Sampling and Analysis Plan
Altoona Mine Removal Action

Contract No.: EP-S5-08-01
TDD No.: 09-08-06-0001
Job No.: 002693.2002.01RF02

August 2008

Prepared for:

U.S. ENVIRONMENTAL PROTECTION AGENCY
Region IX

Prepared by:

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Superfund Technical Assessment and Response Team

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List of Abbreviations and Acronyms

AA	Atomic Absorption
AOC	area of concern
bgs	below ground surface
CDFG	California Department of Fish and Game
CVAA	Cold Vapor Atomic Absorption
DTSC	California Department of Toxic Substances Control
DQO	Data Quality Objective
DQI	Data Quality Indicator
E & E	Ecology and Environment, Inc.
ERRS	Emergency Response and Removal Services
ERT	Emergency Response Team
FOSC	Federal On-Scene Coordinator
GPS	Global Positioning System
ICP	Inductively Coupled Plasma
IDW	investigation-derived waste
LCS	laboratory control sample
MS/MSD	matrix spike/matrix spike duplicate
mg/kg	milligrams per kilogram
NA	not applicable or not available

List of Abbreviations and Acronyms (cont.)

NCRWQCB	North Coast Regional Water Quality Control Board
OSWER	Office of Solid Waste and Emergency Response
PA/SI	Preliminary Assessment/Site Inspection
PE	Performance Evaluation
PM	Project Manager
PPE	personal protective equipment
PRG	Preliminary Remediation Goal
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RM	Response Manager
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SOP	standard operating procedure
SSL	Site Screening Level
START	Superfund Technical Assessment and Response Team
TICs	tentatively identified compounds
TM	Task Monitor
USFS	United States Department of Agriculture, Forest Service
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VSP	Visual Sample Plan

1 Introduction

The United States Environmental Protection Agency (U.S. EPA) tasked Ecology and Environment, Inc.'s (E & E's) Superfund Technical Assessment and Response Team (START) to support a U.S. EPA funded Removal Action at Altoona Mine, in Trinity County, California. In order to support the U.S. EPA's environmental data collection activities, the START has identified project data quality objectives and developed this Sampling and Analysis Plan (SAP).

The United States Department of Agriculture's Forest Service (USFS) requested assistance from the U.S. EPA, Region IX Emergency Response Section for the assessment, removal, and/or remediation of mine waste and mercury-contaminated soil at the site. The request was made because a previous investigation of mercury concentrations in biota, water, and sediments in the area, performed by the United States Geological Survey (USGS), found elevated levels of mercury in fish tissue, amphibian carcasses, and aquatic insects. The USGS determined that the Altoona mercury mine may be a significant source of mercury to the Trinity River Watershed and Trinity Lake, which are downstream of the mine. Additional assessments by U.S. EPA and START were done to determine the magnitude and extent of mercury and other metals contamination at the site. The additional assessment information was used to estimate the volume of soil and mine waste that would need to be removed to stabilize the site.

The scope of work and objective outlined in this SAP are derived from direction from the U.S. EPA. This SAP describes the project and data use objectives, data collection rationale, quality assurance goals, and requirements for sampling and analysis activities. It also defines the sampling and data collection methods that will be used for this project. This SAP is intended to reflect accurately the planned data-gathering activities for this support activity; however, site conditions, budget, and additional U.S. EPA direction may warrant modifications. All significant changes are to be documented in site records.

The specific field sampling and chemical analysis information in this SAP was 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); and Uniform Federal Policy for Implementing Environmental Quality System (EPA/505/F-03/001, March 2005).

1.1 Project Organization

The following is a list of project personnel and their responsibilities:

U.S. EPA Federal On-Scene Coordinator (FOSC) – The U.S. EPA On-Scene Coordinator is Michelle Rogow. Ms. Rogow is the primary decision-maker and will direct the project, specify tasks, and ensure that the project is proceeding on schedule and is within budget. Additional duties include coordination of communication with the START Project Manager, U.S. EPA Quality Assurance (QA) Office, and USFS.

Response Manager (RM) – Mr. Jason Coury of the Emergency Response and Removal Services (ERRS) contract is the RM for this project. The RM is responsible for managing removal subcontract personnel, developing and implementing a daily work plan, and managing removal resources.

START Project Manager (PM) – Mr. Michael Friedman of START is the PM. The PM manages the project's data collection efforts and is responsible for implementing the SAP, coordinating project tasks and field sampling, managing field data, and completing all preliminary and final reporting.

Principal Data Users – Data generated during the implementation of this SAP will be utilized by the RM and FOSC to make decisions regarding initial and on-going removal activities.

START Quality Assurance Coordinator – Mr. Howard Edwards is responsible for the development of this SAP. Specifically, Mr. Edwards is responsible for the documentation of project objectives and for preparation and review of the draft and final SAP document. Mr. Edwards will coordinate with the U.S. EPA's Quality Assurance Office as needed.

Sample Analysis and Laboratory Support - The U.S. EPA's Region IX laboratory in Richmond, California, will be responsible for sample analysis by definitive analytical methodologies. The START will be responsible for field sample analysis by non-definitive analytical methodologies.

1.2 Distribution List

Copies of the final SAP will be distributed to the following persons and organizations:

- Michelle Rogow, U.S. EPA, Region IX
- U.S. EPA, Region IX, Quality Assurance Office (through Michelle Rogow)

- E & E START Field Team
- E & E START project files

1.3 Statement of the Specific Problem

Mine tailings and waste rock containing elevated levels of metals, principally mercury and to a lesser extent arsenic, are present at the Altoona Mine site. This contamination has been documented by previous USGS studies and by recent U.S. EPA/START studies. In addition, elevated concentrations of mercury and arsenic are evident in soils and surface water in the vicinity of the mine and in sediments within the gulch that drains from the site towards the East Fork of the Trinity River. Mercury and arsenic from the mine may be impacting the east fork of the Trinity River through runoff via the gulch. Contamination has been documented to be at concentrations at or above human health or risk-based action levels. The USFS is particularly concerned about the exposure risk to wildlife and the public, which have access to downstream waters.

Based primarily upon the documented concentration of mercury, the U.S. EPA has decided to mitigate this threat by removing tailings and waste rock from their current locations and placing the contaminated materials in an on-site repository. In order to document that contaminated materials are being removed effectively, environmental data collection during and following removal is necessary. The results of the data collection activity may also be used to evaluate whether final conditions on the site continue to pose a threat to human health and/ or the environment.

2 Background

2.1 Location

The Altoona Mine is an abandoned mercury mine and ore processing facility located approximately 11 miles west of the town of Castella in Trinity County, California (Figure 2-1). The mine is located on private land within the Shasta-Trinity National Forest. The Shasta-Trinity National Forest is administered by the USFS. The approximate geographic coordinates of the mine are 41°8'12.7" north latitude, 122°32'51" west longitude. The mine is accessible from the west via a series of gravel logging roads from California Route 3 or from the east via Ramshorn Road from Interstate 5.

2.2 Site Description

The Altoona Mine site is comprises an abandoned and backfilled vertical mine with an adjacent ore processing area, former retort areas, and waste rock and tailings piles (Figure 2-2). There are collapsed remains of wooden structures at the ore processing area, and other collapsed wooden structures are scattered about the periphery of the mine site.

The mine itself comprises a two-compartment vertical shaft which is 450 feet deep, and a vertical winze sunk 150 feet below the 450-foot level at a point approximately 230 feet northwest of the [main] shaft. Six levels of horizontal shafts branch out from the main vertical shaft, and two levels of horizontal shafts branch out from the second vertical shaft. The eight horizontal shafts total over 10,000 linear feet.

The mine is located on an escarpment that faces southeast. The ore processing area is located immediately southwest of the surmised location of the main shaft. The base of the tailings piles are located approximately 80 feet southeast, below the elevation of the processing area (down slope). Based on START global positioning system (GPS) survey measurements, the total area of the mine and its associated tailings piles is approximately eight acres.

Directions to Altoona Mine Site

Directions to the Site:
From Castella on the Forest Service Rd. 25 - Travel west for approximately 17 miles.
After crossing a concrete bridge with a large culvert, on a switchback, take the first dirt road - 580W - up the hill.
Follow the road which is marked with 3 pink survey flags on the tree at each intersection, to the site.

DIGITALGLOBE

25

580W

133

EPA Camp

Altoona Mine

Ramshorn Meadow Creek Rd

0 0.25 0.5 1 Miles

N

Roads

Ownership

Figure 2-1

USFS

EPA Region 9 GIS Center

SFD0801612.4

June 30, 2008

Figure 2-2
Altoona Mine Site
Operations Map

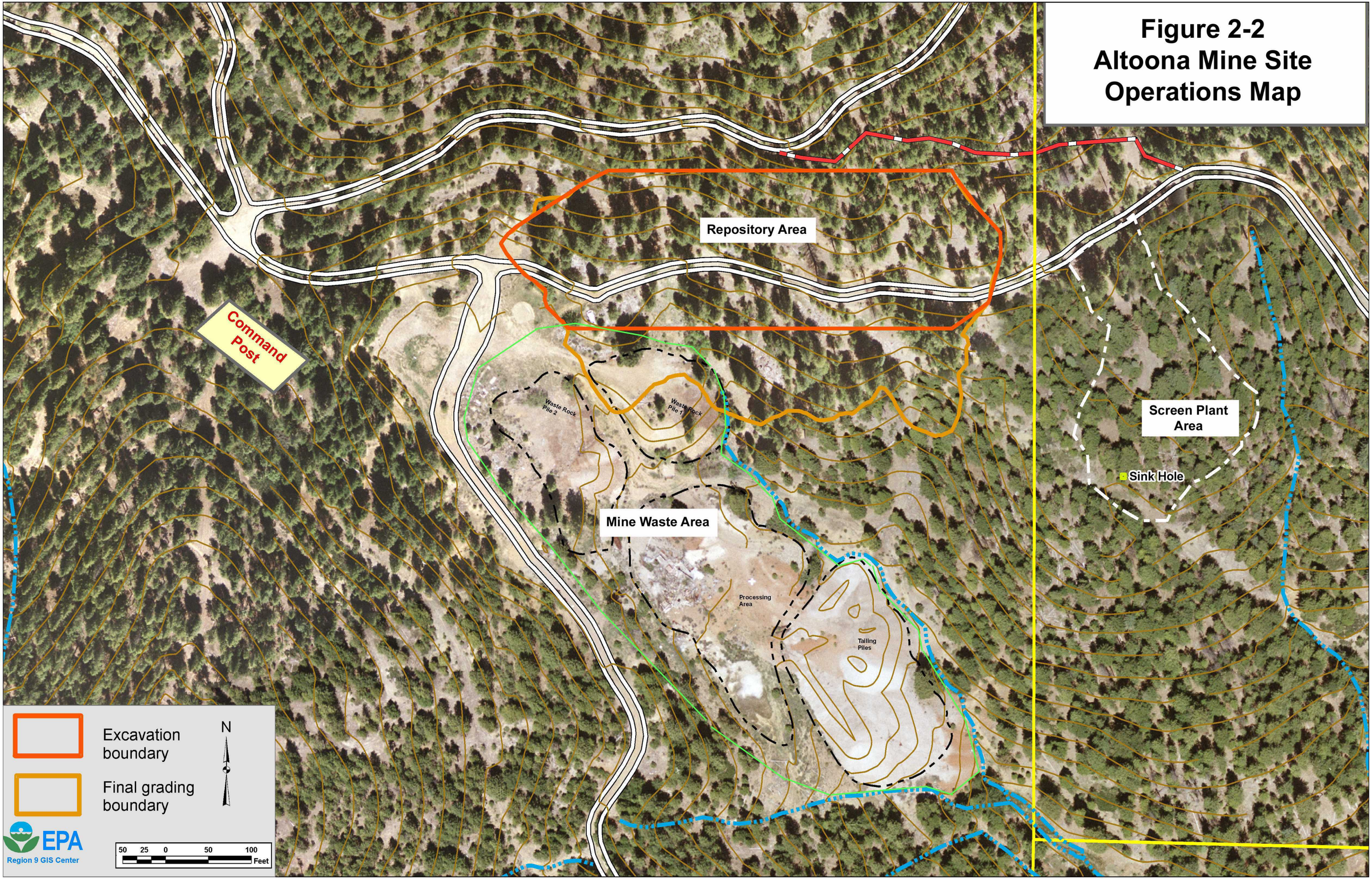

Figure 2-3
Altoona Mine Site
Upper Soda Gulch Area Map

50 25 0 50 100 Feet

EPA
Region 9 GIS Center

Excavation boundary

Final grading boundary

ALT-CK-120 Sample ID

Sample location

47.6 Mercury result

170 Arsenic result

Mercury results	Arsenic results
2.00 - 50.00	17.00 - 50.00
50.001 - 100.00	50.01 - 100.00
100.01 - 300.00	100.01 - 300.00
300.01 - 1000.00	300.01 - 1000.00
1000.01 - 5000.00	1000.01 - 5000.00
5000.01 - 22200.00	5000.01 - 7000.00

N

SFD0801620.4

Water emerges from the subsurface at an area immediately down-gradient of the tailings piles and flows down Soda Gulch (Figure 2-3) for approximately one mile to merge with the East Fork of the Trinity River. Flowing water was not observed on the mine site or immediately up-gradient of the mine site. According to mining maps, water appears to emanate from the Castella Drain, a horizontal adit that was used to dewater the mine tunnels when working below the water table. Water flows from the Castella Drain year-round.

2.3 Site History

Cinnabar mining and mercury extraction operations at the site date back to 1871. Major periods of mine operation were from 1875 to 1880 and 1895 to 1901, when 27,000 flasks (about 1,000 tons) of mercury were produced. Since 1901, the mine operated intermittently by leases, and produced less mercury than in previous years. Previous START reports indicated USFS file reviews showed the mine was reworked from 1943 to 1945 and from 1955 to 1960. A California Department of Fish and Game (CDFG) document from 1966 indicates that the mine was in full operation at that date. Another CDFG document references a smelting operation at the mine in 1968. A California Department of Toxic Substances Control (DTSC) drive-by survey in 1989 indicated that the mine site was in ruins.

2.4 Previous Investigations and Regulatory Involvement

In 1968, dewatering of the mine was removing up to 300 gallons per minute into Soda Gulch, and the North Coast Regional Water Quality Control Board (NCRWQCB) established water quality discharge limits for the mine operations. In 1969, a CDFG letter indicated that the mine effluent was having “an influence on the trout population” downstream. Assay tests performed on trout using mine effluent resulted in the death of the fish tested.

In 1989, the DTSC collected and analyzed two surface water samples from the Altoona site, one from the bottom of the tailings pile and one from 220 to 300 feet downstream. Mercury concentrations in the DTSC samples were below the laboratory detection limit.

In 1990, the DTSC conducted a preliminary assessment (PA) at the mine. The PA recommended a referral to the NCRWQCB (CDM Federal Programs Corporation 2003). There was no information in documents available to the START that indicates that the NCRWQCB had any further involvement at the site.

In 2000 and 2001, the USGS collected samples of aquatic insects at and downstream of the Altoona mine as part of a regional investigation of mercury mines within the Sierra Nevada and Shasta-Trinity mountains. The samples were investigated for total mercury and methyl mercury concentrations. The highest total mercury concentration found in the insects from this investigation was 5.439

milligrams per kilogram (mg/kg), from a sample collected in wetlands near the southern toe of the tailings piles. The highest methyl mercury concentration found in the insects was 0.476 mg/kg, also from a sample collected from the wetlands below the tailings piles. Based on relatively the high concentrations of mercury, the USGS has stated that the Altoona Mine was the only mercury hot spot found in the regional investigation (CDM Federal Programs Corporation 2003).

In 2001, CDM Federal Programs Corporation conducted a Preliminary Assessment/Site Inspection (PA/SI) at the Altoona Mine Site on behalf of the USFS. The purpose of the PA/SI was to determine whether Altoona mining operations have had an adverse effect on adjacent Forest Service property and/or the waters of the East Fork of the Trinity River. Six surface water and five sediment samples were collected from the creek below the tailings piles and at intervals down the creek to the east fork of the Trinity River. The samples were analyzed for 17 metals. Results of the sampling indicated that total mercury and arsenic concentrations in surface water and sediment samples generally decreased with distance from the mine site. In addition, in early 2002, six water samples were collected from the same locations for methyl mercury analysis. The methyl mercury results also indicated a decrease in concentration with increased distance from the mine site (CDM Federal Programs Corporation, 2003).

Based on the results of the USGS aquatic insect sampling and the PA/SI, the USFS requested U.S. EPA assistance at the site in 2002.

In September 2005, the START collected 164 soil samples and five water samples at the site. The sample results documented moderate to high concentrations of mercury and arsenic contamination at various areas of the site, including the tailings piles, and showed probable elevated concentrations of mercury and arsenic in Soda Gulch near its outfall to the east fork of the Trinity River. A START report describing the September 2005 sampling event was submitted to the U.S. EPA under Technical Direction Document No. TO1-09-05-08-0003.

Based on the results of the START's September 2005 sampling, the U.S. EPA investigated the possibility of confining mine tailings and other site material in an on-site repository. Under Technical Direction Document No. TO1-09-06-06-0007, additional site activities were conducted by the START in August 2006 that included an investigation of down-gradient contamination and an engineering assessment. The August 2006 investigation documented that mercury and arsenic contamination was impacting Soda Gulch and the east fork of the Trinity River. The engineering assessment identified at least two possible repository locations; one at the mine site and one offsite.

In May 2007, the START conducted an additional investigation of on-site subsurface soils and surface water in the site's vicinity to support the repository site selection process.

3 Project Objectives

3.1 Data Use Objectives

The data generated by implementing this SAP will be used to evaluate the progress of the removal operation and the environmental conditions on the site at the conclusion of the Removal Action. The sampling results will be reviewed to identify and delineate areas above site specific action levels. The data will be used to document the final site conditions.

3.2 Project Task/Sampling Objectives

The U.S. EPA tasked the START to prepare this SAP to support the environmental data collection activities needed to support the removal operation at the site.

Soil sampling followed by immediate field analysis will be implemented to accomplish the project objectives. Definitive laboratory sample analysis will be performed in order to document and validate the field analysis data. Sampling objectives include the following:

- Identify whether soil in the designated Repository Area can be used as backfill or cap material.
- Document the mercury and arsenic concentrations in the infrastructure areas of the site, including: the Screen Plant Area, the Camp Area, the Office/Command Post Area, and other areas at the Site which may be utilized for infrastructure and/or operations.
- Delineate the boundary of the Mine Waste Area excavation.
- Identify whether an area requires additional excavation.
- Document the final concentrations of mercury and arsenic within an area.

3.3 Action Levels

The action levels are based on the threat and exposure resulting from the continuing migration of contaminated sediments from the site to groundwater and surface water. Action levels for the Altoona Mine Site were developed to provide a maximum concentration of mercury at the site which would not adversely

impact aquatic insects, and subsequent fish and humans, down gradient of the site in the East Fork of the Trinity River. The U. S. EPA Emergency Response Team (ERT) West developed models of the drainage basin relevant to the Altoona Mine that incorporated the anticipated water flows on and off the site, the expected sediment loads, and the contaminant concentration limits to affected downstream species. There criteria were used to calculate the acceptable concentration of mercury in soils at the Altoona Site.

The site-specific action levels for the Altoona site are 70 mg/kg for delineation of contamination associated with the mine and 40 mg/kg for the removal.
The following benchmarks were considered prior to establishment of the site-specific action levels:

- Regional Screening Levels for Chemical Contaminants at Superfund Sites, May 20, 2008.
- February 2005 California Regional Water Quality Control Board Site Screening Level.
- Calculation of local background levels for arsenic and mercury.

Benchmarks for mercury and arsenic are presented in Table 3-1 and Table 3-2.

The Region IX PRGs combine current U.S. EPA toxicity values with standard exposure factors to estimate contaminant concentrations in environmental media (soil, air, and water) that are considered protective of humans, including sensitive groups, over a lifetime. Chemical concentrations above these levels would not automatically designate a site as contaminated or trigger a response action. However, exceeding a PRG suggests that further evaluation of the potential risks that may be posed by site contaminants is appropriate.

Background concentrations for the site were calculated based on a review of the previous analytical data collected and recent analytical data collected during the development of this SAP. All possible background sample locations were reviewed and evaluated for potential influence from historical mining activities. All samples locations that were suspected of impacts from mining activities were removed from the background calculations.

3.4 Data Quality Objectives

3.4.1 Data Quality Objective (DQO) Process

The DQO process, as set forth in the U.S. EPA document, *Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA/240/B-06/001),* (U.S. EPA 2006), was followed to establish the data quality objectives for this project. An outline of the process and the outputs for this project are included in Appendix A. The following sections outline the seven step DQO process completed in accordance with the guidance.

3.4.2 Step 1 – State the Problem

The following paragraphs outline Step 1 of the DQO process. A concise description of the problem is given in Section 1.3, Statement of the Specific Problem.

Planning Team

Planning Team members have been identified in Section 1.2, Project Organization. Planning and scoping meetings were held with the U.S. EPA and ERRS starting on June 19 through June 30, 2008.

START will be responsible for data generation, collection and disemmination; report preparation, and quality assurance/quality control. During the field effort the START will report field data to the FOSC and distribute to U.S. EPA GIS support as required for map generation.

Table 3-1 Benchmarks and Data Quality Indicator Goals Definitive Data

Chemical of Potential Concern	Calculated Estimated Average Background Concentration (mg/kg)	Specific Action Level for Removal	U. S. EPA Region IX PRG (mg/kg)	U. S. EPA Region IX SSL (mg/kg)	California Regional Water Quality Control Board SSL (mg/kg)	U. S. EPA Region IX Laboratory Reporting Limits (mg/kg) and SW-846 Method	Accuracy (% Recovery for MS/ MSD)	Precision (RPD from MS/MSD and Duplicates)	Percent Complete
Mercury	13.8	40 (70)	310	NA	10	1.0 – 7471B	75 - 135	<20	> 10%
Arsenic	144	300	0.25	29	5.5	1.0 – 6010B	75 - 135	<20	> 10%

Notes:
mg/kg = milligrams per Kilogram
NA = Not applicable or Not available
PRG = Preliminary Remediation Goal (U. S. EPA October 2004)
( ) = For Delineation Sampling only
MS/MSD: Matrix Spike/Matrix Spike Duplicate
RPD: Relative Percent Difference
CVAA = Cold Vapor Atomic Absorption
ICP = Inductively Coupled Plasma
SSL = Site Screening Level

Table 3-2 Benchmarks and Data Quality Indicator Goals Non-Definitive Data

Chemical of Potential Concern	Calculated Estimated Average Background Concentration (mg/kg)	Site-Specific Action Level for Removal	Innov-X XRF Site Specific MDL SW-846 Method 6200 (mg/kg)	Lumex Soil Method AA Method Detection Limit (mg/kg) Modified 7473	Accuracy (% Recovery of Check Standards) SW-846 Method 6200	Precision (RPD from Duplicates)	Percent Complete
Mercury	13.8	40 (70)	7	0.000,5	65 - 135	<40	> 90%
Arsenic	144	300	5	NA	65 – 135	<40	> 90%

Notes:
mg/kg = milligrams per Kilogram
NA = Not applicable or Not available
( ) = For Delineation Sampling only

RPD: Relative Percent Difference
AA = Atomic Absorption
ICP = Inductively Coupled Plasma

Exposure Scenario
Migration of mercury and arsenic from the site is currently impacting down-slope surface water. If the contamination is not mitigated, it is expected to have the potential to impact both humans and wildlife.

Available Resources
The current budget for the START activities including the planning, coordination, development and implementation of the SAPs, and post sampling activities is $ 559,560. The U.S. EPA has partially funded the START for $300,000. U.S. EPA resources to be used include laboratory analytical services and field analytical instruments.

Other Considerations and Constraints
The scheduling of data collection activities is dictated by the U.S. EPA Funded Removal schedule. Mobilization to the site for removal activities is scheduled to begin on July 8, 2008, with the excavation of the soil repository planned for July 21, 2008. Excavation of the waste piles should commence the week of July 21, 2008.

START personnel conducting data collection activities at the soil repository location will mobilize to the site on July 14, 2008. START field work is not expected to exceed eighty field days.

3.4.3 Step 2 – Identify the Decision
This section describes the decision that requires new data to address the contamination problem. The principal study questions and alternative actions are outlined below.

Principal Study Question 1: Are the concentrations of mercury and/or arsenic in soil to be excavated from the repository area below the site-specific removal action levels?

> Alternative Action 1a: If yes, the associated soil is excavated and used as backfill or cap material.
>
> Alternative Action 1b: If no, the associated soil is excavated, stock-piled, and returned to the repository area.

Principal Study Question 2: What is the lateral extent of the contamination in areas that are to be excavated?

> Alternative Action 2a: If a perimeter area is not contaminated above the site-specific removal action level, the associated soil is not excavated.

Alternative Action 2b: If a perimeter area is contaminated above the site-specific removal action level, the associated soil is excavated and placed in the repository area and additional delineation samples may be required.

Principal Study Question 3: Are the concentrations of mercury and/or arsenic in the removal area below the site-specific action levels?

Alternative Action 3a: If yes, then it may be determined that no further excavation is needed.

Alternative Action 3b: If no, then mercury and arsenic concentrations in site materials and the potential for mercury and arsenic runoff and leaching due to physical parameters will be evaluated, and it may be determined that further excavation is needed.

Principal Study Question 4: What is the final concentration of mercury and/or arsenic in the mine waste area after completion of the removal action?

Alternative Action for Question 4: There are no alternative outcomes for this question. The data will be used to document the concentrations of mercury and arsenic in the mine waste areas after the removal action is complete.

Principal Study Question 5: Are the concentrations of mercury and/or arsenic in the Screening Plant Area and infrastructure areas of the site below the site-specific removal action levels?

Alternative Action for Question 5: There are no alternative outcomes for this question. The data will be used to document the concentrations of mercury and arsenic in the Screening Plant and Infrastructure areas before and after use.

Principal Study Question 6: Are concentrations of mercury in sediments or soil along the Soda Gulch and downstream of the site along Soda Gulch less than the action level?

Alternative Action 6a: If yes, then it may be determined that no further excavation is needed.

Alternative Action 6b: If no, then sediment or soil will be excavated from Soda Gulch and placed in the repository.

.

Decision Statement

XRF and definitive laboratory data will be used to evaluate if material has mercury or arsenic concentrations greater than the site-specific action levels in

order to assist with determining material that needs to be excavated, stockpiled for backfill/cap material, or left in place.

3.4.4 Step 3 – Inputs to the Decision

The following paragraphs describe inputs required to make the decision.

Information Currently Available

A review of available files was conducted while preparing this SAP is summarized in Sections 2.2 and 2.3. Historic monitoring data indicates that mercury and arsenic are present in site soil and downgradient surface water.

New Data Required

The following data are required to resolve the decision statement.

- Field analytical sampling data that will be generated within several hours of sampling.
- Physical site data that will be generated in the field with the GPS mapping, photography, and physical observations.
- Definitive confirmation data that will be generated from samples collected by START and submitted to the U.S. EPA Region IX Laboratory by U.S. EPA SW-846 methods.

Basis for Determining the Action Levels

The basis for determining the action levels is discussed in Section 3.3.

Data Collection Methods

Planned sampling techniques are described in Sections 6.2 of this SAP.

Data Measurement Methods

The site-specific measurement methods are described in Section 5 of this document. The screening-level methods of analyses to determine mercury and arsenic concentrations are outlined in Section 6.3.

3.4.5 Step 4 – Define the Boundaries of the Study

The following summary contains specific characteristics that define the population being studied:

- The mercury and arsenic concentrations in soil, waste rock, tailings and potentially sediment within the specified spatial boundaries.

Spatial Boundaries

New data will be generated from samples collected from the five areas of concern (AOCs) as designated below and shown on Figure 2-2 and Figure 2-3:

- The Repository Area – The repository area is approximately 3 acres.

- Screening Plant Area – The Screening Plant Area has an approximate area of one acre.
- Infrastructure Areas – The Infrastructure Areas include the Camp Area, the Office/Command Post Area and other areas used to stage equipment and personnel during the removal action and may be outside the Operations Area of the site.
- Mine Waste Area - The Mine Waste Area has an approximate area of 5 acres and has three distinct sections: the waste rock piles, the processing area, and the tailings. However, for the purpose of this study, all of the contaminated areas of the mine are considered to be part of the Mine Waste Area.
- Upper Soda Gulch – For the purposes of the sampling event, Soda Gulch is a 1,200 feet long drainage area that is located downgradient of the repository, screening plant, and mine waste areas. Soda Gulch is approximately one mile long from the site to the East Fork of the Trinity River, but only up to approximately 1,200 feet is likely to be sampled as part of the removal action.

Temporal Boundaries

Sample collection at the Screening Area must be done prior to the excavation at the Repository Area. Sample collection at the Repository Area must be started prior to and continued during the excavation of the Repository Area. Delineation samples to evaluate the boundaries of the Mine Waste Area should be completed prior to excavation of the Mine Waste Area. The study of the Mine Waste Area must coincide with the excavation activities at the Mine Waste Area. The data generated from the sample collection and field analysis efforts will be used during the removal and prior to any cap installation.

Based on the above considerations, the following project schedule has been completed/is proposed.

- June 19, 2008 – Verbal authorization to proceed given to START by U.S. EPA
- June 26, 2008 – Scoping Meeting with planning team.
- June 30, 2008 – Scoping Meeting with START team.
- July 11, 2008 – Draft SAP submitted by START to U.S. EPA FOSC for review and comment.
- July 14, 2008 – Comments on Draft SAP received from U.S. EPA FOSC. START mobilizes to Altoona for sampling and analysis of Repository Area.
- July 21, 2008 – ERRS excavation of Repository Area begins.
- July 21, 2008 – ERRS excavation of Waste Pile 1 in the Mine Waste Area begins.
- August 15, 2008 – SAP revisions complete

- August 25, 2008 – ERRS begins excavation of Mine Waste Area for placement into the Repository.

Scale of Decision-Making

The AOCs are described in the "spatial boundary" section above. Each AOC will be divided into multiple decision areas based on known perimeter (e.g. Repository Area) or on data defining the lateral extent of contamination (e.g Mine Waste Area). These individual decision areas will be capable of locating a 12 foot hot spot.

3.4.6 Step 5 – Develop Decision Rules

Site Action Level

The site action levels are specified in Table 3-1 and Table 3-2. The action level for mercury is 40 mg/kg. The action level for arsenic is expected to be approximately 300 mg/kg.

Decision Rule for Decision Units within the Repository Area

1. If the mercury and/or arsenic concentrations in soil for a repository decision unit exceeds the action level then the decision-maker may excavate, stock-pile, and return the soil to the repository.
2. If the and/or arsenic concentrations in soil for a repository decision unit does not exceed the action level then the decision-maker would likely use the soil for back-fill or top cover.

Decision Rule for Decision Units within the Mine Waste Area

1. If the mercury and/or arsenic concentrations in soil/ tailings/ waste rock for a mine waste area decision unit exceeds the action level, then the decision-maker may initiate additional action that would include further excavation or a cap.
2. If the mercury and/or arsenic concentrations in soil/ tailings/ waste rock for a mine waste area decision unit does not exceed the action level, then the decision-maker would likely initiate no further action.

Decision Rule for Decision Units within the Screen Plant and Infrastructure Areas

1. If the mercury and/ or arsenic concentrations in soil within a decision making unit exceeds the action level, then the decision-maker will document the situation in-order to document that level were pre-existing.
2. If the and/ or arsenic concentrations in soil within a decision making unit does not exceed the action level, then the decision-maker will document the situation for comparisons with post removal concentrations.

3.4.7 Step 6 – Specify Tolerable Limits on Decision Errors

Range of the parameter(s) of interest
Based on data from START investigations of the proposed excavation areas, the range of mercury contamination in site materials can be expected to range from 2 mg/kg to 22,200 mg/kg. Arsenic concentrations range from 60 mg/kg to 1,700 mg/kg. Background concentrations, in areas in undisturbed areas away from the mine, range from 2 to 32.4 mg/kg for mercury and 17to 240 mg/kg for arsenic. The Repository Area is expected to contain mercury concentrations between 3 and 740 mg/kg for mercury and 45 to 310 mg/kg for arsenic.

Baseline Condition (The Null Hypothesis) for Excavation Area
The contaminant concentrations in site soils and tailings are greater than or equal to the action levels.

Alternative Condition (The Alternative Hypothesis) for Excavation Area
The contaminant concentrations in site soils and tailings are less than action levels.

Baseline Condition (The Null Hypothesis) for Repository Area and Screening Area
The contaminant concentrations in the repository area are less than action levels.

Alternative Condition (The Alternative Hypothesis) for Repository Area and Screening Area
The contaminant concentrations in the repository area are greater or equal to than the action levels

Decision Error
Decision error and error limit goals are discussed in Appendix A.

3.4.8 Step 7 – Optimize the Design for Obtaining Data
To optimize the sampling design, U. S. EPA and START will use a Triad Approach that utilizes several on-site analytical tools.

3.5 Data Quality Indicators (DQIs)
Data quality indicators (DQIs) are defined as: precision, accuracy, representativeness, completeness, comparability, and method detection limits. The DQIs for this project were developed following the guidelines in *U.S. EPA Guidance for Quality Assurance Project Plans, EPA QA/G 5 Final*. All sampling procedures are documented in Sections 6.2 and 6.3. Standard operating procedures will be followed to ensure representativeness of sample results by obtaining characteristic samples. Approved U.S. EPA methods and standard reporting limits will be used. All data not rejected will be considered complete. Table 3-1 and Table 3-2 documents the site-specific DQI goals for the mercury and arsenic.

3.6 Schedule of Sampling Activities

The field sampling activities are schedule to commence on July 14, 2008. Samples will be submitted for field analysis on July 15, 2008, and laboratory analysis on July 17, 2008. Excavation at the Repository Area will commence on July 21, 2008. Excavation of the waste rock to anable construction of the Repository is expected to commence during the week of July 21, 2008. Excavation of the remaining Mine Waste Areas for placement into the Repository will begin August 25, 2008.

3.7 Special Training Requirements/Certifications

The operation of the field analytical instruments requires specialized training that will be administered, prior to mobilization, to all START personnel scheduled to be onsite.

Data validation requires specialized training and experience. Project management must determine and verify a qualified data validation resource prior to data validation.

Field sampling personnel should be trained and have experience with soil sampling at hazardous waste sites while wearing respiratory protective equipment. One field sampler should be trained and familiar with Global Positioning System (GPS) data collection. All sampling personnel must have appropriate training that complies with 29 Code of Federal Regulations 1910.120. The site-specific health and safety plan for this project is to be appended to this plan by project management (Appendix B).

4 Sampling Rationale and Design

As discussed in previous sections of this SAP, the START reviewed available site information including recent sampling data and the U. S. EPA FOSC's objectives for the Removal Action to determine the specific sampling design.

The removal operation has two principal phases that require data collection. The first is the excavation of soil from the Repository Area. The second is the excavation of waste rock, tailings and contaminated materials from the Mine Waste Area.

The sampling design and rationale for the five AOCs, as outlined in Section 3.4.5, is discussed below. Figure 2-2 shows the AOCs within the Mine Waste Area while Figure 4-1 outlines the sample locations. Table 4-1 summarizes the samples to be collected. Additional samples may be identified and investigated if directed by the U.S. EPA FOSC.

The sampling rationale and design for each AOC is described in more detail in the following sections. For all AOCs, a statistical sampling design, described in Appendix A and in the following subsections, has been determined to be appropriate. The sampling design and locations were determined using statistical features in th software *Visual Sample Plan (VSP) Version 5.1* (Battelle Memorial Institute, 2004). *The Superfund Program Representative Sampling Guidance, Volume 1: Soil* (OSWER Directive 9360.4-10, EPA 540/R-95-141, December 1995) was referenced during development of the DQO process and sampling design. Table 4-2 indicates the input parameters for VSP for each AOC. After collection, samples will be handled and analyzed according to Sections 5.1, 6.2, and 6.3 of this SAP. Sample locations will be recorded in the field logbook as sampling is completed. Individual sample locations will be recorded using GPS equipment. The GPS location of the center point sample will be recorded where five point composite samples are collected in the Repository Area.

Table 4-1 Sampling Summary

Area	Minimum Unique Samples	Expected Unique Samples
Infrastructure Area Sampling (Camp Area, Water Tower, Office Area, Screen Plant Area, Background, etc.)	60	60
Repository Area	60	300
Delineation of Perimeter	50	300
Waste Pile Area	300	600
Sediment Sampling	60	60
Estimated Total Unique Sample	530	1,320

Source: 2008 Ecology and Environment, Inc.

Table 4-2 VSP Input Parameters

Repository Area Sampling	
Probability of detecting a hot spot with the given size	95%
Size of hot spot greater than 10 times back ground	Circle with radius equal to 12 feet
Size of Grid	50 feet with 5 sample point at 20 feet apart
Hot Spot formula for calculating the number of sample locations	Singer and Wickman algorithm
Total initial area to be sampled for Repository Area	136,930 square feet
Mine Waste Area, Delineation and Upper Soda Gulch Sampling	
Probability of detecting a hot spot with the given size	95%
Size of hot spot	circle with radius equal to 12 feet
Size of Grid	20 feet side or interval
Hot Spot formula for calculating the number of sample locations	Singer and Wickman algorithm
Total initial area to be sampled for Mine Waste Area	Up.to 217,800.square feet depending on the U. S. EPA determined extent of excavation.
Total length of Soda Gulch	1,200 feet

Source: 2008 Ecology and Environment, Inc.

4.1 Repository Area Sampling

The START will systematically collect surface soil throughout the proposed Repository Area. The Repository Area will be divided into grid sectors of 50 by 50 feet in dimensions as referenced in Figure 4-1 and Table 4-2. Since only a few samples have previously been collected in this area, the design is based upon an assumption that most of the area contains low concentrations of mercury and arsenic with a few localized areas of mercury and arsenic concentrations that may be greater than the site action levels.

The sample collected from each grid sector will be a five point composite. The sample points will include a central point and four corner compass points located

approximately 20 feet from the central point. Care will be taken to obtain as representative of a sample as possible. If the composite samples contain concentrations of mercury greater than the action limit then each of the five discrete samples will be analyzed for mercury. Once excavation of contaminated soil commences within the Repository Area the sampling design will switch to confirmation sampling as described in Section 4.4 "Mine Waste Area Excavation Sampling".

4.2 Infrastructure Area Sampling

The START will collect surface soil throughout the individual infrastructure areas, including the Screen Plant Area, the Camp Area, the Office/Command Post Area, and any additional areas that may be used for facilities or operations. Each area will be evaluated individually with a combination of systematic sampling and random sampling. Since these areas are not part of the site they are assumed to have background concentrations. Some sample locations will be determined based on proposed use of the area.

4.3 Mine Waste Area Delineation Sampling

To delineate the extent of the contamination around the Mine Waste Area, samples will be collected at compass points 20 feet horizontally from any sample location that exceeds the action level for mercury. The sample should only be collected in a direction away from the Mine Waste Area perimeter. This sampling process will be continued as necessary until the horizontal extent of contamination is delineated. The 20-foot distance between samples creates a grid with a sampling density that is able to locate a potential hot spot with a radius of 12-feet.

4.4 Mine Waste Area Excavation Sampling

To document the concentrations of mercury and arsenic in material left in-place in the mine waste area, the area will be divided into of 20 by 20 feet grid sectors as detailed in Table 4-2. The sampling will be conducted after an area has been excavated.

4.5 Soda Gulch Sediment / Soil Sampling

To document the concentrations of mercury and arsenic concentration in Soda Gulch, the START will sample the gulch along a transect line. The transect line will follow along the center of the gulch for approximately 1,200 feet. The sampling interval will be 20 foot interval as referenced in Figure 4-2. The sampling is statistically equivalent to the grid-based sampling approach described in Section 4.4 and Table 4-2.

4.6 Analytes of Concern

The primary and secondary analytes of concern are mercury and arsenic, respectively. All samples collected in the field will be field analyzed for mercury using the XRF and/or the Lumex® with soil attachment. Ten percent of the samples collected in the field will be sent to a laboratory for definitive analysis for mercury and arsenic.

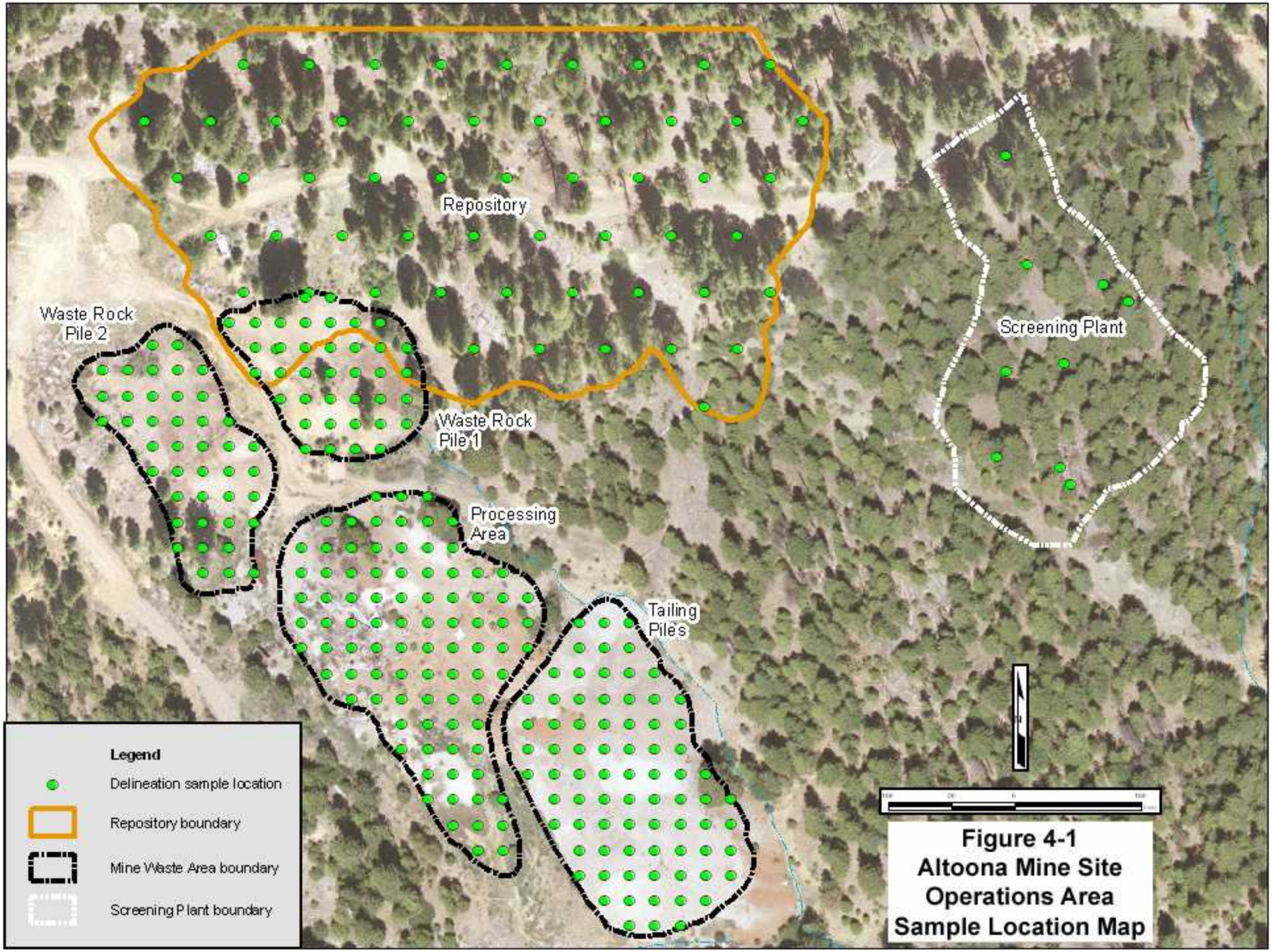

Figure 4-1
Altoona Mine Site Operations Area Sample Location Map

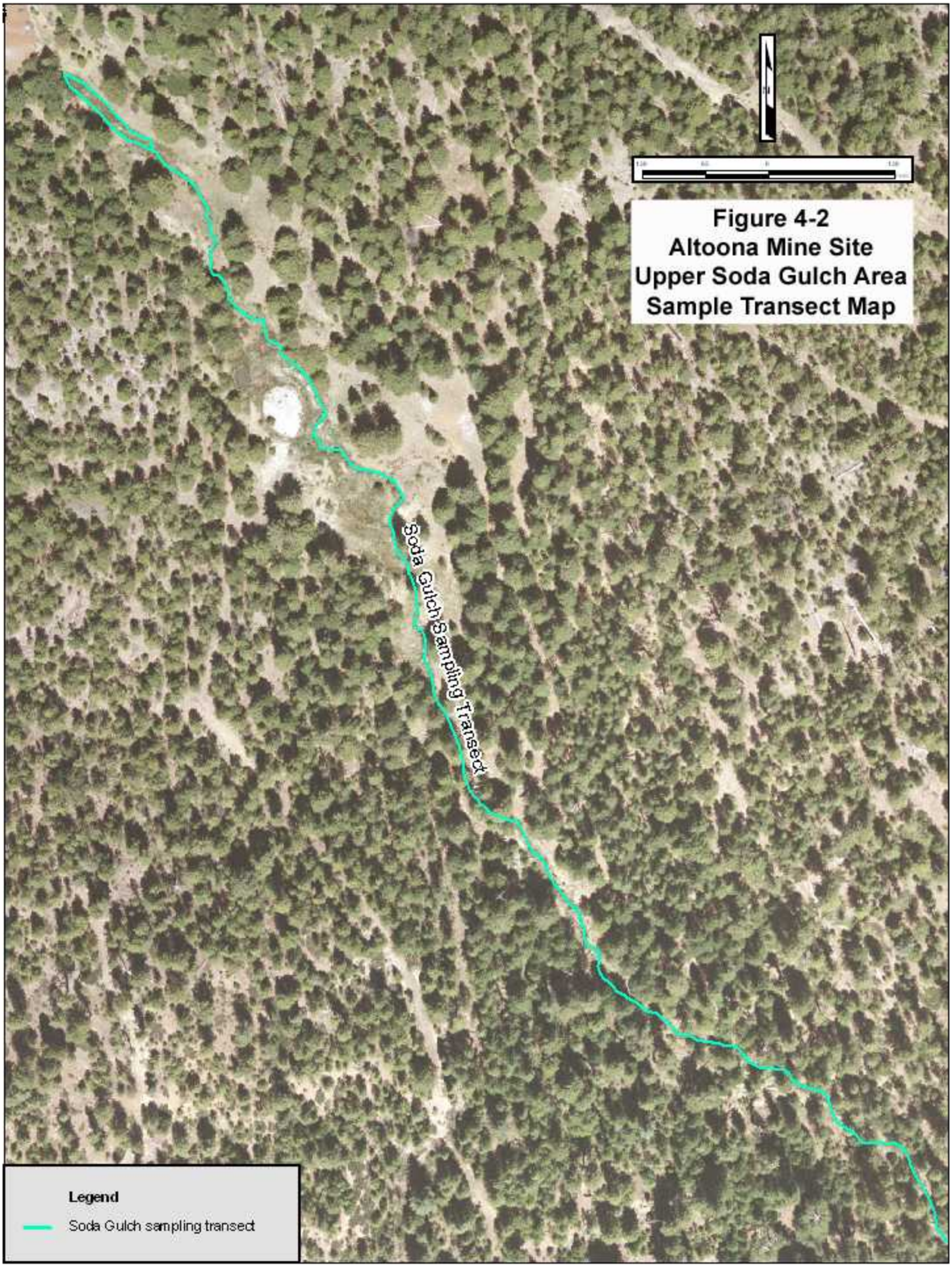

Figure 4-2
Altoona Mine Site
Upper Soda Gulch Area
Sample Transect Map

5 Request for Analyses

Samples will be analyzed in the field for mercury and arsenic by U.S. EPA Method 6200. Low level mercury samples may be analyzed in the field by a modified U.S. EPA 7473. Samples will be analyzed at the U.S. EPA Region IX Laboratory in Richmond, California by U.S. EPA SW-846 methods 6010B for arsenic and either 7471A for mercury.

5.1 Field Analysis

All samples collected will be analyzed in the field by START using the XRF. The manufacturer's guidance and SW-846 Method 6200 (Appendix C) will be used to conduct analysis. The Lumex® combined with the RP-91C Attachment soil analyzer will be available for field analysis if sample results are below the XRF detection limit.

To provide analytical quality control for the field analytical effort, the following measures will be utilized:

- Analytical precision and sensitivity of the XRF instrument in the determination of mercury concentrations in site specific samples will be determined during the initial days of field analysis.
- The correlation between field mercury data and data generated by standard U.S. EPA SW-846 Method 6200 methodology will be determined during the initial days of field analysis.
- From each AOC, the START will submit a minimum of 10 percent of the soil/ sediment/ tailings/ waste rock samples analyzed in the field to an off-site laboratory for confirmation analysis of metals. There must be a minimum of seven samples submitted from each AOC. At least seven samples from each AOC will be submitted and represent the following ranges: less than the instrument detection limit, just below action level, just above the action level, and high mercury concentrations, as determined by the field analysis, will be submitted to the laboratory for data correlation purposes.

- A traceable performance standard at a mercury concentration around the cleanup level will be frequently analyzed to document the field method's accuracy and performance.
- In areas where the null hypothesis is that mercury and arsenic concentrations are low (e.g. Repository Area and Screening Plant Area), samples will initially be field analyzed for mercury and arsenic using the XRF. Samples with concentrations below the XRF detection limit may be field screened using the Lumex® with soil analysis attachment because the Lumex® detection technology has a lower detection limit than the XRF instrument. XRF has a higher calibration range, so it must be used first to reduce the potential for contaminating the Lumex® with high mercury concentrations.

5.2 Laboratory Analysis

A minimum of ten and a maximum of twenty percent of field-screened samples will be submitted to a laboratory for mercury analysis using U. S. EPA Method 7471A for Mercury in Solid or Semi-Solid Waste (Manual Cold-Vapor Technique).
Sample containers, preservatives, holding times, and estimated number of field samples, confirmation samples, and Quality Control (QC) samples are summarized in Table 5-1 and Table 5-2.

To provide analytical quality control for the analytical program, the following measures will be utilized:

- Additional sample volume will be collected for at least 5% of samples per each analytical method, to be utilized for matrix spike/matrix spike duplicate analysis.

Laboratory blind co-located duplicate samples or split duplicate samples will be collected from 10 percent of the sampling locations then submitted for soil analysis. A co-located duplicate sample is a composite sample that is collected and composited separately from its multiple-increment duplicate. A duplicate split sample is a 50/50 split of a multi-incremental sample after collection.

Table 5-1 Initial Sampling and Analysis Summary

Method	Mercury by U. S. EPA 7471A Arsenic by U. S. EPA 6010B	Mercury and Arsenic by XRF and/or Mercury by Lumex® Field Analysis
Sample Container	125 or 250 ml glass or plastic (4 or 8 oz.)	Plastic sample bag
Preservation	4°C	4°C
Analysis Holding Time	28 days	28 days (if transferred to glass jar)
Sampling Location (expected start)	**Number of Samples**	**Number of Samples**
Initial Repository Area Field Samples (week 1)	(10%) 30	300 (estimated)
Initial Infrastructure Area Field Samples (week 1)	(10%) 6	60 (estimated)
Initial Mine Waste Area Delineation Samples (weeks 2-4)	(10%) 30	300 (estimated)
Initial Mine Waste Area Excavation Samples (weeks 15 - 20)	(10%) 60	600 (estimated)
Initial Sediment (Gulch) Samples (weeks 4 - 5)	(10%) 6	60 (estimated)
Initial Repository Area Sample Duplicates	(10%) 3	(10%) 30
Initial Infrastructure Area Sample Duplicates	(10%) 1	(10%) 6
Initial Mine Waste Area Delineation Sample Duplicates	(10%) 3	(10%) 30
Initial Mine Waste Area Excavation Sample Duplicates	(10%) 6	(10%) 60
Initial Sediment (Gulch) Sample Duplicates	(10%) 1	(10%) 6
Field Analysis Duplicates Detailed Below		
An analysis duplicate run in same batch (same XRF cup, run twice)	N/A	1 per 20 samples (34)
Preparation duplicate run in same batch (2 XRF cups prepared from same sample collection bag)	N/A	1 per 20 samples (34)
Blank run in same batch	N/A	1 per 10 samples (68)
Control Sample (field analysis only)	N/A	1 per 10 samples (68)
MS/MSDs	(1 per 20 samples) 4 Submit one-250 ml glass or poly (8 oz.)	N/A
Total Initial Analyses	**150**	**1656**

Source: 2008 Ecology and Environment, Inc.

Note:

A soil duplicate or a preparation duplicate will be prepared once every 10 samples. The type of duplicate, soil, or preparation will be alternated every 10 samples.

Table 5-2 Estimated Final Sampling and Analysis Summary

Method	Mercury by U. S. EPA 7471A Arsenic by U. S. EPA 6010B	Mercury and Arsenic by XRF and/or Mercury by Lumex® Field Analysis
Sample Container	125 or 250 ml glass or plastic (4 or 8 oz.)	Plastic sample bag
Preservation	4°C	4°C
Analysis Holding Time	28 days	28 days (if transferred to glass jar)
Sampling Location (expected start)	**Number of Samples**	**Number of Samples**
Total Repository Area Field Samples (3weeks)	(10%) 30	300 (estimated)
Total Mine Waste Delineation Samples (4 weeks)	(10%) 30	300 (estimated)
Total Mine Waste Excavation Samples (14 weeks)	(10%) 60	600 (estimated)
Total Infrastructure Area Field Samples (First and Final week)	(10%) 7	60 (estimated)
Sediment (Gulch) Samples	(10%) 7	60 (estimated)
Total Repository Area Field Samples Duplicates	(10%) 6	(10%) 30
Total Mine Waste Delineation Samples Duplicates	(10%) 6	(10%) 30
Total Mine Waste Excavation Samples Duplicates	(10%) 6	(10%) 60
Total Infrastructure Area Field Samples Duplicates	(10%) 1	(10%) 6
Sediment (Gulch) Samples Duplicates	(10%) 1	(10%) 6
Field Analysis Duplicates Detailed Below		
An analysis duplicate run in same batch (same XRF cup, run twice)	N/A	1 per 20 samples (73)
Preparation duplicate run in same batch (2 XRF cups prepared from same sample collection bag)	N/A	1 per 20 samples (73)
Blank run in same batch	N/A	1 per 10 samples (145)
Control Sample (field analysis only)	N/A	1 per 10 samples (145)
MS/MSDs	(1 per 20 samples) 8	N/A
Total Analyses	**154**	**1,888**

Source: 2008 Ecology and Environment, Inc.

Notes:

A soil duplicate or a preparation duplicate will be prepared once every 10 samples. The type of duplicate, soil, or preparation will be alternated every 10 samples.

The final number of collected samples could be several times greater than indicated.

6 Field Methods and Procedures

6.1 Field Procedures

The following sections describe field procedures and equipment used during the site activities.

6.1.1 Equipment

The equipment listed below may be utilized to obtain environmental samples from the respective media in accordance with the following sampling SOPs or their equivalent:

- Environmental Response Team SOP #2012 Soil Sampling
- Ecology and Environment Inc. SOP # ENV 3.13: Soil Sampling
- Ecology and Environment Inc. SOP# ENV 3.15: Sampling Equipment Decontamination

The following is a partial list of equipment that is anticipated to come in contact with samples:

- Shovels, hand augers, trowels, scoops
- Stainless steel buckets or glass containers
- Dedicated plastic baggies and disposable trowels

6.1.2 Equipment Maintenance

Field instrumentation for the collection of soil samples will be operated, calibrated, and maintained by the sampling team in accordance with the SOPs listed in Section 6.1.1 or their equivalent. Field instrumentation utilized for health and safety purposes will be operated, calibrated, and maintained by the sampling team according to the manufacturer's instruction. Calibration and field use data will be recorded in the instrument log books.

6.1.3 Inspection/Acceptance Requirements for Supplies and Consumables

There are no project-specific inspection/acceptance criteria for supplies and consumables. It is standard operating procedure that personnel will not use broken

or defective materials; items will not be used past their expiration date; supplies and consumables will be checked against order and packing slips to verify the correct items were received; and the supplier will be notified of any missing or damaged items.

6.1.4 Logbooks

Field logbooks will document where, when, how, and from whom any vital project information was obtained. Logbook entries will be complete and accurate enough to permit reconstruction of field activities. A separate logbook will be maintained for each project. Logbooks are bound with consecutively numbered pages. Each page will be dated and the time of entry noted in military time. All entries will be legible, written in ink, and signed by the individual making the entries. Language will be factual, objective, and free of personal opinions. The following information will be recorded, if applicable, during the collection of each sample:

- Sample location and description
- Site sketch showing sample location and measured distances
- Sampler's name(s)
- Date and time of sample collection
- Type of sample (matrix)
- Type of sampling equipment used
- Onsite measurement data (e.g., temperature, pH, conductivity)
- Field observations and details important to analysis or integrity of samples (rain, odors, etc.)
- Type(s) of preservation used
- Field instrument reading (such as Lumex readings for health and safety purposes, etc.)
- Shipping arrangements (air bill numbers)
- Receiving laboratory(ies)

Several START team members will be onsite performing different duties related to sample collection, processing, and analysis. Individual logbooks will be maintained for specific activities at the site, including: Sample collection, sample log-in to the field laboratory, Lumex analysis, XRF analysis and air monitoring. Each logbook will document the information relevant to the site activity, and at a minimum will include:

- Team members and their responsibilities
- Time of activities

- Deviations from sampling plans, site safety plans, and SAP procedures
- Levels of safety protection
- Calibration information
- Analytical data

6.1.5 Photographs

Photographs will be taken at representative sampling locations and at other areas of interest onsite. They will serve to verify information entered in the field logbook. When a photograph is taken, the following information will be written in the logbook or will be recorded in a separate field photography log:

- Time, date, location, and, if appropriate, weather conditions
- Description of the subject photographed
- Name of person taking the photograph

6.1.6 Electronic Sample Logging

The sampling team may utilize field management software to prepare sample labels and chain-of-custody forms.

The following information should be entered for each sample after collection:

- Sample name
- Sample date and time
- Number of Sample bottles
- Type of Preservation
- Analyses

In addition to these items, the software may also be used to keep track of other information such as sample depth, field measurements (e.g., pH), and split samples.

The field team will generate chain-of-custody forms for each cooler of samples packaged and sent to a laboratory. Each chain-of-custody form will refer to the shipping method and tracking number. Printed chain-of-custody forms will be submitted to the laboratory with the samples.

The use of field management software will require that the field team have access to a computer, a printer, computer paper, and labels while in the field. Field team members will have received specific training in use of the software.

6.1.7 Mapping Equipment

Sample points and site features will be located and documented with a GPS unit. The GPS will be used to assign precise geographic coordinates to sample locations on the site. GPS mapping will be done by personnel trained in the use of the equipment and will be completed in accordance with the manufacturer's instructions. Expected output from the use of GPS mapping will be site maps with sample locations and major site features. Through a separate contracting mechanism, the U.S. EPA FOSC has requested the site be surveyed by a licensed surveyor. The request includes a survey of the entire property to determine its legal boundaries.

6.2 Surface Soil Sampling Procedures

All sample locations will be recorded in the field logbook as sampling is completed. A sketch, if needed, of the sample location will be entered into the logbook and any physical reference points will be labeled. If possible, distances to reference points will be given.

Collection Procedure for Repository Area

Surface soil samples will be collected from a depth of 0-0.5 feet below ground surface (bgs). Surface samples will be collected using a disposable plastic or stainless steel trowel and will be placed in a plastic zip-lock bag for holding and homogenization. A composite sample will be collected from five points within each grid sector. Approximately 4 ounces of soil will be collected from each of the five collection points. A portion of each sample point to be composited will be kept separate for potential future analysis. The soil will be placed into a zip-lock sampling bag.

Collection Procedure for Random Samples

Surface soil samples will be collected from a depth of 0-0.5 feet bgs. Surface samples will be collected using a disposable plastic or stainless steel trowel and will be placed in a plastic bag for holding and homogenization.

Collection Procedure for Delineation and Confirmation Samples

Surface soil samples will be collected from a depth of 0-0.5 feet bgs. Surface samples will be collected using a disposable plastic or stainless steel trowel and will be placed in a plastic bag for holding and homogenization.

6.3 Field Analytical Procedures

Soil samples will be field analyzed for total mercury and arsenic using U. S. EPA Method 6200. All total mercury analyses using the XRF will be completed in accordance with manufacturer's guidance and the U. S. EPA SW-846 Method 6200 (Appendix C). Additionally, field duplicate samples, second source control samples, and blanks will be analyzed and evaluated as quality control checks as described in Section 9.1 of this SAP.

Samples will be delivered to the field laboratory in heavy-duty plastic bags. Upon receipt the samples will be logged into the analytical logbook. Twigs, other organic matter and rocks or pebbles will be removed from the samples. Samples will be homogenized while in the sample bag by kneading, crushing, and shaking the sample until mixing of the soil is complete. If the sample is wet, a 30-gram or more aliquot of the sample will be placed in a sample boat or on a coffee filter to air dry. Once the aliquot has dried, it will be placed in a clean bag and homogenized. After the sample is dried, it will be passed through a size #60-mesh sieve to remove large particles. The remaining aliquot will be transferred to a pre-labeled polyethylene cup and covered with Mylar film to be analyzed by XRF.

Sample analysis will be performed in accordance with the manufacturer's guidance and SW-846 Method 6200 (Appendix C). At the beginning of the project and prior to analysis of samples, the START will perform quality control checks including energy calibration, resolution check, background check, and a precision sample analysis. Daily quality control checks to be performed include resolution check, background check, initial calibration verification, method blank, continuing calibration verification, and an instrument blank analysis. Once calibrated and at the end of each set of 10 samples, a second source control standard and sand blank will be analyzed to determine instrument performance. One out of every 10 samples will be selected for a preparation duplicate.

If the concentrations of mercury in the soil sample are less than the XRF detection limit, then an aliquot of soil from the XRF cup may be analyzed with the Lumex® with soil analysis attachment.

Initial and continuing calibration verifications will be completed using standards at and below the site action level.

One out of every 10 samples will be selected for an analysis duplicate.

After field analysis has been completed, samples for laboratory confirmation analysis will be selected. For each area, the START will submit 10 percent of the soil samples analyzed in the field to a laboratory for confirmation analysis of metals. There must be a minimum of seven samples submitted. At least seven samples representing the dynamic range of non-detect, just below action level, just above action level, and high mercury concentrations, as determined by the field analysis, will be submitted to the laboratory for data correlation purposes. The remainder of the confirmatory samples will be selected at the discretion of the START Project Manager but should be somewhat random.

Selected samples will then be transferred from the holding bag to the appropriate sample containers. Samples selected for laboratory analysis will be placed in 4 or 8-ounce jars. Sample containers will be filled to the top, taking care to prevent soil from remaining in the threads prior to being closed to prevent potential contaminant migration to or from the sample. Sample containers will be closed as

soon as they are filled, chilled, and processed for shipment to the laboratory. In addition to the jar, the cup that was analyzed using the XRF will be sent to the laboratory for analysis. The 4- or 8-ounce jar will be used to determine percent moisture. The cup and sample jar will be chilled pending shipment to the laboratory. All remaining sample volume will be returned to its point of origin.

6.4 Field Analytical Decontamination Procedures

Decontamination activities will be conducted by the START in accordance with E & E SOP #3.15. All non-dedicated sample handling devices will be decontaminated according to the following procedure:

- Non-phosphate detergent and tap water wash using a brush to scrub solids from the surface
- Tap water rinse
- 10% nitric acid rinse
- Triple deionized/distilled water rinse

The soil sieves, used during preparation of a sample for analysis with the XRF, will be decontaminated by brushing out the excess soil with coarse-hair brushes and wiping out with a paper towel and a small amount of rubbing alcohol. Decontamination procedures for the soil sieves deviate from E & E SOP #3.15 due to the drying time that would be required for the fine mesh sieve.

7 Disposal of Investigation-Derived Waste

In the process of collecting environmental samples at this site, several different types of potentially contaminated investigation derived wastes (IDW) will be generated, including the following:

- Used personal protective equipment (PPE)
- Disposable sampling equipment
- Decontamination fluids

The USEPA's National Contingency Plan required that management of IDW generated during site investigations comply with all relevant or appropriate requirements to the extent practicable. This sampling plan will follow the Office of Emergency and Remedial Response Directive 9345.3-02 (May 1991), which provides the guidance for management of IDW during site investigations. Listed below are the procedures that will be followed for handling IDW. The procedures are flexible enough to allow the site investigation team to use its professional judgment on the proper method for the disposal of each type of IDW generated at each sampling location.

- Used PPE and disposable sampling equipment will be double bagged in plastic trash bags and disposed of in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfill. Any PPE or dedicated equipment that is to be disposed of that can still be reused will be rendered inoperable before disposal.
- Decontamination fluids will consist of water with residual contaminants and/or non-phosphate detergent. These fluids will be left onsite to evaporate.

8 Sample Identification, Documentation, and Shipment

8.1 Sample Nomenclature

A unique, identifiable name will be assigned to each sample. Samples will have a prefix indicating the area of the site from which they were collected. The prefix will be followed by a number based on the order in which the samples were collected from that area. All samples will have a final two digit integer indicating the approximate depth at which the sample was collected. Field duplicate samples will have the same designations as their originals except the sequential number will be 800; thus, the field duplicate of REP-020-05 will be REP-820-05. XRF preparation duplicate samples will have the same designations as their originals except the sample number will be followed with a "PD"; thus, the preparatory duplicate of REP-020-05 will be REP-020-05 PD. A summary of this sample naming system is shown in Table 8-1.

8.2 Container, Preservation, and Holding Time Requirements

All sample containers will have been delivered to the START in a pre-cleaned condition. Container, preservation, and holding time requirements are summarized in Tables 5-1 and Table 5-2.

8.3 Sample Labeling, Packaging, and Shipping

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. Sample labels will be affixed to the sample containers and will contain the following information:

- Sample number
- Date and time of collection
- Site name
- Analytical parameter and method of preservation

Table 8-1 Sample Numbering System

Location	Prefix	Sample ID
Repository Area	REP	REP-###[1]-depth[2]
Screen Plant Area	SCN	SCN-###-depth
Waste Rock Pile 1	WR1	WR1-###-depth
Waste Rock Pile 2	WR2	WR2 -###-depth
Processing Area	PRO	PRO-###-depth
Tailing Pile 1	TP1	TP1-###-depth
Camp Area	CMP	CMP-###-depth
Office/Command Post	OFF	OFF-###-depth
Delineation Samples	Will use prefix of adjacent area	
Field Duplicate	Prefix of area	<Prefix>-<800 plus #>-depth
Preparation Duplicate for U. S. EPA 6200	Prefix of area	<Prefix>-###-depth PD

Source: 2008 Ecology and Environment, Inc.

Notes:

[1] sample numbers (#) during the removal action will begin with 100 at each area of concern to set them apart from the removal assessment samples.

[2] If surface sample, then use "00". Always us two digits.

Samples will be stored in a secure location onsite pending onsite analysis and shipment to the laboratory. Sample coolers will be retained in the custody of site personnel at all times or secured so as to deny access to anyone else. When samples are not under the direct control of the individual responsible for them, they must be stored in a locked container sealed with a custody seal.

The procedures for shipping soil samples are:

- If ice it used then will be packed in double zip-lock plastic bags.
- The drain plug of the cooler will be sealed with tape to prevent melting ice from leaking.
- The bottom of the cooler will be lined with bubble wrap to prevent breakage during shipment.
- Screw caps will be checked for tightness.
- Containers will have custody seals affixed so as to prevent opening of the container without breaking the seal.
- All glass sample containers will be wrapped in bubble wrap.
- All containers will be sealed in zip-lock plastic bags.

All samples will be placed in coolers with the appropriate chain-of-custody forms. All forms will be enclosed in plastic bags and affixed to the underside of the cooler lid. If samples require refrigeration during shipment then bags of ice will be placed on top of and around samples. Empty space in the cooler will be filled with bubble wrap or styrofoam peanuts to prevent movement and breakage during shipment. Each ice chest will be securely taped shut with strapping tape, and custody seals will be affixed to the front, right, and back of each cooler.

Samples will be shipped for immediate delivery to the contracted laboratory. Upon shipping, the laboratory will be notified of:

- Sampling contractor's name.
- The name of the site.
- Shipment date and expected delivery date.
- Total number of samples, by matrix and for each sample the relative level of contamination (i.e., low, medium, or high).
- Carrier; air bill number(s), method of shipment (e.g., priority).
- Irregularities or anticipated problems associated with the samples.
- Whether additional samples will be sent; whether this is the last shipment.

8.4 Chain-of-Custody Forms and QA/QC Summary Forms

A chain-of-custody form will be maintained for all samples to be submitted for analysis, from the time the sample is collected until its final deposition. Every transfer of custody must be noted and a signature affixed. Corrections on sample paperwork will be made by drawing a single line through the mistake and initialing and dating the change. The correct information will be entered above, below, or after the mistake. When samples are not under the direct control of the individual responsible for them, they must be stored in a locked container sealed with a custody seal. The chain-of-custody form must include the following:

- Sample identification numbers
- Identification of sample to be used for Matrix Spike/Matrix Spike Duplicate (MS/MSD) purposes
- Site name
- Sample date
- Number and volume of sample containers
- Required analyses
- Signature and name of samplers
- Signature(s) of any individual(s) with control over samples

- Airbill number
- Note(s) indicating special holding times and/or detection limits

The chain-of-custody form will be completed and sent with the samples for each laboratory and each shipment. Each sample cooler should contain a chain-of-custody form for all samples within the sample cooler.

A QA/QC sample summary form will be completed for each method and each matrix of the sampling event. The sample number for all blanks, reference samples, laboratory QC samples (MS/MSDs), and duplicates will be documented on this form. This form is not sent to the laboratory. The original form will be sent to the reviewer who is validating and evaluating the data; a photocopy of the original will be made for the project manager master file.

9 Quality Assurance and Control (QA/QC)

9.1 Field Quality Control Samples

The QA/QC samples described in the following subsections, which are also listed in Tables 5-1 and 5-2, will be collected during this investigation.

9.1.1 Assessment of Field Contamination (Blanks)

9.1.1.1 Equipment Blank Samples

Equipment rinsate blanks will not be collected to evaluate field sampling and decontamination procedures since all sampling equipment will be dedicated.

9.1.1.2 Field Blank Samples

Field blanks will not be collected to evaluate whether contaminants have been introduced into the samples during soil sampling procedures.

9.1.2 Assessment of Sample Variability (Field Duplicate or Co-located Samples)

Duplicate soil samples will be collected at selected sample locations. These locations will be chosen in the field based on field observations and will be collected at a rate of 1 for every 10 field samples.

9.1.3 Laboratory Quality Control (QC) Samples

A laboratory QC sample, also referred to as a matrix spike/matrix spike duplicate (MS/MSD), is not an extra sample; rather, it is a sample that requires additional QC analyses and therefore may require a larger sample volume. The chain-of-custody records for these samples will identify them as laboratory QC samples. The location of laboratory QC samples will be selected at random. At a minimum, one laboratory QC sample per 20 samples (or one per delivery group), per matrix, for each analytical parameter will be submitted. If the DQIs for analytical parameters are not achieved, further data review will be conducted to assess the impact on data quality. Laboratory QC samples, including laboratory MS/MSD and field duplicate samples, will be selected randomly.

Additional sample volume will be submitted for all mercury samples designated as laboratory QC samples and will be designated as MS/MSD samples on the chain-of-custody to the fixed-base laboratory.

9.1.4 Conformation Samples

The samples submitted to the laboratory for definitive analysis will be used to establish and/or document the comparability and correlation between the definitive and non-definitive data sets. The START will determine correlation of the data sets by linear regression analysis and will determine relative percent differences for each data pair and for the data sets as a whole. These results will be compared to the field screening data and will be used to determine the effectiveness of the field screening technique.

9.1.5 Field Analytical Quality Control (QC) Samples

Field analytical QC samples, also referred to as precision samples, calibration verification samples, and control standards, will be analyzed with field samples to verify and document the precision and accuracy of field analytical methods. QC samples include blanks, preparation duplicates, analysis duplicates, and check standard from two different sources.

9.2 Analytical and Data Package Requirements

It is required that all samples be analyzed in accordance with U.S. EPA Methods listed in Tables 5-1. The laboratory is required to supply documentation to demonstrate that their data meet the requirements specified in the method. A preliminary data summary will be required 15 working days after submission of samples for analysis. A full validation data package will be required five weeks after submission of samples. The laboratory(ies) will also provide all data electronically in a Lotus123-compatible format or delimited text file.

Deliverables for this project must meet the guidelines in *Laboratory Documentation Requirements for Data Evaluation* (EPA Region IX R9/QA/00.4.1, March 2001). The following deliverables are required. Note that the following data requirements are included to specify and emphasize general documentation requirements and are not intended to supersede or change requirements of each method.

- A copy of the chain-of-custody, sample log-in records, and a case narrative describing the analyses and methods used.
- Analytical data (results) for up to three significant figures for all samples, method blanks, MS/MSD, Laboratory Control Samples (LCS), duplicates, Performance Evaluation (PE) samples, and field QC samples.
- QC summary sheets/forms that summarize the following:
  - MS/MSD/LCS recovery summary
  - Method/preparation blank summary
  - Initial and continuing calibration summary (including retention time windows)

  - Sample holding time and analytical sequence (i.e., extraction and analysis)
  - Calibration curves and correlation coefficients
  - Duplicate summary
  - Detection limit information

- Analyst bench records describing dilution, sample weight, percent moisture (solids), sample size, sample extraction and cleanup, final extract volumes, and amount injected.
- Standard preparation logs, including certificates of analysis for stock standards.
- Detailed explanation of the quantitation and identification procedure used for specific analyses, giving examples of calculations from the raw data.
- The final deliverable report will consist of sequentially numbered pages.
- Internal/surrogate recoveries.
- Gas Chromatograph/Mass Spectrometer tuning conditions.
- Reconstructed ion current chromatogram and quantitation reports for all sample standards, blanks, MS/MSD, and PE samples.
- For every compound identified and each field sample, provide raw versus enhanced spectra and enhanced versus reference spectra.
- For target analytes, the reference spectrum shall be the check standard for that sample. For tentatively identified compounds (TICs), the reference mass spectrum shall be the best fit spectrum from a search of the spectral library.
- For confirmation analysis data consisting of second column confirmation required for all TICs, provide all associated raw data and summary sheets.

9.3 Data Management

Samples will be collected and described in a logbook, as discussed in Section 6.1.2.1. Samples will be kept secure in the custody of the sampler at all times; the sampler will assure that all preservation parameters are being followed. All samples are being submitted to an onsite field laboratory for field analysis. The field analysis laboratory will document sample receipt in an analytical logbook. All samples that are to be sent to the analytical laboratories will be collected and logged on chain-of-custody forms as discussed in Section 8.4. A START member will only submit samples to the analytical laboratory with chain-of-custody documentation. All submitted samples will be in a properly custody-sealed container. Specifics are discussed in Section 8.3. The laboratories will note any evidence of tampering upon receipt.

All data summary reports and complete data packages will be archived by the project manager. The data validation reports and laboratory data summary reports will be included in the final report to be submitted to the EPA.

All field data including, XRF, Lumex® with soil attachment and GPS data, will be managed in SCRIBE.

9.4 Data Validation

Data validation of all data will be performed by the START or their subcontractor in accordance with U.S. EPA Region IX Superfund Data Evaluation/Validation Guidance R9QA/006.1, December 2001.

Standard data quality review requirements, including Tier 1A data validation of 80 percent of the data and Tier 2 validation of the remaining 20 percent of the data (as defined in *Requirements for Quality Assurance Project Plans*, March 2001), will satisfy the data quality requirements for this project. Upon completion of validation, data will be classified as one of the following: acceptable for use without qualifications, acceptable for use with qualifications, or unacceptable for use.

If during or after the evaluation of the project's analytical data it is found that the data contains excess QA/QC problems or if the data does not meet the DQI goals, then the independent reviewer may determine that additional data evaluation is necessary. Additional evaluation may include U. S. EPA Region IX Superfund Data Evaluation/Validation Guidance R9QA/006.1 for evaluation Tier 2 or evaluation Tier 3.

To meet evaluation and project requirements, the following criteria will be evaluated during a Tier 1A evaluation:

- Data package completeness
- Laboratory QA/QC summaries
- Holding times
- Blank contamination
- Matrix related recoveries
- Field duplicates
- Random data checks

Upon completion of evaluation, an analytical data evaluation Tier 1A review report will be delivered to the project manager, and the data will be classified within the report as one of the following:

- acceptable for use without qualifications
- acceptable for use with qualifications
- unacceptable for use

The data with applicable qualifications will be attached to the report. The analytical data evaluation Tier 1A review report will not compare data to specific project quality objectives, which include target analytes, sensitivity, analytical accuracy, analytical and sampling precision, and analytical completeness.

Unacceptable data may be more thoroughly examined to determine whether corrective action could mitigate data usability.

9.5 Field Variances

As conditions in the field may vary, it may become necessary to implement minor modifications to this plan. When appropriate, the START QA Coordinator will be notified of the modifications and a verbal approval obtained before implementing the modifications. Modifications to the original plan will be recorded in site records and documented in the final report.

9.6 Assessment of Project Activities

9.6.1 Assessment Activities

The following assessment activities will be performed by the START:

- All project deliverables (SAP, Data Summaries, Data Validation Reports, Investigation Report) will be peer reviewed prior to submission to the U.S. EPA. In time critical situations, the peer review may be concurrent with the release of a draft document to the U.S. EPA. Errors discovered in the peer review process will be reported by the reviewer to the originator of the document, who will be responsible for corrective action.
- The QA Coordinator will review project documentation (logbooks, chain-of-custody forms, etc.) to ensure the SAP was followed and that sampling activities were adequately documented. The QA Coordinator will document deficiencies, and the PM will be responsible for corrective actions.

9.6.2 Project Status Reports to Management

It is standard procedure for the START PM to report to the U.S. EPA Task Monitor (TM) any issues, as they occur, that arise during the course of the project which could affect data quality, data use objectives, the project objectives, or project schedules.

As requested, the START will provide XRF results to the U.S. EPA TM daily, and unvalidated data will be provided as it is received from the laboratory.

9.6.3 Reconciliation of Data with DQOs

Assessment of data quality is an ongoing activity throughout all phases of a project. The following outlines the methods to be used by the START for evaluating the results obtained from the project.

Review of the DQO outputs and the sampling design will be conducted by the START QA Coordinator prior to sampling activities. The reviewer will submit comments to the START PM for action, comment, or clarification. This process will be iterative.

A preliminary data review will be conducted by the START. The purpose of this review is to look for problems or anomalies in the implementation of the sample collection and analysis procedures and to examine QC data for information to verify assumptions underlying the DQOs and the SAP. When appropriate to sample design, basic statistical quantities will be calculated and the data will be graphically represented.

When appropriate to the sample design and if specifically tasked to do so by the U.S. EPA TM, the START will select a statistical hypothesis test and identify assumptions underlying the test.

10 References

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

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U.S. EPA, 2002. *Guidance on Choosing a Sampling Design for Environmental Data Collection* (EPA QA/G 5S, EPA/240/R 02/005), December

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

U.S. EPA, 2008. *Regional Screening Levels for Chemical Contaminants at Superfund Sites*, May 20

United States Environmental Protection Agency, 2007 *Office of Solid Waste Method 6200 - Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment, February*

A Data Quality Objective Process Worksheet

Data Quality Objectives for Altoona Mine Removal Support Waste Pile Delineation and Excavation		
Step	**DQO Guidance of Purpose and Outputs of Step**	**Objectives**
1. Problem Statement	**Purpose:** Summarize the contamination problem that will require new environmental data, and identify the resources available to resolve the problem. **Output From This Step:** A concise description of the problem A list of the planning team members and identification of the decision- maker. A summary of available resources and relevant deadlines for the study.	**Problem:** The Altoona Mine site is comprised of mine tailings and waste rock containing elevated levels of metals, particularly mercury and arsenic. This contamination has been documented by previous USGS studies and by recent U.S. EPA/START studies. In addition elevated concentrations of mercury and arsenic are evident in soils and surface water in the vicinity of the mine and in sediments within Soda Gulch that leads from the site. Recent studies also indicate that mercury and arsenic from the mine may be impacting the east fork of the Trinity River. Concentrations of contaminants have been documented at or above health or risk-based action levels. The USFS is particularly concerned about the exposure risk to wildlife and to the public, which has access to downstream waters. Based upon the documented concentration of mercury and arsenic the U.S. EPA has decided to mitigate this threat by removing tailings and waste rock from its location and placing the contaminated materials in an on-site repository. In order to document that contaminated materials are being removed effectively, environmental data collection during removal and following the removal is necessary. The results of the data collection activity may also be used to evaluate whether final conditions on the site continue to pose a threat to human health and the environment. **Planning Team:** U.S. EPA On-Scene Coordinator (OSC) – The U.S. EPA On-Scene Coordinator is Michelle Rogow. Ms. Rogow is the primary decision-maker and will direct the project, specify tasks, and ensure that the project is proceeding on schedule and is within budget. Response Manager (RM) – Mr. Jason Courey of ERRS . START Project Manager (PM) – Mr. Michael Friedman of START START Quality Assurance Coordinator – Mr. Howard Edwards of START **Limitation on Available Resources:** The total START budget for all support and data collection is $ 559,560. The START budget for data collection to support this study is not expected to exceed 70 % of that budget. Definitive analytical data is to be generated by the US EPA Regional laboratory with non-START funds. Field data will be generated by START using EPA instruments.

Data Quality Objectives for Altoona Mine Removal Support Waste Pile Delineation and Excavation		
Step	**DQO Guidance of Purpose and Outputs of Step**	**Objectives**
2. Decision Statement	**Purpose:** Define the decisions that will be resolved with the generated data. **Output From This Step:** A statement of the decision that must be resolved using data to address or solve the problem. A list of possible actions or outcomes that would result from each resolution of the decision statement. Note from USEPA guidance on DQO: If the principal study question is not obvious and specific alternative actions cannot be identified, then the study may fall in the category of exploratory research.	**Key Question:** 1. What is the final concentration of mercury and/or arsenic in the removal area after the removal is complete? 2. During the removal, is the concentration of mercury and/or arsenic in the removal area below the site-specific removal action level for that area? 3. What is the lateral extent of the contamination in areas that are to be excavated? **Possible Outcomes: Key Question:** 1. There are no alternative outcomes. The data is used to document the conditions of an area after the removal. 2. For each area: a) The data and physical parameters were evaluated and it is determined that no further excavation is needed. b) The data and physical parameters were evaluated and it is determined that further excavation is needed. 3. The limits of the excavation will be established.

Data Quality Objectives for Altoona Mine Removal Support Waste Pile Delineation and Excavation		
Step	**DQO Guidance of Purpose and Outputs of Step**	**Objectives**
3. Inputs to the Decision	**Purpose:** The purpose of this step is to identify the data inputs that will be required to resolve the decision and to determine which inputs require environmental measurement. **Output From This Step:** Identify the information that will be required to resolve the decision. Determine the sources for each item of information identified. Identify the information that is needed to establish the action level for the study. Confirm that appropriate field sampling techniques and analytical methods exist to provide the necessary data. A list of informational inputs (including sources and potential action levels) needed to resolve the decision. The list of environmental variables or characteristics that will be measured.	**Informational Needs:** 1) The estimated total mercury and arsenic concentration in the surface soil of each excavated area that requires a decision or documentation. (Excavation decision area) 2) The relative elevation above grade of the excavation decision area. 3) The location of the excavation decision area. 4) The estimated total mercury and arsenic concentration in the surface soil around the perimeter of the Waste Piles **Sources of Information:** Field analytical data generated in the field within several hours of sampling. Physical data will be generated in the field with the GPS and physical observations. Definitive confirmation data will be generated from samples collected by START and submitted to the EPA Regional Laboratory for analysis. **Establishment of the Action Level for the Study:** An USEPA risk-based remediation goal, the I-PRG, exists for mercury and arsenic contamination in industrial soil. However, the USEPA has no risk-based remediation goal for mercury and arsenic contamination for rural mining site such as Altoona. The START will calculate an estimated average concentration for background contamination level by using background concentrations of mercury and arsenic detected during the previous EPA/START investigations. The EPA may derive a risk-based site specific action level using U.S. EPA risk assessment group or other source. The EPA may determine the risk-based and background based action level are significantly below what is achievable by excavation and set a practical action level. **Analytical Methods:** Modified EPA 6200, EPA 6200, Modified EPA 7473, EPA methods 6010 and EPA method 7471 or 7473. **Analytical Detection Limits:** The lowest required project detection limits are listed in Table 2-1 and the target analytical detection limits are listed in Table 2-2 or the SAP.

Data Quality Objectives for Altoona Mine Removal Support Waste Pile Delineation and Excavation		
Step	**DQO Guidance of Purpose and Outputs of Step**	**Objectives**
4. Site Boundaries	**Purpose:** Specify the spatial and temporal circumstances that are covered by the decision. Outputs From This Step: Define the domain or geographic area within which all decisions must apply. Specify the characteristics that define the population of interest. When appropriate, divide the population into strata that have relatively homogeneous characteristics. Define the scale of decision-making. Determine when to collect data. Determine the timeframe to which the study data apply. Identify any practical constraints on data collection. Characteristics that define the domain of the study. A detailed description of the spatial and temporal boundaries of the decision. A list of any practical constraints that may interfere with the study.	**Spatial** The project area is defined as Altoona Mine site. The Altoona Mine site is an abandoned mercury mine and mining operation that is located approximately 11 miles due west of the town of Castella in Trinity County, California (Figure 2-1). The mine is located on private land within the Shasta-Trinity National Forest. The Shasta-Trinity National Forest is administered by the United States Forest Service (USFS). The approximate geographic coordinates of the mine are 41°8'12.7" north latitude, 122°32'51" west longitude. The location of the Waste Pile Areas is shown on Figure 2-3 of the SAPP. The estimated size of the Waste Pile area to be excavated is 150,000 square feet. This study is restricted to surface area from ground surface to six inches below ground surface only; however, the location of the ground surface will change upon excavation. **Temporal** The study data will be used during the removal and prior to any cap installation. The study must be done during the removal. Delineation data should be generated prior to the excavation of the waste piles. **Practical Constraints on Data Collection** There may be constraints associated with the following: The slope in areas that need to be removed may be steep.

Data Quality Objectives for Altoona Mine Removal Support Waste Pile Delineation and Excavation		
Step	**DQO Guidance of Purpose and Outputs of Step**	**Objectives**
5. Decision Rules	**Purpose:** The purpose of this step is to integrate the outputs from previous steps into a single statement that describes the logical basis for choosing among alternative actions. **Outputs From This Step:** Specify the parameter that characterizes the population of interest. Specify the action level for the study. Combine the outputs of the previous DQO steps into: • an 'if…then…' decision rule that defines the conditions that would cause the decision-maker tochoose among alternative actions. • an 'if…then…' statement that defines the conditions that would cause the decision-maker to choose among alternative courses of action.	**Specify the parameter that characterizes the population of interest** The parameter is a data point or average that is assumed to represent the geospatial area from which it was derived. **Specify the action level for the study** The selected site action level for mercury is 40 mg/kg for excavated soil. The selected site action level for arsenic is 70 mg/kg for excavated soil. **Develop a decision rule:** If the data for an excavation area exceeds the action level then the decision-maker may initiate additional action that would include further excavation or a cap. If the data for an excavation area does not exceed the action level then the decision-maker would likely initiate no further action.

Data Quality Objectives for Altoona Mine Removal Support Waste Pile Delineation and Excavation		
Step	**DQO Guidance of Purpose and Outputs of Step**	**Objectives**
6. Tolerable Limit on Decision Rules	**Purpose:** Specify the decision-maker's acceptable limits on decision errors, which are used to establish appropriate performance goals for limiting uncertainty in the data. **Outputs From This Step:** Determine the possible range of the parameter of interest. Define the decision errors and identify the potential consequences of each. Specify a range of possible parameter values where the consequences of the decision errors are relatively minor (gray region). Assign probability values to points above and below the action level, that reflect the acceptable possibility for the occurrence of decision errors. Check the limits on decision errors to ensure that they accurately reflect the decision-maker's concern about the relative consequences for each type of decision error. The decision-maker's acceptable decision error rates based on a consideration of the consequences of making an incorrect decision.	**Determine the range of the parameters of interest** Based on data from START's investigation of the proposed excavation areas, the range of mercury contamination in site soils and tailings can be expected to range from the 11 mg/kg to 22,200 mg/kg. Arsenic concentrations range from 60 mg/kg to 1,700 mg/kg. Background concentrations in the immediate area range from 2 mg/kg to 60 mg/kg for mercury and 45 mg/kg to 310 mg/kg for arsenic. However, background concentratons in undisturbed areas away from the mine range from 2 mg/kg to 32.4 mg/kg for mercury and 17 mg/kg to 240 mg/kg for arsenic. **Baseline Condition (The Null Hypothesis)** The contaminant concentrations in site soils and tailings are greater or equal to than the action levels. **Alternative Condition (The Alternative Hypothesis)** The contaminant concentrations site soils and tailings are less than action levels. **Identify the decision errors** 1) Decide that the average concentration of mercury and/or arsenic does not exceed the action level when, in fact, it does. 2) Decide that the average concentration of mercury and/or arsenic exceeds the action level when, in fact, it does not. The first decision error occurs when the average concentration of mercury and/or arsenic is erroneously reported as being below the action level. This decision error could result from measurement error (i.e. errors in analysis, matrix interference, low extraction recovery, improper calibration, poor standards, operator error, or calculation errors) and/or sampling error (i.e. improper selection of sampling points, failure to collect enough samples to represent the study area, failure to thoroughly homogenize samples). The second decision error occurs when the average concentration of mercury and/or arsenic is erroneously reported as exceeding the action level. This decision could occur from measurement error (i.e. errors in analysis such as improper calibration, poor standards, matrix interference, high extraction recovery, operator error, calculation errors) or sampling error (i.e. cross contamination of samples, collecting biased samples were random sampling is required, failure to homogenize samples). Reference the Decision Error table. **Specify a range of possible values of the parameter of interest where the consequences of decision error are relatively minor** Reference the Decision Error Limit table **Assign probability values to points above and below the action level that reflect the tolerable probability for the occurrence of decision errors** Reference the Decision Error Limit table

Data Quality Objectives for Altoona Mine Removal Support Waste Pile Delineation and Excavation		
Step	**DQO Guidance of Purpose and Outputs of Step**	**Objectives**
7. Sampling Design Optimization	**Purpose:** Identify the most resource-effective sampling and analysis design for generating data that are expected to satisfy the DQOs. **Outputs From This Step** Review the DQO outputs and existing environmental data. Translate the information from the DQOs into a statistical hypothesis. Develop general sampling and analysis design alternatives. For each design alternative, formulate the mathematical expressions needed to solve the design problems. For each design alternative, select the optimal sample size that satisfies the DQOs. Select the most resource-effective design that satisfies all of the DQOs. Document the operational details and theoretical assumptions of the selected design in the Sampling and Analysis Plan. The most resource-effective design for the study that is expected to achieve the DQOs, selected from a group of alternative designs generated during this step.	Delineation Samples Soil samples will be collected at intervals around the Waste Pile perimeter in areas where there is no clear delineation based on previous data. These samples will be analyzed in the field by XRF or Lumex AA and sent to the laboratory for expedited analysis. The laboratory data is needed to determine and verify the agreement and correlation between non-definitive and definitive analysis methods. The delineation study will use systematic step-outs from know perimeter hotspots. For consistency the initial step will be 20 feet in direction 90 degrees apart. Collection of samples at these points will generate sensitivity to a 450 square foot hotspot (12 foot radius). The total number of samples collected for delineation is unknown, but it is not expected to exceed 150 samples. Repository Assessment Samples Because a statistical parameter is the characteristic of interest at the mine site, a probabilistic sampling design is required to meet the project objectives. Based on visual observations and research on historic mining practices, the concentration of mercury and arsenic at the site is not believed to be homogenous. Therefore, systematic random sampling of the site is an appropriate probabilistic sampling design for the Repository Area. A grid will be established in area with sectors that will be approximately 2,500 square feet in area. ProUCL Version 3.00.02 (Lockheed Martin,2004) and Visual Sample Plan (VSP)Version 5.1 (Battelle Memorial Institute, 2004) software was used to statistically evaluate existing data and assist with the determination of the number of random samples that will be required in the Repository Area to calculate an average concentration that meets project decision error limit goals. Due to the high variance documented for the Repository Area approximately 300 samples are needed to meet objectives. For that reason and to insure sensitivity to a 450 square foot hotspot (12 foot radius), a five point composite of each grid sector will be done. Confirmation Samples. Systematic sampling will be used to document the concentrations of mercury and arsenic remaining in the soil after the removal is complete. VSP Version 5.1 software was used to assist with the determination of the number of random samples that will be required in the Repository Area to calculate an average concentration that meets project decision error limit goals. Due to the high variance documented for the existing contaminated portions of the site, approximately 300 samples are needed to meet the mitigation objectives. For that reason and to insure sensitivity to a 450 square foot hotspot (12 foot radius), a 20-foot square grid cell was determined. The total number of sample collected for the Mine Waste Area excavation area is unknown, but it is not expected to exceed 300 samples. Reference attached VSP and ProUCL attachments.

Data Quality Objectives for Altoona Mine Removal Support Waste Pile Excavation and Delineation DECISION ERROR *Site Soils and Tailings*		
Decision Error	Deciding that the excavated decision area is contaminated and requires additional action when the excavated decision area is not contaminated.	Deciding that the excavated decision area is not contaminated and requires no additional action when the excavated decision area is contaminated.
True Nature of Decision Error	The sample concentrations are either not representative or are biased low.	The sample concentrations are either not representative or are biased high.
The Consequence of Error	1) This situations would cost additional resources of time, money and manpower.	1) Contaminants in soil and tailing would continue to migrate into the down-slope surface water.
Which Decision Error Has More Severe Consequences near the action level?	**LESS SEVERE** to human health, but with appreciable economic consequences.	**MORE SEVERE** since the contaminated soil may pose risks to human health and/or the environment.
Error Type Based on Consequences	**False Acceptance Decisions** A decision that the area is contaminated when it is not.	**False Rejection Decisions** A decision that the area is not contaminated when it is.

Definitions
False Acceptance Decisions = A false acceptance decision error occurs when the null hypothesis is not rejected when it is false.
False Rejection Decisions = A false rejection decision error occurs when the null hypothesis is rejected when it is true.
* = a excavated decision areas is that individual decision areas within the excavated Waste Pile Area.

Data Quality Objectives for Altoona Mine Removal Support
Waste Pile Excavation

Decision Error Limit Table - Statistical Sampling of Tailings and Soil
(where standard deviation is 600 % of AL)

True Concentration (% of Action Level)	Decision	Decision Error Probability Goal (%) .	Type of Decision Error
<25	Area is Contaminated	01	False Acceptance Decisions
50	Area is Contaminated	.40	False Acceptance Decisions (beta)
50 - 100	Area is Contaminated	Gray Area	Gray Area (delta)
100	Area is Not Contaminated	.25	False Rejection Decisions (alpha)
>150	Area is Not Contaminated	.01	False Rejection Decisions

1. Gray Area is where relatively large decision errors are acceptable.

2. Note that relatively large decision errors are expected when the true contaminant concentrations are between 100 and 150 % of the action level. Decreasing the probability for any given sample is not practical since sampling and analytical uncertainties and biases cannot be eliminated.

Data Quality Objectives for Altoona Mine Removal Support Hot Spot Search				
Hot Spot Size	Grid Size	Probability of Locating A Hot Spot	Samples in a 150,000 square foot area	Decision
<100	10 feet	0.91	1, 500	Not Selected
<100	20 feet	0.25	750	Not Selected
<100	30 feet	0.11	167	Not Selected
<250	10 feet	1.00	1, 500	Not Selected
<250	20 feet	.625	750	Not Selected
<250	30 feet	0.278	167	Not Selected
>500	10 feet	1.000	1, 500	Not Selected
>500	20 feet	0.976	750	Selected for perimeter and confirmation
>500	30 feet	0.556	167	Not Selected
>500	50 feet	0.20	60	Not Selected
>500	50 feet with 5 collection points at 20 feet	0.976	60	Selected for Areas

B Site Specific Health and Safety Plan

A Site Specific Health & Safety Plan must be prepared by the consultant/contractor who actually performs the sampling work.

Revision 8
January 2008

Ecology and Environment, Inc.

SITE-SPECIFIC HEALTH AND SAFETY PLAN

Project: Altoona Mine Removal

Project No.: 002693.2001.01RZ

TDD/PAN No.:

Project Location: 11 miles west of Castella in the Shasta-Trinity National Forest, Trinity County, CA (Latitude 41.136904 North, Longitude 122.547502 West)

Proposed Date of Field Activities: July 2008 through October 2008

Project Director: Cindy McLeod

Project Manager: Michael Friedman

Prepared by: Sara Dwight Date Prepared: July 1, 2008

Approved by: C. McLeod Date Approved: 07/06/08

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1. INTRODUCTION

1.1 POLICY

It is E & E's policy to ensure the health and safety of its employees, the public, and the environment during the performance of work it conducts. This site-specific health and safety plan (SHASP) establishes the procedures and requirements to ensure the health and safety of E & E employees for the above-named project. E & E's overall safety and health program is described in *Corporate Health and Safety Program* (CHSP). After reading this plan, applicable E & E employees shall read and sign E & E's Site-Specific Health and Safety Plan Acceptance form.

This SHASP has been developed for the sole use of E & E employees and is not intended for use by firms not participating in E & E's training and health and safety programs. Subcontractors are responsible for developing and providing their own safety plans.

This SHASP has been prepared to meet the following applicable regulatory requirements and guidance:

Applicable Regulation/Guidance
29 CFR 1910.120, Hazardous Waste Operations and Emergency Response (HAZWOPER)
Other:

1.2 SCOPE OF WORK

Description of Work: Mine tailings and waste from the Altoona Mine will be excavated from the site and placed in a repository that will be constructed to contain this material. START will perform sampling of the repository area prior to and during its construction, perform sampling after waste pile removal to document contaminant concentrations left in place, and perform dust monitoring during waste pile removal activities.

Equipment/Supplies: Attachment 1 contains a checklist of equipment and supplies that will be needed for this work.

The following is a description of each numbered task:

Task Number	Task Description
1	Repository area soil sampling
2	Waste pile sampling
3	Dust monitoring and air sampling during waste pile removal activities
4	Decontamination
5	XRF Field Screening
6	Site Documentation – GPS, photographic and written

1.3 SITE DESCRIPTION

Site Map: A site map or sketch is attached at the end of this plan.

Site History/Description (see project work plan for detailed description): The Altoona Mine is an abandoned and backfilled vertical mine, with an adjacent ore processing area, former retort areas, and waste rock and tailings piles. There are collapsed remains of

wooden structures at the ore processing area, as well as scattered about the periphery of the mine site. Cinnabar and mining extraction operations at the site date back to 1871.

Is the site currently in operation? ☐ Yes ☒ No

Locations of Contaminants/Wastes: The mine is located on an escarpment that faces southeast. The ore processing area is located immediately southwest of the surmised location of the main adit, and tailings piles are located southeast (downhill) of the processing area. The base of the tailings piles is approximately 80 feet below the elevation of the processing area. The area of the mine and its associated tailings piles comprises approximately 8 acres. Elevated concentrations of mercury and arsenic were found in samples collected from the tailings piles and processing area, as well as in Soda Creek near its outfall to the east fork of the Trinity River.

Types and Characteristics of Contaminants/Wastes:

☐ Liquid	☒ Solid	☐ Sludge	☐ Gas/Vapor
☐ Flammable/Ignitable	☒ Volatile	☐ Corrosive	☒ Acutely Toxic
☐ Explosive	☐ Reactive	☒ Carcinogenic	☐ Radioactive
☐ Medical/Pathogenic	Other:		

2. ORGANIZATION AND RESPONSIBILITIES

E & E team personnel shall have on-site responsibilities as described in E & E's standard operating procedure (SOP) for Site Entry Procedures (GENTECH 2.2). The project team, including qualified alternates, is identified below.

Name	Site Role/Responsibility
Michael Friedman	Project/Task Manager
Mike Folan	Site Safety Officer
Adam Ellis	Field Support
Adam Smith	Field Support
Sara Dwight	Field Support
Neil Ellis	Field Support

3. TRAINING

Prior to work, E & E team personnel shall have received training as indicated below. As applicable, personnel shall have read the project work plan, sampling and analysis plan, and/or quality assurance project plan prior to project work.

Training	Required
40-Hour OSHA HAZWOPER Initial Training and Annual Refresher (29 CFR 1910.120)	X
Annual First Aid/CPR	X
Hazard Communication (29 CFR 1910.1200)	X
40-Hour Radiation Protection Procedures and Investigative Methods	
8-Hour General Radiation Health and Safety	
Radiation Refresher	
DOT and Biannual Refresher	
Other: _____	

4. MEDICAL SURVEILLANCE

4.1 MEDICAL SURVEILLANCE PROGRAM

E & E field personnel shall actively participate in E & E's medical surveillance program as described in the CHSP and shall have received, within the past year, an appropriate physical examination and health rating.

E & E's health and safety record (HSR) form will be maintained on site by each E & E employee for the duration of his or her work. E & E employees should inform the site safety officer (SSO) of any allergies, medical conditions, or similar situations that are relevant to the safe conduct of the work to which this SHASP applies.

Is there a concern for radiation at the site? ☐ Yes ☒ No

If no, go to 5.1.

4.2 RADIATION EXPOSURE

4.2.1 External Dosimetry

Thermoluminescent Dosimeter (TLD) Badges: TLD badges are to be worn by all E & E field personnel.

Pocket Dosimeters: _____

_____

Other: _____

_____

4.2.2 Internal Dosimetry

☐ Whole body count ☐ Bioassay ☐ Other

Requirements: _____

_____

4.2.3 Radiation Dose

Dose Limits: E & E's radiation dose limits are stated in the CHSP. Implementation of these dose limits may be designated on a

site specific basis.

Site-Specific Dose Limits:

ALARA Policy: Radiation doses to E & E personnel shall be maintained as low as reasonably achievable (ALARA), taking into account the work objective, state of technology available, economics of improvements in dose reduction with respect to overall health and safety, and other societal and socioeconomic considerations.

5. SITE CONTROL

5.1 SITE LAYOUT AND WORK ZONES

Site Work Zones: Refer to the map or site sketch, attached at the end of this plan, for designated work zones.

Site Access Requirements and Special Considerations: The Altoona Mine site is located in a remote area of the Shasta-Trinity National Forest and is accessible by logging roads. A camp will be set up for site personnel, and leaving the site is not advised due to hazardous road conditions and active logging (i.e. numerous logging trucks) in the vicinity of the site.

Illumination Requirements: Work will be conducted during daylight hours. In the event that nighttime work is required, proper illumination of working areas is required.

Sanitary Facilities (e.g., toilet, shower, potable water): Sanitary facilities will be provided at the site.

On-Site Communications: Satellite phones will be used at the site as no cell phone coverage is available. Radio contact with U.S. Forest Service is available. Internet access will be available.

Other Site-Control Requirements:

5.2 SAFE WORK PRACTICES

Daily Safety Meeting: A daily safety meeting will be conducted for all E & E personnel and documented on the Daily Safety Meeting Record form or in the field logbook. The information and data obtained from applicable site characterization and analysis will be addressed in the safety meetings and also used to update this SHASP, as necessary.

Work Limitations: Work shall be limited to a maximum of 12 hours per day. If 12 consecutive days are worked, at least one day off shall be provided before work is resumed. Work will be conducted in daylight hours unless prior approval is obtained and the illumination requirements in 29 CFR 1910.120(m) are satisfied.

Weather Limitations: Work shall not be conducted during electrical storms. Work conducted in other inclement weather (e.g., rain, snow) will be approved by project management and the regional safety coordinator or designee.

Other Work Limitations: _____

Buddy System: Field work will be conducted in pairs of team members according to the buddy system.

Line of Sight: Each field team member shall remain in the line of sight and within verbal communication of at least one other team member.

Eating, Drinking, and Smoking: Eating, drinking, smoking, and the use of tobacco products shall be prohibited in the exclusion and contamination reduction areas, at a minimum, and shall only be permitted in designated areas.

Contamination Avoidance: Field personnel shall avoid unnecessary contamination of personnel, equipment, and materials to the extent practicable.

Sample Handling: Protective gloves of a type designated in Section 7 will be worn when containerized samples are handled for labeling, packaging, transportation, and other purposes.

Other Safe Work Practices: _____

6. HAZARD EVALUATION AND CONTROL

6.1 PHYSICAL HAZARD EVALUATION AND CONTROL

Potential physical hazards and their applicable control measures are described in the following table for each task.

Hazard	Task Number	Hazard Control Measures
Biological (flora, fauna, etc.)	1-4 and 6	■ Potential hazard: poison oak, insects, animals (bears, snakes, etc.) ■ Establish site-specific procedures for working around identified hazards. ■ Other:
Cold Stress	1-4 and 6	■ Provide warm break area and adequate breaks. ■ Provide warm noncaffeinated beverages. ■ Promote cold stress awareness. ■ See *Cold Stress Prevention and Treatment* (attached at the end of this plan if cold stress is a potential hazard).
Compressed Gas Cylinders		■ Use caution when moving or storing cylinders. ■ A cylinder is a projectile hazard if it is damaged or its neck is

Hazard	Task Number	Hazard Control Measures
		broken. ■ Store cylinders upright and secure them by chains or other means. ■ Other:
Confined Space	1-4 and 6	■ Ensure compliance with 29 CFR 1910.146. ■ See SOP for Confined Space Entry. Additional documentation is required. ■ Other: Site personnel shall not enter mine adits, shafts, or tunnels.
Drilling		■ See SOP for Health and Safety on Drilling Rig Operations. Additional documentation may be required. ■ Landfill caps will not be penetrated without prior discussions with corporate health and safety staff. ■ Other:
Drums and Containers		■ Ensure compliance with 29 CFR 1910.120(j). ■ Consider unlabeled drums or containers to contain hazardous substances and handle accordingly until the contents are identified. ■ Inspect drums or containers and assure integrity prior to handling. ■ Move drums or containers only as necessary; use caution and warn nearby personnel of potential hazards.
		■ Open, sample, and/or move drums or containers in accordance with established procedures; use approved drum/container-handling equipment. ■ Other:
Electrical		■ Ensure compliance with 29 CFR 1910 Subparts J and S. ■ Locate and mark energized lines. ■ De-energize lines as necessary. ■ Ground all electrical circuits. ■ Guard or isolate temporary wiring to prevent accidental contact. ■ Evaluate potential areas of high moisture or standing water and define special electrical needs. ■ Other:
Excavation and Trenching	1-3 and 6	■ Ensure that excavations comply with and personnel are informed of the requirements of 29 CFR 1926 Subpart P. ■ Ensure that any required sloping or shoring systems are approved as per 29 CFR 1926 Subpart P. ■ Identify special personal protective equipment (PPE) (see Section 7) and monitoring (see Section 8) needs if personnel are required to enter approved excavated areas or trenches. ■ Maintain line of sight between equipment operators and personnel in excavations/trenches. Such personnel are prohibited from working in close proximity to operating machinery. ■ Suspend or shut down operations at signs of cave in, excessive water, defective shoring, changing weather, or unacceptable monitoring results. ■ Other:
Fire and Explosion		■ Inform personnel of the location(s) of potential fire/explosion hazards.

Hazard	Task Number	Hazard Control Measures
		■ Establish site-specific procedures for working around flammables. ■ Ensure that appropriate fire suppression equipment and systems are available and in good working order. ■ Define requirements for intrinsically safe equipment. ■ Identify special monitoring needs (see Section 8). ■ Remove ignition sources from flammable atmospheres. ■ Coordinate with local fire-fighting groups regarding potential fire/explosion situations. ■ Establish contingency plans and review daily with team members. ■ Other:
Heat Stress	1-4 and 6	■ Provide cool break area and adequate breaks. ■ Provide cool noncaffeinated beverages. ■ Promote heat stress awareness. ■ Use active cooling devices (e.g., cooling vests) where specified. ■ See *Heat Stress Prevention and Treatment* (attached at the end of this plan if heat stress is a potential hazard).
Heavy Equipment Operation	1-3 and 6	■ Define equipment routes, traffic patterns, and site-specific safety measures. ■ Ensure that operators are properly trained and equipment has been properly inspected and maintained. Verify back-up alarms. ■ Ensure that ground spotters are assigned and informed of proper hand signals and communication protocols. ■ Identify special PPE (Section 7) and monitoring (Section 8) needs. ■ Ensure that field personnel do not work in close proximity to operating equipment. ■ Ensure that lifting capacities, load limits, etc., are not exceeded. ■ Other:
Heights (Scaffolding, Ladders, etc.)		■ Ensure compliance with applicable subparts of 29 CFR 1910. ■ Identify special PPE needs (e.g., lanyards, safety nets, etc.) ■ Other:
Noise	1-3 and 6	■ Establish noise level standards for on-site equipment/operations. ■ Inform personnel of hearing protection requirements (Section 7). ■ Define site-specific requirements for noise monitoring (Section 8). ■ Other:
Overhead Obstructions	1-3 and 6	■ Wear hard hat. ■ Other: Hard hats required in the vicinity of heavy equipment.
Power Tools		■ Ensure compliance with 29 CFR 1910 Subpart P. ■ Other:
Sunburn	1-4 and 6	■ Apply sunscreen. ■ Wear hats/caps and long sleeves. ■ Other:
Utility Lines		■ Identify/locate existing utilities prior to work.

Hazard	Task Number	Hazard Control Measures
		■ Ensure that overhead utility lines are at least 25 feet away from project activities. ■ Contact utilities to confirm locations, as necessary. ■ Other:
Weather Extremes	1-4 and 6	■ Potential hazards: ■ Establish site-specific contingencies for severe weather situations. ■ Provide for frequent weather broadcasts. ■ Weatherize safety gear, as necessary (e.g., ensure eye wash units cannot freeze, etc.). ■ Identify special PPE (Section 7) needs. ■ Discontinue work during severe weather. ■ Other:
Other:		■ ■
Other:		■ ■

6.2 CHEMICAL HAZARD EVALUATION AND CONTROL

6.2.1 Chemical Hazard Evaluation

Potential chemical hazards are described by task number in Table 6-1. Hazard Evaluation Sheets for major known contaminants are attached at the end of this plan.

6.2.2 Chemical Hazard Control

An appropriate combination of engineering/administrative controls, work practices, and PPE shall be used to reduce and maintain employee exposures to a level at or below published exposure levels (see Section 6.2.1).

Applicable Engineering/Administrative Control Measures: Support zones will be located upwind/up-gradient of contaminated areas. Water will be used for dust suppression if warranted.

PPE: See Section 7.

6.3 RADIOLOGICAL HAZARD EVALUATION AND CONTROL

6.3.1 Radiological Hazard Evaluation

Potential radiological hazards are described below by task number. Hazard Evaluation Sheets for major known contaminants are attached at the end of this plan.

Task Number	Radionuclide	DAC (μCi/ml)	Route(s) of Exposure	Major Radiation(s)	Energy(s) (MeV)	Half-Life

Task Number	Radionuclide	DAC (μCi/ml)	Route(s) of Exposure	Major Radiation(s)	Energy(s) (MeV)	Half-Life

6.3.2 Radiological Hazard Control

Engineering/administrative controls and work practices shall be instituted to reduce and maintain employee exposures to a level at or below the permissible exposure/dose limits (see sections 4.2.3 and 6.3.1). Whenever engineering/administrative controls and work practices are not feasible or effective, any reasonable combination of engineering/administrative controls, work practices, and PPE shall be used to reduce and maintain employee exposures to a level at or below permissible exposure/dose limits.

Applicable Engineering/Administrative Control Measures: Radiological hazards are not anticipated.

PPE: See Section 7.

TABLE 6-1

CHEMICAL HAZARD EVALUATION

Task Number	Compound	Exposure Limits (TWA)			Dermal Hazard (Y/N)	Route(s) of Exposure	Acute Symptoms	Odor Threshold/ Description	FID/PID	
		PEL	REL	TLV					Relative Response	Ioniz. Poten. (eV)
1-5	Arsenic *	0.01 mg/m^3 [TWA]	0.002 mg/m^3 [15 min, ceiling]	0.01 mg/m^3	Y	Inhalation, skin absorption, ingestion, skin and/or eye contact	Ulceration of nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin	Silver-grey or tin-white, brittle, odorless solid.	NA	NA
1-5	Asbestos *	0.1 fiber/cm^3 [TWA]	0.1 fiber/cm^3	0.1 fiber/cm^3	Y	Inhalation, ingestion, skin and/or eye contact	Asbestosis (chronic exposure): dyspnea (breathing difficulty), interstitial fibrosis, restricted pulmonary function, finger clubbing; irritation eyes	White or greenish (chrysotile), blue (crocidolite), or grey-green (amosite) fibrous, odorless solids.	NA	NA
1-5	Mercury	Vapor: 0.1 mg/m^3	Vapor: 0.05 mg/m^3 [TWA] 0.1 mg/m^3 [ceiling]	0.025 mg/m^3	Y	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; cough, chest pain, dyspnea (breathing difficulty), bronchitis, pneumonitis; tremor, insomnia, irritability, indecision, headache, lassitude (weakness, exhaustion); stomatitis, salivation; gastrointestinal disturbance, anorexia, weight loss; proteinuria	Silver-white, heavy, odorless liquid.	NA	NA

Note: Use an asterisk (*) to indicate known or suspected carcinogens.
mg/m^3 = milligrams per cubic meter
cm^3 = cubic centimetersr

7. LEVEL OF PROTECTION AND PERSONAL PROTECTIVE EQUIPMENT

7.1 LEVEL OF PROTECTION

The following levels of protection (LOPs) have been selected for each work task based on an evaluation of the potential or known hazards, the routes of potential hazard, and the performance specifications of the PPE. On-site monitoring results and other information obtained from on-site activities will be used to modify these LOPs and the PPE, as necessary, to ensure sufficient personnel protection. The authorized LOP and PPE shall only be changed with the approval of the regional safety coordinator or designee. Level A is not included below because Level A activities, which are performed infrequently, will require special planning and addenda to this SHASP.

Task Number	B	C	D	Modifications Allowed
1		(X)	X	Hard hats required when in the vicinity of heavy equipment in operation
2		(X)	X	Hard hats required when in the vicinity of heavy equipment in operation
3		(X)	X	Hard hats required when in the vicinity of heavy equipment in operation
4			X	Hard hats required when in the vicinity of heavy equipment in operation
5			X	
6		(X)	X	Hard hats required when in the vicinity of heavy equipment in operation

Note: Use "X" for initial levels of protection. Use "(X)" to indicate levels of protection that may be used as site conditions warrant.

7.2 PERSONAL PROTECTIVE EQUIPMENT

The PPE selected for each task is indicated below. E & E's PPE program complies with 29 CFR 1910.120 and 29 CFR 1910 Subpart I and is described in detail in the CHSP. Refer to 29 CFR 1910 for the minimum PPE required for each LOP.

PPE	Task Number/LOP					
	1	2	3	4	5	6
Full-face APR – may be used based on dust monitoring results	(X)	(X)	(X)			(X)
PAPR						
Cartridges:						
P100 and Mersorb	(X)	(X)	(X)			(X)

PPE	Task Number/LOP					
	1	2	3	4	5	6
GMC-P100						
GME-P100						
Other:						
Positive-pressure, full-face SCBA						
Spare air tanks (Grade D air)						
Positive-pressure, full-face, supplied-air system						
Cascade system (Grade D air)						
Manifold system						
5-Minute escape mask						
Safety glasses				X	X	
Monogoggles						
Coveralls/clothing						
Protective clothing:						
Tyvek	(X)	(X)	(X)	(X)		
Saranex						
Other:						
Splash apron				(X)		
Inner gloves:						
Cotton						
Nitrile	X	X	X	X	X	
Latex						
Other:						
Outer gloves:						
Viton						
Rubber						
Neoprene						
Nitrile						
Other:						
Work gloves						
Safety boots (as per ANSI Z41)	X	X	X	X	X	X
Neoprene safety boots (as per ANSI Z41)						
Boot covers (type: _____)						

PPE	Task Number/LOP					
	1	2	3	4	5	6
Hearing protection (type: _____)	(X)	(X)	(X)			(X)
Hard hat – required when in the vicinity of heavy equipment in operation	(X)	(X)	(X)			(X)
Face shield						
Other:						
Other:						

8. HEALTH AND SAFETY MONITORING

Health and safety monitoring will be conducted to ensure proper selection of engineering/administrative controls, work practices, and/or PPE so that employees are not exposed to hazardous substances at levels that exceed permissible exposure/dose limits or published exposure levels. Health and safety monitoring will be conducted using the instruments, frequency, and action levels described in Table 8-1. Health and safety monitoring instruments shall have been appropriately calibrated and/or performance-checked prior to use.

9. DECONTAMINATION PROCEDURES

All equipment, materials, and personnel will be evaluated for contamination upon leaving the exclusion area. Equipment and materials will be decontaminated and/or disposed and personnel will be decontaminated, as necessary. Decontamination will be performed in the contamination reduction area or any designated area such that the exposure of uncontaminated employees, equipment, and materials will be minimized. Specific procedures are described below.

Equipment/Material Decontamination Procedures (specified by work plan): Any non-disposable sampling equipment will be washed in an alconox-water solution and double rinsed. Equipment will be wiped clean of dust and particulates prior to leaving the site.

Ventilation: All decontamination procedures will be conducted in a well-ventilated area.

Personnel Decontamination Procedures: Remove and dispose of PPE. Wash hands prior to taking breaks, such as lunch, and prior to leaving the site.

PPE Requirements for Personnel Performing Decontamination: Level D

Personnel Decontamination in General: Following appropriate decontamination procedures, all field personnel will wash their hands and face with soap and potable water. Personnel should shower at the end of each work shift.

Disposition of Disposable PPE: Disposable PPE must be rendered unusable and disposed as investigation derived waste.

Disposition of Decontamination Wastes (e.g., dry wastes, decontamination fluids, etc.): Decontamination wastes will be

drummed and disposed of as investigation derived waste.

TABLE 8-1

HEALTH AND SAFETY MONITORING

Instrument	Task Number	Contaminant(s)	Monitoring Location	Monitoring Frequency	Action Levels[a]	
☐ PID (e.g., RAE mini RAE) ☐ FID (e.g., OVA 128-) ☐ TVA 1000					**Unknown Vapors** Background to 1 ppm above background: Level D 1 to 5 ppm above background: Level C 5 to 500 ppm above background: Level B >500 ppm above background: Level A	**Contaminant-Specific**
Oxygen Meter/Explosimeter					**Oxygen** <19.5% or >22.0%: Evacuate area; eliminate ignition sources; reassess conditions. 19.5 to 22.0%: Continue work in accordance with action levels for other instruments.	**Explosivity** ≤10% LEL: Continue work in accordance with action levels for other instruments; monitor continuously for combustible atmospheres. >10% LEL: Evacuate area; eliminate ignition sources; reassess conditions.
Radiation Alert Monitor (Rad-mini or RAM-4)					<0.1 mR/hr: Continue work in accordance with action levels for other instruments. ≥0.1 mR/hr: Evacuate area; reassess work plan and contact radiation safety specialist.	
Mini-Ram Particulate Monitors (Personal Data Ram and/or Data Ram)	3	Arsenic, Asbestos, Mercury, Dust	Perimeter of work zone, inside work zone (worst case)	Continuous during dirt moving operations	**General/Unknown** If dust levels exceed 5 mg/m^3, cease work until dust levels decrease or don respirator.	**Contaminant-Specific** Mercury: 3.26 mg/m^3 Arsenic: 1.52 mg/m^3 Use respirator if dust levels exceed these concentrations. See attachments for more information and calculation.
HCN/H_2S (Monitox)					≥4 ppm: Leave area and consult with SSO.	
Draeger Colorimetric Tubes					**Tube** **Action Level** **Action**	
Air Monitor/Sampler Type: _____ Sampling medium: _____					**Action Level**	**Action**

TABLE 8-1

HEALTH AND SAFETY MONITORING

Instrument	Task Number	Contaminant(s)	Monitoring Location	Monitoring Frequency	Action Levels[a]
Personal Sampling Pump Type: GilAir 5 low flow sampling pump or equivalent Sampling medium: Filter cassettes	3	Arsenic, Asbestos, Mercury	2 locations inside work zone (worst case), 1 background location	Samples to be taken during AM and PM work shifts over 2-3 days. See method for sample times.	**Action Level** — **Action** Asbestos: <0.1 fiber/cm^3 per 8 hour workday — Continue work >0.1 fibers/cm^3 per 8 hour workday — Use respirator Arsenic: <0.01 mg/m^3 per 8 hour workday — Continue work >0.01 mg/m^3 per 8 hour workday — Use respirator Mercury: <0.025 mg/m^3 per 8 hour workday — Continue work >0.025 mg/m^3 per 8 hour workday — Use respirator
Micro R Meter					<2 mR/hr: Continue work in accordance with action levels for other instruments. 2 to 5 mR/hr: In conjunction with a radiation safety specialist, continue work and perform stay-time calculations to ensure compliance with dose limits and ALARA policy. >5 mR/hr: Evacuate area to reassess work plan and evaluate options to maintain personnel exposures ALARA and within dose limits.
Ion Chamber					See micro R meter action levels above.
Radiation Survey Ratemeter/Scaler with External Detector(s)					**Detector** — **Action Level** — **Action**
Noise Dosimeter (Sound Level Meter)					≤85 decibels as measured using the A-weighed network (dBa): Use hearing protection if exposure will be sustained throughout work shift. >85 dBA: Use hearing protection. >120 dBA: Leave area and consult with safety personnel.
Other: Lumex Mercury Vapor Analyzer	1-3 5	Mercury vapor	Throughout site In field screening area	Continuous Hourly during screening operations	>0.025 mg/m^3 (OSHA PEL) Continue work. (0.1 mg/m^3 = 100,000 ng/m^3) 0.025 to 2.5 mg/m^3: Use full face respirator with Mersorb chemical cartridge 2.5 to 10 mg/m^3: Use supplied air respirator operated in positive pressure mode
Other:					

a Unless stated otherwise, airborne contaminant concentrations are measured as a time-weighted average in the worker's breathing zone. Acceptable concentrations for known airborne contaminants will be determined based on OSHA/NIOSH/ACGIH and/or NRC exposure limits. As a guideline, 1/2 the PEL/REL/TLV, whichever is lower should be used.

10. EMERGENCY RESPONSE

This section contains additional information pertaining to on-site emergency response and does not duplicate pertinent emergency response information contained in earlier sections of this plan (e.g., site layout, monitoring equipment, etc.). Emergency response procedures will be rehearsed regularly, as applicable, during project activities.

10.1 EMERGENCY RESPONSIBILITIES

All Personnel: All personnel shall be alert to the possibility of an on-site emergency; report potential or actual emergency situations to the team leader and SSO; and notify appropriate emergency resources, as necessary.

Team Leader: The team leader will determine the emergency actions to be performed by E & E personnel and will direct these actions. The team leader also will ensure that applicable incidents are reported to appropriate E & E and client project personnel and government agencies.

SSO: The SSO will recommend health/safety and protective measures appropriate to the emergency.

Other:

10.2 LOCAL AND SITE RESOURCES (including phone numbers)

Ambulance: Mt. Shasta Ambulance Services (530) 926-2665

Hospital: Mercy Medical Center Mt. Shasta, 914 Pine Street, Mount Shasta, CA 96097 (530) 926-6111

Directions to Hospital (map attached at the end of this plan): Travel from project site back to Castella, CA. Turn RIGHT to take ramp onto I-5 N (13.7 miles). Take exit #738 toward Central Mt. Shasta. (0.2 miles) Turn RIGHT at W. Lake St. (0.2 miles) Turn LEFT at Pine St. (0.6 miles) Arrive 914 Pine St., Mt. Shasta, on the RIGHT. (230 feet)

Poison Control: California Poison Control System – Sacramento Division, UC Davis Medical Center, 2315 Stockton Blvd., Sacramento, CA 95817 (800) 222-1222

Police Department: Mt. Shasta Police Department (530) 926-7539 or Highway Patrol, Mt. Shasta (530) 926-2425

Fire Department: Castella Fire Dept., Dunsmuir, CA 96025 911 or (530) 235-4581

Client Contact: Michelle Rogow, EPA OSC (415) 595-8347

Site Contact: Michelle Rogow, EPA OSC (415) 595-8347

On-Site Telephone Number: To be determined.

Cellular Telephone Number: Satellite phones will be available. Numbers to be determined.

Radios Available: Radios will be available on site.

Other: A first aid center and licensed Emergency Medical Technician will be onsite.

10.3 E & E EMERGENCY CONTACTS

E & E Emergency Operations Center (24 Hours):	716-684-8060
Corporate Health and Safety Director, Dr. Paul Jonmaire:	716-684-8060 (office) 716-655-1260 (home)

Regional Office Contact: Cindy McLeod	415-981-2811 (office) 415-238-3379 (cell) 510-654-6250 (home)
Other:	_____ (office)
a. E & E Emergency Response Center:	716-684-8060
b. Corporate Health and Safety Director, Dr. Paul Jonmaire:	716-684-8060 (office) 716-655-1260 (home)
c. Assistant Corporate Safety Director, Tom Siener, CIH:	716-684-8060 (office) 716-662-4740 (home) 716-597-5868 (Cell)

10.4 OTHER EMERGENCY RESPONSE PROCEDURES

On-Site Evacuation Signal/Alarm (must be audible and perceptible above ambient noise and light levels): 2 long blasts of vehicle horn.

On-Site Assembly Area: Lab trailer

Emergency Egress Route to Get Off Site: Both logging roads back to Castella, CA can be used to exit the site.

Off-Site Assembly Area: Work camp (appxoximately 1/4-1/2 mile from the site)

Preferred Means of Reporting Emergencies: Call 911, notify E&E personnel and project manager, notify EPA OSC.

Site Security and Control: In an emergency situation, personnel will attempt to secure the affected area and control site access.

Spill Control Procedures: Spill response materials will be available onsite. Spills will be attended to and cleaned up as soon as possible using adsorbents, excavation, or other means.

Emergency Decontamination Procedures: Remove PPE.

PPE: Personnel will don appropriate PPE when responding to an emergency situation. The SSO and Section 7 of this plan will provide guidance regarding appropriate PPE.

Emergency Equipment: Appropriate emergency equipment is listed in Attachment 1. Adequate supplies of this equipment shall be maintained in the support area or other approved work location.

Incident Reporting Procedures: Notify authorities as appropriate. Notify E&E personnel as soon as possible.

ATTACHMENT 1

EQUIPMENT/SUPPLIES CHECKLIST

	No.
INSTRUMENTATION	
FID	
Thermal desorber	
O_2/explosimeter w/cal. Kit	
Photovac tip	
PID (probe: _____eV)	
Magnetometer	
Pipe locator	
Weather station	
Draeger tube kit (tubes: _____)	
Brunton compass	
Real-time cyanide monitor	
Real-time H_2S monitor	
Heat stress monitor	
Noise equipment	
Personal sampling pumps and supplies	X
MiniRam dust monitor	X
Sample stands for PDR and air sampling	X
Mercury monitor - Lumex	X
Mercury monitor – Lumex soil attachment	X
Innovex	X
GPS	X
Spare batteries (type: _____)	
RADIATION EQUIPMENT/SUPPLIES	
Documentation forms	
Portable ratemeter	
Scaler/ratemeter	
1" NaI gamma probe	
2" NaI gamma probe	
ZnS alpha probe	
GM pancake probe	
Tungsten-shielded GM probe	
Micro R meter	
Ion chamber	
Alert monitor	

	No.
Pocket dosimeter	
Dosimeter charger	
Radiation warning tape	
Radiation decon supplies	
Spare batteries (type: _____)	
TLD Badges	X
SAMPLING EQUIPMENT	
8-oz. jars	200
Half-gallon bottles	
VOA bottles	
String	
Hand bailers	
Thieving rods with bulbs	
Disposable Sampling Scoops	1000
Knives	
Plastic bags	1000
Sample cups (XRF)	1000
Coffee filters	1000
Sample labels	200
Mortar/Pestle	2
Mylar film	X
Asbestos cassettes	X
Metals cassettes	X
Air sampling tubing	X
Splitter for air sampling cassettes	3
MISCELLANEOUS	
Pump	
Surveyor's tape	
100' Fiberglass tape	
300' Nylon rope	
Nylon string	
Surveying/Sampling flags	1000
Spray Paint	3
Camera	X

	No.
Film	
Bung wrench	
Soil auger	
Pick	
Shovel	
Catalytic heater	
Propane gas	
Banner tape	
Surveying meter stick	
Chaining pins and ring	
Logbooks (__4__ large, _____ small)	X
Required MSDSs	
Intrinsically safe flashlight	X
Potable water	X
Gatorade or equivalent	X
Tables	X
Chairs	X
Weather radio	
Two-way radios	X
Binoculars	
Megaphone	
Cooling vest	
Sunscreen	X
EMERGENCY EQUIPMENT	
First aid kit	X
Stretcher	
Portable eye wash	X
Blood pressure monitor	
Fire blanket	
Fire extinguisher	X
Thermometer (medical)	
Spill kit	
DECONTAMINATION EQUIPMENT	
Wash tubs	
Buckets	X
Scrub brushes	X

	No.
Pressurized sprayer	
Spray bottle	2
Detergent (type: Alconox)	X
Solvent (type:)	
Plastic sheeting	
Tarps and poles	
Trash bags	25
Trash cans	
Masking tape	
Duct tape	4
Paper towels	25
Step ladders	
Distilled water	X
Deionized water	
SHIPPING EQUIPMENT	
Coolers	3
Paint cans with lids, 7 clips each	
Vermiculite	
Shipping labels	X
DOT labels:	
"Up"	
"Danger"	
"Inside Container Complies ..."	
Hazard Group	
Strapping tape	
Box cutter	4
Custody seals	1000
Chain-of-custody forms	25
Express shipment forms	
Clear packing tape	4
Packing tape dispenser	2
Permanent markers – thin	12
Permanent markers - thick	12
Ballpoint pens	12
Cable ties	100
PPE	

	No.
Tyvek L	X
Tyvek XL	X
Tyvek XXL	X
Safety Vest	X
MSA Respirator	X
MSA Cartridges – Combo w/Mersorb	X
Respirator wipes	X
Hard Hat	X
Steel Toed Boots	X
Safety glasses/sunglasses	X
Nitrile gloves – M	2
Nitrile gloves – L	4
Nitrile gloves - XL	2

Start **Castella, CA**
End **Mercy Medical Center**
Mount Shasta, California
Travel **14.8 mi – about 16 mins**

Castella, CA

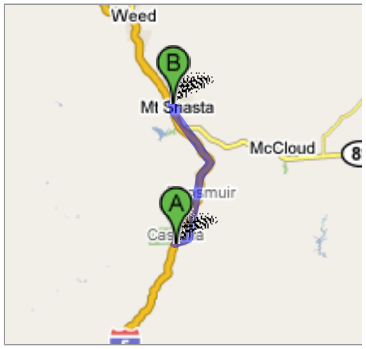
Drive: 14.8 mi – about 16 mins

	1. Head **northwest** on **Castle Creek Rd** toward **Exit 724**	59 ft
→	2. Turn **right** to merge onto **I-5 N**	13.7 mi 13 mins
	3. Take exit **738** toward **Central Mt Shasta**	0.2 mi
→	4. Turn **right** at **W Lake St**	0.2 mi 1 min
←	5. Turn **left** at **Pine St**	0.6 mi 2 mins
→	6. Turn **right**	230 ft

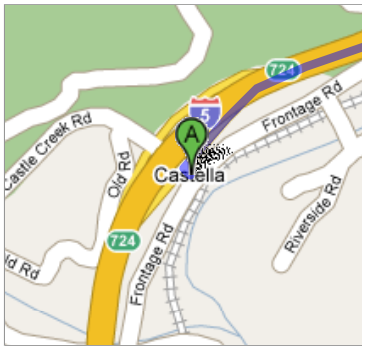
Mercy Medical Center
Mount Shasta, California

These directions are for planning purposes only. You may find that construction projects, traffic, or other events may cause road conditions to differ from the map results.

Overview



Start



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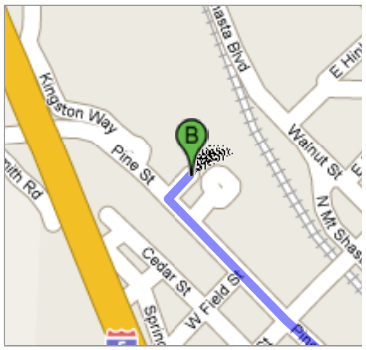

Directions to Altoona Mine Site

Directions to the Site:
From Castella on the Forest Service Rd. 25 - Travel west for approximately 17 miles.
After crossing a concrete bridge with a large culvert, on a switchback, take the first dirt road - 580W - up the hill.
Follow the road which is marked with 3 pink survey flags on the tree at each intersection, to the site.

DIGITALGLOBE

25

580W

133

EPA Camp

Altoona Mine

Ramshorn Meadow Creek Rd

0 0.25 0.5 1 Miles

N

Roads

Ownership

Figure 2-1

USFS

EPA Region 9 GIS Center

SFD0801612.4

June 30, 2008

COLD STRESS PREVENTION AND TREATMENT

Cold temperatures are potentially hazardous, especially when work is conducted without appropriate precautions. The following sections describe cold stress prevention and the recognition and treatment of cold stress emergencies.

Preventing Emergencies Due to Cold Stress

When working in situations where the ambient temperature is low, especially if low temperatures are accompanied by windy conditions, personnel should use the following cold-stress prevention measures:

- X Wear warm, dry, loose-fitting clothing that is preferably worn in layers. Outer clothing should be waterproof and windproof. Inner clothing should be capable of retaining warmth even when it is wet (e.g., wool or polypropylene) or have wicking capabilities (to draw moisture and perspiration away from the skin).
- X Wear lined and insulated footwear and warm gloves or mittens.
- X Alternately remove and don clothing layers as necessary to regulate body temperature and reduce excess perspiration.
- X Drink warm fluids as often as desired.
- X Take frequent breaks to provide for cold stress monitoring.

Cold Stress Emergencies

Hypothermia. Exposure to cold can cause the body's internal temperature to drop to a dangerously low level. Hypothermia occurs when a person's body loses heat faster than it can be produced. The body's normal deep-body temperature is approximately 98.6 degrees Fahrenheit. If body temperature drops to 95 degrees Fahrenheit, uncontrollable shivering may occur. If cooling continues, these other symptoms may occur:

- ∃ Vague, slow, slurred speech;
- ∃ Forgetfulness, memory lapses;
- ∃ Inability to use hands;
- ∃ Frequent stumbling;
- ∃ Drowsiness;
- ∃ Exhaustion, collapse;
- ∃ Unconsciousness; and
- ∃ Death.

Hypothermia impairs the judgment of the victim. Hypothermia is possible even in temperatures above freezing and can be prevented by remaining warm and dry and avoiding overexposure to the cold.

If a person shows symptoms of hypothermia, perform the following:

- ∃ Remove the victim from exposure to wet and cold weather.
- ∃ Remove wet clothing.
- ∃ If the victim is only mildly affected, provide warm drinks and dry clothing.
- ∃ If the victim is more seriously affected (clumsy, confused, unable to shiver), begin safe-warming procedures such as hugging, wrapping in dry blankets, and the use of warm objects such as hot water bottles or heat packs, and arrange for evacuation. Do not give the victim warm drinks until he or she exhibits a clear level of consciousness and appears to be warming up.

Frostbite. Frostbite occurs when body tissue freezes. Severe frostbite can lead to reduced circulation and the possible need for amputation. To prevent frostbite, maintain good circulation and keep extremities warm and dry. In extreme cold, it is important to prevent heat loss from as many areas of the body as possible. Exposed limbs and the head are major areas of heat loss.

Tall, thin people; those in poor physical condition; people with chronic diseases; heavy smokers; children; the elderly; and those who have been drinking alcohol are more susceptible to frostbite than other people due to poor circulation, poor production of body heat, or both.

There may be no pain or numbness experienced with gradual freezing of body tissues. While in the cold, it is important to test extremities for sensation and ensure that clothing is loose-fitting and warm. Exposed parts of the body should be inspected routinely. Just before freezing, skin becomes bright red. As freezing continues, small white patches will appear and the skin will become less elastic, often remaining pitted after it is touched or squeezed.

Serious freezing is most common in the feet because people are less aware of them, circulation and sensation are poorer, and warm footwear is difficult to obtain. Hands are usually the next to freeze. Exposed parts of the head will freeze less rapidly because they are conditioned to exposure and have a better blood supply.

In very cold weather, avoid touching cold metal with bare body parts. In the event that this happens, release the skin gently using heat, warm water, or urine. Avoid handling gasoline, kerosene, or similar liquids which, when handled in cold weather, can cause immediate frostbite.

If a person shows symptoms of frostbite, consult a medical professional, if possible, and perform the following:

- Initiate rewarming only if subsequent refreezing is not a possibility (thawing and refreezing should always be avoided because this is very injurious to tissue). Rewarm body parts in water that is approximately 100 to 105 degrees Fahrenheit. Do not try to thaw the body parts using cold water, snow, or intense heat from fires or stoves. The whole body may be immersed in warm water if necessary.

- If a large portion of an extremity is frozen when rewarming is initiated, the deep body temperature may drop as cooled blood begins to circulate throughout the body. Provide warm liquids to alleviate this situation.

- Move the afflicted part gently and voluntarily during rewarming.

- Use pain medication if it is available. Rewarming can be acutely painful. After thawing is completed, a deep pain may persist for several days, depending on the severity of the frostbite. Pain may be a good sign as it indicates that nerve function is present.

- A dull purple color, swelling, or blisters indicate serious injury and the need for medical attention. Consult a medical professional.

HEAT STRESS PREVENTION AND TREATMENT

Elevated temperatures are potentially hazardous, especially when work is conducted without appropriate precautions. The following sections describe heat stress prevention and the recognition and treatment of heat emergencies.

Effects of Heat

A predictable amount of heat is generated as a result of normal oxidation processes within the body. If heat is liberated rapidly, the body cools to a point at which the production of heat is accelerated, and the excess heat brings the body temperature back to normal.

Interference with the elimination of heat leads to its accumulation and to the elevation of body temperature. This condition produces a vicious cycle in which certain body processes accelerate and generate additional heat. Afterward, the body must eliminate not only the heat that is normally generated but also the additional quantities of heat.

Most body heat is brought to the surface by the bloodstream and escapes to cooler surroundings by conduction and radiation. If moving air or a breeze strikes the body, additional heat is lost by convection. When the temperature of the surrounding air becomes equal to or rises above the body temperature, all the heat must be lost by vaporization of the moisture or sweat from skin surfaces. As the air becomes more humid (contains more moisture), vaporization from the skin decreases. Weather conditions including high temperatures (90 to 100 degrees F), high humidity, and little or no breeze cause the retention of body heat. Such conditions or a succession of such days (a heat wave) increase the chances of a medical emergency due to heat.

Preventing Emergencies Due to Heat

When working in situations where the ambient temperatures and humidity are high, and especially in situations where protection levels A, B, or C are required, the site safety officer should:

- Ensure that all employees drink plenty of fluids (Gatorade or its equivalent);
- Ensure that frequent breaks are scheduled so overheating does not occur; and
- Revise work schedules, when necessary, to take advantage of the cooler parts of the day (i.e., 5:00 a.m. to 11:00 a.m. and 6:00 p.m. to nightfall).

When protective clothing is required, the suggested guidelines correlating ambient temperature and maximum wearing time per excursion are:

Ambient Temperature	Maximum Wearing Time per Excursion
Above 90 degrees F	15 minutes
85 to 90 degrees F	30 minutes
80 to 85 degrees F	60 minutes
70 to 80 degrees F	90 minutes
60 to 70 degrees F	120 minutes
50 to 60 degrees F	180 minutes

One method of measuring the effectiveness of an employee's rest-recovery regime is by monitoring the heart rate. The "Brouha guideline" is one such method and is performed as follows:

- Count the pulse rate for the **last** 30 seconds of the first minute of a 3-minute period, the **last** 30 seconds of the second minute, and the **last** 30 seconds of the third minute; and

- Double each result to yield beats per minute.

If the recovery pulse rate during the last 30 seconds of the first minute is 110 beats/minute or less, and the deceleration between the first, second, and third minutes is **at least** 10 beats/minute, then the work-recovery regime is acceptable. If the employee's rate is above the rate specified, a longer rest period will be required, accompanied by an increased intake of fluids.

Heat Emergencies

Heat Cramps. Heat cramps usually affect people who work in hot environments and perspire a great deal. Loss of salt from the body causes very painful cramps in leg and abdominal muscles. Heat cramps may also result from drinking iced water or other drinks either too quickly or in too large a quantity. The symptoms of heat cramps are:

- Painful muscle cramps in legs and abdomen;

- Faintness; and

- Profuse perspiration.

To provide emergency care for heat cramps, move the patient to a cool place. Give him or her sips of liquids such as Gatorade or its equivalent. Apply manual pressure to the cramped muscle. Move the patient to a hospital if there is any indication of a more serious problem.

Heat Exhaustion. Heat exhaustion also may occur in individuals working in hot environments and may be associated with heat cramps. Heat exhaustion is caused by the pooling of blood in the vessels of the skin. The heat is transported from the interior of the body to the surface by the blood. The skin vessels become dilated and a large amount of blood is pooled in the skin. This condition, plus the blood that is pooled in the lower extremities when in an upright position, may lead to an inadequate return of blood to the heart and eventual physical collapse. The symptoms of heat exhaustion are:

- Weak pulse;

- Rapid and usually shallow breathing;
- Generalized weakness;
- Pale, clammy skin;
- Profuse perspiration;
- Dizziness/faintness; and
- Unconsciousness.

To provide emergency care for heat exhaustion, move the patient to a cool place and remove as much clothing as possible. Have the patient drink cool water, Gatorade, or its equivalent. If possible, fan the patient continually to remove heat by convection, but do not allow chilling or overcooling. Treat the patient for shock and move him or her to a medical facility if there is any indication of a more serious problem.

Heat Stroke. Heat stroke is a profound disturbance of the heat-regulating mechanism and is associated with high fever and collapse. It is a serious threat to life and carries a 20% mortality rate. Sometimes this condition results in convulsions, unconsciousness, and even death. Direct exposure to sun, poor air circulation, poor physical condition, and advanced age (over 40) increase the chance of heat stroke. Alcoholics are extremely susceptible. The symptoms of heat stroke are:

- Sudden onset;
- Dry, hot, and flushed skin;
- Dilated pupils;
- Early loss of consciousness;
- Full and fast pulse;
- Deep breathing at first, followed by shallow or faint breathing;
- Muscle twitching, growing into convulsions; and
- Body temperature reaching 105 to 106 degrees F or higher.

When providing emergency care for heat stroke, remember that it is a life-threatening emergency. Transportation to a medical facility should not be delayed. Move the patient to a cool environment, if possible, and remove as much clothing as possible. Ensure an open airway. Reduce body temperature promptly by dousing the body with water or, preferably, by wrapping the patient in a wet sheet. If cold packs are available, place them under the arms, around the neck, at the ankles, or any place where blood vessels that lie close to the skin can be cooled. Protect the patient from injury during convulsions.

C Standard Operating Procedures