	125.80	0.6	0.4	No
Zinc	mg/kg	79	252	13,300	**3**	**168**	**Yes**
Cyanide, Total	mg/kg	330	0.374	NS	0.001	--	No

ISM - Incremental Sampling Method
mg/kg - milligrams per kilogram
HQ - Hazard Quotient
ESV - ecological screening value
EPC - exposure point concentration

ESVs are from NPS Protocol for the Selection and Use of Ecological Screening Values for Non-radiological Analytes (November 2018)

EPC is mean concentration if data are based on ISM data.
EPC is lower of maximum detections or 95% UCL if the data are based on discrete sample data.
NS - not sampled.
Analytes that are bolded have an HQ > 1 in at least one DU. HQ is based on refined ESV.

Table 7. Ecological Screening - Birds using Maximum Concentration

Analyte	Units	SLERA COPEC Selection ESV (Birds and Mammals)	Refined SLERA ESVs (Birds)	Gold Hill DU-1 Mill Foundation	Gold Hill DU-2 Eroded Tailings in Wash along Road	Refined Hazard Quotient (HQ) based on Maximum Concentration		Retain for further assessment - Birds?
				Max	Max	DU-1	DU-2	
Antimony	mg/kg	0.248	No ESV	**1,070**	**1,490**	**4315**	**6008**	**Yes**
Arsenic	mg/kg	0.25	43	**612**	**854**	**14**	**20**	**Yes**
Barium	mg/kg	17.2	720	**129**	**175**	0.2	0.2	No
Beryllium	mg/kg	2.42	No ESV	0.38	0.52	0.2	0.2	No
Cadmium	mg/kg	0.27	0.77	**1.58**	**22.80**	**2**	**30**	Yes
Chromium	mg/kg	23	23	10.00	9.94	0.4	0.4	No
Cobalt	mg/kg	76	120	3.73	5.70	0.03	0.05	No
Copper	mg/kg	14	28	**1,260**	**1,920**	**45**	**69**	**Yes**
Lead	mg/kg	0.94	11	**13,900**	**12,000**	**1264**	**1091**	**Yes**
Mercury	mg/kg	0.00035	0.013	**25**	**8**	**1938**	**651**	**Yes**
Molybdenum	mg/kg	0.52	15	0.51	**0.94**	0.03	0.1	No
Nickel	mg/kg	10	210	7.37	9.17	0.04	0.04	No
Selenium	mg/kg	0.331	1.2	**4.07**	**5.51**	**3.4**	**4.6**	**Yes**
Silver	mg/kg	2.6	4.2	**86.50**	**63.60**	**21**	**15**	**Yes**
Thallium	mg/kg	0.027	4.5	**2.07**	**1.62**	0.5	0.4	No
Vanadium	mg/kg	0.714	7.8	**178**	**151**	**23**	**19**	**Yes**
Zinc	mg/kg	12	46	**306**	**13,300**	**7**	**289**	**Yes**
Cyanide, Total	mg/kg	0.098	0.098	**0.468**	NS	**5**	**--**	**Yes**

ISM - Incremental Sampling Method
mg/kg - milligrams per kilogram
HQ - Hazard Quotient

ESVs are from NPS Protocol for the Selection and Use of Ecological Screening Values for Non-radiological Analytes (November 2018)

Maximum detections are the from the individual ISM samples.
NS - not sampled.
Maximum detections greater than screening level are bolded. Refined HQs > 1 are bolded.
Analytes that are bolded have an HQ > 1 in at least one DU. HQ is based on refined ESV.

Table 8. Ecological Screening - Birds using EPC

Analyte	Units	Refined SLERA ESVs (Birds)	Gold Hill DU-1 Mill Foundation	Gold Hill DU-2 Eroded Tailings in Wash along Road	Refined Hazard Quotient (HQ) based on EPC		BERA COPEC - Birds?
			EPC	EPC	DU-1	DU-2	
Antimony	mg/kg	No ESV	1,017	1,054	--	--	**Yes**
Arsenic	mg/kg	43	557	621	**13**	**14**	**Yes**
Barium	mg/kg	720	112	120	0.2	0.17	No
Beryllium	mg/kg	No ESV	0.35	0.49	--	--	No
Cadmium	mg/kg	0.77	1.49	22.80	**2**	**30**	**Yes**
Chromium	mg/kg	23	8.83	8.19	0.4	0.4	No
Cobalt	mg/kg	120	3.58	4.89	0.03	0.04	No
Copper	mg/kg	28	1,133	1,358	**40**	**49**	**Yes**
Lead	mg/kg	11	12,575	8,940	**1143**	**813**	**Yes**
Mercury	mg/kg	0.013	21.33	7.53	**1641**	**579**	**Yes**
Molybdenum	mg/kg	15	0.47	0.78	0.03	0.1	No
Nickel	mg/kg	210	6.78	7.71	0.03	0.04	No
Selenium	mg/kg	1.2	3.58	4.67	**3**	**4**	**Yes**
Silver	mg/kg	4.2	80.78	51.24	**19**	**12**	**Yes**
Thallium	mg/kg	4.5	1.48	1.29	0.3	0.3	No
Vanadium	mg/kg	7.8	169	126	**22**	**16**	**Yes**
Zinc	mg/kg	46	252	13,300	**5**	**289**	**Yes**
Cyanide, Total	mg/kg	0.098	0.374	NS	**4**	--	**Yes**

Note: beryllium concentrations below SLERA screening values (See Table 7)
ISM - Incremental Sampling Method
mg/kg - milligrams per kilogram
HQ - Hazard Quotient
ESV - ecological screening value
EPC - exposure point concentration

ESVs are from NPS Protocol for the Selection and Use of Ecological Screening Values for Non-radiological Analytes (November 2018)

EPC is mean concentration if data are based on ISM data.
EPC is lower of maximum detections or 95% UCL if the data are based on discrete sample data.
NS - not sampled.
Analytes that are bolded have an HQ > 1 in at least one DU. HQ is based on refined ESV.

Table 9. Ecological Screening - Surface Water

Analyte	NPS ESV µg/L	NPS Refined ESV µg/L	280-80478-8 DEVA-GOLD-SW1 2/29/2016	280-80478-9 DEVA-GOLD-SW2 2/29/2016
Antimony	30	30	0.702 J	1.06 J
Arsenic	3.1	150	5.65	6.92
Barium	3.9	4	**45.4**	**45.5**
Beryllium	0.66	0.66	0.300 U	0.300 U
Cadmium	0.07	0.07	***1.00 U***	***1.00 U***
Chromium	8.9	8.9	1.69 J	3.30 J
Cobalt	3	23	0.200 U	0.105 J
Copper	0.23	0.23	***1.80 U***	**1.46 J**
Lead	0.92	0.92	0.700 U	0.195 J
Mercury	0.026	0.77	***0.0800 U***	***0.0800 U***
Molybdenum	73	370	9.62	11.4
Nickel	5	5	1.00 U	0.374 J
Selenium	1	5	2.75 J	2.68 J
Silver	0.067	0.067	***0.100 U***	***0.100 U***
Thallium	0.03	12	***0.200 U***	***0.200 U***
Vanadium	19	20	3.82 J	10.2
Zinc	30	30	2.20 J	8.00 U

ESV – Environmental Screening Level (NPS 2018); SLERA COPEC Selection ESV

ESVs are chronic values

SLERA – Screening Level Ecological Risk Assessment

J - Laboratory estimated value

µg/L - micrograms per liter

Bold and shaded indicates that detected concentration > Refined ESV.

Bold and Italics indicates that detection limit > ESV.

Table 10. Wildlife Toxicity Reference Values

COPEC	Avian NOAEL TRV (mg/kg-day)	Avian LOAEL TRV (mg/kg-day)	Avian Notes	Mammal NOAEL TRV (mg/kg-day)	Mammal LOAEL TRV (mg/kg-day)	Mammal Notes	Reptile NOAEL TRV (mg/kg-day)	Reptile LOAEL TRV (mg/kg-day)	Reptile Notes
Antimony	0.04	0.4	American Kestrel (LANL, 2017)	5.6	42	Rat, Growth (EPA 2005, Antimony SSL)	No Value	No Value	--
Arsenic	1.73	17.3	Mallard, growth (Hoffman et al., 1992)	0.75	3	Rabbit, Reproduction (Nemec et al. 1998)	No Value	No Value	--
Cadmium	0.799	2.4	Chicken, Reproduction (Bokori et al. 1996, EPA, 2005)	1	10	Rat, Growth (Sutuo et al., 1980, EPA, 2005)	No Value	No Value	--
Copper	23.2	29.9	Chicken, Reproduction (Jackson et al, 1979, EPA, 2007)	33.8	101	Mouse, Mortality (Hebert et al., 1993, EPA, 2007)	No Value	No Value	--
Lead	4.40	44.00	Chicken, Reproduction (Sample et al., 2019)	4.70	47	EPA 2005, Pb SSL	1	10	western fence lizard (Salice et al, 2009)
Mercury	0.45	0.90	J. Quail, Reproduction (Sample, 1996)	1.01	10	Mink, Reproduction (Sample, 1996)	No Value	No Value	--
Molybdenum	134	1340	Quail, Growth (Stafford et al, 2016)	17.00	60.00	Rat, Growth (Murray et al, 2014)	No Value	No Value	--
Selenium	0.588	1.18	Mallard, Reproduction (Heinz et al, 1987, EPA 2007)	0.39	0.78	Mouse, Reproduction (Kezhou et al., 1987, EPA, 2007)	No Value	No Value	--
Silver	7.08	70.80	Turkey, Growth (EPA, 2006 Silver SSL)	12.5	125	Pig, Mortality (EPA, 2006 Silver SSL)	No Value	No Value	--
Vanadium	0.988	1.98	Chicken, Growth (Ousterhout and Berg, 1981)	3.43	6.85	Rat, Growth (Sanchez et al., 1998)	No Value	No Value	--
Thallium	No Value	No Value	--	No Value	0.074	Rat, Mortality (Formigli et al, 1986, Sample 1996)	No Value	No Value	--
Zinc	14.50	131	Chicken, Reproduction (Sample, 1996)	160	320	Rat, Reproduction (Sample, 1996)	No Value	No Value	
Cyanide	0.0903	0.903	Starling, Mortality (Wiemeyer et al. 1986)	14	140	Rat, Growth (Howard and Hanzal, 1955)	No Value	No Value	--

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Table 11. Uptake Factors

CAS No.	Analyte	Terrestrial Plant UF	Mammal UF	Arthropod UF
7440-36-0	Antimony	0.0249	0.0438	0.00927
7440-38-2	Arsenic	1.103	0.0149	0.1210
7440-43-9	Cadmium	3.25	3.9905	1.51
7440-50-8	Copper	0.625	1.0450	1.80
7439-92-1	Lead	0.468	0.2864	0.152
7439-97-6	Mercury	5.0	0.1920	1.88
7439-98-7	Molybdenum	0.901	0.0438	0.118
7782-49-2	Selenium	3.012	1.1867	3.92
7440-22-4	Silver	0.0367	0.0040	0.102
7440-28-0	Thallium	0.129	0.1120	0.0920
7440-62-2	Vanadium	0.0097	0.1230	0.0264
7440-66-6	Zinc	1.82	2.688	1.9
57-12-5	Cyanide	0.0249	0.0438	0.118

Antimony

Soil-to-plant	Geometric mean of 17 BAFs calculated using plant uptake data from EPA (2007)
Soil-to-mammal	Geometric mean of the general soil-to-mammal BAFs for inorganics in Database (TCEQ, 2020)
Soil-to-arthropod	90th percentile of 24 BAFs from USACHPPM (2004) based on grasshoppers, caterpillars and beetles.

Arsenic

Soil-to-plant	90th percentile value from Bechtel-Jacobs (1998) (Table 6) includes 122 observations from 11 studies.
Soil-to-mammal	90th percentile from Sample (1998) (Table 7) for general trophic group.
Soil-to-arthropod	90th percentile of 45 BAFs from USACHPPM (2004) based on grasshoppers, beetles, and caterpillars.

Cadmium

Soil-to-plant	90th percentile from Bechtel-Jacobs (1998) (Table 6) includes 207 observations from 19 studies.
Soil-to-mammal	90th percentile from Sample (1998) (Table 7) for general trophic group.
Soil-to-arthropod	90th percentile of 289 BAFs from USACHPPM (2004) based on moths, butterflys, hornets, grasshoppers and beetles.

Copper

Soil-to-plant	90th percentile from Bechtel-Jacobs (1998) (Table 6) includes 180 observations from 19 studies.
Soil-to-mammal	90th percentile from Sample (1998) (Table 7) for general trophic group.
Soil-to-arthropod	90th percentile of 70 BAFs from USACHPPM (2004) based on caterpillars, moths, butterflys, flys, hornets, grasshoppers and beetles.

Lead

Soil-to-plant	90th percentile from Bechtel-Jacobs (1998) (Table 6) includes 189 observations from 21 studies.
Soil-to-mammal	90th percentile from Sample (1998) (Table 7) for general trophic group.
Soil-to-arthropod	90th percentile of 67 BAFs from USACHPPM (2004) based on caterpillars, moths, butterflys, flys, hornets, grasshoppers and beetles.

Mercury

Soil-to-plant	90th percentile from Bechtel-Jacobs (1998) includes 145 observations from 14 studies.
Soil-to-mammal	90th percentile from Sample (1998) (Table 7) for general trophic group.
Soil-to-arthropod	90th percentile of 24 BAFs from USACHPPM (2004) for caterpillars, grasshoppers and bettles.

Molybdenum

	Soil-to-plant	Median of 10 BAFs calculated using concentrations in co-located soil and plants (snap bean and barley; 5 samples each) grown in mixtures of dredged river sediments and biosolid (Diez-Ortiz et al., 2010).
	Soil-to-mammal	Geometric mean of the general soil-to-mammal BAFs for inorganics in Database (TCEQ, 2020)
	Soil-to-arthropod	Estimated based on other BAFs for inorganics (TCEQ, 2020).

Selenium

	Soil-to-plant	90th pecentile from Bechtel-Jacobs (1998) (Table 6) includes 158 observations from 16 studies.
	Soil-to-mammal	90th percentile from Sample (1998) (Table 7) for general trophic group.
	Soil-to-arthropod	90th percentile of 27 BAFs from USACHPPM (2004) for caterpillars, grasshoppers and moths.

Silver

	Soil-to-plant	90th percentile from Bechtel-Jacobs (1998) (Table D-1) includes 10 observations
	Soil-to-mammal	90th percentile of the general soil-to-mammal BAFs from Sample et al. (1998).
	Soil-to-arthropod	90th percentile of 24 BAFs from USACHPPM (2004) for beetles, caterpillars, and grasshoppers.

Thallium

	Soil-to-plant	Geometric mean of the general soil-to-plants BAFs for inorganics in Database (TCEQ, 2020)
	Soil-to-mammal	Geometric mean of the general soil-to-mammal BAFs for inorganics in Database (TCEQ, 2020)
	Soil-to-arthropod	90th percentile of 12 BAFs from USACHPPM (2004) based on caterpillars and beetles.

Vanadium

	Soil-to-plant	90th percentile from Bechtel-Jacobs (1998) (Table D-1) includes 21 observations
	Soil-to-mammal	Value is the median of two soil-to-mammal BAFs from Sample et al. (1998)
	Soil-to-arthropod	90th percentile of 19 BAFs from USACHPPM (2004) based on caterpillars, grasshoppers and beetles.

Zinc

	Soil-to-plant	90th percentile from Bechtel-Jacobs (1998) (Table 6) includes 220 observations from 22 studies.
	Soil-to-mammal	90th percentile from Sample (1998) (Table 7) for general trophic group.
	Soil-to-arthropod	90th percentile of 61 BAFs from USACHPPM (2004) for grasshoppers, capapillars, moths, butterflys, flys, hornets, and beetles.

Cyanide

	Soil-to-plant	Geometric mean of 17 BAFs calculated using plant uptake data from EPA (2007)
	Soil-to-mammal	Geometric mean of the general soil-to-mammal BAFs for inorganics in Database (TCEQ, 2020)
	Soil-to-arthropod	Estimated based on other BAFs for inorganics (TCEQ, 2020).

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Table 12. Wildlife Exposure Assumptions

Ingestion-Pathway Exposure Assumptions for Wildlife Measurement Receptors										
Common Name	**Scientific Name**	**Dietary Composition**	**Body Weight (kg)**	**Food Ingestion Rate (kg/day)**	**Soil Ingestion (% of diet)**	**Soil Ingestion rate**	**Migration Modifying Factor (Unitless)**	**Exposure Area Size (Acres)**	**Home Range (acres)**	**Exposure Modifying Factor (unitless)**
Birds										
Black-Throated Sparrow	*Amphispiza bilineata*	50% Arthropods, 50% Plants	0.014	0.00442	9.3	0.00041	0.75	1	2.1	0.48
Common Raven	*Corvus corax*	50% Arthropods, 25% Small Mammals, 25% Plants	1.157	0.0902	4.4	0.00397	1	1	50	0.02
Red-Tailed Hawk	*Buteo jamaicensis*	100% Small Mammals	1.1	0.036	5.7	0.00205	1	1	576	0.0017
Mammals										
White-Tailed Antelope Squirrel	*Ammospermophilus leucurus*	80% Plants, 20% Arthropods	0.105	0.0097	2	0.00019	1	1	4	0.25
Southern Grasshopper Mouse	*Onychomys torridus*	85% Arthropods, 5% Plants, 10% Small Mammals	0.03	0.0047	2.2	0.00010	1	1	6.6	0.15
Desert Bighorn Sheep	*Ovis canadensis nelson*	100% Plants	90	2.60	2	0.05206	1	1	100	0.01
Townsend's Big-Eared Bat	*Corynorhinus townsendii*	100% Arthropods	0.012	0.0027	1	0.00003	1	1	230	0.004
Reptiles										
Side-Botched Lizard	*Uta stansburiana*	100% Arthropods	0.0034	0.0000297	4.5	0.000001	1	1	3.4	0.3

Black-Throated Sparrow

Body Weight - 14 grams (Dunning, 2008)
Home Range - 2.1 acres (Johnson et al., 2002), Assume present 9 months out of year
Migration - present 9 months of the year (assumed)
Food Ingestion Rate - Determined using (Nagy, 2001) for perching birds.
Soil Ingestion Rate - 9.3% (Based on wild turkey, Beyer et al., 1994)
Dietary Composition - insects during breeding season, seeds in nonbreeding season (Johnson et al., 2002

Common Raven

Body Weight - 689-1625 grams, average = 1157 grams (https://www.allaboutbirds.org/guide/Common_Raven/id
Home Range - 50 acres (assumed)
Food Ingestion Rate - Determined using (Nagy, 2001) for perching birds.
Soil Ingestion Rate - 4.4% (Engel and Young, 1989)
Dietary Composition - Kristan et al., 2004 based on pellet analysis.

Red-Tailed Hawk

Body Weight - Dunning, 2008
Home Range - Preston and Beane, 1993
Food Ingestion Rate - Average of three empirical values from Craighead & Craighead (1956) as reported by EPA (1993). Converted to dry weight assuming 68 % moisture.
Soil Ingestion Rate - EPA, 2005
Dietary Composition - EPA, 1993

Whitetailed Antelope Squirrel

Body Weight - 105 grams (https://animaldiversity.org/accounts/Ammospermophilus_leucurus/)
Home Range - 4 acre foraging range (Bradley and Deacon, 1965)
Food Ingestion Rate - Determined using (Nagy, 2001) for desert rodents.
Soil Ingestion Rate - Assumed 2%
Dietary Composition - Assumed 80% plants and 20% arthropods

Southern Grasshopper Mouse

Body Weight - McCarty, 1975
Home Range - McCarty, 1975
Food Ingestion Rate - Determined using (Nagy, 2001) for desert rodents.
Soil Ingestion Rate - Average of white-footed mouse and meadow vole (Beyer et al., 1994)
Dietary Composition - McCarty, 1975

Desert Bighorn Sheep

Body Weight - Average of reported values www.nps.gov/jotr/learn/nature/bighorn.htm
Home Range - 100 acres (assumed)
Food Ingestion Rate - Determined using (Nagy, 2001) for desert mammals.
Soil Ingestion Rate - Use Mule Deer as surrogate (Beyer et al., 1994)
Dietary Composition - 100% plants

Townsend's Big-Eared Bat

Body Weight - 9-14 grams (www.desertmuseum.org/kids/bats/townsends.php)
Home Range - Average home range reported for bats in pine forests of South Carolina (Menzel et al, 2001).
Food Ingestion Rate - Determined using (Nagy, 2001) for bats.
Soil Ingestion Rate - Assume 1%
Dietary Composition - moths, flies, lacewings, dung beetles, sawflies (www.ndow.org/Species/Furbearer/Townsend's_Big-eared_Bat/).

Side-Botched Lizard

Body Weight - Mean of non-breeding adult population in Texas (Tinkle and Woodard 1967).
Home Range - Average of male and female population in Texas (Tinkle and Woodard 1967).
Food Ingestion Rate - Determined using (Nagy, 2001) for desert lizards.
Soil Ingestion Rate - Assume 4.5% based on box turtle (Beyer et al., 1994).
Dietary Composition - 100 % arthropods (Galina-Tessaro, 1997)

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Table 13. Black-Throated Sparrow Calculations
DU-1 Mill Foundation
Appendix C, Attachment 2 - Ecological Risk Assessment Screening Output and BERA HQ Calculations
Hazard Quotient Calculations

Black-throated Sparrow COPEC	EPC Soil Conc. (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Plant Uptake Factor	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	Toxicity Reference Value Geomean (mg/kg BW-day)	NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)	NOAEL Hazard Quotient (unitless) Adjusted	LOAEL Hazard Quotient (unitless) Adjusted	TRV Geomean Hazard Quotient (unitless) Adjusted
Antimony	1,017	0.0093	9	0.0249	25	35.37	13	0.04	0.40	0.13	**884**	**88**	**316**	**32**	**100**
Arsenic	557	0.1210	67	1.1030	614	124.07	44.31	1.73	17.30	5.47	**72**	**7**	**26**	**3**	**8**
Cadmium	1.5	1.510	2.25	3.250	4.84	1.16	0.42	0.799	2.40	1.38	1	0.5	--	--	--
Copper	1,133	1.800	2039	0.625	708	467.34	166.91	23.20	29.90	26.34	**20**	**16**	**7**	**6**	**6**
Lead	12,575	0.1520	1911	0.4680	5885	1601.18	571.85	4.40	44.00	13.91	**364**	**36**	**130**	**13**	**41**
Mercury	21.3	1.880	40	5.000	107	23.81	8.50	0.45	0.90	0.64	**53**	**26**	**19**	**9**	**13**
Selenium	3.6	3.920	14.05	3.012	10.79	4.03	1.44	0.588	1.18	0.83	**7**	**3**	**2**	1	**2**
Silver	80.8	0.1020	8.24	0.0367	2.96	4.14	1.48	7.08	70.80	22.39	0.6	0.06	--	--	--
Vanadium	169	0.0264	4.46	0.0097	1.64	5.92	2.12	0.99	1.98	1.40	**6**	**3**	**2**	1	**2**
Zinc	252	1.900	478	1.820	458	155.38	55.49	14.50	131.00	43.58	**11**	1	**4**	0.4	1
Cyanide	0.374	0.118	0.044	0.025	0.009	0.02	0.01	0.09	0.90	0.29	0.22	0.022	--	--	--

Dose = $[(Conc_{Arthropods} \times IR_{food})0.50 + (IR_{food} \times Conc_{Plants})0.50 + (IR_{soil} \times Conc_{Soil})]$ / Body Weight
EPC is mean concentration if data are based on ISM data.
EPC is lower of maximum detections or 95% UCL if the data are based on discrete sample data.
UCL - upper confidence limit
Bolded HQs > 1, COPECs with adjusted HQs > 1 move to PRG development

Preliminary Remediation Goal Calculations

Black-throated Sparrow COPEC	PRG Soil Conc. (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Plant Uptake Factor	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	Toxicity Reference Value Geomean (mg/kg BW-day)	Hazard Quotient (unitless)
Antimony	10	0.00927	0.0927	0.0249	0.249	0.124	0.126	1.0
Arsenic	70	0.1210	8	1.1030	77	5.57	5.47	1.0
Copper	175	1.800	315	0.625	109	25.78	26.34	1.0
Lead	80	0.1520	12	0.4680	37	3.64	13.91	0.3
Mercury	1.6	1.880	3	5.000	8	0.64	0.64	1.0
Selenium	2.1	3.920	8.23	3.012	6.33	0.84	0.833	1.0
Vanadium	115	0.0264	3.04	0.0097	1.12	1.44	1.40	1.0
Zinc	205	1.900	390	1.820	373	45.18	43.58	1.0

PRG = Preliminary Remedial Goal
Toxicity Reference Value is the geomean of the NOAEL and LOAEL Toxicity Reference Values.

Table 14. Black-Throated Sparrow Calculations
DU-2 Eroded Tailings in Wash Along Road
Appendix C, Attachment 2 - Ecological Risk Assessment Screening Output and BERA HQ Calculations
Hazard Quotient Calculations

Black-throated Sparrow COPEC	EPC Soil Conc. (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Plant Uptake Factor	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	Toxicity Reference Value Geomean (mg/kg BW-day)	NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)	NOAEL Hazard Quotient (unitless) Adjusted	LOAEL Hazard Quotient (unitless) Adjusted	TRV Geomean Hazard Quotient (unitless) Adjusted
Antimony	1,054	0.0093	10	0.0249	26	36.660	13	0.04	0.40	0.13	**917**	**92**	**327**	**33**	**104**
Arsenic	621	0.1210	75	1.1030	685	138.372	49.42	1.73	17.30	5.47	**80**	**8**	**29**	**3**	**9**
Cadmium	22.8	1.510	34.43	3.250	74.10	17.815	6	0.799	2.40	1.38	**22**	**7**	**8**	**3**	**5**
Copper	1,358	1.800	2444	0.625	849	560.149	200.05	23.20	29.90	26.34	**24**	**19**	**9**	**7**	**8**
Lead	8,940	0.1520	1359	0.4680	4184	1138.334	406.55	4.40	44.00	13.91	**259**	**26**	**92**	**9**	**29**
Mercury	7.5	1.880	14	5.000	38	8.404	3.00	0.45	0.90	0.64	**19**	**9**	**7**	**3**	**5**
Selenium	4.7	3.920	18.29	3.012	14.06	5.248	1.87	0.588	1.18	0.83	**9**	**4**	**3**	**2**	**2**
Silver	51.2	0.1020	5.23	0.0367	1.88	2.628	0.94	7.08	70.80	22.39	0.4	0.04	--	--	--
Vanadium	126	0.0264	3.32	0.0097	1.22	4.414	1.58	0.99	1.98	1.40	**4**	**2**	**2**	1	1
Zinc	13,300	1.900	25270	1.820	24206	8206.933	2931.05	14.50	131.00	43.58	**566**	**63**	**202**	**22**	**67**
Cyanide	NS	0.118	--	0.025	--	--	--	0.09	0.90	0.29	--	--	--	--	--

Dose = $[(Conc_{Arthropods} \times IR_{food})0.50 + (IR_{food} \times Conc_{Plants})0.50 + (IR_{soil} \times Conc_{Soil})]$ / Body Weight
EPC is mean concentration if data are based on ISM data.
EPC is lower of maximum detections or 95% UCL if the data are based on discrete sample data.
UCL - upper confidence limit
Bolded HQs > 1, COPECs with adjusted HQs > 1 move to PRG development

Preliminary Remediation Goal Calculations

Black-throated Sparrow COPEC	PRG Soil Conc. (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Plant Uptake Factor	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	Toxicity Reference Value Geomean (mg/kg BW-day)	Hazard Quotient (unitless)
Antimony	10	0.00927	0.0927	0.0249	0.249	0.12	0.13	1.0
Arsenic	70	0.1210	8	1.1030	77	5.57	5.47	1.0
Cadmium	5	1.510	7.55	3.250	16.25	1	1.385	1.0
Copper	175	1.800	315	0.625	109	25.78	26.34	1.0
Lead	80	0.1520	12	0.4680	37	3.64	13.91	0.3
Mercury	1.6	1.880	3	5.000	8	0.64	0.64	1.0
Selenium	2.1	3.920	8.23	3.012	6.33	0.84	0.833	1.0
Vanadium	115	0.0264	3.04	0.0097	1.12	1.44	1.40	1.0
Zinc	205	1.900	390	1.820	373	45.18	43.58	1.0

PRG = Preliminary Remedial Goal
Toxicity Reference Value is the geomean of the NOAEL and LOAEL Toxicity Reference Values.

Table 15. Common Raven Calculations
DU-1 Mill Foundation
Appendix C, Attachment 2 - Ecological Risk Assessment Screening Output and BERA HQ Calculations
Hazard Quotient Calculations

Common Raven COPEC	EPC Soil Conc. (mg/kg)	Mammal Uptake Factor	Mammal Conc (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Plant Uptake Factor	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)	NOAEL Hazard Quotient (unitless) Adjusted	LOAEL Hazard Quotient (unitless) Adjusted
Antimony	1,017	0.0438	45	0.0093	9	0.0249	25	5.218	0.104	0.04	0.40	**130**	**13**	**3**	0.3
Arsenic	557	0.0149	8.30	0.1210	67	1.1030	614	16.674	0.333	1.73	17.30	**10**	1	0.2	0.02
Cadmium	1.5	3.9905	5.94	1.510	2.25	3.2500	4.84	0.303	--	0.799	2.40	0.4	0.1	--	--
Copper	1,133	1.0450	1184	1.800	2039	0.625	708	120.260	2.405	23.20	29.90	**5**	**4**	0.10	0.08
Lead	12,575	0.2864	3601	0.1520	1911	0.4680	5885	302.536	6.051	4.40	44.00	**69**	**7**	1	0.1
Mercury	21.3	0.1920	4.10	1.880	40	5.000	107	3.795	0.076	0.45	0.90	**8**	**4**	0.2	0.08
Selenium	3.6	1.1867	4.25	3.920	14.05	3.012	10.79	0.853	--	0.588	1.18	1	0.7	--	--
Silver	80.8	0.004	0.32	0.1020	8.24	0.037	2.96	0.662	--	7.08	70.80	0.09	0.009	--	--
Vanadium	169	0.123	20.76	0.0264	4.46	0.00970	1.64	1.189	--	0.99	1.98	1	0.6	--	--
Zinc	252	2.688	677	1.900	478	1.820	458	41.635	0.833	14.50	131.00	**3**	0.3	0.06	0.01
Cyanide	0.374	0.0438	0.02	0.118	0.044	0.0249	0.009	0.004	--	0.09	0.90	0.04	0.004	--	--

Dose = $[(Conc_{Arthropods} \times IR_{food})0.50 + (IR_{food} \times Conc_{Plants})0.25 + (IRfood \times Conc_{Mammals})0.25 + (IR_{soil} \times Conc_{Soil})]$ / Body Weight
EPC is mean concentration if data are based on ISM data.
EPC is lower of maximum detections or 95% UCL if the data are based on discrete sample data.
UCL - upper confidence limit
Bolded HQs > 1, COPECs with adjusted HQs > 1 move to PRG development

Preliminary Remediation Goal Calculations

Common Raven COPEC	PRG Soil Conc. (mg/kg)	Mammal Uptake Factor	Mammal Conc (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Plant Uptake Factor	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	Toxicity Reference Value Geomean (mg/kg BW-day)	Hazard Quotient (unitless)
Antimony	1200	0.0438	52.56	0.00927	11.124	0.0249	29.88	0.12	0.13	1.0
Lead	7,500	0.2864	2148	0.1520	1140	0.4680	3510	3.609	13.914	0.3

PRG = Preliminary Remedial Goal
Toxicity Reference Value is the geomean of the NOAEL and LOAEL Toxicity Reference Values.

Table 16. Common Raven Calculations
DU-2 Eroded Tailings in Wash Along Road
Appendix C, Attachment 2 - Ecological Risk Assessment Screening Output and BERA HQ Calculations
Hazard Quotient Calculations

Common Raven COPEC	EPC Soil Conc. (mg/kg)	Mammal Uptake Factor	Mammal Conc (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Plant Uptake Factor	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	Toxicity Reference Value Geomean (mg/kg BW-day)	NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)	NOAEL Hazard Quotient (unitless) Adjusted	LOAEL Hazard Quotient (unitless) Adjusted	TRV Geomean Hazard Quotient (unitless) Adjusted
Antimony	1,054	0.0438	46	0.009	10	0.025	26	5.408	0.11	0.04	0.40	0.13	**135**	**14**	**3**	0.3	0.9
Arsenic	621	0.0149	9.26	0.121	75	1.103	685	18.595	0.372	1.73	17.30	5.47	**11**	1	0.2	0.02	--
Cadmium	22.8	3.9905	90.98	1.510	34	3.250	74	4.638	0.09	0.80	2.40	1.38	**6**	**2**	0.1	0.04	--
Copper	1,358	1.0450	1419.11	1.800	2444	0.625	849	144.142	2.883	23.20	29.90	26.34	**6**	**5**	0.1	0.1	--
Lead	8,940	0.2864	2560.42	0.152	1359	0.468	4184	215.083	4.302	4.40	44.00	13.91	**49**	**5**	**1**	0.1	0.3
Mercury	7.5	0.1920	1.45	1.880	14.15	5.000	37.65	1.339	0.027	0.45	0.90	0.64	**3**	1	0.06	0.03	--
Selenium	4.7	1.1867	5.54	3.920	18.29	3.012	14.06	1.111	0.022	0.59	1.18	0.83	**2**	0.9	0.04	0.02	--
Silver	51.2	0.0040	0.20	0.102	5.23	0.037	1.88	0.420	0.008	7.08	70.80	22.39	0.06	0.006	0.001	0.0001	--
Vanadium	126	0.1230	15.47	0.026	3.32	0.010	1.22	0.886	0.018	0.99	1.98	1.40	1	0.4	0.02	0.009	--
Zinc	13,300	2.6878	35748	1.900	25270	1.820	24206	2199.151	43.983	14.50	131.00	43.58	**152**	**17**	**3**	0.3	1
Cyanide	NS	0.0438	--	0.118	--	0.025	--	--	--	0.09	0.90	0.29	No Value	No Value	No Value	No Value	--

Dose = $[(Conc_{Arthropods} \times IR_{food})0.50 + (IR_{food} \times Conc_{Plants})0.25 + (IRfood \times Conc_{Mammals})0.25 + (IR_{soil} \times Conc_{Soil})]$ / Body Weight
NS - Not Sampled. Cyanide not sampled in wash.
EPC is mean concentration if data are based on ISM data.
EPC is lower of maximum detections or 95% UCL if the data are based on discrete sample data.
UCL - upper confidence limit
Bolded HQs > 1, COPECs with adjusted HQs > 1 move to PRG development

Preliminary Remediation Goal Calculations

Common Raven COPEC	PRG Soil Conc. (mg/kg)	Mammal Uptake Factor	Mammal Conc (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Plant Uptake Factor	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	Toxicity Reference Value Geomean (mg/kg BW-day)	Hazard Quotient (unitless)
Antimony	1200	0.0438	52.56	0.00927	11.124	0.0249	29.88	0.12	0.13	1.0
Lead	7,500	0.2864	2148.00	0.152	1140	0.468	3510	3.609	13.91	0.3
Zinc	13,000	2.6878	34941	1.900	24700	1.820	23660	42.991	43.58	1.0

PRG = Preliminary Remedial Goal
Toxicity Reference Value is the geomean of the NOAEL and LOAEL Toxicity Reference Values.

Table 17. Red-tailed Hawk Calculations
DU-1 Mill Foundation
Appendix C, Attachment 2 - Ecological Risk Assessment Screening Output and BERA HQ Calculations
Hazard Quotient Calculations for the Red-Tailed Hawk

Red-Tailed Hawk COPEC	EPC Soil Conc. (mg/kg)	Mammal Uptake Factor	Mammal Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)	NOAEL Hazard Quotient (unitless) Adjusted	LOAEL Hazard Quotient (unitless) Adjusted
Antimony	1,070	0.0438	46.87	3.530	0.006	0.04	0.40	**88**	**9**	0.15	0.02
Arsenic	612	0.0149	9.12	1.44	--	1.73	17.30	0.8	0.08	--	--
Cadmium	1.6	3.9905	6.30	0.21	--	0.799	2.40	0.3	0.09	--	--
Copper	1,260	1.0450	1316.70	45.44	0.079	23.20	29.90	**2**	**2**	0.003	0.003
Lead	13,900	0.2864	3980.96	156.22	0.271	4.40	44.00	**36**	**4**	0.1	0.01
Mercury	25.2	0.1920	4.84	0.21	--	0.45	0.90	0.5	0.2	--	--
Selenium	3.6	1.1867	4.25	0.15	--	0.59	1.18	0.2	0.1	--	--
Silver	80.8	0.0040	0.32	0.161	--	7.08	70.80	0.02	0.002	--	--
Vanadium	169	0.1230	20.76	0.994	--	0.99	1.98	1	0.5	--	--
Zinc	252	2.6878	676.79	22.619	0.039	14.50	131.00	**2**	0.2	0.003	0.0003
Cyanide	0.374	0.0438	0.02	0.001	--	0.09	0.90	0.01	0.001	--	--

Dose = [(IRfood x $Conc_{Mammals}$)1+ (IR_{soil} x $Conc_{Soil}$)] / Body Weight
EPC is mean concentration if data are based on ISM data.
EPC is lower of maximum detections or 95% UCL if the data are based on discrete sample data.
UCL - upper confidence limit
Bolded HQs > 1, COPECs with adjusted HQs > 1 move to PRG development

Table 18. Red-tailed Hawk Calculations
DU-2 Eroded Tailings in Wash Along Road
Appendix C, Attachment 2 - Ecological Risk Assessment Screening Output and BERA HQ Calculations
Hazard Quotient Calculations for the Red-Tailed Hawk

Red-Tailed Hawk COPEC	EPC Soil Conc. (mg/kg)	Mammal Uptake Factor	Mammal Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)	NOAEL Hazard Quotient (unitless) Adjusted	LOAEL Hazard Quotient (unitless) Adjusted
Antimony	1,054	0.0438	46.17	3.477	0.006	0.04	0.40	**87**	**9**	0.15	0.02
Arsenic	621	0.0149	9.26	1.462	--	1.73	17.30	0.8	0.08	--	--
Cadmium	22.8	3.9905	90.98	3.020	0.005	0.80	2.40	**4**	1	0.01	0.002
Copper	1,358	1.0450	1419.11	48.977	0.085	23.20	29.90	**2**	**2**	0.004	0.003
Lead	8,940	0.2864	2560.42	100.473	0.174	4.40	44.00	**23**	**2**	0.0	0.00
Mercury	7.5	0.1920	1.45	0.061	--	0.45	0.90	0.1	0.07	--	--
Selenium	4.7	1.1867	5.54	0.190	--	0.59	1.18	0.3	0.2	--	--
Silver	51.2	0.0040	0.20	0.102	--	7.08	70.80	0.01	0.001	--	--
Vanadium	126	0.1230	15.47	0.741	--	0.99	1.98	0.8	0.4	--	--
Zinc	13,300	2.6878	35747.74	1194.737	2.074	14.50	131.00	**82**	**9**	0.1	0.02
Cyanide	NS	0.0438	--	--	--	0.09	0.90	No Value	No Value	--	--

Dose = [(IRfood x $Conc_{Mammals}$)1+ (IR_{soil} x $Conc_{Soil}$)] / Body Weight
NS - Not Sampled. Cyanide not sampled in wash.
EPC is mean concentration if data are based on ISM data.
EPC is lower of maximum detections or 95% UCL if the data are based on discrete sample data.
UCL - upper confidence limit
Bolded HQs > 1, COPECs with adjusted HQs > 1 move to PRG development

Table 19. Southern Grasshopper Mouse Calculations
DU-1 Mill Foundation
Appendix C, Attachment 2 - Ecological Risk Assessment Screening Output and BERA HQ Calculations
Hazard Quotient Calculations

Southern Grasshopper Mouse COPEC	EPC Soil Conc. (mg/kg)	Mammal Uptake Factor	Mammal Conc (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Plant Uptake Factor	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	Toxicity Reference Value Geomean (mg/kg BW-day)	NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)	NOAEL Hazard Quotient (unitless) Adjusted	LOAEL Hazard Quotient (unitless) Adjusted	TRV Geomean Hazard Quotient (unitless) Adjusted
Antimony	1,017	0.0438	45	0.0093	9	0.0249	25	5.64	0.85	5.60	42.00	15.34	1	0.1	--	--	--
Arsenic	557	0.0149	8.30	0.1210	67	1.1030	614	15.79	2.39	0.75	3.00	1.50	**21**	5.3	**3**	0.8	**2**
Cadmium	1.5	3.9905	5.94	1.510	2.25	3.2500	4.84	0.43	0.07	1.00	10.00	3.16	0.4	0.04	--	--	--
Copper	1,133	1.0450	1184	1.800	2039	0.625	708	298.60	45.24	33.80	101.00	58.43	**9**	**3**	1	0.4	--
Lead	12,575	0.2864	3601	0.1520	1911	0.4680	5885	399.08	60.47	4.70	47.00	14.86	**85**	**8**	**13**	1	**4**
Mercury	21.3	0.1920	4.10	1.880	40	5.000	107	6.29	0.95	1.01	10.10	3.19	**6**	**1**	1	0.1	--
Selenium	3.6	1.1867	4.25	3.920	14.05	3.012	10.79	2.03	0.31	0.39	0.78	0.55	**5**	**3**	0.8	0.4	0.6
Silver	80.8	0.004	0.32	0.1020	8.24	0.037	2.96	1.40	0.21	12.50	125.00	39.53	0.1	0.01	--	--	--
Vanadium	169	0.123	20.76	0.0264	4.46	0.00970	1.64	1.51	0.23	3.43	6.85	4.85	0.4	0.2	--	--	--
Zinc	252	2.688	677	1.900	478	1.820	458	78.51	11.90	160.00	320.00	226.27	0.5	0.2	--	--	--
Cyanide	0.374	0.0438	0.02	0.118	0.044	0.0249	0.009	0.01	0.001	14.00	140.000	44.27	0.001	0.0001	--	--	--

Dose = [(Conc$_{Arthropods}$ x IR$_{food}$)0.85 + (IR$_{food}$ x Conc$_{Plants}$)0.05 + (IRfood x Conc$_{Mammals}$)0.10+ (IR$_{soil}$ x Conc $_{Soil}$)] / Body Weight
EPC is mean concentration if data are based on ISM data.
EPC is lower of maximum detections or 95% UCL if the data are based on discrete sample data.
UCL - upper confidence limit
Bolded HQs > 1, COPECs with adjusted HQs > 1 move to PRG development

Prelininary Remediation Goal Calculations

Southern Grasshopper Mouse COPEC	PRG Soil Conc. (mg/kg)	Mammal Uptake Factor	Mammal Conc (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Plant Uptake Factor	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	Toxicity Reference Value Geomean (mg/kg BW-day)	Hazard Quotient (unitless)
Arsenic	350	0.0149	5	0.1210	42	1.1030	386	1.50	1.50	1.0
Lead	3,200	0.2864	916	0.1520	486	0.4680	1498	15.39	14.86	1.0

PRG = Preliminary Remedial Goal
Toxicity Reference Value is the geomean of the NOAEL and LOAEL Toxicity Reference Values.

Table 20. Southern Grasshopper Mouse Calculations
DU-2 Eroded Tailings in Wash Along Road
Appendix C, Attachment 2 - Ecological Risk Assessment Screening Output and BERA HQ Calculations
Hazard Quotient Calculations

Southern Grasshopper Mouse COPEC	EPC Soil Conc. (mg/kg)	Mammal Uptake Factor	Mammal Conc (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Plant Uptake Factor	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	Toxicity Reference Value Geomean (mg/kg BW-day)	NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)	NOAEL Hazard Quotient (unitless) Adjusted	LOAEL Hazard Quotient (unitless) Adjusted	TRV Geomean Hazard Quotient (unitless) Adjusted
Antimony	1,054	0.0438	46	0.0093	10	0.0249	26	5.84	0.89	5.60	42.00	15.34	1	0.1	--	--	--
Arsenic	621	0.0149	9.26	0.1210	75	1.1030	685	17.60	2.67	0.75	3.00	1.50	**23**	**6**	**4**	0.9	**2**
Cadmium	22.8	3.9905	90.98	1.510	34.43	3.2500	74.10	6.65	1.01	1.00	10.00	3.16	**7**	1	1	0.1	--
Copper	1,358	1.0450	1419	1.800	2444	0.625	849	357.89	54.23	33.80	101.00	58.43	**11**	**4**	**2**	1	0.9
Lead	8,940	0.2864	2560	0.1520	1359	0.4680	4184	283.72	42.99	4.70	47.00	14.86	**60**	**6**	**9**	1	**3**
Mercury	7.5	0.1920	1.45	1.880	14	5.000	38	2.22	0.34	1.01	10.10	3.19	**2**	0.2	0.3	0.03	--
Selenium	4.7	1.1867	5.58	3.920	18.42	3.012	14.16	2.66	0.40	0.39	0.78	0.55	**7**	**3**	1	0.5	--
Silver	51.2	0.004	0.20	0.1020	5.22	0.037	1.88	0.89	0.13	12.50	125.00	39.53	0.1	0.01	--	--	--
Vanadium	126	0.123	15.50	0.0264	3.33	0.00970	1.22	1.13	0.17	3.43	6.85	4.85	0.3	0.2	--	--	--
Zinc	13,300	2.688	35748	1.900	25270	1.820	24206	4146.93	628.32	160	320	226.27	**26**	**13**	**4**	**2**	**3**

Dose = [(Conc$_{Arthropods}$ x IR$_{food}$)0.85 + (IR$_{food}$ x Conc$_{Plants}$)0.05 + (IRfood x Conc$_{Mammals}$)0.10+ (IR$_{soil}$ x Conc $_{Soil}$)] / Body Weight
EPC is mean concentration if data are based on ISM data.
EPC is lower of maximum detections or 95% UCL if the data are based on discrete sample data.
UCL - upper confidence limit
Bolded HQs > 1, COPECs with adjusted HQs > 1 move to PRG development

Preliminary Remediation Goal Calculations

Southern Grasshopper Mouse COPEC	PRG Soil Conc. (mg/kg)	Mammal Uptake Factor	Mammal Conc (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Plant Uptake Factor	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	Toxicity Reference Value Geomean (mg/kg BW-day)	Hazard Quotient (unitless)
Arsenic	350	0.0149	5.22	0.1210	42	1.1030	386	1.50	1.50	1.0
Copper	1,500	1.0450	1568	1.800	2700	0.625	938	59.90	58.43	1.0
Lead	3,200	0.2864	916	0.1520	486	0.4680	1498	15.39	14.86	1.0
Zinc	5,000	2.688	13439	1.900	9500	1.820	9100	236.21	226.27	1.0

PRG = Preliminary Remedial Goal
Toxicity Reference Value is the geomean of the NOAEL and LOAEL Toxicity Reference Values.

Table 21. White-Tailed Antelope Squirrel Calculations
DU-1 Mill Foundation
Appendix C, Attachment 2 - Ecological Risk Assessment Screening Output and BERA HQ Calculations
Hazard Quotient Calculations

White-Tailed Antelope Squirrel COPEC	EPC Soil Conc. (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Plant Uptake Factor	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	Toxicity Reference Value Geomean (mg/kg BW-day)	NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)	NOAEL Hazard Quotient (unitless) Adjusted	LOAEL Hazard Quotient (unitless) Adjusted	TRV Geomean Hazard Quotient (unitless) Adjusted
Antimony	1,017	0.009	9.428	0.025	25.32	3.944	--	5.60	42.00	15.34	0.7	0.1	--	--	--
Arsenic	557	0.121	67.397	1.103	614.37	47.919	11.980	0.75	3.00	1.50	**64**	**16**	**16**	**4**	**8**
Cadmium	1.5	1.510	2.247	3.250	4.84	0.404	--	1.00	10.00	3.16	0.40	0.04	--	--	--
Copper	1,133	1.800	2039.400	0.625	708.13	92.570	23.142	33.80	101.00	58.43	**3**	0.9	1	0.2	--
Lead	12,575	0.152	1911.40	0.468	5885.10	495.963	123.991	4.70	47	14.86	**106**	**11**	**26**	**3**	**8**
Mercury	21.3	1.880	40.10	5.000	106.65	8.706	2.176	1.01	10.10	3.19	**9**	0.9	**2**	0.2	0.7
Molybdenum	0.5	0.118	0.055	0.901	0.42	0.033	--	17	60	31.94	0.002	0.001	--	--	--
Selenium	3.6	3.920	14.045	3.012	10.79	1.069	0.267	0.388	0.8	0.55	**3**	1	0.7	0.3	--
Silver	80.8	0.102	8.240	0.037	2.96	0.523	--	12.5	125	39.53	0.04	0.004	--	--	--
Thallium	1.5	0.092	0.136	0.129	0.19	0.019	--	No Value	0.074	0.07	--	0.3	--	--	--
Zinc	252	1.900	478	1.820	458.28	43.390	--	160	320	226	0.3	0.1	--	--	--

Dose = $[(Conc_{Arthropods} \times IR_{food})0.20 + (IR_{food} \times Conc_{Plants})0.80 + (IR_{soil} \times Conc_{Soil})]$ / Body Weight
EPC is mean concentration if data are based on ISM data.
EPC is lower of maximum detections or 95% UCL if the data are based on discrete sample data.
UCL - upper confidence limit
Bolded HQs > 1, COPECs with adjusted HQs > 1 move to PRG development

Preliminary Remedial Goal Calculations

White-Tailed Antelope Squirrel COPEC	PRG Soil Conc. (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Plant Uptake Factor	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	Toxicity Reference Value Geomean (mg/kg BW-day)	Hazard Quotient (unitless)
Arsenic	**70**	0.121	8.470	1.103	77.21	1.506	1.50	1.0
Lead	**1,500**	0.152	228.00	0.468	702.00	14.790	14.86	1.0
Mercury	**30**	1.880	56.40	5.000	150.00	3.061	3.19	1.0

PRG = Preliminary Remedial Goal
Toxicity Reference Value is the geomean of the NOAEL and LOAEL Toxicity Reference Values.

Table 22. White-Tailed Antelope Squirrel Calculations
DU-2 Eroded Tailings in Wash Along Road
Appendix C, Attachment 2 - Ecological Risk Assessment Screening Output and BERA HQ Calculations
Hazard Quotient Calculations

White-Tailed Antelope Squirrel COPEC	EPC Soil Conc. (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Plant Uptake Factor	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	Toxicity Reference Value Geomean (mg/kg BW-day)	NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)	NOAEL Hazard Quotient (unitless) Adjusted	LOAEL Hazard Quotient (unitless) Adjusted	TRV Geomean Hazard Quotient (unitless) Adjusted
Antimony	1,054	0.009	10	0.025	26	4.088	1.022	5.60	42.00	15.34	1	0.1	--	--	--
Arsenic	621	0.121	75	1.103	685	53.442	13.360	0.75	3.00	1.50	**71**	**18**	**18**	**4**	**9**
Cadmium	22.8	1.510	34	3.250	74	6.185	1.546	1.00	10.00	3.16	**6**	0.6	**2**	0.2	0.5
Copper	1,358	1.800	2444	0.625	849	110.953	27.738	33.80	101.00	58.43	**3**	1	0.8	0.3	--
Lead	8,940	0.152	1359	0.468	4184	352.597	88.149	4.70	47.00	14.86	**75**	**8**	**19**	**2**	**6**
Mercury	8	1.880	14.15	5.000	37.6	3.073	0.768	1.01	10.10	3.19	**3**	0.3	1	0.1	--
Molybdenum	0.8	0.118	0.09	0.901	0.7	0.055	0.014	17.00	60.00	31.94	0.003	0.001	0.001	0.000	--
Selenium	4.7	3.920	18.29	3.012	14.1	1.392	0.348	0.39	0.78	0.55	**4**	**2**	1	0.4	--
Silver	51.2	0.102	5.23	0.037	1.9	0.332	0.083	12.50	125.00	39.53	0.03	0.003	0.01	0.001	--
Thallium	1.3	0.092	0.12	0.129	0.2	0.017	0.004	No Value	0.07	0.07	--	0.2	--	0.1	--
Zinc	13,300	1.900	25270	1.820	24206.0	2291.851	572.963	160	320	226	**14**	**7**	**4**	**2**	**3**

Dose = $[(Conc_{Arthropods} \times IR_{food})0.20 + (IR_{food} \times Conc_{Plants})0.80 + (IR_{soil} \times Conc_{Soil})]$ / Body Weight
EPC is mean concentration if data are based on ISM data.
EPC is lower of maximum detections or 95% UCL if the data are based on discrete sample data.
UCL - upper confidence limit
NS - Not Sampled. Cyanide not sampled in wash.
Bolded HQs > 1, COPECs with adjusted HQs > 1 move to PRG development

Preliminary Remedial Goal Calculations

White-Tailed Antelope Squirrel COPEC	PRG Soil Conc. (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Plant Uptake Factor	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	Toxicity Reference Value Geomean (mg/kg BW-day)	Hazard Quotient (unitless)
Arsenic	**70**	0.121	8	1.103	77	1.506	1.50	1.0
Cadmium	**45**	1.510	68	3.250	146	3.052	3.16	1.0
Lead	**1,500**	0.152	228	0.468	702	14.790	14.86	1.0
Zinc	**5,500**	1.900	10450	1.820	10010.0	236.940	226	1.0

PRG = Preliminary Remedial Goal
Toxicity Reference Value is the geomean of the NOAEL and LOAEL Toxicity Reference Values.

Table 23. Desert Bighorn Sheep Calculations
DU-1 Mill Foundation
Appendix C, Attachment 2 - Ecological Risk Assessment Screening Output and BERA HQ Calculations
Hazard Quotient Calculations

Desert Bighorn Sheep COPEC	EPC Soil Conc. (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Plant Uptake Factor	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)	NOAEL Hazard Quotient (unitless) Adjusted	LOAEL Hazard Quotient (unitless) Adjusted
Antimony	1,017	0.009	9.428	0.025	25.323	1.321	--	5.60	42.00	0.2	0.03	--	--
Arsenic	557	0.121	67	1.103	614.371	18.091	0.181	0.75	3.00	**24**	**6**	0.2	0.1
Cadmium	1.5	1.510	2.2	3.250	4.836	0.141	--	1.00	10.00	0.1	0.01	--	--
Copper	1,133	1.800	2039	0.625	708	21.135	--	33.80	101.00	0.6	0.2	--	--
Lead	12,575	0.152	1911.40	0.468	5885	177.478	1.775	4.70	47.00	**38**	**4**	0.4	0.04
Mercury	21.3	1.880	40.10	5.000	107	3.097	--	1.01	10.10	3	0.3	--	--
Molybdenum	0.5	0.118	0.055	0.901	0.423	0.013	--	17	60	0.001	0.0002	--	--
Selenium	3.6	3.920	14.045	3.012	10.792	0.314	--	0.39	0.78	0.8	0.4	--	--
Silver	80.8	0.102	8.240	0.037	2.965	0.132	--	13	125	0.011	0.001	--	--
Thallium	1.5	0.092	0.136	0.129	0.191	0.006	--	No Value	0.074	--	0.1	--	--
Zinc	252	1.900	478	1.820	458.3	13.400	--	160	320	0.08	0.04	--	--

Dose = $[(IR_{food} \times Conc_{Plants})1 + (IR_{soil} \times Conc_{Soil})]$ / Body Weight
EPC is mean concentration if data are based on ISM data.
EPC is lower of maximum detections or 95% UCL if the data are based on discrete sample data.
UCL - upper confidence limit
Bolded HQs > 1, COPECs with adjusted HQs > 1 move to PRG development

Table 24. Desert Bighorn Sheep Calculations
DU-2 Eroded Tailings in Wash Along Road
Appendix C, Attachment 2 - Ecological Risk Assessment Screening Output and BERA HQ Calculations
Hazard Quotient Calculations

Desert Bighorn Sheep COPEC	EPC Soil Conc. (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Plant Uptake Factor	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)	NOAEL Hazard Quotient (unitless) Adjusted	LOAEL Hazard Quotient (unitless) Adjusted
Antimony	1,054	0.009	9.8	0.025	26.2	1.369	--	5.60	42.00	0.2	0.03	--	--
Arsenic	621	0.121	75	1.103	685.2	20.176	0.202	0.75	3.00	**27**	**7**	0.3	0.1
Cadmium	22.8	1.510	34	3.250	74.1	2.156	0.022	1.00	10.00	**2**	0.2	0.02	0.002
Copper	1,358	1.800	2444	0.625	848.8	25.332	0.253	33.80	101.00	0.7	0.3	--	--
Lead	8,940	0.152	1359	0.468	4183.9	126.176	1.262	4.70	47.00	**27**	**3**	0.3	0.03
Mercury	8	1.880	14.15	5.000	37.6	1.093	0.011	1.01	10.10	1	0.1	--	--
Molybdenum	0.8	0.118	0.09	0.901	0.70	0.021	0.000	17	60	0.001	0.0003	--	--
Selenium	4.7	3.920	18.29	3.012	14.06	0.409	0.004	0.39	0.78	1	0.5	--	--
Silver	51.2	0.102	5.23	0.037	1.88	0.084	0.001	12.5	125	0.007	0.001	--	--
Thallium	1.3	0.092	0.12	0.129	0.17	0.006	0.000	No Value	0.074	--	0.08	--	--
Zinc	13,300	1.900	25270	1.820	24206.0	707.762	7.078	160	320	**4**	**2**	0.04	0.02

Dose = $[(IR_{food} \times Conc_{Plants})1 + (IR_{soil} \times Conc_{Soil})]$ / Body Weight
EPC is mean concentration if data are based on ISM data.
EPC is lower of maximum detections or 95% UCL if the data are based on discrete sample data.
UCL - upper confidence limit
Bolded HQs > 1, COPECs with adjusted HQs > 1 move to PRG development

Table 25. Townsend's Big Eared Bat Calculations
DU-1 Mill Foundation
Appendix C, Attachment 2 - Ecological Risk Assessment Screening Output and BERA HQ Calculations
Hazard Quotient Calculations

Townsend's Big Eared Bat COPEC	EPC Soil Conc. (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)	NOAEL Hazard Quotient (unitless) Adjusted	LOAEL Hazard Quotient (unitless) Adjusted
Antimony	1,017	0.009	9.4	4.400	--	5.60	42	0.8	0.1	--	--
Arsenic	557	0.121	67	16.382	0.071	0.75	3	**22**	**5**	0.1	0.02
Cadmium	1.5	1.510	2.247	0.508	0.002	1.00	10	0.5	0.05	--	--
Copper	1,133	1.800	2039	460.422	2.002	33.80	101	**14**	**5**	0.06	0.02
Lead	12,575	0.152	1911.40	457.373	1.989	4.70	47	**97**	**10**	0.4	0.04
Mercury	21.3	1.880	40.10	9.051	0.039	1.01	10.10	**9**	0.9	0.04	0.004
Molybdenum	0.5	0.118	0.055	0.014	0.000	17	60	0.001	0.0002	--	--
Selenium	3.6	3.920	14.045	3.161	0.014	0	1	**8**	**4**	0.04	0.02
Silver	80.8	0.102	8.240	2.031	0.009	13	125	0.2	0.02	--	--
Thallium	1.5	0.092	0.136	0.034	0.000	No Value	0.074	--	0.5	--	--
Zinc	252	1.900	478	107.978	0.469	160	320	0.7	0.3	--	--

Dose = $[(IR_{food} \times Conc_{Arthropods})1 + (IR_{soil} \times Conc_{Soil})]$ / Body Weight
EPC is mean concentration if data are based on ISM data.
EPC is lower of maximum detections or 95% UCL if the data are based on discrete sample data.
UCL - upper confidence limit
Bolded HQs > 1, COPECs with adjusted HQs > 1 move to PRG development

Table 26. Townsend's Big Eared Bat Calculations
DU-2 Eroded Tailings in Wash Along Road
Appendix C, Attachment 2 - Ecological Risk Assessment Screening Output and BERA HQ Calculations
Hazard Quotient Calculations

Townsend's Big Eared Bat COPEC	EPC Soil Conc. (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)	NOAEL Hazard Quotient (unitless) Adjusted	LOAEL Hazard Quotient (unitless) Adjusted
Antimony	1,054	0.009	10	4.560	--	5.60	42	0.8	0.1	--	--
Arsenic	621	0.121	75	18.271	0.079	0.75	3	**24**	**6**	0.1	0.03
Cadmium	22.8	1.510	34	7.781	0.034	1.00	10	**8**	0.8	0.03	0.003
Copper	1,358	1.800	2444	551.857	2.399	33.80	101	**16**	**5**	0.1	0.02
Lead	8,940	0.152	1359	325.162	1.414	4.70	47	**69**	**7**	0.3	0.03
Mercury	8	1.880	14.15	3.195	0.014	1.01	10	**3**	0.3	0.01	0.001
Molybdenum	0.8	0.118	0.09	0.022	--	17	60	0.001	0.0004	--	--
Selenium	4.7	3.920	18.29	4.118	0.018	0.388	0.776	**11**	**5**	0.05	0.02
Silver	51.2	0.102	5.23	1.288	--	13	125	0.1	0.01	--	--
Thallium	1.3	0.092	0.12	0.029	--	No Value	0	--	0.4	--	--
Zinc	13,300	1.900	25270	5703.388	24.797	160	320	**36**	**18**	0.2	0.08

Dose = $[(IR_{food} \times Conc_{Arthropods})1 + (IR_{soil} \times Conc_{Soil})]$ / Body Weight
EPC is mean concentration if data are based on ISM data.
EPC is lower of maximum detections or 95% UCL if the data are based on discrete sample data.
UCL - upper confidence limit
Bolded HQs > 1, COPECs with adjusted HQs > 1 move to PRG development

Table 27. Side Botched Lizard Calculations
DU-1 Mill Foundation
Appendix C, Attachment 2 - Ecological Risk Assessment Screening Output and BERA HQ Calculations
Hazard Quotient Calculations

Side Botched Lizard COPEC	EPC Soil Conc. (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	Toxicity Reference Value Geomean (mg/kg BW-day)	NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)	NOAEL Hazard Quotient (unitless) Adjusted	LOAEL Hazard Quotient (unitless) Adjusted	TRV Geomean Hazard Quotient (unitless) Adjusted
Lead	12,575	0.152	1911.40	21.640	6.365	1.00	10.00	3.16	**22**	**2**	**6**	0.6	**2**

Dose = $[(IR_{food} \times Conc_{Arthropods})1 + (IR_{soil} \times Conc_{Soil})]$ / Body Weight
EPC is mean concentration if data are based on ISM data.
EPC is lower of maximum detections or 95% UCL if the data are based on discrete sample data.
UCL - upper confidence limit
Bolded HQs > 1, COPECs with adjusted HQs > 1 move to PRG developmen

Preliminary Remedial Goal Calculations

Side Botched Lizard COPEC	PRG Soil Conc. (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	Toxicity Reference Value Geomean (mg/kg BW-day)	Hazard Quotient (unitless)
Lead	6,500	0.152	988.00	3.290	3.2	1.0

PRG = Preliminary Remedial Goal
Toxicity Reference Value is the geomean of the NOAEL and LOAEL Toxicity Reference Values.

Table 28. Side Botched Lizard Calculations
DU-2 Eroded Tailings in Wash Along Road
Appendix C, Attachment 2 - Ecological Risk Assessment Screening Output and BERA HQ Calculations
Hazard Quotient Calculations

Side Botched Lizard COPEC	EPC Soil Conc. (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	Toxicity Reference Value Geomean (mg/kg BW-day)	NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)	NOAEL Hazard Quotient (unitless) Adjusted	LOAEL Hazard Quotient (unitless) Adjusted	TRV Geomean Hazard Quotient (unitless) Adjusted
Lead	8,940	0.152	1358.88	15.384	4.525	1.00	10.00	3.16	**15**	**2**	**5**	0.5	1

Dose = [(IR_{food} x $Conc_{Arthropods}$)1 + (IR_{soil} x $Conc_{Soil}$)] / Body Weight
EPC is mean concentration if data are based on ISM data.
EPC is lower of maximum detections or 95% UCL if the data are based on discrete sample data.
UCL - upper confidence limit
Bolded HQs > 1, COPECs with adjusted HQs > 1 move to PRG development

Preliminary Remedial Goal Calculations

Side Botched Lizard COPEC	PRG Soil Conc. (mg/kg)	Arthropod Uptake Factor	Arthropod Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day) Adjusted for Area Use	Toxicity Reference Value Geomean (mg/kg BW-day)	Hazard Quotient (unitless)
Lead	6,500	0.152	988.00	3.290	3.2	1.0

PRG = Preliminary Remedial Goal
Toxicity Reference Value is the geomean of the NOAEL and LOAEL Toxicity Reference Values.

Table 29. Summary of PRGs

Appendix C, Attachment 2 - Ecological Risk Assessment Screening Output and BERA HQ Calculations

COPEC	DU-1 Mill Foundation EPC	DU-2 Tailings in Wash EPC	Background Mean	Lowest Ecological PRG	Plants		Invertebrates		Black-throated sparrow	Common raven	Red-tailed hawk	Grasshopper mouse	Antelope squirrel	Bighorn sheep	Big-eared bat	Side-botched lizard
Antimony	1017	1054	0.754	10	25.26	a	246.66	a	10	1,200	--	--	--	--	--	No TRV
Arsenic	557	621.2	3.753	40.47	40.47	a	--		70	--	--	350	70	--	--	No TRV
Barium	112.4	120.3	93.9	Not a CEC	--		--		--	--	--	--	--	--	--	No TRV
Beryllium	0.352	0.487	0.283	Not a CEC	--		--		--	--	--	--	--	--	--	No TRV
Cadmium	1.488	22.8	0.147	5	--		--		5	--	--	--	45	--	--	No TRV
Chromium (total)	8.828	8.19	5.857	5.8	No Value		No Value		--	--	--	--	--	--	--	No TRV
Cobalt	3.578	4.891	4.59	Not a CEC	--		No Value		--	--	--	--	--	--	--	No TRV
Copper	1133	1358	6.873	175	185.2	a	205.91	a	175	--	--	1,500	--	--	--	No TRV
Lead	12,575	8,940	6.16	261.53	261.53	a	3,779	a	300	--	--	3,200	1,500	--	--	6,500
Mercury (Inorganic)	21.33	7.529	0.0116	0.16	46.65	a	0.16	a	1.6	--	--	--	30	--	--	No TRV
Molybdenum	0.47	0.778	0.129	Not a CEC	--		--		--	--	--	--	--	--	--	No TRV
Nickel	6.78	7.708	6.163	Not a CEC	--		--		--	--	--	--	--	--	--	No TRV
Selenium	3.583	4.667	All ND	1.25	1.25	a	--		2.1	--	--	--	--	--	--	No TRV
Silver	80.78	51.24	0.0233	Not a CEC, Uncert with Inverts	--		No Value		--	--	--	--	--	--	--	No TRV
Thallium	1.478	1.288	0.138	Not a CEC, Uncert with Inverts	--		No Value		--	--	--	--	--	--	--	No TRV
Vanadium	168.8	125.8	18.83	69.28	69.28	a	No Value		115				--	--	--	No TRV
Zinc	251.8	13,300	28.5	205	360	a	334.07	a	205	13,000		5,000	5,500	--	--	No TRV
Cyanide, Total	0.374	NS	NS	Not a CEC, Uncert with Plants and Inverts	No Value		No Value		--	--	--	--	--	--	--	No TRV

All concentrations in mg/kg.
a - Geomean of NOEC and LOEC from LANL database (2017).
Wildlife PRGs based on geomentric mean of NOAEL and LOAEL TRVs.
-- indicates that hazard quotient was less than 1
CEC - Contaminant of ecological concern
NS - not sampled
EPC - Exposure Point Concentration

Appendix D – Detailed Cost Estimates

Site Cost Detail Report
(with Markups)

System:

RACER Version: RACER® Version 11.3.18.0
Database Location: C:\Users\Workstation02\Documents\RACER 11.3\Racer.mdb

Folder:

Folder Name: New Folder

Project:

ID: DEVA
Name: Death Valley National Park
Category: None

Location

State / Country: CALIFORNIA
City: DESERT AREA

Location Modifier	Default	User	Reason for changes
	1.240	1.240	

Options

Database: System Costs
Cost Database Date: 2016
Report Option: Fiscal

Description DEVA Skidoo EE/CA

Site:

Site Cost Detail Report
(with Markups)

ID: Gold Hill
Name: Alternative #4 - Excavation
Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Metals
Secondary: None

Phase Names

Pre-Study
Study
Design
Removal/Interim Action
Remedial Action
Operations & Maintenance
Long Term Monitoring
Site Closeout

Documentation

Description: The Gold Hill Mill Site is located 35 miles south of Furnace Creek, California, in Warm Spring Canyon at an elevation of 2,360 feet above sea level. The Gold Hill Mining District is one of the oldest mining areas within DEVA, with prospecting and work dating from the 1970s. The Gold Hill region is located within DEVA in the southwest corner, in the Panamint Mountain Range, at the northeastern end of Butte Valley and north of Warm Spring. The Site is heavily visited due to its location next to the Warm Spring Mining Camp and along the road to Butte Valley. This site is accessed via 14 imles of infrequently graded dirt roads requiring high clearance, four-wheel drive vehicles. The Site experiences moderate annual visitation.

The Site covers less than 1 acre and consists of a complete and well-preserved mill with evidence of mercury amalgamation. A spring and an abandoned mining camp are located south of the mill ruins. Minor mill tailings from the

amalgamated mercury process used to extract the gold have accumulated in and around the mill workings, primarily on the east side, scattered in and around the equipment, and comingling with native rock.

Support Team: Essi Esmaili, Jeff Oslick, Ryley Robitaille

References:

Environmental Cost Management. 2014. "Preliminary Assessment, 27 Abandoned Minerals Lands Sites, Death Valley National Park, Inyo and San Bernardino Counties, California and Nye County, Nevada." November.

NOREAS, Inc. 2016. "Final Site Inspection Report, Death Valley National Park, Site Inspections of Abandoned Mineral Lands (AML) Sites (Skidoo, Homestake, Journigan's, Starr, Tucki, Cashier and Gold Hill), California and Nevada." October.

Estimator Information

Estimator Name: Ryley Robitaille
Estimator Title: Engineer
Agency/Org./Office: NOREAS, Inc.
Business Address: 16361 Scientific Way
Irvine, CA 92618
Telephone Number: (949) 877-3726
Email Address: ryley.robitaille@noreasinc.com
Estimate Prepared Date: 04/30/2020
Estimator Signature: ______________________ **Date:** ______________

Reviewer Information

Reviewer Name: Jeff Oslick
Reviewer Title: Principal Geologist
Agency/Org./Office: NOREAS, Inc.
Business Address: 16361 Scientific Way
Irvine, CA 92618
Telephone Number: (949) 467-9105
Email Address: jeff.oslick@noreasinc.com
Date Reviewed: 05/15/2020

Site Cost Detail Report (with Markups)

Reviewer Signature: ______________________ **Date:** ______________

Site Cost Detail Report (with Markups)

Phase (Markup Template)	Direct Cost	Sub Overhead	Sub Profit	Prime Overhead	Prime Profit	Contingency	Owner Cost	Markup Total	Total
Documentation and Meetings (DEVA)	$60,801	$58,655	$8,773	$6,517	$10,478	$14,145	$0	$98,568	$159,368
Mill Foundation (DEVA)	$43,682	$0	$0	$17,106	$4,657	$6,287	$0	$28,051	$71,733
Mill Tailings (DEVA)	$73,960	$0	$0	$13,322	$6,686	$9,027	$0	$29,035	$102,995
Total Site Cost	$178,442	$58,655	$8,773	$36,945	$21,822	$29,459	$0	$155,654	$334,096

Total Site Cost $334,096

	Direct Cost	Markups	Total
Total Site Cost	$178,442	$155,654	$334,096

Estimate Documentation Report

System:

RACER Version: RACER® Version 11.3.18.0
Database Location: C:\Users\Workstation02\Documents\RACER 11.3\Racer.mdb

Folder:

Folder Name: New Folder

Project:

ID: DEVA
Name: Death Valley National Park
Category: None

Location

State / Country: CALIFORNIA
City: DESERT AREA

Location Modifier	Default	User	Reason for changes
	1.240	#	

Options

Database: System Costs
Cost Database Date: 2016
Report Option: Fiscal

Description DEVA Skidoo EE/CA

Estimate Documentation Report

Site:

ID: Gold Hill
Name: Alternative #4 - Excavation
Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Metals
Secondary: None

Phase Names

Pre-Study
Study
Design
Removal/Interim Action
Remedial Action
Operations & Maintenance
Long Term Monitoring
Site Closeout

Documentation

Description: The Gold Hill Mill Site is located 35 miles south of Furnace Creek, California, in Warm Spring Canyon at an elevation of 2,360 feet above sea level. The Gold Hill Mining District is one of the oldest mining areas within DEVA, with prospecting and work dating from the 1970s. The Gold Hill region is located within DEVA in the southwest corner, in the Panamint Mountain Range, at the northeastern end of Butte Valley and north of Warm Spring. The Site is heavily visisted due to its location next to the Warm Spring Mining Camp and along the road to Butte Valley. This site is accessed via 14 imles of infrequently graded dirt roads requiring high clearance, four-wheel drive vehicles. The Site experiences moderate annual visitation.

The Site covers less than 1 acre and consists of a complete and well-preserved mill with evidence of mercury amalgamation. A spring and an abandoned mining camp are located south of the mill ruins. Minor mill tailings from the amalgamated mercury process used to extract the gold have accumulated in and around the mill workings, primarily on the east side, scattered in and around the equipment, and comingling with native rock.

Support Team: Essi Esmaili, Jeff Oslick, Ryley Robitaille

References:

Environmental Cost Management. 2014. "Preliminary Assessment, 27 Abandoned Minerals Lands Sites, Death Valley National Park, Inyo and San Bernardino Counties, California and Nye County, Nevada." November.

NOREAS, Inc. 2016. "Final Site Inspection Report, Death Valley National Park, Site Inspections of Abandoned Mineral Lands (AML) Sites (Skidoo, Homestake, Journigan's, Starr, Tucki, Cashier and Gold Hill), California and Nevada." October.

Estimator Information

Estimator Name: Ryley Robitaille

Estimate Documentation Report

Estimator Title: Engineer
Agency/Org./Office: NOREAS, Inc.
Business Address: 16361 Scientific Way
Irvine, CA 92618
Telephone Number: (949) 877-3726
Email Address: ryley.robitaille@noreasinc.com
Estimate Prepared Date: 04/30/2020
Estimator Signature: ______________________________ **Date:** ____________________

Reviewer Information

Reviewer Name: Jeff Oslick
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Agency/Org./Office: NOREAS, Inc.
Business Address: 16361 Scientific Way
Irvine, CA 92618
Telephone Number: (949) 467-9105
Email Address: jeff.oslick@noreasinc.com
Date Reviewed: 05/15/2020
Reviewer Signature: ______________________________ **Date:** ____________________

Estimate Costs:

Phase Names	Direct Cost	Marked-Up Cost
Mill Tailings	$73,960	$102,995
Mill Foundation	$43,682	$71,733
Documentation and Meetings	$60,801	$159,368
Total Cost:	$178,442	$334,096
Total Project Cost:	$178,442	$334,096

Phase Documentation:

Phase Type: Removal/Interim Action
Phase Name: Mill Tailings
Description: Excavation and off-Site disposal involves the removal of contaminated materials, final classification of the waste as RCRA Subtitle C or other regulated hazardous waste, and subsequent disposal at a facility licensed to accept the waste. The type of facility is dependent on the class and concentration of hazardous materials in the waste. Wastes found to exceed state or federal guidelines for hazardous material must be transported to a RCRA landfill for disposal. Wastes not exceeding the guidelines can be placed in any landfill licensed to accept the waste. All excavated wastes will be managed in accordance with all applicable federal, state, and local requirements.

Estimate Documentation Report

Approach: None
Start Date: #########
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate
Phase Markup Template: DEVA

Technology Markups	Markup	% Prime	% Sub.
Off-site Transportation and Waste Disposal	True	100	0
Hand Excavation	True	100	0
Professional Labor Management	False	0	0

Total Marked-up Cost: $102,994.71

Technologies:

Technology Name: **Off-site Transportation and Waste Disposal (#2)**
User Name: **Off-site Transportation and Waste Disposal**

Description	Default	Value	UOM
System Definition			
Required Parameters			
Waste Type		Hazardous	n/a
Waste Form		Solid	n/a
Condition of Waste		Bulk to remain as bulk	n/a
Volume of Bulk Solid Waste		50	CY
Stabilization		Required	n/a
Transportation Type		Truck	n/a
Truck Distance (One-way)		50	MI
Safety Level		D	n/a

Comments:

Technology Name: **Professional Labor Management (#1)**
User Name: **Professional Labor Management**

Description	Default	Value	UOM
System Definition			
Required Parameters			
Markedup Construction Cost ($)		18413.00	$
Percentage	20.10	20.10	%
Dollar Amount		3701.00	$

Comments:

Estimate Documentation Report

Technology Name: **User Defined Estimate (#2)**
User Name: **Hand Excavation**

Description	Default	Value	UOM
System Definition			
Required Parameters			
Model Name		Hand Excavation	n/a
WBS Type		HTRW	n/a
Selected WBS		331.03.90	n/a
Safety Level		D	n/a

Comments: Two (2) laborers each excavating 6 cubic yards (CY) per day working 10 hours/day. Assuming approximately 50 CY needs to be excavated from the mill tailings. Five (5) total days of work estimated.

Phase Documentation:

Phase Type: Removal/Interim Action
Phase Name: Mill Foundation
Description: Removal of contaminated soil in the mill foundation area by hand.
Approach: Ex Situ
Start Date: #########
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate
Phase Markup Template: DEVA

Technology Markups	Markup	% Prime	% Sub.
Hand Excavation	True	100	0
Off-site Transportation and Waste Disposal	True	100	0
Professional Labor Management	False	0	0

Total Marked-up Cost: $71,733.17

Technologies:

Technology Name: **Off-site Transportation and Waste Disposal (#2)**
User Name: **Off-site Transportation and Waste Disposal**

Description	Default	Value	UOM
System Definition			
Required Parameters			
Waste Type		Hazardous	n/a
Waste Form		Solid	n/a

Estimate Documentation Report

Technology Name: **Off-site Transportation and Waste Disposal (#2)**
User Name: **Off-site Transportation and Waste Disposal**

Description	Default	Value	UOM
System Definition			
Secondary Parameters			
Condition of Waste		Bulk to remain as bulk	n/a
Volume of Bulk Solid Waste		35	CY
Stabilization		Required	n/a
Transportation Type		Truck	n/a
Truck Distance (One-way)		35	MI
Safety Level		D	n/a

Comments: DU-1 (mill foundations) is 2,804 square feet. Assuming a 4-inch layer of soil.

Technology Name: **Professional Labor Management (#1)**
User Name: **Professional Labor Management**

Description	Default	Value	UOM
System Definition			
Required Parameters			
Markedup Construction Cost ($)		12791.00	$
Percentage	20.10	20.10	%
Dollar Amount		2571.00	$

Comments:

Technology Name: **User Defined Estimate (#2)**
User Name: **Hand Excavation**

Description	Default	Value	UOM
System Definition			
Required Parameters			
Model Name		Hand Excavation	n/a
WBS Type		HTRW	n/a
Selected WBS		331.03.90	n/a
Safety Level		D	n/a

Comments: Two (2) laborers each excavating 6 cubic yards (CY) per day working 10 hours/day. Assuming 35 CY needs to be excavated. Three (3) total days of work estimated.

Phase Documentation:

Phase Type: Removal/Interim Action
Phase Name: Documentation and Meetings
Description: Preparation of a Work Plan, Closure Report, and attending project meetings.

Estimate Documentation Report

Approach: Ex Situ
Start Date: May, 2020
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate
Phase Markup Template: DEVA

Technology Markups	Markup	% Prime	% Sub.
Site Close-Out Documentation	True	10	90

Total Marked-up Cost: $159,368.36

Technologies:

Technology Name: **Site Close-Out Documentation (#2)**
User Name: **Site Close-Out Documentation**

Description	Default	Value	UOM
System Definition			
Required Parameters			
Meetings		True	n/a
Work Plans and Reports		True	n/a
Documents		False	n/a
Site Close-Out Complexity		High	n/a
Meetings			
Required Parameters			
Kick Off/Scoping Meetings		True	n/a
Kick Off/Scoping Meetings: Number of Meetings	1	1	EA
Kick Off/Scoping Meetings: Travel		True	n/a
Kick Off/Scoping Meetings: Travelers		1	EA
Kick Off/Scoping Meetings: Days		1	Days
Kick Off/Scoping Meetings: Air Fare		500.00	$
Review Meetings		True	n/a
Review Meetings: Number of Meetings	1	3	EA
Review Meetings: Travel		True	n/a
Review Meetings: Travelers		1	EA
Review Meetings: Days		1	Days
Review Meetings: Air Fare		500.00	$
Regulatory Review Meetings		True	n/a
Regulatory Review Meetings: Number of Meetings	1	2	EA
Regulatory Review Meetings: Travel		True	n/a
Regulatory Review Meetings: Travelers		1	EA
Regulatory Review Meetings: Days		1	Days
Regulatory Review Meetings: Air Fare		500.00	$

Estimate Documentation Report

Technology Name: **Site Close-Out Documentation (#2)**
User Name: **Site Close-Out Documentation**

Description	Default	Value	UOM
Work Plans & Reports			
Required Parameters			
Work Plans		True	n/a
Draft Work Plan		True	n/a
Final Work Plan		True	n/a
Reports		True	n/a
Draft Close-Out Report		True	n/a
Draft Final Close-Out Report		True	n/a
Final Close-Out Report		True	n/a
Progress Reports		True	n/a
Project Duration	12	12	months

Comments:

Cost Detail by Task

Work Phase Name	Work Element	Description	Qty	UOM	Materials	Labor	Equipment	SubBid	Extended Cost
Mill Tailings	Off-site Transportation and Waste Disposal	Bulk Solid Waste Loading Into Disposal Vehicle or Bulk Disposal Container	50	BCY	1.24	1.44	0.51	0.00	159.18
Mill Tailings	Off-site Transportation and Waste Disposal	Transport Bulk Solid Hazardous Waste, Maximum 20 CY (per Mile)	150	MI	0.00	0.00	0.00	2.75	412.92
Mill Tailings	Off-site Transportation and Waste Disposal	Waste Stream Evaluation Fee, Not Including 50% Rebate on 1st Shipment	1	EA	0.00	0.00	0.00	62.00	62.00
Mill Tailings	Off-site Transportation and Waste Disposal	32 Ft. Dump Truck, 6 Mil Liner, disposable	3	EA	30.84	0.00	0.00	0.00	92.52
Mill Tailings	Off-site Transportation and Waste Disposal	Landfill Hazardous Solid Bulk Waste Requiring Stabilization	50	CY	0.00	0.00	0.00	291.40	14,570.00
								Subtotal	**15,296.61**
Mill Tailings	Hand Excavation	Remove Misc. (2 Laborers)	250	HR	0.00	190.13	0.00	0.00	47,533.21
Mill Tailings	Hand Excavation	Project Manager	10	HR	0.00	116.29	0.00	0.00	1,162.87
Mill Tailings	Hand Excavation	Senior Staff Engineer	50	HR	0.00	125.32	0.00	0.00	6,266.08
								Subtotal	**54,962.16**
Mill Tailings	Professional Labor Management	Lump Sum Percentage Labor Cost	1	LS	0.00	3,701.00	0.00	0.00	3,701.00
								Subtotal	**3,701.00**
Mill Foundation	Hand Excavation	Remove Misc. (2 Laborers)	90	HR	0.00	190.13	0.00	0.00	17,111.95
Mill Foundation	Hand Excavation	Project Manager	18	HR	0.00	116.29	0.00	0.00	2,093.17
Mill Foundation	Hand Excavation	Senior Staff Engineer	90	HR	0.00	125.32	0.00	0.00	11,278.95
								Subtotal	**30,484.07**
Mill Foundation	Off-site Transportation and Waste Disposal	Bulk Solid Waste Loading Into Disposal Vehicle or Bulk Disposal Container	35	BCY	1.24	1.44	0.51	0.00	111.42
Mill Foundation	Off-site Transportation and Waste Disposal	Transport Bulk Solid Hazardous Waste, Maximum 20 CY (per Mile)	70	MI	0.00	0.00	0.00	2.75	192.70
Mill Foundation	Off-site Transportation and Waste Disposal	Waste Stream Evaluation Fee, Not Including 50% Rebate on 1st Shipment	1	EA	0.00	0.00	0.00	62.00	62.00
Mill Foundation	Off-site Transportation and Waste Disposal	32 Ft. Dump Truck, 6 Mil Liner, disposable	2	EA	30.84	0.00	0.00	0.00	61.68
Mill Foundation	Off-site Transportation and Waste Disposal	Landfill Hazardous Solid Bulk Waste Requiring Stabilization	35	CY	0.00	0.00	0.00	291.40	10,199.00
								Subtotal	**10,626.80**
Mill Foundation	Professional Labor Management	Lump Sum Percentage Labor Cost	1	LS	0.00	2,571.00	0.00	0.00	2,571.00
								Subtotal	**2,571.00**
Documentation and Meetings	Site Close-Out Documentation	Automobile, Rental	6	DAY	0.00	0.00	0.00	59.23	355.41
Documentation and Meetings	Site Close-Out Documentation	Per Diem (per person)	6	DAY	0.00	0.00	0.00	129.00	774.00
Documentation and Meetings	Site Close-Out Documentation	Airfare (Client meetings)	1	LS	0.00	0.00	0.00	3,000.00	3,000.00
Documentation and Meetings	Site Close-Out Documentation	Senior Project Manager	26	HR	0.00	126.46	0.00	0.00	3,287.95
Documentation and Meetings	Site Close-Out Documentation	Senior Project Manager	2	HR	0.00	126.46	0.00	0.00	252.92
Documentation and Meetings	Site Close-Out Documentation	Project Manager	80	HR	0.00	116.29	0.00	0.00	9,302.98
Documentation and Meetings	Site Close-Out Documentation	Project Manager	194	HR	0.00	116.29	0.00	0.00	22,559.72
Documentation and Meetings	Site Close-Out Documentation	Senior Staff Engineer	5	HR	0.00	125.32	0.00	0.00	626.61
Documentation and Meetings	Site Close-Out Documentation	Staff Engineer	65	HR	0.00	105.74	0.00	0.00	6,873.21
Documentation and Meetings	Site Close-Out Documentation	Staff Scientist	7	HR	0.00	106.24	0.00	0.00	743.67
Documentation and Meetings	Site Close-Out Documentation	Word Processing/Clerical	28	HR	0.00	54.42	0.00	0.00	1,523.71
Documentation and Meetings	Site Close-Out Documentation	Word Processing/Clerical	166	HR	0.00	54.42	0.00	0.00	9,033.41
Documentation and Meetings	Site Close-Out Documentation	Draftsman/CADD	8	HR	0.00	85.08	0.00	0.00	680.62
Documentation and Meetings	Site Close-Out Documentation	Draftsman/CADD	21	HR	0.00	85.08	0.00	0.00	1,786.62
								Subtotal	**60,800.82**
									178,442.47