Argonaut Mine Tailings Pile
AOC-5 Removal Assessment Report
Jackson, California

TDD No.: TO-02-09-13-01-0004
Project No.: EE-002693-2213

January 2014

Prepared for:
U.S. ENVIRONMENTAL PROTECTION AGENCY
Region 9

Prepared by:
ECOLOGY AND ENVIRONMENT, INC.
1940 Webster Street, Suite 100
Oakland, California 94612

Table of Contents

List of Tables

List of Figures

List of Abbreviations and Acronyms

ACEHD	Amador County Environmental Health Department
AOC	area of concern
bgs	below ground surface
COC	contaminant of concern
DQO	Data Quality Objective
DTSC	California Department of Toxic Substances Control
E & E	Ecology and Environment, Inc.
EMAD	Eastwood Multiple Arch Dam
J	concentration is estimated
mg/kg	milligrams per kilogram
µg/L	micrograms per liter
RPD	relative percent difference
r-RSL	Regional Screening Level for a residential scenario
R9 Laboratory	United States Environmental Protection Agency Region 9 Richmond Laboratory
SAP	Sampling and Analysis Plan
START	Superfund Technical Assessment and Response Team
STLC	Soluble Threshold Limit Concentration
TDD	Technical Direction Document
TTLC	Total Threshold Limit Concentration
U.S. EPA	United States Environmental Protection Agency
XRF	x-ray fluorescence

1 Introduction

The United States Environmental Protection Agency (U.S. EPA) Region 9 tasked Ecology and Environment, Inc.'s (E & E's) Superfund Technical Assessment and Response Team (START) to conduct a time-critical removal assessment at the Argonaut Mine Tailings Pile (site) located in the City of Jackson, Amador County, California (Figure 1 in Appendix A). These assessment activities were conducted under E & E's U.S. EPA Region 9 START Contract number EP-S5-08-01, under Technical Direction Document (TDD) number TO-02-09-13-01-0004. The U.S. EPA is concerned about exposure risks posed by the site based on findings of previous assessments conducted for the U.S. EPA and California Environmental Protection Agency's Department of Toxic Substances Control (DTSC), which documented contamination from arsenic and other toxic heavy metals (U.S. EPA 1998a and b, URS 2009) and outlined a removal action plan (URS 2011). The previous U.S. EPA assessment work was initiated in 2013 and is presented in the *Argonaut Mine Tailings Pile Removal Assessment Report (Argonaut Assessment Report)*, E & E, December 2013 (E & E 2013b). However, the assessment did not include Area of Concern No. 5 (AOC-5). Characterization work at AOC-5 was originally scheduled to occur as part of the July 2013 assessment work; however, site access agreements had not been executed with the property owner at AOC-5 at that time.

The assessment of AOC-5 described herein was conducted in September 2013. AOC-5 is an undeveloped residential lot located approximately 100 yards north of the primary tailings storage area for the former Argonaut Mine. It is located on the northeast corner of the intersection of Argonaut Lane and Pioneer Street. AOC-5 consists of assessor's parcel numbers 044-071-002 and 044-071-003 and is approximately 0.39 acres in area.

Prior to mobilizing to the site for the July 2013 assessment work, and in order to support the U.S. EPA's environmental data collection activities, the START identified project data quality objectives (DQOs) and developed the *Sampling and Analysis Plan, Argonaut Mine Tailings Pile Assessment, Jackson California* (SAP), July 2013 (E & E 2013a). The scope of work and objectives outlined in the SAP were derived based on direction from the U.S. EPA. The SAP describes the project and data use objectives, data collection rationale, data quality assurance goals, and requirements for sampling and analysis activities. It also defined the sampling and data collection methods used during the removal assessment work. A copy of the SAP is included as Appendix B.

In general, the objective of the assessment work at AOC-5 was to characterize contaminant concentrations in shallow soil to provide the appropriate environmental data required to determine whether an imminent and substantial danger to human health or the environment exists and a removal action is warranted. The specific sampling objectives for the assessment were the following:

- Assess potential contamination of surface and shallow subsurface soils previously identified as being impacted by arsenic at hazardous concentrations (Amador County Environmental Health Department [ACEHD] 2003);

- Assess potential contamination of subsurface sediments in an ephemeral watercourse that traverses the subject property, including areas where low-pH runoff was identified by the ACEHD during a 2003 assessment.

This report was prepared based on information collected from the historical file review and during the July 2013 and September 2013 START field assessment activities. This report contains a summary of historical documents related to AOC-5, a discussion of the E & E START September 2013 site activities, a discussion of laboratory analytical data from this assessment, and a discussion of the findings from this assessment. A more complete description of the entire Argonaut Mine Tailings Pile site and related assessment data are included in the *Argonaut Assessment Report* (E & E 2013b).

2 Site Background

2.1 AOC-5 Location and Description

The site is located in a single-family residential neighborhood and consists of open space characterized by surface deposits of unprocessed and partially processed ore, and processed mine tailings (Figure 2 in Appendix A). The site is abutted by houses to the north and east. An undeveloped area used for grazing cattle is located on the opposite side of Argonaut Lane. A residential care facility is located to the south, across Pioneer Street. The approximate geographic coordinates for the site are Longitude 120°47'20.63" West and Latitude 38°21'34.68" North (Figure 1 in Appendix A).

A small surface drainage swale traverses the site from east to west. The swale drains AOC-5, the residences directly east of it, and portions of Buena Vista Drive and El Dorado Way, which are located one block east of Argonaut Lane and AOC-5. Water draining from these areas enters AOC-5 on the east side and discharges to a drain inlet and culvert adjacent to Argonaut Lane. Runoff entering the culvert is discharged to the cattle pasture located west of the site. Water from the site eventually drains to an unnamed tributary to Stony Creek.

Site soils in AOC-5 are predominantly ore and/or tailings. These soils are generally rocky and acidic (two samples collected by START as part of the September 2013 assessment had pH values of 1.3 and 2.7 respectively). Evidence of metal corrosion (i.e. pitting and discoloration) on sewer manhole covers and grates from contact with acidic soils and surface runoff were observed on the east side of Argonaut Lane, adjacent to AOC-5. Site soils generally do not support vegetation.

The locations of AOC-1 through AOC-5, the approximate parcel boundaries, and other site features are shown on Figure 2 (Appendix A).

2.2 Site Geology and Hydrogeology

Gold deposits in the Jackson area are in a north and northwest trending mile-wide belt of gray to black slate of the Mariposa Formation (Upper Jurassic age), with some interbedded coarse and locally sheared conglomerate and minor sandy layers. Massive greenstone of the Logtown Ridge Formation (Upper Jurassic) lies west of the belt of Mariposa Formation slate. Metasedimentary rocks, chiefly graphitic schist, metachert, and amphibolite of the Calaveras Formation (Carboniferous to Permian) are to the east. Several deposits of Tertiary auriferous (gold-bearing) channel gravels are exposed south of Jackson. Alluvial soils, such as Pardee cobbly loam, are found throughout the ground surface in the Jackson area (URS 2009). The ore deposits contain disseminated fine free gold, arsenopyrite (arsenic sulfide), and minor amounts of other sulfide minerals.

The depth to groundwater at AOC-5 and/or the remaining portions of the Argonaut Mine Tailings Pile site is unknown but expected to be between 26 and 48 feet below ground surface (bgs). During the URS investigation, groundwater samples were collected from four borings. The depth to groundwater in those borings was reported as 29 feet bgs (SB-27), 48 feet bgs (SB-30), 26 feet bgs (SB-37), and 27 feet bgs (SB-40) [URS 2009].

2.3 Site History

It is unclear when or how the property at AOC-5 became impacted with mine waste. The Argonaut Mine operated in various forms from the 1850s until 1942. The raw ore was processed at one of two stamp mills located approximately 0.5 mile north of the site and topographically up gradient from AOC-5, the Argonaut Mine, and the Argonaut Tailings Pile.

The Pioneer Mine (later known as the Argonaut Mine) was founded in 1850. It ran as a small-scale operation until 1893. From 1893 until 1942, it was operated by the Argonaut Mining Company.

In 1915 an agreement was reached between mining companies, Central Valley farmers, and other interested parties in California to impound mine tailings. In 1916 the Eastwood Multiple Arch Dam (EMAD) was constructed in an alluvial canyon approximately ½-mile southeast of the Argonaut mine. The purpose of the dam was to impound tailings generated from the Argonaut mining and milling operations. This impounded area became what is now known as the Argonaut Mine Tailings Pile Site, the subject of the July 2013 assessment work.

In 1942 the U.S. Government directed the halt of all domestic gold mining operations in favor of other metals and the Argonaut Mine and associated mills ceased operations in March of that year. A more complete description of the history of the Argonaut mine and associated tailings pile is included in the *Argonaut Assessment Report* (E & E 2013b).

2.4 Previous Investigations

AOC-5: Residential Lot-Tailings Disposal Area

On April 30, 2002, Geotechnical Research Development collected two soil samples from AOC-5 on behalf of the property owner and had them analyzed for arsenic (ACEHD 2003) using EPA Method 200.2/200.8. The apparent purpose of the assessment work was to characterize the site prior to residential development of the property. The arsenic concentrations in these two samples were 120 milligrams per kilogram (mg/kg) and 1,300 mg/kg. Soil or mine waste with an arsenic concentration above 500 mg/kg is considered solid hazardous waste. There was no information available concerning where or how the surface soil samples were collected (ACEHD 2003).

On February 24, 2003, the ACEHD sampled runoff from the two adjacent residential lots. The ACEHD measured the pH of the stormwater runoff with pH indicator strips; all results were in the pH 1 to 2 range (ACEHD 2003). In a letter to Mr. Larry White, the Chief Building Official for the City of Jackson, California, dated March 4, 2003, the ACEHD recommended additional testing for metals solubility and preparation of a work plan to address the hazardous concentrations of arsenic identified at the site prior to approval of the grading plans that had been submitted to the City. On March 7, 2003, the property owner apparently collected and submitted a soil sample for analysis for soluble arsenic using the California Waste Extraction Test for soluble threshold leachability characteristics (STLC). It is not clear where or how the sample was collected, or what the total arsenic concentration in the sample was. Sierra Foothill Laboratory Inc. analyzed the sample, which contained soluble arsenic at 150 micrograms per liter (µg/l), below the threshold for soluble hazardous waste of 5,000 µg/l. No other information was available. However, it does not appear that any subsequent characterization work, remedial work, or property development work has occurred since 2003.

3 START Activities

3.1 Project Objectives

At the direction of the U.S. EPA, the START conducted an assessment at AOC-5 to evaluate the nature and extent of elevated arsenic, lead, and mercury in surface and shallow subsurface soils at the site, and in sediment and surface water potentially discharging from the site. Selected samples were also analyzed for pH to evaluate the potential for the site to discharge acidic runoff. The data generated by this assessment will be used to assess whether removal actions and/or additional assessments are warranted at AOC-5.

3.2 Project Planning Activities

Prior to mobilizing to the site and in order to support the U.S. EPA's environmental data collection activities, the START identified project DQOs and developed the SAP (E & E 2013a). The scope of work and objectives outlined in the SAP were derived based on direction from the U.S. EPA. The SAP described the project and data use objectives, data collection rationale, data quality assurance goals, and requirements for sampling and analysis activities. It also defined the sampling and data collection methods used during the removal assessment work. The SAP is included as Appendix B in electronic copies of the report.

The specific field sampling and chemical analysis information in the SAP were prepared in accordance with the following U.S. EPA documents: *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R 5, March 2001, EPA/240/B 01/003); *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA QA/G 4, February 2006, EPA/240/B-06/001); *Guidance on Choosing a Sampling Design for Environmental Data Collection* (EPA QA/G 5S, December 2002, EPA/240/R 02/005); *Superfund Lead-Contaminated Residential Sites Handbook* (OSWER 9285.7-90, August 2003); and *Uniform Federal Policy for Implementing Environmental Quality System* (EPA/505/F-03/001, March 2005).

Based on previous DTSC, URS, and ACEHD investigations at the Argonaut Mine Tailings Pile Site and at AOC-5, the U.S. EPA determined that arsenic, lead, and mercury were the contaminants of concern (COCs) for soil. The site-specific investigation levels for soils during this assessment were 61 mg/kg for arsenic, 400 mg/kg for lead, and 10 mg/kg for mercury. These investigation levels were based in part on the U.S. EPA's regional screening levels (r-RSLs) for soil in a residential scenario (U.S EPA 2013). Based on direction from the U.S. EPA, the screening level for arsenic corresponds to an estimated excess cancer risk of 10^{-4} for a residential scenario. For the purpose of this investigation, surface soils were assumed to include soils from 0-inches to 2-inches bgs and shallow subsurface soils were considered to be from 12-inches to 18-inches bgs.

In addition to the DQOs and the SAP, the START prepared a site-specific health and safety plan for the removal assessment field work.

3.2.1 Deviations from the SAP

There were several deviations from the proposed methods and procedures described in the SAP. The SAP specified the collection of 5-point composite surface and shallow subsurface samples at AOC-5. However, prior to mobilization the U. S. EPA determined that discrete samples would

also be collected from five locations in AOC-5. These locations included the surface drainage channel where it enters and exits the site. Other discrete sample locations were selected based on professional judgment in an attempt to identify hotspots or define the lateral extent of contamination. Sample location AOC5-D-02 was at the downstream end of the channel near the drain inlet and sample location AOC5-D-03 was at the upstream end where the drainage enters the property. Hot spot sample locations were identified as those lacking vegetation and containing stained or discolored soils, uniform grain size, or otherwise having the characteristics typical of mine wastes. Sample location AOC5-D-04 was near the fence in the northeastern portion of the site and location AOC5-D-05 was on the northern property boundary. Discrete judgmental samples were also collected at location AOC5-D-01, which was located approximately 5 feet east of the property line, in the backyard of the adjacent residence. This sample was collected to evaluate the lateral extent of contaminants in surface and shallow subsurface soils east of AOC-5.

The SAP specified the analysis of all soil samples for pH. However, based on verbal direction from the U.S. EPA only a limited number of biased samples were selected for analysis for pH. Sample AOC5-D-02-00 was selected for pH analysis because it was located on the surface immediately prior to where water discharges from the site and, therefore, would provide information on whether low pH waters were potentially being discharged off site. Sample AOC5-D-05-00 was selected for pH analysis because the surface material at that location was obviously discolored with a thin layer (approximately 1/8-inch to 1/4-inch thick) of metal salts, underlain by grey to black uniformly grained material presumed to be processed mine tailings.

Based on the SAP, samples with total metals concentrations between approximately 10 times their respective STLC values and the total threshold limit concentrations values were to be analyzed for soluble metals. However, based on discussions with the U.S. EPA and due to time and budget constraints, samples were not analyzed for soluble metals.

Although the SAP specified the analysis of all samples using X-ray fluorescence (XRF) technology by U.S. EPA Method 6200, XRF technology was not used to analyze the samples. Because there were only a limited number of samples collected, and the laboratory method is considered more definitive, all samples were submitted to the U.S. EPA Region 9 Laboratory in Richmond, California for selected total metals analysis by U.S. EPA Methods 6010B and 7473.

3.3 Removal Assessment Field Activities

On September 26, 2013, START and the U.S. EPA mobilized to Jackson, California, to perform removal assessment (i.e., soil and sediment sampling) activities at AOC-5. Photographs of select removal assessment activities are included as Appendix C.

Four 5-point composite surface soil samples and five composite shallow subsurface samples (including duplicate sample AOC5-C-04-12-7) were collected from AOC-5. Additionally, five discrete surface and five discrete subsurface soil samples were collected. Except as noted in Section 3.2 samples were collected and analyzed in accordance with the SAP. Surface soil samples were collected from 0 to 2 inches bgs at each sampling location using a plastic or stainless steel scoop. Shallow subsurface soil samples were collected from 12 to 18 inches bgs into clean plastic bags or a laboratory-prepared sample jar using a hand auger or shovel. An

equipment rinse blank was collected by pouring distilled water over cleaned non-dedicated soil sampling tools and collecting the water directly into laboratory-prepared sample containers.

All samples were submitted to the U.S. EPA Region 9 Laboratory in Richmond, California for definitive analysis for arsenic, lead, and other toxic heavy metals using U.S. EPA SW-846 Method 6010B and for mercury using U.S. EPA Method 7473. Sample locations for AOC-5 are shown on Figure 3 and Figure 4 in Appendix A.

4 Results

4.1 Data Quality

Laboratory data generated during the removal assessment were validated by START using the *Region 9 Draft Superfund Data Evaluation/Validation Guidance* (U.S. EPA 2001b). Copies of the data validation and laboratory analytical reports are included in Appendix D. All laboratory analytical data were considered valid, definitive, and suitable for the intended project uses with qualifications.

Data validation reports document the following data issues:

- The relative percent difference (RPD) for antimony and nickel for duplicate samples and AOC5-C-04-12 and AOC5-C-04-12-7 were greater than the allowable maximum RPD of 35 percent for soil; therefore, the results for antimony and nickel in these two samples were considered estimates and marked with a J qualifier.
- Arsenic was detected at a concentration of 3.8 µg/l in the equipment rinse blank (sample ERB-01 in Appendix D). The detected concentration was significantly below the quantitation limit for the soil analysis method. Qualification of the results for arsenic was not necessary since the detected concentrations in all samples were greater than five times the concentrations detected in the rinse blank.
- The pH analyses were performed by the lab past the 24-hour hold time specified by the method; therefore, the results are considered estimates and marked with a J-qualifier.

4.2 Results for Arsenic, Lead, and Mercury in AOC-5

A summary of the results for arsenic, lead, and mercury in AOC-5 is shown in Table 1 (Appendix E). The results for arsenic, lead, and mercury in surface soils are shown on Figure 3 (Appendix A). The results for samples collected from 12 inches to 18 inches bgs are shown on Figure 4.

Arsenic concentrations in soil samples ranged from 27 mg/kg in surface soil sample AOC5-D-01-00 to 25,000 mg/kg in subsurface soil sample AOC5-D-05-12. The former sample was collected in the backyard of the residence that abuts the southeastern portion of the property. Arsenic was detected at 480 mg/kg in the subsurface sample collected at that location. The sample with the maximum arsenic concentration was collected from fine-grained dark gray to black tailings material located adjacent to the property line in the northern portion of the site. Except for the samples collected in the adjacent yard, arsenic concentrations were all above the total threshold limit concentration (TTLC) value (i.e. greater than 500 mg/kg) for classification as hazardous waste by the State of California, and were more than an order of magnitude greater than the project screening level.

Lead concentrations ranged from 30 mg/kg in sample AOC5-D-01-00 to 2,500 mg/kg in subsurface sample AOC5-D-05-12. Except for sample AOC5-C01-00, lead concentrations were above the 400 mg/kg screening level in all composite soil samples collected. Lead concentrations were greater than the 1,000 mg/kg TTLC value for lead in five of the eight composite soil samples. Lead concentrations in discrete samples from locations AOC5-D-01 thru AOC5-D-03

did not contain lead at concentrations above the screening level. Lead was detected at 630 mg/kg in surface sample AOC5-D-04-00 and at 620 mg/kg in subsurface sample AOC5-D-04-12. All samples that were above the screening level for lead were also above the screening level for arsenic.

Mercury concentrations were above the 10 mg/kg screening level in one surface composite soil sample (AOC5-C-01-00) and three subsurface composite soil samples (AOC5-C-01-12, AOC5-C-03-12 and AOC5-C-04-12). The maximum concentration of 22 mg/kg was detected in sample AOC5-C-01-12. Except for sample AOC5-D-05-12 (10 mg/kg), detected mercury concentrations in discrete soil samples were all less than 10 mg/kg. In all samples where mercury concentrations exceeded the screening level, arsenic and lead concentrations also exceeded their screening level and TTLC values.

4.3 Soil pH

Two soil samples from AOC-5 were analyzed for pH. Detected soil pH concentrations were 1.3J in sample AOC5-D-05-00 and pH 2.7J in sample AOC5-D-02-00. The latter sample was collected from surface sediment immediately prior to the drain inlet where runoff from the drainage channel discharges from the site.

5 Summary and Discussion

5.1 Discussion of Soil Sampling Data

Based on the arsenic, lead, and mercury concentrations, pH levels, and visually observed soil color, texture, and grain size, partially processed ore and mine tailings are present in AOC-5. Large sections of the surface and shallow subsurface of AOC-5 are contaminated with arsenic at concentrations that are considered hazardous by the State of California (i.e. greater than 500 mg/kg). Arsenic concentrations in all but two samples collected from AOC-5 were greater than one order of magnitude above the 61 mg/kg screening level. Except possibly to the east, the lateral extent of surface arsenic concentrations above 61 mg/kg was not defined. Arsenic concentrations in subsurface soil samples were all greater than 61 mg/kg; therefore, the lateral extent of subsurface arsenic concentrations above 61 mg/kg was not defined in any direction, including vertically. However, based on the results for samples collected in AOC-1 and AOC-6 at the site, and based on visual observation of terrain, surface cover, vegetation, and soil type, exposed (i.e. surface) mine wastes do not appear to extend past the current property boundaries. Subsurface mine wastes do appear to extend beyond the property boundaries.

Lead and mercury were also detected at concentrations above their screening levels; in all cases, elevated levels of lead and mercury were associated with samples that also yielded arsenic at concentrations above the screening level. This suggests that arsenic can be used as the primary COC and that reducing the exposure risks to arsenic by removal or capping will also reduce exposure risks from other contaminants.

Mercury concentrations were generally higher in the surface samples than in the samples collected from 12 inches to 18 inches bgs at the same location. This result, combined with the relatively low concentrations for total mercury, suggests that mercury is present as an inorganic salt and not as the more volatile and toxic elemental mercury.

Changes in arsenic and lead concentrations generally appeared to be correlated with observed changes in vegetation and soil type. It was visually observed that areas with higher concentrations were generally devoid of vegetation, or the vegetation that was present showed signs of stress. Additionally, although no formal study was made, higher arsenic and lead concentrations appeared to correlate with more stained or discolored material, or with more uniformly fine-grained (generally less than 1 millimeter) gray-black material (i.e. tailings).

5.2 Summary

On September 26, 2013, START collected four 5-point composite surface soil samples and five 5-point composite subsurface samples (including one duplicate) from AOC-5. Additionally, START collected 11 discrete surface and shallow subsurface soil samples (including one duplicate) at five additional locations on or near AOC-5. Arsenic concentrations at AOC-5 were all well above the 61 mg/kg project screening level. Lead concentrations in most samples were also above the 400 mg/kg project screening level. The site is currently unsecured (i.e. unfenced) and open to casual trespassers. Based on the relatively high arsenic and lead concentrations in surface soils, which suggest significant impacts to human health and/or the environment are possible, and the lack of site controls, a remove action may be warranted.

6 References

ACEHD 2003. *Letter from R. Fourt, Registered Environmental Health Specialist with ACEHD to L. White, Chief Building Official, City of Jackson, RE: Proposed Grading and Development at Lots 30 and 31, Argonaut Heights, Jackson (APN 044-071-002 and 044-071-003)*. March 4, 2003.

California EPA 2005. *Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties*. January.

California EPA 2009. *Revised California Human Health Screening Levels (CHHSLs) for Lead. September.*

E & E 2013a. *Sampling and Analysis Plan, Argonaut Mine Tailings Pile Assessment, Jackson California* (SAP), Ecology and Environment Inc., July 2013.

E & E 2013b. *Argonaut Mine Tailings Pile Removal Assessment Report*, Ecology And Environment Inc., December 2013.

URS 2009. *Argonaut Mine Tailings Site, Site Investigation Report, Draft.* URS Corporation, March 2009.

URS 2011. *Interim Soil Removal Action Work Plan, Argonaut Mine Tailings Site, Jackson, California, Draft Final.* URS Corporation, June 2011.

U.S. EPA. 1998a *Remedial Site Assessment Decision, Argonaut Mine Tailings, Pioneer Mine,* EPA ID# CAD983650011, June 1998.

U.S. EPA, 1998b, *Preliminary Assessment, Argonaut Mine Tailings (Pioneer Mine),Argonaut Lane, Hoffman Street, Jackson, Amador County, California,* October 1998.

U.S. EPA, 1991. *Management of Investigation-Derived Wastes During Site Inspections*, Office of Emergency and Remedial Response, OERR Directive 9345.3-02, May.

U.S. EPA, 2001a. *Requirements for Quality Assurance Project Plans* (EPA QA/R 5, EPA/240/B 01/003), March.

U.S. EPA, 2001b. *Region 9 Draft Superfund Data Evaluation/Validation Guidance* (EPA Region 9 R9/QA/00.4.1), March.

U.S. EPA, 2002. *Guidance on Choosing a Sampling Design for Environmental Data Collection,* (U.S. EPA QA/G5S, EPA/240/R 02/005) December.

U.S. EPA, 2003. *Superfund Lead-Contaminated Residential Sites Handbook* (OSWER Directive 9285.7-90), August.

U.S. EPA, 2005. *Uniform Federal Policy for Implementing Environmental Quality System,* (EPA/505/F-03/001), March.

U.S. EPA, 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA/240/B-06/001), February.

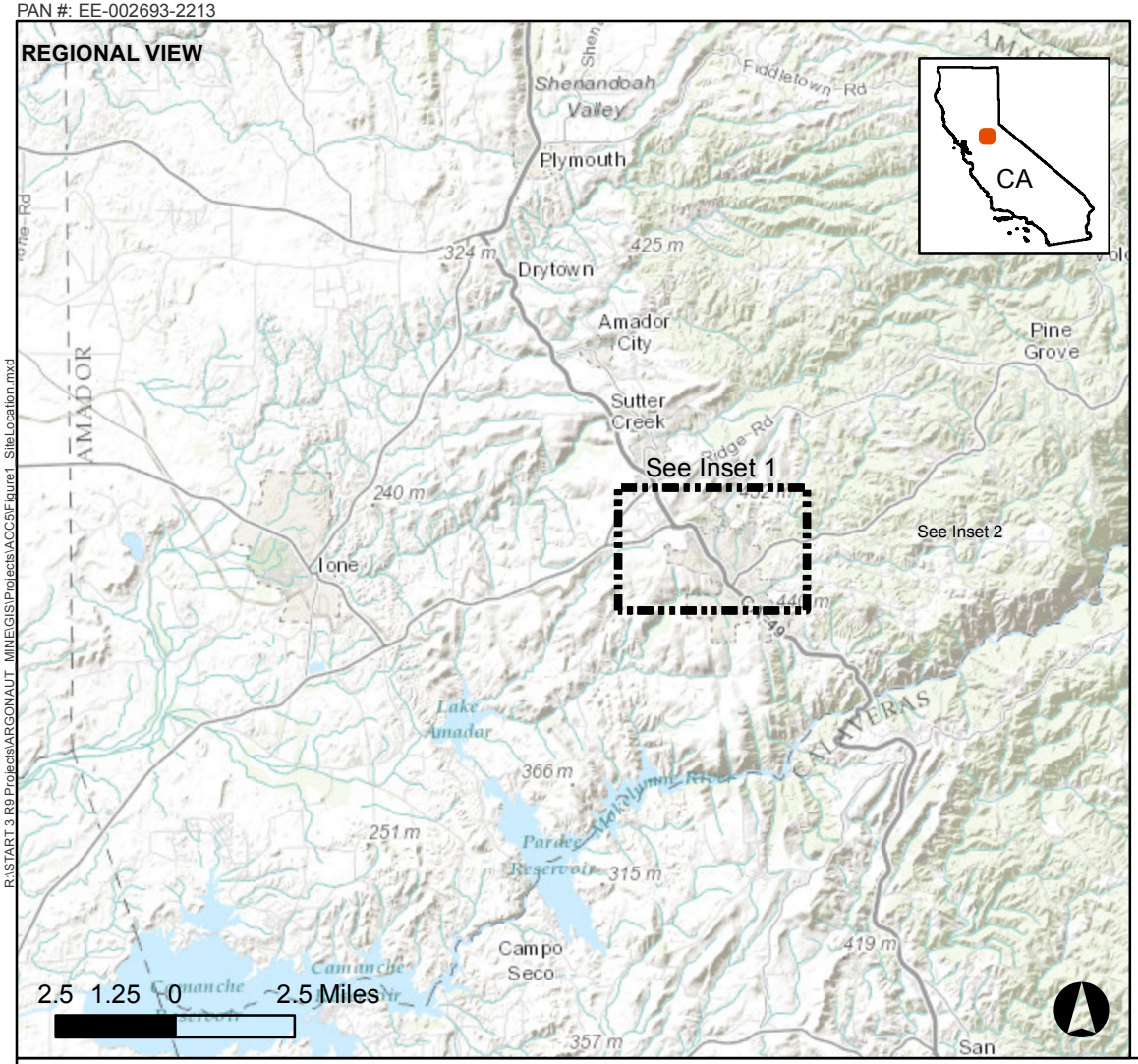
U.S. EPA, 2007. *Method 6200 Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment, Revision O,* February.

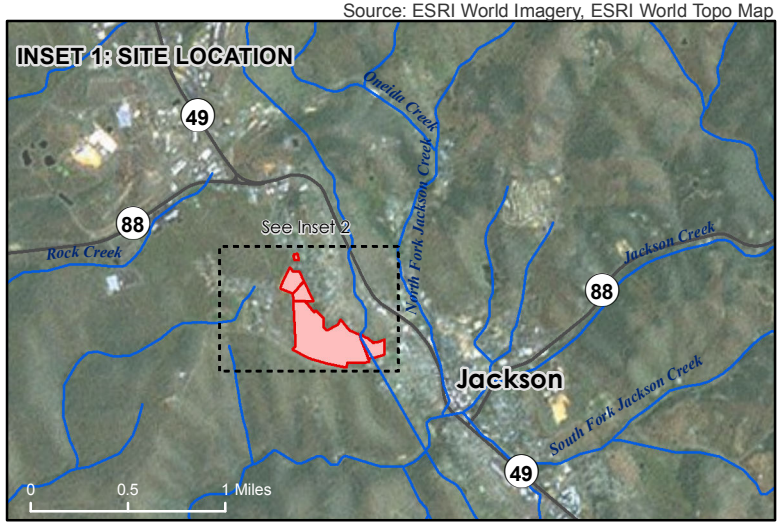
U.S. EPA, 2013. *Regional Screening Levels for Chemical Contaminants at Superfund Sites*, May, 2013.

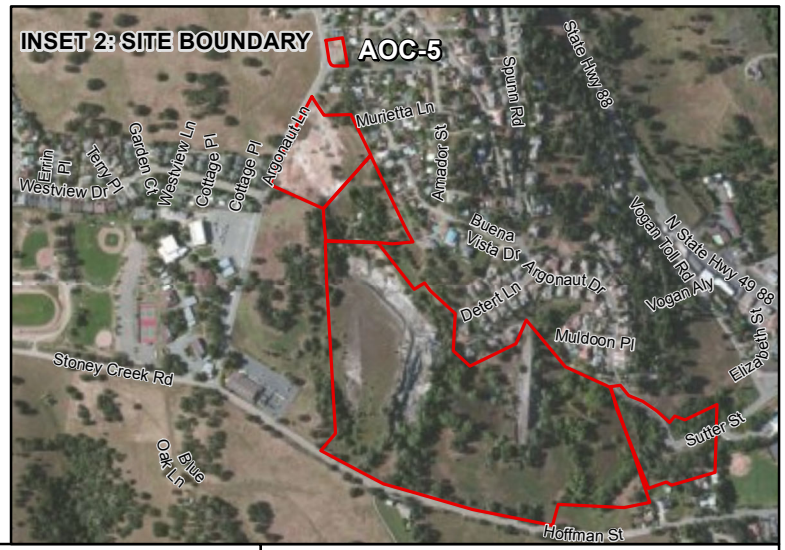
A Figures

TDD #: TO-02-09-13-01-0004
PAN #: EE-002693-2213

Source: ESRI World Imagery, ESRI World Topo Map







R:\START 3 R9 Projects\ARGONAUT_MINE\GIS\Projects\AOC5\Figure1_SiteLocation.mxd

LEGEND

- Site Boundaries
- Rivers
- Major Roads

Figure 1

Site Location Map
AOC-5
Argonaut Mine Tailings Pile

Jackson, California

ecology and environment, inc.
International Specialists in the Environment

TDD #: TO-02-09-13-01-0004, PAN #: EE-002693-2213

Source: ESRI World Imagery, World Street Map

LEGEND

- Vats and Tanks Associated with the Cyanide Plant in AOC2
- Approximate AOC Boundary
- Taxlots (Labeled with 12 digit ID if within the site boundary)
- Culvert
- Surface Drainage (Approximate)
- Underground Drainage (Approximate)

AOC: Area of Concern

044-071-020: Amador County Assessor's Parcel Number

0 250 500 1,000 Feet

Figure 2

Site Features Map
Argonaut Mine Tailings Pile

Jackson, California

ecology and environment, inc.
International Specialists in the Environment

R:\START 3 R9 Projects\ARGONAUT_MINE\GIS\Projects\FirstDraftReportFigures\Figure2_SiteFeatures.mxd

Source: ESRI World Imagery

R:\START 3 R9 Projects\ARGONAUT_MINE\GIS\Projects\SeptemberSamplingAddendumFigure3_AOC5_PbAsHg.mxd

LEGEND

- Composite sample aliquot location
- Discrete sample location
- Direction of Flow
- Surface Drainage Channel
- Approximate Decision Unit Boundary
- Approximate AOC Boundary

ESLs:
Lead: 400
Arsenic: 61
Mercury: 10

Sample ID	Lead Concentration	Arsenic Concentration	Mercury Concentration

Notes:
All concentrations in milligrams per kilogram (mg/kg)
US EPA - United States Environmental Protection Agency
Bold - Above Environmental Screening Level (ESL)
C - 5 point composite soil sample
D - Discrete soil sample
AOC - Area of Concern

Analytical Methods:
Lead/Arsenic by US EPA Method 6010C/SOP503 on unprocessed sample, results reported as dry weight and Mercury by US EPA Method 7473/SOP535.

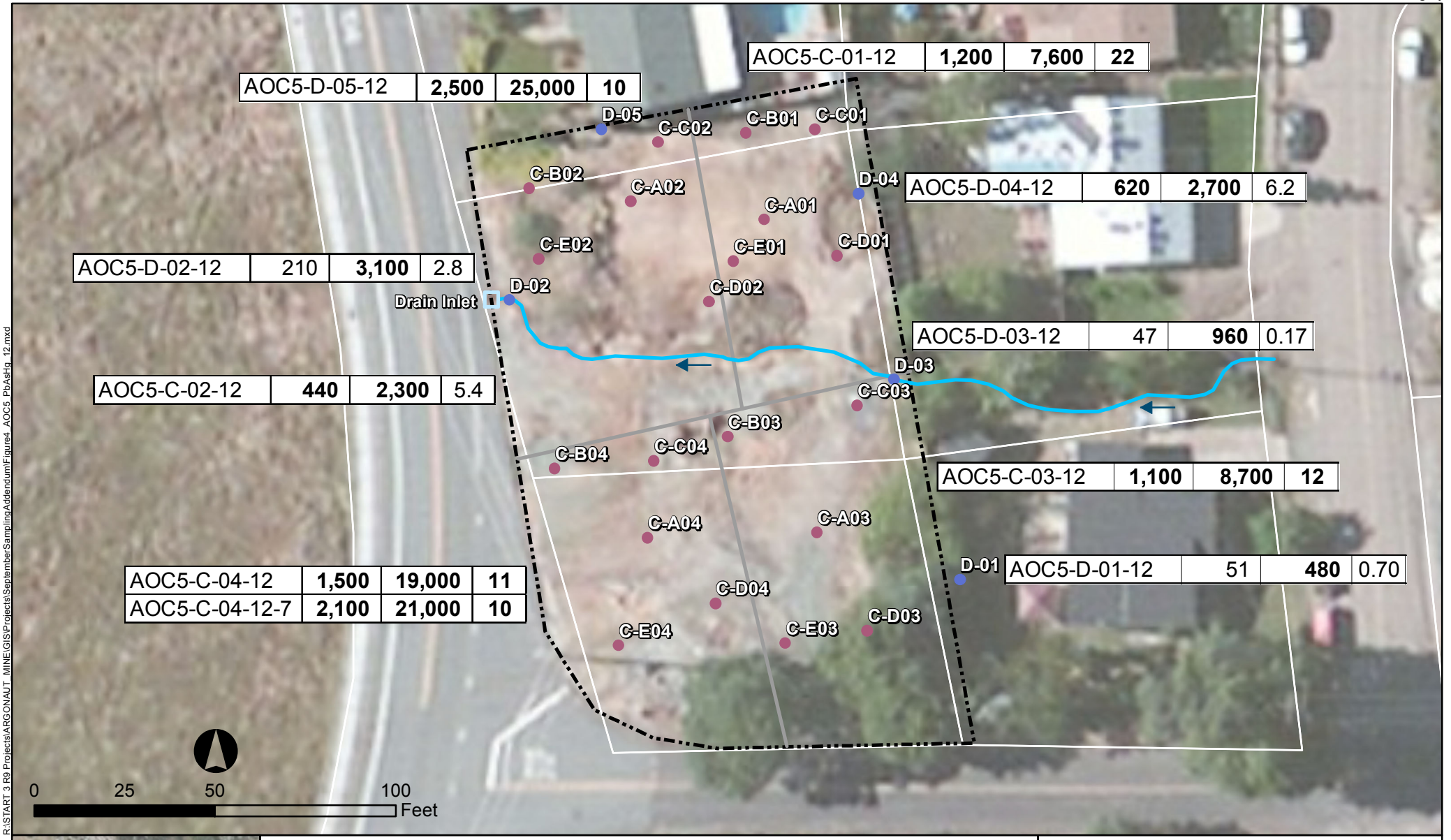
Figure 3

AOC-5: Lead, Arsenic, and Mercury Concentrations in Surface Soil Samples Argonaut Mine Tailings Pile

Jackson, California

ecology and environment, inc.
International Specialists in the Environment

Source: ESRI World Imagery



R:\START 3 R9 Projects\ARGONAUT_MINE\GIS\Projects\SeptemberSamplingAddendumFigure4_AOC5_PbAsHg_12.mxd

LEGEND

- Composite sample aliquot location
- Discrete sample location
- Direction of Flow
- Surface Drainage Channel
- Approximate Decision Unit Boundary
- Approximate AOC Boundary

ESLs:
Lead: 400
Arsenic: 61
Mercury: 10

Sample ID	Lead Concentration	Arsenic Concentration	Mercury Concentration

Notes:
All concentrations in milligrams per kilogram (mg/kg)
US EPA - United States Environmental Protection Agency
Bold - Above Environmental Screening Level (ESL)
C - 5 point composite soil sample
D - Discrete soil sample
AOC - Area of Concern

Analytical Methods:
Lead/Arsenic by US EPA Method 6010C/SOP503 on unprocessed sample, results reported as dry weight and Mercury by US EPA Method 7473/SOP535.

Figure 4

AOC-5: Lead, Arsenic, and Mercury Concentrations in Subsurface Soil Samples Argonaut Mine Tailings Pile

Jackson, California

ecology and environment, inc.
International Specialists in the Environment

B Sampling and Analysis Plan

(Included Electronically on Attached CD)

C Photo Documentation

Argonaut Mine Tailings Pile AOC-5 Removal Assessment Report-Photolog
Jackson, Amador County, California

PHOTO 1

Date: September 26, 2013

Direction: Down

Photographer: B. Milton

Location: 12-inch to 18-inch aliquot for composite sample AOC5-C-02-12

Description: Note color change from yellow/red/brown (ore) to gray/black (tailings) at approximately 12 inches below ground.

PHOTO 2

Date: September 26, 2013

Direction: North

Photographer: B. Milton

Location: Sample location AOC5-D-01 in backyard east of AOC-5.

Description: Yellow case in center of photo denotes sample location.

PHOTO 3

Date: September 26, 2013

Direction: Northeast

Photographer: B. Milton

Location: Intersection of Pioneer St. and Argonaut Lane, Jackson, California.

Description: Looking NE at AOC-5 from west side of Argonaut Lane. Note stained and discolored soils.

PHOTO 4

Date: September 26, 2013

Direction: Northeast

Photographer: B. Milton

Location: Southwest portion of AOC-5 looking northeast.

Description: Note stained soils. Gray-black material is likely tailings.

PHOTO 5

Date: September 26, 2013

Direction: North

Photographer: B. Milton

Location: Southwest portion of AOC-5 looking north.

Description: Note stained soils. Gray-black material is likely tailings.

PHOTO 6

Date: July 10, 2013

Direction: North-Northwest

Photographer: B. Milton

Location: Near center of AOC-5.

Description: Western half of ephemeral drainage in center of photo. Flows to west (left) to a drain inlet at Argonaut Lane.

PHOTO 7

Date: September 26, 2013

Direction: East

Photographer: B. Milton

Location: Near center of AOC-5.

Description: Note staining and discoloration, lack of vegetation or stressed vegetation in surface soils.

D Data Validation and Laboratory Analytical Reports

(Included Electronically on Attached CD)

E Table

Table 1. Summary of Arsenic, Lead, and Mercury Soil Sample Results in AOC-5
Argonaut Mine Tailings Pile, Jackson, California

TDD #: TO-02-09-13-01-0004 **PAN #: EE-002693-2213**

Sample ID	Date Collected	Arsenic (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Comment
AOC5-C-01-00	09/26/13	**1100**	150	0.95	
AOC5-C-01-12	09/26/13	**7600**	**1200**	**22**	
AOC5-C-02-00	09/26/13	**3700**	**590**	3.6	
AOC5-C-02-12	09/26/13	**2300**	**440**	5.4	
AOC5-C-03-00	09/26/13	**7200**	**1100**	**12**	
AOC5-C-03-12	09/26/13	**8700**	**1100**	**12**	
AOC5-C-04-00	09/26/13	**8200**	**1500**	8.5	
AOC5-C-04-12	09/26/13	**19000**	**1500**	**11**	
AOC5-C-04-12-7	09/26/13	**21000**	**2100**	**10**	
AOC5-D-01-00	09/26/13	27	30	0.23	Surface sample in adjacent yard.
AOC5-D-01-12	09/26/13	**480**	51	0.70	Sample from 12 inches to 18 inches below ground in adjacent yard
AOC5-D-02-00	09/26/13	**2200**	220	2.1	soil pH=2.7J, collected from drainage at down gradient perimeter of site.
AOC5-D-02-12	09/26/13	**3100**	210	2.8	
AOC5-D-03-00	09/26/13	**810**	300	2.8	Collected from drainage at up gradient perimeter of site.
AOC5-D-03-12	09/26/13	**960**	47	0.17	
AOC5-D-04-00	09/26/13	**2800**	**630**	5.5	
AOC5-D-04-12	09/26/13	**2700**	**620**	6.2	
AOC5-D-05-00	09/26/13	**1300**	270	4.2	soil pH=1.3J
AOC5-D-05-12	09/26/13	**25000**	**2500**	**10**	
Screening Level		61	400	10	
TTLC Concentration		500	1,000	20	

Notes:
Analysis for arsenic and lead by U.S. EPA Method 6010C/SOP503 on unprocessed sample, results reported as dry weight.
Analysis for mercury by U.S. EPA Method 7473/SOP535
Analysis for pH by U.S. EPA Method 9040C/9045D/SOP582
-7 Indicates sample is a field duplicate
-00 - Sample collected 0 to 2 inches below ground surface
-12 - Sample collected 12 to 18 inches below ground surface
J - Value is estimated
mg/kg - Milligram per kilogram
C- indicates sample is a 5-point composite
D - Discrete sample
AOC - Area of Concern
TTLC-California State Total Threshold Limit Concentration for classification as hazardous waste
Bold - Indicates contaminant was detected at or above the environmental screening level
Screening levels are from the *Sampling and Analysis Plan, Argonaut Mine Tailings Pile Assessment, Jackson, California, July, 2013* , Ecology and Environment Inc. (E & E, 2013).
XRF Samples analyzed by X-ray fluorescence, U.S. EPA Method 6200
Laboratory samples analyzed for arsenic and lead using U.S. EPA Method 6010B and for mercury using U.S. EPA Method 7471A