RECLAMATION WORK PLAN

Forest Rose Mine Site

Prepared for

Montana Department of Environmental Quality

July 2010

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Forest Rose Mine Site

Prepared for

Montana Department of Environmental Quality
Abandoned Mine Section
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Acronyms and Abbreviations

AA	atomic adsorption
ABA	acid base accounting
ASA	American Society of Agronomy
CEC	cation exchange capacity
CLP	contract laboratory program
CVAA	cold vapor atomic absorption
DEQ/MWCB	Montana Department of Environmental Quality/Mine Waste Cleanup Bureau
DQO	data quality objective
EEE/CA	expanded engineering evaluation and cost analysis
ELI	Energy Laboratories, Inc.
EPA	U.S. Environmental Protection Agency
FSP	field sampling plan
ft	foot
HHS	human health standards
HMI	hazardous materials inventory
HASP	health and safety plan
in.	inch
ICP	inductively coupled plasma
J	estimated quantity
LAP	laboratory analytical plan
lb	pound

LCS	laboratory control standard
MBMG	Montana Bureau of Mines and Geology
MCL	maximum contaminant level
µg/L	micrograms per liter
mg/m^3	milligrams per cubic meter
mg/kg	milligrams per kilogram
MS	matrix spike
ORP	oxygen reduction potential
oz	ounce
ppm	parts per million
PRG	preliminary reclamation goal
QA	quality assurance
QAPP	quality assurance protocol plan
QC	quality control
RA	risk assessment
RBCG	risk-based cleanup guidelines
RI	reclamation investigation
RPD	relative percent difference
RSL	regional screening levels
RWP	reclamation work plan
SPLP	synthetic precipitation leaching procedure
TAL	target analyte level
TDS	total dissolved solids

TRL	target reporting level
U	undetected
USDA	U.S. Department of Agriculture
USFS	United States Forest Service
XRF	x-ray fluorescence
yd^3	cubic yard

1.0 Introduction

Herrera Environmental Consultants (Herrera) received Task Order No. 7 from the Montana Department of Environmental Quality, Mine Waste Cleanup Bureau (DEQ/MWCB), under DEQ Contract No. 407032. The purpose of Task Order No. 7 is to complete a site reconnaissance, prepare a Reclamation Work Plan (RWP), collect onsite field and laboratory data, and prepare a Reclamation Investigation (RI) report for the Forest Rose Mine Site.

The Forest Rose Mine is an abandoned hardrock mine that produced of silver, lead, and zinc. The Forest Rose Mine is located approximately 6 miles southwest of Jens, Montana in Granite County.

1.1 Purpose of Reclamation Work Plan

The Forest Rose Mine Site consists of approximately 4 acres of mining impacted lands. Three tailings impoundments and one waste rock area have been identified in previous reports written for the United States Forest Service, Region 1 (USFS) and the DEQ/MWCB. The tailings impoundments cover Dunkleberg Creek, which generally runs south to north through the project area. The quantities of tailings and waste rock differ greatly between the two reports, ranging between 23,000 and 95,000 cubic yards of tailings and 8,000 and 21,000 cubic yards of waste rock, respectively.

Based on the previous reports, four potentially contaminated media (surface water, soil, sediment, and groundwater) are present at the Forest Mine Site. Elevated levels of arsenic, cadmium, copper, iron, mercury, lead, antimony, and zinc were found in the tailings and waste rock samples. Surface water and groundwater samples showed elevated levels of arsenic, cadmium, copper, iron, lead, and zinc. Sediment samples showed elevated levels of arsenic, copper, iron and lead. Based on these samples, the DEQ/MWCB contracted Herrera to prepare a RWP to identify the potential environmental impacts associated with the existing mine waste and to present a plan for completing an RI at the Forest Rose Mine Site.

1.2 Work Plan Organization

The RWP is organized into four sections:

Section 1.0 Introduction – This section outlines the task order requirements and presents the purpose, organization, and management of the mine site investigation.

Section 2.0 Environmental Setting – This section describes the location of the Forest Rose Mine Site, including (1) climatic, geologic, and hydrologic characteristics; (2) the biological setting; and (3) current land uses and local population.

Section 3.0 Description of Property – This section presents a summary of past metal mining activities and available site characterization information. The estimated types, volumes, and contaminant concentrations from existing data are provided. Ownership information and cultural concerns are also provided in this section.

Section 4.0 Reclamation Work Plan – This section presents the RWP, including (1) preliminary reclamation objectives and goals; (2) the field sampling plan (FSP); (3) the quality assurance protocol plan (QAPP); (4) the laboratory analytical plan (LAP); (5) the health and safety plan (HASP); (6) permitting requirements; and (7) estimated RI costs.

1.3 Project Management Plan

The project management plan identifies project personnel, their responsibilities, and contact information.

1.3.1 Project Team

The project team is shown in Table 1-1 below.

Table 1-1. Project Team for Forest Rose Mine Project

Agency/Firm	Personnel	Project Title	Contact Information
Montana Department of Environmental Quality/Mine Waste Cleanup Bureau	John Koerth	Section Supervisor	406-841-5026
	Devin Clary	Forest Rose Project Manager	406-841-5029
Herrera Environmental Consultants	Kevin Houck, P.E.	Project Manager	406-721-4204
	Peter Jowise	Quality Assurance Manager	206-441-9080
	Gina Catarra	Field Team Leader/ Project Chemist	206-441-9080
	Bruce Carpenter	Field Team Member/ Health and Safety Coordinator	206-441-9080
	Susan Wall	Field Team Member	406-721-4204
	Heidi Machel, P.E.	Civil Engineer	406-721-4204
	Michael Spillane, P.E.	Technical Support	206-441-9080
	Vincent Perrone, P.E.	Technical Support/Geotechnical Engineer	206-441-9080

1.3.1.1 Mine Waste Cleanup Bureau Personnel Responsibilities

- **Section Supervisor** - The section supervisor oversees all DEQ/MWCB activities.

- **Project Manager** - The DEQ/MWCB project manager monitors the performance of the contractor, reviews and approves quality assurance (QA) measures, and provides direction to the Herrera project liaison, project manager, and field team leader, as well as coordinate all site activities with the property owner.

Herrera Personnel

- Project Manager - The project manager will administer all project activities, staffing, and budgets and coordinate project activities with the DEQ/MWCB project manager. The project manager will oversee project field activities and work products. The project manager will keep the field team informed of all project activities.

- Field Team Leader - The field team leader will oversee the field sampling activities and coordinate with the DEQ/MWCB project manager to schedule all field activities.

- Field Team Member – The field team members will assist the field team leader to complete the field activities.

- Civil Engineer - Support the field team to identify engineering data needs for the RI.

- Health and Safety Coordinator - Review the HASP and provide guidance and direction to the field team leader on safe conduct of the RI.

- QA Manager - The QA manager will review all work products for technical quality and consistency and coordinate data review, validation, and auditing requirements as necessary.

- Project Chemist – The project chemist will review the laboratory electronic data deliverable and electronic field data, enter the data qualifiers into the database, and prepare analytical data summary tables.

- Technical Support Team Members - The technical support team members will assist the Herrera project manager to complete all work products.

1.3.2 Project Schedule

The preliminary project schedule is presented in Table 1-2. This schedule assumes that field work can be conducted in July 2010, and that the work assignments and agency and stakeholder reviews proceed in an expeditious manner. The effective dates of Task Order No. 7 are February 26, 2010 through October 29, 2010.

Table 1-2. Forest Rose Project Schedule

Document Submittal and Task	Date
Draft Reclamation Work Plan	May 2010
Final Reclamation Work Plan	June 2010
Reclamation Field Activities	July 2010
Draft Reclamation Investigation Report	September 2010
Final Reclamation Investigation Report	October 2010

2.0 Environmental Setting

The environmental setting of the Forest Rose Mine Site is provided in Sections 2.1 through 2.6.

2.1 Setting and Climate

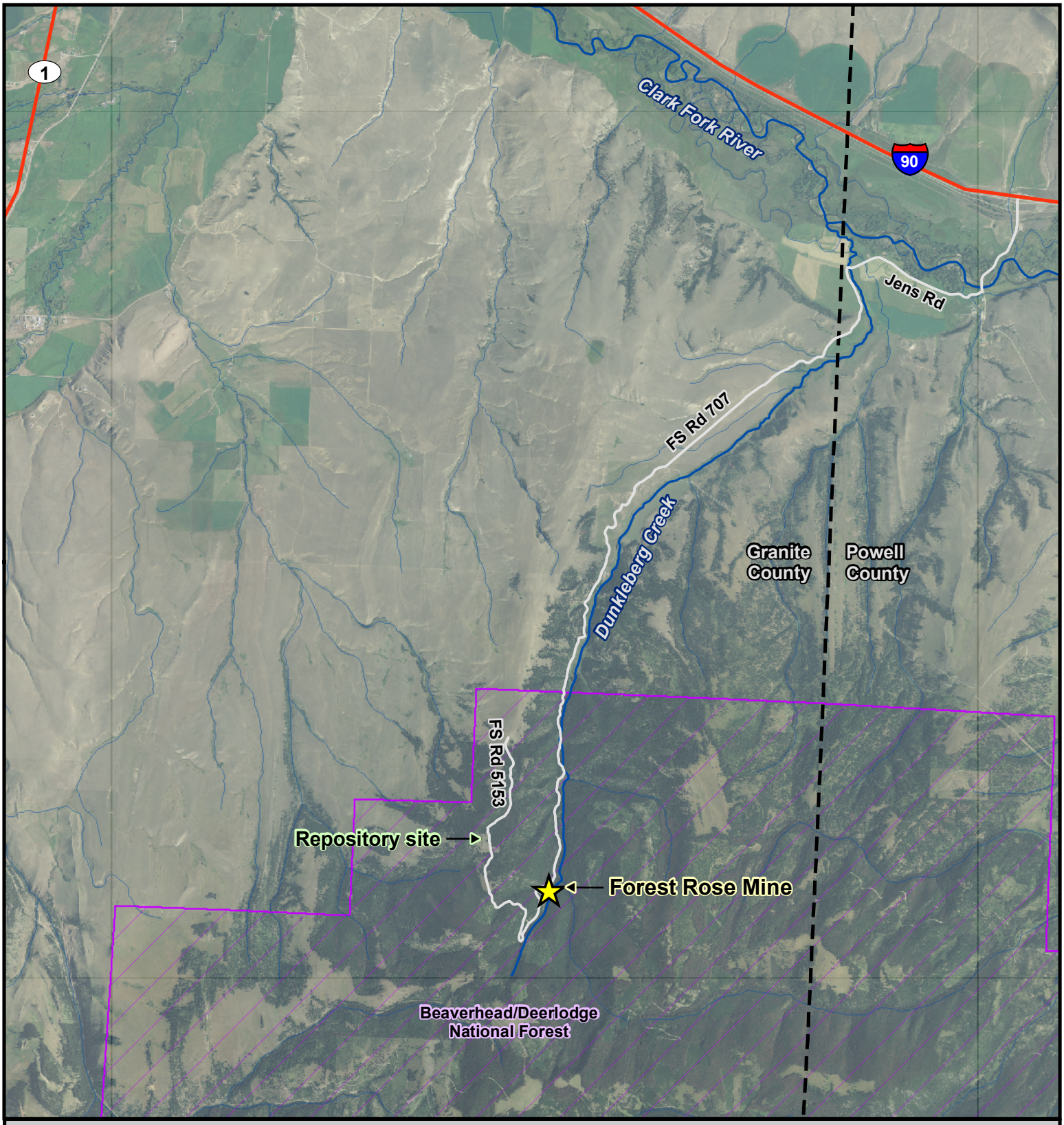
The Forest Rose Mine is located in Granite County, within the Beaverhead-Deerlodge National Forest. The site is accessible from Interstate 90, approximately 8 miles east of Drummond at Exit 162 (Jens Exit), then traveling south-southwest approximately 11 miles on Dunkleberg Creek Road (FDR 707) (Figure 2-1). The Forest Rose Mine and Mill Complex is located on the east side of FDR 707. The legal description of the site is Section 22, Township 9 North, Range 12 West, Granite County, Montana (Latitude North 46° 30’ 29”; Longitude West 113° 05’ 21”). The Forest Rose Mine Site is comprised of approximately 4 acres of metal mining-impacted land along Dunkleberg Creek. Dunkleberg Creek lies in the Dunkleberg Creek drainage, which flows north to the Clark Fork River. The surrounding areas consist of moderately steep to steep mountain slopes and hillsides (25 degrees). The mine is located at an elevation of approximately 5,500 feet above sea level.

Climate information was obtained from the Drummond, Montana airport (WRCC 2010). Average monthly temperatures range from a high of 85°F to a low of 45°F in July and a high of 32°F to a low of 12°F in January. Average annual precipitation is 13 inches with May and June being the wettest months of the year. Precipitation is mostly in the form of snow in the winter months, snow and rain in the spring and fall, and rain in the summer.

2.2 Geology and Soils

The Forest Rose Mine is located within heavily folded and intruded Cretaceous rocks in the northeast quarter of the Sapphire tectonic block. Gabbroic and dioritic sills, up to 1,000 or more feet in thickness, outcrop within a half-mile of the Forest Rose Mine Site. These sills are intruded at a higher stratigraphic level than the Forest Rose Mine Site and predate the local folding. The Forest Rose Mine is located near the axial plane of the west limb of a northeast trending, northward plunging anticline, near a local marker bed of Lower Cretaceous Kootenai formation gastropod bearing limestone (MCS Environmental, Inc. 2004, Pardee 1917). Mineralization of the limestone produces ore that consists mainly of galena, sphalerite, pyrite, quartz, and calcite. Along Dunkleberg Ridge, most of the lodes containing lead, zinc, silver and other metals are simple quartz veins in fissures that follow bedding planes or cut across the sediments and diorite sills. The veins are usually narrow, but widen in places to flat lenses 3 or 4 feet thick.

The soil mapped at the Forest Rose Mine site is a combination of Lamellic Haplustepts and Typic Haplustalfs (USDA-NRCS 2010). Both types of soil are located on 10 to 35 percent



Legend

- Highway
- Road
- County boundary
- Stream
- National forest

Figure 2-1. Vicinity map, Forest Rose Mine.

N

0 3,000 6,000 12,000 Feet

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Aerial photograph: USDA, 2009

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slopes in elevations ranging from 4,500 to 6,000 feet. Lamellic Haplustepts are well drained soils that formed in glacial till and colluvium and are defined as gravelly loam. Typic Haplustalfs are well drained soils that formed in colluvium and till from mixed rock sources and are defined as gravelly loam (USDA-NRCS 2010).

2.3 Hydrogeology

Four piezometers were installed as part of MCS's investigation (PZ-1, PZ-2, PZ-3, and PZ-4). The piezometers were installed at depths of 31.5, 28.5, 60.5, and 43.5 feet. The water surface elevations in the piezometers varied from a depth of 2.0 to 16.0 feet below ground surface. The Montana Bureau of Mines and Geology Groundwater Information Center (GWIC) database only list two springs within a mile radius of the project area that are described as Forest Rose Mine-Upstream and Forest Rose Mine-Seep at Toe. No well information is available for either listing.

It is assumed that a shallow aquifer exists above bedrock that is near the surface.

2.4 Hydrology

The Forest Rose Mine Site is located within the Dunkleberg Creek subwatershed of the Upper Clark Fork River watershed (HUC 17010201). Dunkleberg Creek flows 27.9 miles north through the Deer lodge National Forest and drains directly into the Clark Fork River. Winter snowmelt and stormwater runoff combined with spring and seep flows provide enough water to Dunkleberg Creek to qualify the creek at the mine site as a perennial stream.

Dunkleberg Creek flows onto the site from the south through a steep-sided ravine. The creek has been filled by waste rock and tailings to a depth of approximately 50 feet at its base. Water flows into the bottom of the waste deposits with no apparent upstream ponding. Water has been found to be distributed throughout the waste rock and tailings deposits, with some ponding at the surface. Drains have been installed by the USFS to facilitate movement of ponded water out of the tailings impoundments and back to the creek below the waste deposits.

2.5 Vegetation and Wildlife

The Forest Rose Mine site is characterized by native and introduced species of vegetation. These include plants growing on undisturbed areas around the site, while little or no vegetation is growing on the tailings piles. Dominant trees include lodge pole pine (*Pinups contorta*), Douglas fir (*Pseudotsuga menziesii*), and ponderosa pine (*Pinus ponderosa*). Shrubs and other vegetative species include grouse whortleberry (*Vaccinium scoparium*), snowberry (*Symphoricarpos alba*), and blue huckleberry (*Vaccinium globurlare*) (MNHP 2010). There is regrowth of the forest on the T2 tailings impoundment dam face.

The habitat supports a variety of wildlife – deer, elk, black bear, bobcat, potentially lynx, and miscellaneous smaller mammals such as rabbits, squirrels, mice, and voles (MNHP 2010). Many species of bird are found around the site including owls, eagles, and raptors. Dunkleberg Creek provides habitat for amphibians, fish, and other aquatic organisms and serves as water source for other wildlife. Brown trout and westslope cutthroat trout also reside in Dunkleberg Creek.

2.6 Land Use and Population

The Forest Rose Mine Site is located on private land and the Beaverhead-Deerlodge National Forest. The primary land use is the vicinity of the site is recreational. The population in Granite County is 2,879 people, with 2 persons per square mile (USCB 2009).

3.0 Description of the Property

The following sections describe the history of mining operations, previous studies, and the current environmental condition of the Forest Rose Mine Site property. A site map is provided in Figure 3-1.

3.1 Site History

Lode mining in the Dunkleberg mining district began in the early 1880s. The Forest Rose and several other claims were staked in 1884: the Forest Rose Mine operated intermittently through the 1940s. Approximately $200,000 in silver and lead were produced by 1916 in the Dunkleberg mining district, of which about half was produced by the Forest Rose Mine. Other mines in the district included the Hatta, Jackson, Monarch or Old Tanlefoot, Pearl or Happy New Year, Summit, Sunset, and Wasa. The majority of production came from the Forest Rose, Wasa, and Jackson Mines (DEQ 2002).

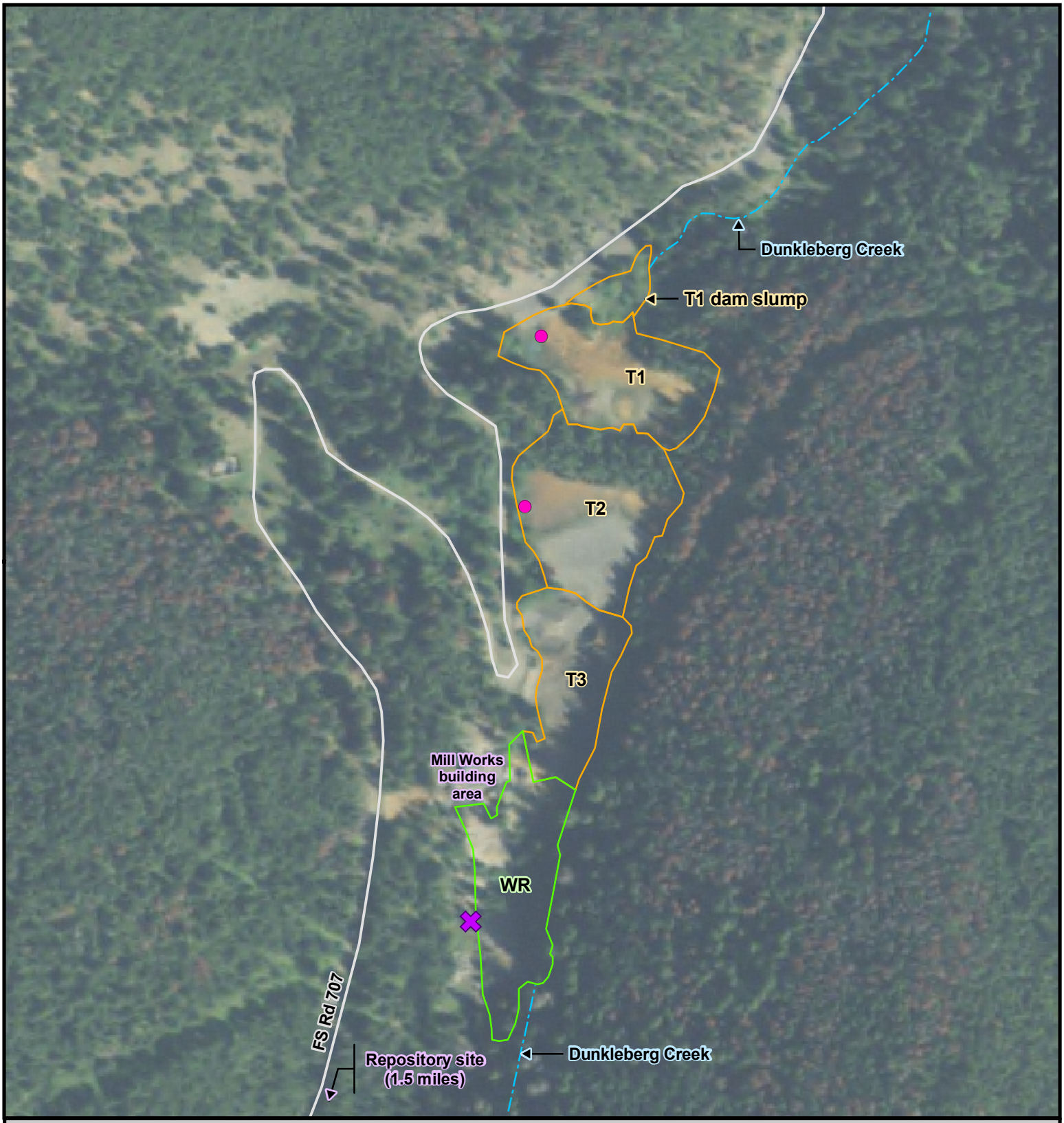
The Forest Rose Mine is located north of the Wasa Mine on the steep western slope of the Dunkleberg Creek ravine. The mine was first claimed by Farnk Carnes and is on the patented Forest Rose and Acrobat claims. J.T. Pardee visited the mine in 1916, and according to his notes the size of the dumps indicated extensive underground development. The ore consists of quartz, limonite, galena, and pyrite (DEQ 2002).

The mine reopened in 1918 and recorded production until 1927. Forest Rose and Wasa Mine were reopened again during World War II. Together, the mines produced 113,000 tons of ore. The main adit is at 5,150 feet above sea level. It is driven 480 feet west into the hill, with 3,000 feet of underground workings located off the adit. In 1941, the Forest Rose Syndicate built a 100-ton concentrator to work the mine's ore. The product was conditioned for lead flotation and then the ore was reconditioned for the zinc circuit. Lead concentrates were sent to East Helena and zinc concentrates were sent to Anaconda (DEQ 2002).

3.2 Previous Site Work

3.2.1 1993 Hazardous Material Inventory

Pioneer Technical Services, Inc. completed a site inspection and a hazardous materials inventory (HMI) of the Forest Rose Mine Site in June 1993 (P.A. # 20-004). Three surface water and three sediment samples were collected at the site from Dunkleberg Creek. Three composite samples were collected from the tailings impoundments and waste rock areas. The tailings samples were collected from each of the three impoundments.



Legend

- T1 — Tailings impoundment
- Decant tower inlet
- WR — Waste Rock area
- Collapsed adit
- Road
- Stream

Figure 3-1. Site map, Forest Rose Mine.

N

0 100 200 400 Feet

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Aerial photograph: USDA, 2009

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Pioneer identified potential safety hazards as an open discharging adit, 12 collapsing structures, and two unstable tailings dams. Approximately 23,000 cubic yards (yd^3) of tailings and 8,000 yd^3 of waste rock were estimated on the site. A copy of the HMI is included in Appendix A.

3.2.2 1993 Removal Site Evaluation

The USFS, Region 1, conducted a removal evaluation at the site in 1993 in response to the tailings dam failing. In May 1993, a portion of the lower tailings dam (T1) slumped, resulting in an unknown amount of tailings material and native shale entering Dunkleberg Creek. In response to the slumping, the USFS drained the ponded water off the lower tailings impoundment and initiated a time critical removal action. The action involved stabilizing the existing dam structure and installation of drainage structures to control and facilitate drainage of surface water from the lower impoundment area.

3.2.3 1998 Montana Bureau of Mines and Geology

The Montana Bureau of Mines and Geology investigated abandoned mine sites in the Deerlodge National Forest in 1998. The Forest Rose Mine was investigated as part of the study. Water seeps from two caved adits located on the southern end of the mine site were identified in the study. Three surface water samples were collected at the following locations: 1,500 feet upstream of the site, from seeps at the toe of the impoundment, and from a seep that feeds the pond. Mercury concentrations exceeded the chronic aquatic life standard, but no other metals exceeded water quality standards (MBMG 1998).

3.2.4 2004 Site Investigation

MCS Environmental, Inc. completed a site investigation for the USFS in 2004. MCS personnel estimated 95,000 yd^3 of tailings and approximately 21,000 yd^3 of waste rock (MCS 2004).

Four near-surface composite soil samples were collected from the tailings impoundments and one composite soil sample was collected from the waste rock area. One sediment sample was collected 300 feet upstream of mine operations and another sediment sample was collected below the slumped area of the lower impoundment dam. Four soil borings were advanced into the tailings to the native soil below; each was completed as a piezometer to measure water levels and collect water samples. Six subsurface tailings grab samples and two underlying native soils samples were collected from the soil borings and sampled. Groundwater depths were measured in the piezometers and groundwater samples were collected from the borings. Eight surface water samples also were collected for analysis from the creek, adit discharge, and seep discharges at the lower tailings impoundment.

3.2.5 2010 Herrera Site Visit

Herrera completed a Forest Rose Mine site visit with DEQ/MWCB on April 21, 2010. DEQ/MWCB, Herrera, and Will McDowell from the Clark Fork Coalition accessed the site from Dunkleberg Creek Road (FDR 707). The road crossed three wooden crossings constructed by Montana Fish, Wildlife, and Parks. The road to the site also crossed numerous cattle guards, and was narrow and rutted in areas.

The road accesses the Forest Rose Mine Site at the waste rock dump area at the upper end; the three tailings impoundments extend to the north below the road (Figure 3-1). The tailings impoundments fill the Dunkleberg Creek ravine, each with a steep dam on the north end and essentially level tailings extending to the next dam to the south. The impoundments have been designated as T1, T2, and T3, from north to south. Waste rock from the mine has been deposited to the south, upstream of T3. Impoundments T2 and T3 and the waste rock area are located on private property, while the majority of T1 is located on Beaverhead-Deerlodge National Forest property. The collapsed adit is located on private property, upslope of the waste rock area. The adit was discharging a trickle of water during the site visit.

The T1 dam had been breached, as previously described in the 1993 and 2004 reports. The tailings had been transported downslope to the north, toward Dunkleberg Creek. The T1 decant outlet had a gap in the outlet piping and was discharging water upstream of the discharge outlet.

Dunkleberg Creek flows north beneath waste rock that has been piled into the creek ravine at the south end of mine operations. Creek water flows through the waste rock and into the tailings impoundments below. The water has caused erosion of T3 tailings into a deeply incised channel leading to T2. A drain has been installed in T2 to direct ponded water to T1 below. A drain also has been installed in T1 to direct ponded water back to Dunkleberg Creek below the impoundment dam.

Photographs of the site visit are provided in Appendix B.

3.3 Current Owners

The current private property owners of the Forest Rose Mine site are the Forest Rose Mining Company and JoJamette Antonioli. The lower tailings impoundment (T1) is located on Beaverhead-Deerlodge National Forest.

3.4 Description of the Current Property

The Forest Rose Mine is located immediately west of Dunkleberg Creek on a steep slope rising to the west. Mine waste material has been deposited in the ravine, below the mine and ore processing areas. The mine reclamation site includes the Dunkleberg Creek ravine, bounded by the extent of waste rock deposited in the ravine to the south (upstream of the mine operations

area) and then downstream to below the slumped T1 impoundment dam. The site covers approximately 4 acres and is situated approximately 11 miles south-southwest of Jens (Exit 162) on Interstate 90, approximately 8 miles east of Drummond.

The following sections describe the site starting from the downstream end. Two-letter site designations are provided for each site Area of Concern (AOC).

3.4.1 Downstream of Forest Rose Mine Site (DS)

After flowing through the waste rock and tailings impoundments, Dunkleberg Creek becomes channelized again roughly 10-feet downstream of T1. The creek downstream of the mine site is known to support Westslope Cutthroat Trout (a species of concern) and Brown Trout. Montana Department of Fish, Wildlife, and Parks completed a creek restoration project in 2001 to increase fish habitat between river miles 5.1 and 5.2.

3.4.2 Lower Tailings Impoundment (T1)

The T1 impoundment is on the northern edge of the mine site and is located on lands predominately administered by the Beaverhead-Deerlodge National Forest. The surface area of the top of the impoundment is approximately 1 acre. The impoundment is not vegetated and contains ponded water in the northwest corner where a surface water drainage pipe (decant tower inlet) is installed. Surface water from the impoundment is piped to below the impoundment dam face. The dam wall has been breached and tailings have slumped on top of and below the dam face. The colors of the surface tailings in T1 are orange to red-orange.

3.4.3 Middle Tailings Impoundment (T2)

The T2 impoundment is south of T1 and is situated entirely on private property. The surface area of the top of the impoundment is approximately 1.2 acres. The surface of the impoundment is not vegetated and water ponds on the west side. A decant tower inlet is located on the west side of the impoundment; the pipe has been reported to be blocked. The impoundment dam face is intact and is heavily vegetated with lodge pole pines and spruce. The surface tailings are orange on the north and gray on the south side of the impoundment.

3.4.4 Upper Tailings Impoundment (T3)

The T3 impoundment is south of T2 and is situated entirely on private property. The surface area of the top of the impoundment is approximately 0.75 acres. The surface of the impoundment has a small amount of vegetation, which includes pine trees and shrubs. The T3 impoundment dam is breached and a channel has eroded through the central portion of the dam. Trash has been thrown in the channel that includes tires, 50-gallon barrels, and car bodies.

3.4.5 Waste Rock Impoundments (WR)

The waste rock impoundment is south of T3 and is situated entirely on private property. The waste rock is located at the south end of the project site and covers and approximate area of 0.4 acres. The waste rock in the dump consists of mineralized limestone, iron cemented sand and silts, and silty sands. Very little vegetation is established on the steeper slopes.

3.4.6 Area-wide Condition (AW)

The mine site is located in a steep ravine that runs north-south along the Dunkleberg Creek drainage. The general area surrounding the site includes evidence of waste rock and the potential for incidental contamination associated with wind-blown dust. It is generally covered by lodge pole pines, spruce trees, Douglas-fir, and Ponderosa pine. Forest service road FDR 707 cuts along the west side of the mine site through part of this area.

3.4.7 Repository (RY)

A potential site repository location has been identified approximately 2 miles from the mine site (Figure 2-1). It is situated at the edge of the Dunkleberg Creek drainage basin on Beaverhead-Deerlodge National Forest property. It covers approximately 2 acres facing to the east. The area is vegetated with grasses.

3.4.8 Background (BG)

The Dunkleberg mining district began operations in the early 1880s and was mined through World War II. The mining district is located in a north-south valley that is vegetated with lodge pole pines, spruce trees, Douglas-fir, and Ponderosa pine.

3.4.9 Upstream of the Forest Rose Mine Site (US)

Dunkleberg Creek begins upstream of the mine site. Previous samples collected upstream have shown elevated levels of antimony.

3.4.10 Waste Characteristics

Table 3-1 provides a summary of the 1993 HMI data generated for the site. One surface composite sample was collected from each tailings impoundment, three composite samples were collected from the waste rock area, and three sediment samples were collected from the creek and adit discharge pathways. Surface water samples were collected at each sediment sample location; one downstream of the breached dam on T1, one at the toe of waste rock dump, and one approximately 400-feet upstream of the waste rock dump. A groundwater sample was collected from adit 1. The soil samples were analyzed by an off-site laboratory for total metals. A summary of metals analytical results are presented in Table 3-1. Contaminants of concern

included arsenic, cadmium, copper, iron, mercury, lead, antimony, and zinc (DEQ/MWCB 1993).

Tables 3-2 and 3-3 provide a summary of the 2004 USFS site investigation. Four composite near-surface soil samples were collected from the tailings impoundments and one composite soil sample was collected from the waste rock area. One sediment sample was collected 300 feet upstream of mine operations and another sediment sample was collected below the slumped area of the T1 dam. Four soil borings were advanced into the tailings to the native soil below; each was completed as a piezometer to measure water levels and collect water samples. Six subsurface tailings samples and two underlying native soils samples were collected from the borings. Depth to water was measured in each piezometer and a water sample was collected from each piezometer. Eight surface water samples also were collected for analysis from the creek, adit discharge, and seep discharges at the lower tailings impoundment. Results from the testing identified lead and arsenic as metals of concern in the tailings and waste rock, and cadmium, lead, and zinc as metals of concern in surface water (MCS 2004).

Table 3-1. 1993 DEQ/MWCB Soil and Water Sampling.

SOLID MATRIX ANALYSES

FIELD ID	**Metals in Soils** As (mg/Kg)	Ba (mg/Kg)	**Results per dry weight basis** Cd (mg/Kg)	Co (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Fe (mg/Kg)	Hg (mg/Kg)	Mn (mg/Kg)	Ni (mg/Kg)	Pb (mg/Kg)	Sb (mg/Kg)	Zn (mg/Kg)	CYANIDE (mg/Kg)
20-004-SE-1	116 JX	65.8	14.8 J	11.1 J	19.9 J	125	45600 J	0.13	1370 J	34 J	1010 J	4 U	2040 J	NR
20-004-SE-2	51 JX	25.6	22 J	3 J	3.3 J	53.7	13700 J	0.1	1310 J	17 J	428 J	4 U	1270 J	NR
20-004-SE-3	67 JX	11.8	13.5 J	9.5 J	16.2 J	41.7	43200 J	0.049	819 J	34 J	2820 J	6 J	2230 J	NR
20-004-TP-1	336 JX	37.6	58.2 J	2 J	3.8 J	444	38800 J	0.342	2090 J	15 J	6810 J	49 J	7430 J	NR
20-004-TP-2	444 JX	15	143 J	11.2 J	4.4 J	563	109000 J	0.377	1720 J	28 J	1820 J	28 J	16800 J	NR
20-004-TP-3	330 JX	12.2	65.1 J	14.3 J	3.4 J	404	113000 J	0.052	1730 J	29 J	690 J	9 J	6590 J	NR
20-004-WR-1	227	13.1	40.9	8.6	2.9	208	39200	0.648 J	1110	29	4570	24 J	5660	NR
20-004-WR-2	801 JX	31.2	477 J	3.5 J	4 J	1770	75700 J	2.93	1760 J	15 J	60400 J	470 J	51500 J	NR
20-004-WR-3	350 JX	23.1	3.2 J	4 J	3 J	526	164000 J	0.934	165 J	16 J	242 J	7 J	2840 J	NR
BACKGROUND	17 JX	122	0.8 J	10.4 J	34.2 J	34.6	23500 J	0.06	1040 J	36 J	38 J	5 U	106 J	NR

WATER MATRIX ANALYSES

FIELD ID	**Metals in Water** As	Ba	**Results in ug/L** Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Zn	HARDNESS CALC. (mg CaCO3/L)
20-004-GW-1	3 J	22.6 JX	4.1 J	9.7 U	6.83 U	4.1 J	113	0.038 U	35.5	12.7 U	3.86	30.7 U	1700	258
20-004-SW-1	6.45	82.2	3.7 J	7.63 JX	17.9	31.9	16100	0.038 U	453	24.2	68.7	23.8	474	358
20-004-SW-2	1.92	13.3	2.55 U	5.99 UX	8.83	1.43	104	0.038 U	7.47	9	9.13	18.3 U	374	199
20-004-SW-3	1.41	11.3	3.3 J	5.99 UX	5.27	5.7	54.5	0.038 U	6.07	8.78 U	1.73	19.4	346	175

LEGEND

U - Not Detected
J - Rational Quantity
X - Outlier for Accuracy or Precision
NR - Not Requested

SE-1 Downstream of breached dam on tailing pond 3.
SE-2 At toe of wast rock dump 1.
SE-3 Approx. 400' upstream of end of waste rock dump 2.
TP-1 Composite of subsamples TP1A-A, 1A-B, 1A-C, 1A-D, 1B-A, 1B-B, 1B-C, 1B-D, 1B-E, and 1B-F.
TP-2 Composite of subsamples TP2A-A, 2A-B, 2A-C, 2B-A, 2B-B, and 2B-C.
TP-3 Composite of subsamples TP3A-A, 3A-B, 3B-A, 3B-B, and 3B-C.
WR-1 Composite of subsamples WR1A, 1B, 2C, 2A, and 2B.
WR-3 Composite of subsamples WR3A, 3B, and 3C.
WR-4 Composite of subsamples WR4A and 4B.
BACKGROUND - From the Jackson Park Mine (20-027-SS-1).
TP2DUP - Duplicate of sample 20-004-TP-2.
TP3DUP - Duplicate of sample 20-004-TP-3.
GW-1 Discharge from adit #1.
SW-1 Same as sample SE1.
SW-2 Same as sample SE2.
SW-3 Same as sample SE3.

Table 3-2. 2004 MCS Environmental Soil Sampling.

Sample ID	Arsenic	Cadmium	Copper	Lead	Zinc	Mercury
	All results in mg/kg					
Near Surface Tailings Composite Soil Samples						
T1-04-1.2-T	295	19.6	304	365	2,390	0.176
T2-05-1.5-T	302	3.47	204	633	940	NA
T2-06-1.5-T	311	43.8	412	5,870	4,440	NA
T3-10-1.5-T	539	63.1	584	5,830	5,950	0.2
Subsurface Tailings and Soil Grab Samples from Borings						
B1-17-10-T	139	65.8	639	506	7,030	NA
B1-18-20-T	231	40.5	664	4,790	4,140	NA
B1-19-30-S	38.1	6.58	99.4	353	1,110	NA
B3-22-10-T	540	70.4	573	853	7,930	NA
B3-23-20-T	266	36.2	391	2,300	4,460	NA
B3-24-40-T	367	50.9	449	3,780	5,420	NA
B3-25-50.5-S	44.0	8.49	333	700	1,030	NA
B3-29-49-T	243	32.3	428	6,000	3,320	NA
Waste Rock Dump Composite Soil Sample						
WRD1-16-1-WR	436	51.5	366	5,630	5,710	1.49
Stream Sediment Soil Samples						
STR-02-0.1-S	138	5.73	63.9	299	563	NA
STR-15-0.1-S	33.0	11.2	38.8	201	2,170	<0.0333

Table 3-3. 2004 MCS Environmental Water Survey.

Sample Description	Sample ID	Temp (°C)	Sp. Cond. (mS/cm2)	Cond. (mS/cm)	DO (mg/L)	Alkalinity (mg/L CaCO3)	Arsenic (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Lead (mg/L)	Mercury (mg/L)	Zinc (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Magnesium (mg/L)	Sulfate (mg/L)	Hardness (mg/L)	Lab pH
Dunkleberg Creek below T1 Area slide mass	STR-01-0-SW (Total)	6.68	0.529	0.344	10.58	135	<0.010	<0.0020	<0.0030	<0.0050	<0.00020	0.0641	98.9	0.69	12.1	140	297	7.89
	STR-01-0-SW (Dissolved)						<0.010	<0.0020	<0.0030	<0.00020	<0.0050	0.0655						
Channel water near west edge of T1 Area slide mass	SP-03-0-SW (Total)	5.57	0.641	0.403	6.98	144	<0.010	<0.0020	<0.0030	<0.0050	<0.00020	0.0229	126	0.64	11.2	200	361	7.22
	SP-03-0-SW (Dissolved)						<0.010	NA	NA	NA	NA	NA						
Groundwater discharge from T1 Area failure surface	TS-07-0-SW (Total)	16.54	1.1413	1.184	1.26	NM	**0.033**	**0.0422**	**0.217**	**0.0859**	<0.00020	**6.13**	267	1.03	123	**854**	1,170	**5.48**
	TS-07-0-SW (Dissolved)						NA	NA	NA	NA	NA	NA						
Pond water from T1 Area	DT-08-0-SW (Total)	18.3	0.423	0.368	4.6	145	<0.010	**0.0025**	0.011	**0.0571**	<0.00020	**0.234**	79.4	0.76	9.01	66.5	235	7.66
	DT-08-0-SW (Dissolved)						<0.010	NA	NA	NA	NA	NA						
Decant water discharge at base of T2 impoundment	DTD-09-0-0-SW (Total)	18.95	0.388	0.343	5.17	97	<0.010	**0.0021**	0.0091	**0.0402**	<0.00020	**0.268**	75.6	0.74	5.53	97.1	211	8.22
	DTD-09-0-0-SW (Dissolved)						<0.010	NA	NA	NA	NA	NA						
Wood pipe discharge at NE corner of mill building area	AD-12-0-SW (Total)	7.93	0.472	0.318	8.58	111	<0.010	<0.0020	0.0049	**0.0087**	<0.00020	0.0808	90.2	0.7	8.94	102	262	7.91
	AD-12-0-SW (Dissolved)						<0.010	NA	NA	NA	NA	NA						
Groundwater discharge from head cut of T3 Area incised channel	STR-11-0-SW (Total)	7.26	0.325	0.215	10.51	80	<0.010	**0.0049**	0.0106	**0.187**	<0.00020	**0.595**	69.1	0.68	4.18	49.9	190	7.83
	STR-11-0-SW (Dissolved)						<0.010	NA	NA	NA	NA	NA						
Dunkleberg Creek above waste rock dump	STR-13-0-SW (Total)	13.82	0.312	0.245	9.11	108	<0.010	<0.0020	<0.0030	<0.0050	<0.00020	0.108	6.1	0.69	2.91	40.6	167	8.3
	STR-13-0-SW (Dissolved)						<0.010	<0.0020	<0.0030	<0.00020	<0.0050	0.112						

NA = Not Analyzed for specified analyte
Bold = Exceeds one or more water quality standard

4.0 Reclamation Work Plan

4.1 Preliminary Reclamation Objectives and Goals

The Forest Rose Mine site assessment has been planned to address:

- Protection of public health, safety, general welfare, and property from both extreme dangers and adverse affects associated with mine operations
- Restoration of land and water resources and the environment degraded by the adverse effects of mining operations.

Reclamation requires assessment of site conditions, evaluating possible reclamation actions, designing a preferred alternative, overseeing construction, and monitoring effectiveness over time. Potential for extreme dangers will require assessment of aboveground structure integrity and safety issues associated with the adit entrance. Adverse affects will be evaluated by characterizing mine drainage, tailings and waste rock contamination, and surface water quality. Reclamation will be addressed by removing contaminated material from exposure pathways to minimize impacts on both humans and the environment. An important objective will be to restore Dunkleberg Creek habitat that supports a native fish population.

4.1.1 Preliminary Reclamation Objectives

This Work Plan identifies the sampling and analysis required to support a risk assessment that will define contaminant concentrations protective of human health and the environment. This information will be used in conjunction with a review of Applicable or Relevant and Appropriate Requirements (ARARs) to select the best reclamation approach for the site.

4.1.2 Preliminary Reclamation Goals

Preliminary reclamation goals (PRGs) are contaminant-specific and media-specific concentrations that reflect potential cleanup levels at contaminated sites. They are based on Federal and/or State water quality standards, soil and sediment screening values, or risk-based concentration values. The following sections present the PRGs for surface water and soil (including mine tailings and waste rock) for the Forest Rose Mine Site.

4.1.2.1 Soil, Sediment, Tailings, Waste Rock

PRGs for soil (including mineral processing wastes) are based on EPA Region 9 Regional Screening Levels (RSLs) for residential soil (EPA 2009). PRGs for sediment are based on cleanup guidelines published by the Montana DEQ (DEQ 1996). The risk-based cleanup

guidelines (RBCG) for abandoned mines were set up as conservative cleanup guidelines by selecting the lowest cleanup values for any of DEQ's evaluated receptor groups in the RBCG.

Analysis of soil, tailings, waste rock, and sediment collected in the 1993 and 2004 investigations identified arsenic, cadmium, copper, iron, manganese, mercury, lead, antimony, and zinc at concentrations of potential concern (Tables 3-1 and 3-2). Table 4-1 presents the soil and sediment PRGs for metals of concern at the Forest Rose Mine Site.

Table 4-1. Contaminants of Potential Concern for Soil, Forest Rose Mine Site.

Contaminant of Potential Concern	EPA Regional Screening Level [a] (mg/kg)	DEQ RBCG[b]
Arsenic	0.39 (40) [c]	0.7**
Cadmium	70	19.5**
Copper	3,100	27,100
Iron	55,000	None
Lead	400	1,100
Manganese	1,800	665
Mercury	6.7	220
Silver	390	2.0
Antimony	31	293
Zinc	23,000	2220,000

[a] EPA RSL = Regional Screening Level Table, Residential Soil Values (EPA 2009)

[b] MT DEQ Risk Based Cleanup Guidelines Composite, Conservative Soil Cleanup Guidelines for Recreational Visitors Table 7-10 (DEQ 1996)

[c] 0.39 is the arsenic residential soil RSL for the carcinogenic endpoint; Montana DEQ uses a soil screening value of 40 mg/kg for arsenic based on background arsenic values for Montana soils (DEQ 2005)

** Carcinogenic risk of 5E-07

4.1.2.2 Dunkleberg Creek

PRGs for surface water are based on Montana state water quality standards and include freshwater chronic aquatic life standards (CALS), human health standards (HHS), and maximum contaminant levels (MCLs) (DEQ 2008). PRGs for surface water also include the risk-based cleanup guidelines (RBCG) for abandoned mines (DEQ 1996). The RBCG were set up as conservative cleanup guidelines by selecting the lowest cleanup values for any of DEQ's evaluated receptor groups in the RBCG. Dunkleberg Creek flows directly through the site, entering the waste rock pile from the south, flowing through waste rock and tailings impoundments, and leaving through a drain at the base of impoundment T1 to the north. Ponds develop at the surface of impoundments T1 and T2, where they are drained to control erosion. A small amount of water discharges from an adit to the surface of impoundment T3, where it seeps into the tailings to join the underground creek.

Flow data for Dunkleberg Creek will be collected by measuring cross sections and using a flow meter. Three flow measurements will be conducted upstream of site and three measurements will

be collected downstream of the site on Dunkleberg Creek. The upstream flow data and downstream flow data will be averaged.

Groundwater is presumed to flow beneath the creek bottom, hydraulically connected to surface water flow. The aquifer system below the site has not been characterized; however, it is believed that shallow bedrock may limit upper aquifer thickness. As the site is currently configured, surface water seeps into waste rock and tailings along its flow path, moving as a subsurface creek with poorly defined boundaries. It expresses itself at the surface based on subsurface conditions imposed by the tailings. Groundwater beneath the natural creek bed and the creek water mix to some extent, but it would be difficult to separate the two flow regimes without adequate space to install a network of wells. Due to physical site constraints and the artificial nature of surface water-groundwater interactions within and beneath the tailings impoundments, no groundwater samples are proposed at this time.

Analysis of surface water collected during the 1993 and 2004 investigations identified arsenic, cadmium, copper, iron, manganese, and lead at concentrations of potential concern (Tables 3-1 and 3-3). Table 4-2 presents the soil and sediment PRGs for metals of concern at the Forest Rose Mine Site.

Table 4-2. Contaminants of Potential Concern for Surface Water, Forest Rose Mine Site.

Contaminant of Potential Concern	CALS [a]	HHS [b]	DEQ RBCG[c]
Antimony	None	6	91.1
Arsenic	150	10	0.06**
Barium	None	2,000	17,474
Cadmium	0.097 [e]	5	66.5
Chromium	27.7 [e]	100	100,246
Copper	2.85 [e]	1,300	472
Iron	1,000	300 [d]	4,979
Lead	0.545 [e]	15	47.1
Manganese	None	50 [d]	16.6
Mercury	0.91	0.05	0.15
Nickel	16.1 [e]	100	931
Silver	None	100	None
Zinc	37 [d]	2,000	17.2

[a] Freshwater Chronic Aquatic Life Standards (CALS), Circular DEQ-7, Montana Numeric Water Quality Standards (DEQ 2008)

[b] Human Health Standards (HHS) for Water, Circular DEQ-7, Montana Numeric Water Quality Standards (DEQ 2008)

[c] MT DEQ Risk Based Cleanup Guidelines Composite, Conservative Soil Cleanup Guidelines for Recreational Visitors Table 7-11 (DEQ 1996)

[d] Secondary Maximum Contaminant Level, Circular DEQ-7 Montana Numeric Water Quality

[e] CALS assume water hardness of 25 mg/L

** Carcinogenic risk of 5E-07

4.1.2.3 Mine Adit

A collapsed adit is located on the west slope of the ravine near the mill complex, west of the waste rock area. A reconnaissance of the adit will be performed to address water discharge and soil stability in the adit vicinity. The collapsed adit will be photographed and evaluated for potential re-grading or capping as a part of reclamation activities.

4.2 Field Sampling Plan

This FSP has been prepared as a guide for conducting the Forest Rose Mine Site RI. This section describes the AOCs to be investigated during the project, the sampling objectives and rationales, the field procedures that will be used, and the analytical methods followed. The following subsections include additional site-specific details that are applicable to each AOC.

4.2.1 Sampling Objectives

Soil, sediment, tailings, waste rock, and surface water samples will be collected from the Forest Rose Mine Site as part of the RI. Table 4-3 lists the sample location, matrix, laboratory analysis, sample identification number, sample depth, and rationale for sample collection. Sampling locations are presented on Figure 4-1.

The general sampling objectives for the Forest Rose Mine Site are to:

- Support the human health and ecological risk assessment
- Determine the nature and extent of soil and sediment contamination
- Determine soil background concentrations
- Determine reclamation requirements for disturbed areas including soil texture and grain size, liming requirements, fertilizer requirements, percent organic matter, and identification of native species
- Locate and characterize the repository site
- Characterize potential cover soil
- Collect additional data on metals contamination in water discharged from the adit to determine current concentrations.

Specific objectives for each of the AOCs are provided in the following paragraphs. Sample locations are indicated on Figures 4-1 and 4-2).

Table 4-3. Forest Rose Mine Sampling Summary.

Sample Location	Matrix	Laboratory Analysis	Sample Number	Sample Depth (ft)	Rationale
Downstream (DS)					
200 feet downstream of T1 slump	Surface water	Total recoverable metals WQ parameters Field parameters	FR-DS-SW-T1	–	Downstream recovery conditions Support risk assessment Compare conditions across site
		Dissolved metals (aluminum)	FR-DS-SW-D1	–	Downstream recovery conditions
	Sediment	Total recoverable metals	FR-DS-SD-01	0–.3	Downstream recovery conditions
10 feet downstream of T1 slump	Surface water	Total recoverable metals WQ parameters Field parameters	FR-DS-SW-T2	–	Downstream recovery conditions Support risk assessment Compare conditions across site
		Dissolved metals (aluminum)	FR-DS-SW-D2	–	Downstream recovery conditions
	Sediment	Total recoverable metals	FR-DS-SD-02	0–.3	Measure conditions immediately downstream of site
Lower Tailings Impoundment (T1)					
East side	Tailings	Total recoverable metals ABA SPLP metals Particle size analysis Moisture content	FR-T1-TB-01-00	0–.3	Compare to previous composite sample Compare to previous composite sample Compare to previous composite sample Evaluate tailings consistency Compaction stability and settlement potential
	Tailings	Total recoverable metals ABA Particle size analysis Moisture content	FR-T1-TB-01-10	10	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential
	Tailings	Total recoverable metals ABA Particle size analysis Moisture content	FR-T1-TB-01-20	20	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential
	Soil	Total recoverable metals Particle size analysis Moisture content	FR-T1-SB-01-30	30	Compare to previous composite sample Evaluate soil consistency Evaluate soil consistency

Sample Location	Matrix	Laboratory Analysis	Sample Number	Sample Depth (ft)	Rationale
Middle Tailings Impoundment (T2)					
West side	Tailings	Total recoverable metals ABA SPLP metals Particle size analysis Moisture content	FR-T2-TB-01-00	0–.3	Compare to previous composite sample Compare to previous composite sample Compare to previous composite sample Evaluate tailings consistency Compaction stability and settlement potential
	Tailings	Total recoverable metals ABA Particle size analysis Moisture content	FR-T2-TB-01-10	10	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential
	Tailings	Total recoverable metals ABA Particle size analysis Moisture content	FR-T2-TB-01-20	20	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential
	Soil	Total recoverable metals Particle size analysis Moisture content	FR-T2-SB-01-30	30	Compare to previous composite sample Evaluate soil consistency Evaluate soil consistency
East side	Tailings	Total recoverable metals ABA SPLP metals Particle size analysis Moisture content	FR-T2-TB-02-00	0–.3	Compare to previous composite sample Compare to previous composite sample Compare to previous composite sample Evaluate tailings consistency Compaction stability and settlement potential
	Tailings	Total recoverable metals ABA Particle size analysis Moisture content	FR-T2-TB-02-10	10	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential
	Tailings	Total recoverable metals ABA Particle size analysis Moisture content	FR-T1-TB-02-20	20	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential
	Soil	Total recoverable metals Particle size analysis Moisture content	FR-T1-SB-02-30	30	Compare to previous composite sample Evaluate soil consistency Evaluate soil consistency

Sample Location	Matrix	Laboratory Analysis	Sample Number	Sample Depth (ft)	Rationale
Upper Tailings Impoundment (T3)					
North side	Tailings	Total recoverable metals ABA SPLP metals Particle size analysis Moisture content	FR-T3-TB-01-00	0–.3	Compare to previous composite sample Compare to previous composite sample Compare to previous composite sample Evaluate tailings consistency Compaction stability and settlement potential
	Tailings	Total recoverable metals ABA Particle size analysis Moisture content	FR-T3-TB-01-10	10	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential
	Tailings	Total recoverable metals ABA Particle size analysis Moisture content	FR-T3-TB-01-20	20	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential
	Tailings	Total recoverable metals ABA Particle size analysis Moisture content	FR-T3-TB-01-30	30	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential
	Soil	Total recoverable metals Particle size analysis Moisture content	FR-T3-SB-01-40	40	Compare to previous composite sample Evaluate soil consistency Evaluate soil consistency
South side	Tailings	Total recoverable metals ABA SPLP metals Particle size analysis Moisture content	FR-T3-TB-02-00	0–.3	Compare to previous composite sample Compare to previous composite sample Compare to previous composite sample Evaluate tailings consistency Compaction stability and settlement potential
	Tailings	Total recoverable metals ABA Particle size analysis Moisture content	FR-T3-TB-02-10	10	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential
	Tailings	Total recoverable metals ABA Particle size analysis Moisture content	FR-T3-TB-02-20	20	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential
	Tailings	Total recoverable metals ABA Particle size analysis Moisture content	FR-T3-TB-02-30	30	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential

Sample Location	Matrix	Laboratory Analysis	Sample Number	Sample Depth (ft)	Rationale
	Soil	Total recoverable metals Particle size analysis Moisture content	FR-T3-SB-02-40	40	Compare to previous composite sample Evaluate soil consistency Evaluate soil consistency
Waste Rock Impoundment (WR)					
Impoundment	Waste Rock	Total recoverable metals ABA SPLP metals Particle size analysis Moisture content	FR-WR-RB-01-00	0–.3	Compare to previous composite sample Compare to previous composite sample Compare to previous composite sample Evaluate tailings consistency Compaction stability and settlement potential
	Waste Rock	Total recoverable metals ABA Particle size analysis Moisture content	FR-WR-RB-01-10	10	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential
	Waste Rock	Total recoverable metals ABA Particle size analysis Moisture content	FR-WR-RB-01-20	20	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential
	Waste Rock	Total recoverable metals ABA Particle size analysis Moisture content	FR-WR-RB-01-30	30	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential
	Soil	Total recoverable metals Particle size analysis Moisture content	FR-WR-SB-01-40	40	Compare to previous composite sample Evaluate soil consistency Evaluate soil consistency
Impoundment	Waste Rock	Total recoverable metals ABA SPLP metals Particle size analysis Moisture content	FR-WR-RB-03-00	0–.3	Compare to previous composite sample Compare to previous composite sample Compare to previous composite sample Evaluate tailings consistency Compaction stability and settlement potential
	Waste Rock	Total recoverable metals ABA Particle size analysis Moisture content	FR-WR-RB-03-10	10	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential
	Waste Rock	Total recoverable metals ABA Particle size analysis Moisture content	FR-WR-RB-03-20	20	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential

Sample Location	Matrix	Laboratory Analysis	Sample Number	Sample Depth (ft)	Rationale
	Waste Rock	Total recoverable metals ABA Particle size analysis Moisture content	FR-WR-RB-03-30	30	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential
	Soil	Total recoverable metals Particle size analysis Moisture content	FR-WR-SB-03-40	40	Compare to previous composite sample Evaluate soil consistency Evaluate soil consistency
Berm	Waste Rock	Total recoverable metals ABA SPLP metals Particle size analysis Moisture content	FR-WR-RB-02-00	0–.3	Compare to previous composite sample Compare to previous composite sample Compare to previous composite sample Evaluate tailings consistency Compaction stability and settlement potential
		Total recoverable metals ABA Particle size analysis Moisture content	FR-WR-RB-02-10	10	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential
		Total recoverable metals ABA Particle size analysis Moisture content	FR-WR-RB-02-20	20	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential
		Total recoverable metals ABA Particle size analysis Moisture content	FR-WR-RB-02-30	30	Compare to previous subsurface sample Compare to previous subsurface sample Evaluate tailings consistency Compaction stability and settlement potential
	Soil	Total recoverable metals Particle size analysis Moisture content	FR-WR-SB-02-40	40	Compare to previous composite sample Evaluate soil consistency Evaluate soil consistency
Area-wide Condition (AW)					
West Slope Upgradient	Waste Rock	Total recoverable metals	FR-AW-RS-01-00	0–.3	Residual contamination potentially left in place
West Slope Downgradient	Waste Rock	Total recoverable metals	FR-AW-RS-02-00	0–.3	Residual contamination potentially left in place
West Slope Upgradient	Soil	Total recoverable metals	FR-AW-SS-01-00	0–.3	Residual contamination potentially left in place
West Slope Downgradient	Soil	Total recoverable metals	FR-AW-SS-02-00	0–.3	Residual contamination potentially left in place
East Slope Upgradient	Soil	Total recoverable metals	FR-AW-SS-03-00	0–.3	Residual contamination potentially left in place
East Slope Downgradient	Soil	Total recoverable metals	FR-AW-SS-04-00	0–.3	Residual contamination potentially left in place

Sample Location	Matrix	Laboratory Analysis	Sample Number	Sample Depth (ft)	Rationale
West Slope Adit	Water	Total recoverable metals WQ parameters Field parameters	FR-AW-SW-T1	–	Measure conditions associated with adit drainage Support risk assessment Compare conditions across site
		Dissolved metals (aluminum)	FR-AW-SW-D1	–	Measure conditions associated with adit drainage
Repository (RY)					
Repository	Soil	Total recoverable metals Agricultural Particle size analysis Standard Proctor Specific Gravity of Particles Moisture Content	FR-RY-SS-01-00	0–.3	Background Revegetation viability Engineering properties Engineering properties Engineering properties
Repository	Soil	Total recoverable metals Agricultural Standard Proctor Specific Gravity of Particles Moisture Content	FR-RY-SS-02-00	0–.3	Background Revegetation viability Engineering properties Engineering properties Engineering properties
Repository	Soil	Total recoverable metals Agricultural Standard Proctor Specific Gravity of Particles Moisture Content	FR-RY-SS-03-00	0–.3	Background Revegetation viability Engineering properties Engineering properties Engineering properties
Repository	Soil	Total recoverable metals	FR-RY-WELL-01-00	0–.3	Background
Background (BG)					
Upgradient West	Soil	Total recoverable metals	FR-BG-SS-01-00	0–.3	Background
Upgradient East	Soil	Total recoverable metals	FR-BG-SS-02-00	0–.3	Background
Upstream (US)					
100 feet upstream of waste rock berm	Surface water	Total recoverable metals WQ parameters Field parameters	FR-US-SW-T1	–	Upstream recovery conditions Support risk assessment Compare conditions across site
		Dissolved metals (aluminum)	FR-US-SW-D1	–	Upstream recovery conditions

Sample Location	Matrix	Laboratory Analysis	Sample Number	Sample Depth (ft)	Rationale
100 feet upstream of waste rock berm	Sediment	Total recoverable metals	FR-US-SD-01	0–.3	Measure conditions associated with downstream recovery
Quality Control (QC)					
10 feet downstream of slump	Surface water	Total recoverable metals	FR-DS-QC-T1 Duplicate of FR-DS-SW-T2	–	Measure field variability
		Dissolved metals (aluminum)	FR-DS-QC-D1 Duplicate of FR-DS-SW-D2	–	Measure field variability
Lower Tailings Impoundment	Water	Total recoverable metals	FR-QC-WT-T1	NA	Equipment Rinsate

Agricultural analyses includes: pH, cation exchange capacity, conductivity, nitrogen, phosphorus, potassium, organic matter, and lime including a fertilizer requirement.
Field parameters includes: pH, temperature, specific conductance, dissolved oxygen.
Total recoverable metals analysis for soil and sediment includes: antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, and zinc
Total recoverable metals analysis for water includes: antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, and zinc.
Dissolved metals analysis for water is for aluminum only.
Water quality parameters includes: hardness, chloride, sulfate, nitrate/nitrite, forms of alkalinity/acidity, and total dissolved solids.
ABA =Acid base accounting (total sulfur, sulfate sulfur, pyretic sulfur, and organic sulfur
NA= Not applicable
SPLP = Synthetic precipitation leaching procedure

AW=Area wide
BG=Background
DS=Downstream
QC=quality control
RB=Rock boring (waste rock)
RS=Rock surface (waste rock)
RY=Repository
SW=Surface water
SB=Soil boring
SD=Sediment
SS=Soil surface
TS=Tailing surface
TB=Tailing boring
US=Upstream

Legend

- Surface soil sample
- Subsurface soil sample location (tailings, waste rock, or soil)
- Surface water/sediment sample
- Stream
- Road
- Previous boring location

Figure 4-1. Sample location map, Forest Rose Mine site.

N

0 100 200 400 Feet

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Aerial photograph: USDA, 2009

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Legend

- Surface soil sample
- Monitoring well
- Approximate repository boundary
- Road

Figure 4-2. Sample location map, Forest Rose Mine site repository.

N

0 75 150 300 Feet

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Aerial photograph: USDA, 2009

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4.2.1.1 Downstream (DS)

Two surface water samples and two sediment samples are planned for collection from the DS area. One surface water sample and one sediment sample each will be collected from two locations along Dunkleberg Creek; 10 feet downstream of the T1 dam failure and 200 feet downstream of the T1 dam failure.

Surface water samples will be analyzed for total recoverable metals, dissolved metals (aluminum only), and field parameters. Sediment samples will be analyzed for total recoverable metals.

The sampling objectives for the surface water samples are to determine the existing downstream recovery conditions, support the risk assessment, and to compare conditions across the site. Sampling objectives for sediment are to determine recovery conditions, support the risk assessment, and to provide information for the expanded engineering evaluation and cost analysis (EEE/CA).

4.2.1.2 Lower Tailing Impoundment (T1)

One boring will be advanced on the east side of T1. Three tailings samples will be collected from the surface and at depths of 10 feet and 20 feet; one soil sample will be collected from beneath the tailings at an approximate depth of 30 feet. The boring will extend 10 feet below native soil to locate bedrock. No samples will be collected in the 10 feet below native soil.

Tailings samples will be analyzed for total recoverable metals, acid-base accounting (ABA), grain size, and moisture content. The surface tailings sample will also be analyzed for SPLP. The soil sample will be analyzed for total recoverable metals, grain size, and moisture content.

The sampling objectives for the tailings and soil samples collected from T1 will be to compare to previous analytical results, to evaluate matrix consistency, to determine tailings volumes, and to determine depth to bedrock beneath the creek bed.

Based on the borings collected, additional contingency borings may be drilled to obtain more data. The project manager will discuss contingency borings with DEQ’s project manager prior to any additional drilling.

4.2.1.3 Middle Tailings Impoundment (T2)

Two borings will be advanced in T2, one on the east side and one on the west side. At each soil boring location, three tailings samples will be collected from the surface and at depths of 10 feet and 20 feet; one soil sample will be collected from beneath the tailings at an approximate depth of 30 feet. The borings will extend 10 feet below native soil to locate bedrock. No samples will be collected in the 10 feet below native soil.

Tailings samples will be analyzed for total recoverable metals, ABA, grain size, and moisture content. Surface tailings samples will also be analyzed for SPLP. The soil samples will be analyzed for total recoverable metals, grain size, and moisture content.

The sampling objectives for the tailings and soil samples collected from T2 will be to compare to previous analytical results, to evaluate matrix consistency, to determine tailings volumes, and to determine depth to bedrock beneath the creek bed.

4.2.1.4 Upper Tailings Impoundment (T3)

Two borings will be advanced in T3. A total of eight tailings samples will be collected from the surface and at depths of 10 feet, 20 feet, and 30 feet; two soil samples will be collected from beneath the tailings at an approximate depth of 40 feet. The borings will extend 10 feet below native soil to locate bedrock. No samples will be collected in the 10 feet below native soil.

Tailings samples will be analyzed for total recoverable metals, ABA, grain size, and moisture content. The surface tailings sample will also be analyzed for SPLP. The soil sample will be analyzed for total recoverable metals, grain size, and moisture content.

The sampling objectives for the tailings and soil samples collected from T3 will be to compare to previous analytical results, to evaluate matrix consistency, to determine tailings volumes, and to determine depth to bedrock beneath the creek bed.

Based on the borings collected, additional contingency borings may be drilled to obtain more data. The project manager will discuss contingency borings with DEQ's project manager prior to any additional drilling.

4.2.1.5 Waste Rock Impoundment (WR)

Three borings will be advanced in the WR AOC; two located in the flat impoundment area and one on top of the elevated berm. At each soil boring locations, four waste rock samples will be collected at the surface and at depths of 10 feet, 20 feet, and 30 feet; one soil sample will be collected at an approximate depth of 40 feet. The borings will extend 10 feet below native soil to locate bedrock. No samples will be collected in the 10 feet below native soil.

Waste rock samples will be analyzed for total recoverable metals, ABA, grain size, and moisture content. Surface waste rock samples will also be analyzed for SPLP. The soil samples will be analyzed for total recoverable metals, grain size, and moisture content.

The sampling objectives for the waste rock and soil samples collected from WR will be to compare to previous analytical results, to evaluate matrix consistency, to determine waste rock volumes, and to determine depth to bedrock beneath the creek bed.

Based on the borings collected, additional contingency borings may be drilled to obtain more data. The project manager will discuss contingency borings with DEQ's project manager prior to any additional drilling.

4.2.1.6 Area-wide Condition (AW)

Two surface waste rock samples and two surface soil samples will be collected from the western slope of the ravine and two surface soil samples will be collected from the eastern slope of the ravine, above the operations area. In addition, one surface water sample will be collected from the western slope adit.

All samples will be analyzed for total recoverable metals. In addition, the surface water sample will be analyzed for WQ and field parameters.

The sampling objective for the waste rock and soil samples is to evaluate potential residual contamination remaining along the site periphery. The prevailing wind direction is west to east; however, most mine operations appear to have been conducted on the west ravine slope. Sampling will evaluate track out to the west and aerial deposition to the east. The sampling objectives for the surface water sample are to measure conditions associated with the adit drainage, support the risk assessment, and to compare conditions across the site.

4.2.1.7 Repository (RY)

Three surface soil samples will be collected from the potential repository location. A monitoring well will be installed at the repository location to demonstrate adequate separation from groundwater. The well will be installed to a depth no greater than 60 feet, or until groundwater is encountered. Three test pits will be dug at the surface sample locations to determine the volume and suitability of the salvageable material at the repository and to determine a suitable repository depth. The test pits will be evaluated and documented for geologic conditions, stratigraphy, bedrock, groundwater, and other relevant subsurface conditions. The test pits will be excavated to refusal or to the limits of the excavator. Herrera's geotechnical engineer will be on-site during the test pits excavation and will provide assistance for the collection of soil sample for engineering analysis. The field geotechnical investigation will satisfy the geology, engineering characteristics, construction material suitability, near surface groundwater presence/ or lack thereof components of the USFS repository siting criteria (USFS 2008).

Soil samples collected from the repository will be analyzed for total recoverable metals and agricultural-related analytes. Soil sample will also be collected and sampled for particle size analysis, standard proctor, specific gravity of particles, and moisture content. If water is encountered in the GW well, a water sample will be collected and analyzed for total recoverable metals, dissolved metals (aluminum only), and field parameters.

The sampling objective for the repository samples is to evaluate background conditions distant from the site operational area and to determine salvageable volume and revegetation viability (topsoil removed to excavate the repository will be used to provide final cover). Additional objectives include identifying the depth to groundwater and permeability of soil material.

4.2.1.8 Background (BG)

Two background surface soil samples will be collected distant from the site at locations to be determined in the field (not shown on Figure 4-1). An attempt will be made to locate these

samples beyond the surrounding ridge tops, in adjoining drainage basins to the south and east. Samples will be analyzed for total recoverable metals to provide background conditions away from the site.

4.2.1.9 Upstream (US)

One surface water sample and one sediment sample will be collected from Dunklebery Creek, approximately 100 feet upstream of the waste rock berm.

Surface water samples will be analyzed for total recoverable metals, dissolved metals (aluminum only), and field parameters. Sediment samples will be analyzed for total recoverable metals.

The sampling objectives for the surface water samples are to determine the existing downstream recovery conditions, support the risk assessment, and to compare conditions across the site. Sampling objectives for sediment are to determine recovery conditions, support the risk assessment, and to provide information for the expanded engineering evaluation and cost analysis (EEE/CA).

4.2.1.10 Quality Control (QC)

One surface water field duplicate sample will be collected and one equipment rinsate blank sample will be collected for project field QC. The field duplicate sample will be analyzed for total recoverable metals and dissolved metals (aluminum only); the equipment rinsate blank sample will be analyzed for total recoverable metals.

4.2.2 Soil, Tailings, and Waste Rock Sampling Procedures

Discrete grab samples of soil, tailings, and waste rock will be collected across the mine site, at the repository site, and as background samples. Soil samples will be collected at a total of four surface and six subsurface locations. Tailings samples will be collected at a total of four surface and nine subsurface locations. Waste rock sample will be collected at a total of four surface and six subsurface locations. Table 4-4 lists the analytical testing methods, sample container, volume, and preservation requirements.

All surface solid matrix samples will be collected from a depth of between 0.0 and 0.3 feet below ground surface. Each discrete sample will be collected with a dedicated stainless steel spoon, scoop, or trowel and placed into a dedicated stainless steel bowl and homogenized. Samplers will attempt to exclude coarse material (>1/4 inch in diameter) from the desired fine material. The homogenized sample will be placed into prelabeled sample containers (see Table 4-4).

Table 4-4. Sample analysis summary, preservation, sample container, and holding times, Forest Rose Mine Site.

Number of Samples	Matrix	Analytical Parameters/ Method	Sample Preservation	Technical Holding Time	Sample Container(s)
52	Solid	Total recoverable metals[a] / SW-846 methods 6020/7471	Cool to 4°C	180 days (28 days for mercury)	One 8-oz wide mouth glass
29	Solid	Acid-base accounting / Modified Sobek	Cool to 4°C	None	One 8-oz wide mouth glass
8	Solid	SPLP metals[b] / EPA methods 1312 and 200.7/200.8	Cool to 4°C	180 days from collection	One 8-oz wide mouth glass
40	Solid	Particle size analysis / ASA 15-5	Cool to 4°C	None	Gallon zip-lock plastic bag
40	Solid	Moisture content / USDA Handbook 60, method 26	Cool to 4°C	None	Gallon zip-lock plastic bag
3	Solid	Cation exchange capacity / EPA 6010B/6020	Cool to 4°C	None	One 8-oz wide mouth glass
3	Solid	pH / ASA 10-3.2	Cool to 4°C	None	Gallon zip-lock plastic bag
3	Solid	Conductivity / ASA 10-3.3	Cool to 4°C	None	Gallon zip-lock plastic bag
3	Solid	Nitrate as nitrogen / EPA 353.2	Cool to 4°C	None	One 8-oz wide mouth glass
3	Solid	Total phosphorus / EPA 365.1	Cool to 4°C	None	One 8-oz wide mouth glass
3	Solid	Total potassium / EPA 6010B/6020	Cool to 4°C	None	One 8-oz wide mouth glass
3	Solid	Organic matter / ASA 29-3.5.2	Cool to 4°C	None	One 8-oz wide mouth glass
3	Solid	Lime requirement / ASA 12-3.4.4	Cool to 4°C	None	One 8-oz wide mouth glass
6	Water	Total recoverable metals[c]/ EPA methods 200.7/ 200.8/7470	Cool to 4°C, HNO_3 to pH<2	180 days from collection	250-mL polyethylene bottle
4	Water	Dissolved metals[d] / EPA methods 200.7/ 200.8	Filter (0.45 micron), cool to 4°C, HNO_3 to pH<2	180 days from collection	250-mL polyethylene bottle
4	Water	Hardness / SM2340B	Cool to 4°C	180 days from collection	50-mL polyethylene bottle
4	Water	Chloride / EPA 300.0	Cool to 4°C	28 days from collection	50-mL polyethylene bottle
4	Water	Sulfate / EPA 300.0	Cool to 4°C	28 days from collection	100-mL polyethylene bottle
4	Water	Nitrate/nitrite / EPA 353.2	Cool to 4°C, H_2SO_4 to pH<2	28 days from collection	50-mL polyethylene bottle
4	Water	Alkalinity/SM 2320B	Cool to 4°C	14 days from collection	100-mL polyethylene bottle
4	Water	Acidity / SM 2310B	Cool to 4°C	14 days from collection	250-mL polyethylene bottle
4	Water	Total dissolved solids / SM2540C	Cool to 4°C	7 days from collection	500-mL polyethylene bottle

[a] Total recoverable metals for solid matrices includes: antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, and zinc.
[b] SPLP metals includes: antimony, arsenic, cadmium, copper, iron, lead, mercury, manganese, silver, and zinc.
[c] Total recoverable metals for water includes: antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, and zinc.
[d] Dissolved metals for water is aluminum only.
°C = Degrees Celsius ASA = American Society of Agronomy EPA = U.S. Environmental Protection Agency

All subsurface solid matrix samples will be collected using a track mounted hollow-stem auger drill rig. A brief description of the sample's physical characteristic will be noted in the field logbook. Each sample location will be recorded using a hand-held GPS device.

4.2.3 Sediment Sampling Procedures

Three surface sediment samples will be collected for this project. Two samples will be collected from the downstream AOC and one sample will be collected from the upstream AOC (see Figure 4-1). Table 4-4 lists the analytical testing methods, and sample container, volume, and preservation requirements.

Each discrete sediment sample will be collected with a dedicated stainless steel spoon, scoop, or trowel and placed into a dedicated stainless steel and homogenized. Samplers will attempt to exclude coarse material (>1/4 inch in diameter) from the desired fine material. The homogenized sample will be placed into prelabeled sample containers.

A brief description of the sample's physical characteristic will be noted in the field logbook. Each sample location will be recorded using a hand-held GPS device.

4.2.4 Surface Water Sampling Procedures

A total of three surface water samples will be collected from Dunkleberg Creek and one surface water sample will be collected from the adit discharge. Table 4-4 lists the analytical testing methods, and sample container, volume, and preservation requirements.

Surface water samples will be collected prior to collecting co-located sediment samples by immersing the sample container directly or by using a peristaltic pump. If a peristaltic pump is used, dedicated tubing will be used for each sample location. Samples collected for dissolved metals analysis will be filtered in the field using a 0.45 micron filter prior to preservation. Each sample location will be recorded using a hand-held GPS device.

4.2.5 Field Analytical Procedures

Field analyses, including pH, temperature, specific conductance, and dissolved oxygen will be measured at all four surface water sample locations using field portable meters. The meters will be calibrated using the manufacturer's recommended procedures. The probes will be inserted directly into the water and the pH, temperature, specific conductance, and dissolved oxygen readings will be recorded in the field logbook. A check standard will be measured to verify instrument calibration prior to measuring the sample.

4.2.6 Quality Assurance Sample Collection Procedures

One surface water field duplicate sample will be collected immediately downstream of the T1 dam slump. The sample will be collected as a separate sample as described in Section 4.2.4.

In addition, one sampling equipment rinsate blank sample will be collected. Deionized water will be poured onto a decontaminated split spoon and then poured into an appropriate sample container for total recoverable metals analysis.

4.2.7 Sample Documentation and Custody

4.2.7.1 Sample Identification

Samples will be identified based on the sampling area, location, and sample depth. All samples collected during the investigation will be labeled clearly and legibly. Each sample will be labeled with a unique alphanumeric sample identification number that identifies characteristics of the sample as follows:

Site Name
FR – Abbreviated site name

Sample Location
DS – Downstream
T1 – Lower tailings impoundment
T2 – Middle tailings impoundment
T3 – Upper tailings impoundment
WR – Waste rock impoundment
AW – Area-wide condition
RY – Repository
BG – Background
US – Upstream
QC – Quality Control

Matrix
SW – Surface water
SD – Sediment
TS – Tailings surface
TB – Tailings boring
SS – Soil surface
SB – Soil boring
RS – Rock surface (waste rock)
RB – Rock boring (waste rock)
QC – Quality control

Sample Number
01, 02, 03, etc. (per sample location, per matrix)

Sample Depth
00 – Surface
10 – 10 feet
20 – 20 feet
30 – 30 feet

4.2.7.2 Sample Labels

Sample labels will be made of self-adhering, waterproof material. An indelible pen will be used to fill out each label. Each sample label will contain:

- Project name (FRMS RI)
- Sample identification number
- Date of collection (day/month/year)
- Time of collection (military format)
- Analysis
- Preservative (as applicable)
- Filtered or unfiltered (F or UF)
- Company name and sampler initials (Herrera/GC).

Sample labels will be protected by packaging tape wrapped around the entire jar to prevent loss or damage of the labels during handling and storage.

4.2.7.3Field Logbooks

Field logbooks will be kept onsite during field operations. Activities will be recorded in a bound field logbook of water-resistant paper. All entries will be made legibly, in indelible ink, and will be signed and dated. Information recorded will include the following:

- Date, time, place, and location of sampling
- Onsite personnel and visitors
- Daily safety discussion and any safety issues
- Quality control samples (i.e., duplicate samples, field blanks, etc.)
- Field measurements and their units
- Number of attempts at each sampling station
- Observations about site and location (weather, current, odors, appearance, etc.)

- Observations about the samples (GPS locations, sample media, sample depth, preservative, filtered or unfiltered, comments)
- General sample characteristics (texture, color, biota, odor, sheen, etc.)
- Equipment calibration
- Equipment decontamination verification.

Field logbooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occur during project field activities. Entries should be factual, detailed, and objective. Unless restricted by weather conditions, all original data recorded in field logbooks, on sample identification tags, on chain of custody records, and on field forms will be written in waterproof ink. If an error is made, the individual responsible may make corrections simply by crossing out the error and entering the correct information. The erroneous information will not be obliterated. All corrections will be initialed and dated. All documentation, including voided entries, will be maintained within project files.

Samples will be retained at all times in the field crew's custody until samples are delivered or shipped to the appropriate laboratory by field personnel. Chain of custody forms will be initiated at the time of sample collection to ensure that all collected samples are properly documented and traceable through storage, transport, and analysis. When all line items on the form are completed or when the samples are relinquished, the sample collection custodian will sign and date the form, list the time, and confirm the completeness of all descriptive information contained on the form. Each individual who subsequently assumes responsibility for the samples will sign and date the chain of custody form. The field chain of custody terminates when the laboratory receives the samples. The field sample custodian will retain a copy of the completed, signed chain of custody form(s) for project files.

4.2.8 Sample Preservation and Handling

All samples will be stored in insulated coolers and preserved by cooling with ice to a temperature of 4°C or below. Maximum sample holding and extraction times will be strictly adhered to by field personnel and the analytical and testing laboratories. Preparation of jars for shipment to fixed laboratories will be performed in the following manner:

- Samples will be packaged and shipped in accordance with U.S. Department of Transportation regulations as specified in 49 Code of Federal Regulations (CFR) 173.6 and 49 CFR 173.24.
- Place sample containers in plastic zip-loc bubble-pack bags, or wrap in bubble pack and secure with packaging tape.

- Prepare an empty insulated cooler by placing three to four ice packs in a garbage bag at the bottom of the cooler. Place sample containers in a garbage bag and fill with the sample bottles. Add additional bags of ice as needed to surround the bag containing the samples.

- Chain of custody forms will be enclosed in a plastic bag and taped to the inside lid of the cooler.

- Seal the cooler with strapping tape and a custody seal.

Samples for chemical analyses will be hand-couriered or shipped via overnight delivery to the analytical laboratory at completion of sample collection, accompanied by the chain of custody record, which identifies the shipment contents. The chain of custody will be signed by the individual relinquishing samples to the onsite laboratory representative. Upon receipt of samples at the laboratory, the shipping container seal will be broken and the condition of the samples will be recorded by the receiver. The field personnel will be responsible for the following:

- Packaging the samples

- Signing the chain of custody before placing inside the cooler to be sealed

- Applying a shipping label, a waybill, a custody seal, and strapping tape to the cooler

- Shipping the samples in accordance with the maximum holding time allowed for the analyses to be performed

- Notifying the laboratory of when the samples are shipped

- Confirming receipt of the samples by the laboratory and that the samples were received in good condition.

All samples will be retained for a minimum of 6 months from the time they were received using standard laboratory handling procedures. They may be removed from the laboratory prior to the end of the 6-month period only at the direction of the Herrera project manager.

4.2.9 Decontamination Procedures

The dedicated grab sampling equipment (compositing bowls and sampling utensils) will be thoroughly decontaminated prior to use according to the following procedure:

1. Detergent wash

2. Tap water rinse

3. Nitric acid (10%) wash

4. Deionized water rinse

5. Ultra-pure deionized water rinse

One equipment rinsate blank sample will be collected and analyzed for metals to assess the potential for cross-contamination due to incomplete decontamination procedures.

All handwork will be conducted with disposable nitrile gloves, which will be changed after handling each individual sample and between sampling stations to prevent cross-contamination between samples.

Personal non-disposable field equipment (i.e., boots and waterproof gloves and garments) will be rinsed with water and brushed clean prior to leaving the immediate vicinity of the sample collection area. Special attention will be given to removing tailings, waste rock, and sediment that may adhere to boot treads.

4.3 Quality Assurance Protocol Plan

The purpose of project QA/QC is to provide confidence in project data results through a system of quality control performance checks associated with data collection methods, laboratory analysis, data reporting, and appropriate corrective actions to achieve compliance with established performance and data quality criteria. This section presents the QA/QC procedures to ensure that the investigation data results are defensible and usable for their intended purpose.

4.3.1 Data Quality

The data quality objectives (DQOs) are qualitative and quantitative statements that specify the quality of data required to support RI activities. The DQOs for the project and the type, analytical level, and use of the data are presented below.

4.3.1.1 Data Quality Objectives

The DQOs were prepared using EPA guidance for the DQO process (EPA 2006). The EPA guidance presents the DQOs as a seven-step process:

1. State the Problem—Concisely describe the problem to be studied.

2. Identify the Decision—Identify what questions the study will attempt to resolve and what actions may result.

3. Identify the Inputs to the Decision—Identify the information that needs to be obtained and the measurements that need to be taken to resolve the decision statement.

4. Define the Study Boundaries—Specify the time periods and spatial area to which the decisions will apply.

5. Develop a Decision Rule—Define the statistical parameter of interest, specify the action level, and integrate the previous DQO outputs into a single statement that describes the logical basis for choosing among alternative actions.

6. Specify Tolerable Limits on Decision Errors—Define the decision maker's tolerable decision error rates based on a consideration of the consequences of making an incorrect decision.

7. Optimize the Design—Evaluate information from the previous steps and generate alternative data collection designs.

The following sections describe each step, as listed above, and how it pertains to the investigation of the Forest Rose Mine Site.

Step 1: Stating the Problem—The Forest Rose Mine is an abandoned hardrock mine that was a historical producer of silver and lead. Based on the previous reports, four potentially contaminated media (surface water, soil, sediment, and groundwater) are present at the site. Elevated levels of arsenic, cadmium, copper, iron, mercury, lead, antimony, and zinc were found in the tailings and waste rock samples. Surface water and groundwater samples showed elevated levels of arsenic, cadmium, copper, iron, lead, and zinc. Sediment samples showed elevated levels of arsenic, copper, iron and lead. The objective for the project is to protect human health and the environment.

Step 2: Identify the Decision—Previous data and inspections of the site revealed tailings, waste rock, and water samples with elevated levels of arsenic, cadmium, copper, iron, mercury, lead, antimony, and zinc, which may cause adverse impacts to human health and the environment. The following decisions will be made:

- What reclamation action is necessary at the site to protect human health and the environment?

- What is the areal extent and volume of tailings, waste rock, and metal contaminated soil?

- What is the condition of Dunkleberg Creek?

- How will the characteristics of the mine waste rock and underlying soil impact revegetation of the site?

- How will the physiography of the site affect reclamation alternatives?
- Is there a suitable repository site and soil borrow area near the site?

Step 3: Identify the Inputs to the Decision—The areal extent of tailings, waste rock, and metals-contaminated soil and the characteristics of soil underlying the wastes will be determined by analysis for metals and reclamation-related constituents. The volume of wastes and the physiography of the site will be determined by completing a survey of site topography and site features. The conditions of Dunkleberg Creek will be determined by analyzing for metals and water quality parameters.

Step 4: Define the Study Boundaries— The Forest Rose Mine Site is comprised of approximately 4 acres of metal mining impacted land along Dunkleberg Creek. Mine tailings and waste rock have been placed in the Dunkleberg Creek drainage, which flows north to the Clark Fork River. Wind-blown contaminated dust may have impacted areas immediately surrounding the active mine site operational area.

Step 5: Develop a Decision Rule—The potential receptors at the site include recreational users, terrestrial and creek wildlife, and vegetation. Reclamation of the site will be necessary if levels of contaminants in soil samples exceed PRGs and pose unacceptable risks to human health and the environment. Reclamation may include, but is not limited to, mine waste removal and in-place actions.

Step 6: Specify Tolerable Limits on Decision Errors—In general, environmental data may be strongly indicative of site conditions, but data are not absolutely definitive; therefore, decisions based upon the data could be in error. This is known as the decision error.

Sampling error and measurement error are associated with environmental data collection and may lead to decision error. Sampling error occurs because it is impossible for a sampling effort to measure conditions at every point of a site or at every point in time. Sampling error occurs when the sample is not representative of the true state of the environment at a site. Measurement error occurs because of random and systematic errors associated with sample collection, handling, preparation, analysis, data reduction, and data handling. The two types of errors may lead to incorrect decisions or recommendations. In general, decision errors are controlled by adopting a scientific approach that uses hypothesis testing to minimize the potential for decision errors. EPA guidance suggests the following steps to identify and control decision errors:

- Define the possible range of the parameter of interest
- Define both types of decision errors and the consequences of each
- Specify a range of parameter values for which the consequences of decision errors are relatively minor.

Decision errors are evaluated through hypothesis testing. The reclamation may result in members of the public coming into contact with site wastes. Therefore, the null hypothesis for recreational use is that the site waste contains concentrations of contaminants above the risk-based recreation cleanup levels. The site may also have terrestrial wildlife and vegetation exposed to site wastes. Therefore, the null hypothesis for vegetation and terrestrial wildlife receptors is that site waste materials are contaminated. There are two types of decision errors:

1. False-Negative Error—A false-negative decision error occurs when the hypothesis is rejected, although it is true. For this project, the decision-maker would determine that the site does not contain mineral processing wastes, soil, or surface water that requires additional reclamation, although concentration levels do require additional reclamation. The consequences of a false-negative error would be that contaminated soil and surface water are left in place instead of being reclaimed.

2. False-Positive Error.—A false-positive decision error occurs when the hypothesis is not rejected, although it is false. For this project, the decision-maker would determine that the site contains mineral processing wastes, soil, and surface water that require reclamation based on the results of the analytical data, although the concentrations of contaminants do not require reclamation. The consequences of a false-positive error would be that unnecessary resources may be spent to perform additional reclamation to address contamination that does not exist at levels exceeding action levels or acceptable risk levels.

Limits on decision errors due to sampling error will be minimized by using the analytical results from previous characterization studies by adding a significant number of sampling locations for the current investigation, and by using visual observations to identify potentially contaminated areas. The sampling approach was devised to provide enough data to adequately define the areal and vertical extent of contamination, to determine waste characteristics required for reclamation options evaluation, and determine goals for acceptable conditions following reclamation.

Step 7: Optimize the Design—The collection of soil samples should be adequate to accept or reject the null hypothesis for human (recreational) and environmental (fish) exposure. Visual examination of the site, together with incorporation of previous site analytical data, will be used to bias the collection of samples. The analytical results will be used to locate and characterize the extent of contamination and support the risk assessment and reclamation design.

4.3.1.2 Data Type, Analytical Level, and Use.

Table 4-5 presents DQOs for measurement, location of that measurement, analytical method, analytical support level, sample media, and the data use. There are five general analytical support levels, distinguished by type of technology, documentation use, and degree of sophistication:

- Level V—nonstandard methods where analyses may require method modification and development.

- Level IV—characterized by rigorous QA protocols and documentation and provides qualitative and quantitative analytical data. Documentation includes all information required to complete the full data validation, as defined in the National Functional Guidelines for Inorganic Data Review (EPA 2004).

- Level III—primarily supports engineering studies using standard EPA-approved procedures. Some procedures may be equivalent to Level IV analysis without the requirements for documentation.

- Level II—applied to quantitative field analysis, characterized by the use of onsite portable analytical instruments or mobile laboratories stationed near the site. Examples of field screening instruments include portable X-ray fluorescence spectrometers, gas-chromatographs, and water quality meters.

- Level I—applied to qualitative field screening, characterized by the use of portable instruments that provide real-time measurements to assist in optimizing sampling point locations and for health and safety support. Examples of Level I analysis include photoionization detector, explosive atmosphere, and dust concentration measurements.

Table 4-5. Summary of data quality objectives, Forest Rose Mine Site.

Analysis	Location	Analysis Method	Analytical Support Level	Media	Data Use
Total recoverable metals and dissolved metals	Laboratory	EPA 6020 /200.7 / 200.8/7471/7470	IV	SS, T, WR, SD, SW	SC, RA, EA, ED
SPLP metals	Laboratory	EPA 6020	IV	T, WR	SC, EA, ED
Acid-base accounting	Laboratory	Modified Sobek	III	T, WR	SC, EA, ED
Particle size analysis	Laboratory	ASA 15-5	III	SS, T, WR	SC, EA, ED
Moisture content	Laboratory	USDA	III	SS, T, WR	SC, EA, ED
Agricultural Analysis	Laboratory	ASA, EPA, and USDA	III	SS	SC, EA, ED
Water quality parameters	Laboratory	SM and EPA	III	SW	SC, RA, EA, ED
pH, temperature, specific conductance, dissolved oxygen	Field	Manufacturer's Instructions	II	SW	SC

ASA = American Society of Agronomy (ASA 1996)
EA = Evaluation of Alternatives
EPA = U.S. Environmental Protection Agency
ED = Engineering Design
RA = Risk Assessment
SC = Site Characterization
SD = Sediment
SS = Soil
SW = Surface water
T = Tailings
USDA = U.S. Department of Agriculture
WR = Waste rock

Analytical support levels to be implemented during the Forest Rose Mine Site activities are Levels II, III, and IV.

4.3.2 Quality Assurance Objectives

The overall QA objective for the Forest Rose Mine Site is to produce well-documented data of known quality. Meeting this objective involves establishing and meeting goals for precision, accuracy, completeness, representativeness, comparability, and target reporting limits for the analytical methods. The Herrera QA manager for the Forest Rose Mine Site project will be responsible for communicating QA objectives and expectations with the project laboratory and working with the DEQ/MWCB project manager to meet designated QA standards.

If analytical data fail to meet the QA objectives described in this section, Herrera will explain in the RI report why the data failed to meet the objectives (i.e., because of matrix interferences), and will describe the limitations and usability of the data. The following corrective actions may be taken for data that do not meet QA objectives: (1) verify that the analytical measurement system was in control, (2) thoroughly check all calculations, (3) use data qualifiers, and (4) assuming a sufficient quantity of sample is available, reanalyze the affected samples, if authorized by the DEQ/MWCB project manager. Corrective actions for internal QA and quality control (QC) are presented in detail in Section 4.3.8.

4.3.2.1 Measurement Quality Objectives

Measurement quality objectives (MQOs) that will be evaluated for the laboratory data include completeness, accuracy, precision, and reporting limits. The following sections discuss the calculation of each MQO. The specific MQOs and required reporting limits for this project are listed in Table 4-6.

4.3.2.2 Precision

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average value, usually stated in terms of standard deviation or coefficient of variation. It also may be measured as the relative percent difference (RPD) between two values. Precision includes the interrelated concepts of instrument or method detection limits (MDLs) and field sample variance. Sources of this variance include sample heterogeneity, sampling error, and analytical error.

Table 4-6. Measurement quality objective and reporting limit requirements, Forest Rose Mine Site.

Parameter	Matrix	RL	Laboratory Method Blank	Control Standard Recovery	Matrix Spike Recovery [a]	Laboratory Duplicate RPD [b]	Field Duplicate RPD [b]
Total recoverable metals	Solid	0.1-1 mg/kg	≤RL	80-120%	75-125%	≤20% or ±2 × RL	≤35%
Acid-base accounting	Solid	1 T $CaCO_3$/1000T	≤RL	NA	NA	≤20%	≤35%
SPLP metals	Solid	0.02-5 mg/L	≤RL	80-120%	75-125%	≤20% or ±2 × RL	≤35%
Particle size analysis	Solid	1 percent	NA	NA	NA	≤20% or ±2 × RL	≤35%
Compaction	Solid						
Moisture content	Solid	0.1 percent	NA	NA	NA	≤20% or ±2 × RL	≤35%
Cation exchange capacity	Solid	1 meq /100 g	≤RL	NA	NA	≤20%	≤35%
pH	Solid	0.01 std. units	NA	NA	NA	≤20%	≤35%
Conductivity	Solid	0.01 mmhos/cm	NA	NA	NA	≤20%	≤35%
Nitrate as nitrogen	Solid	1 mg/kg	≤RL	NA	NA	≤20%	≤35%
Total phosphorus	Solid	1 mg/kg	≤RL	80-120%	75-125%	≤20% or ±2 × RL	≤35%
Total potassium	Solid	1 mg/kg	≤RL	NA	NA	≤20%	≤35%
Organic matter	Solid	0.1 percent	≤RL	NA	NA	≤20%	≤35%
Lime requirement	Solid	1 T $CaCO_3$/1000T	≤RL	NA	NA	≤20%	≤35%
Total recoverable metals	Water	1-10 µg/L	≤RL	80-120%	75-125%	≤20% or ±2 × RL	≤35%
Dissolved metals	Water	1-10 µg/L	≤RL	80-120%	75-125%	≤20% or ±2 × RL	≤35%
Hardness	Water	1 mg/L	≤RL	NA	NA	≤20% or ±2 × RL	≤35%
Chloride	Water	1 mg/L	≤RL	NA	NA	≤20%	≤35%
Sulfate	Water	1 mg/L	≤RL	NA	NA	≤20%	≤35%
Nitrate/nitrite	Water	0.01 mg/L	≤RL	NA	NA	≤20%	≤35%
Alkalinity	Water	1 mg/L	≤RL	NA	NA	≤20%	≤35%
Acidity	Water	1 mg/L	≤RL	NA	NA	≤20%	≤35%
Total dissolved solids	Water	10 mg/L	≤RL	NA	NA	≤20% or ±2 × RL	≤35%

[a] For metals, the Contract Laboratory Program Functional Guidelines state that the spike recovery limits do not apply when the sample concentration exceeds the spike concentration by a factor of four or more (EPA 2004).

[b] The relative percent difference must be less than or equal to the indicated percentage for values that are greater than 5 times the reporting limit. RPD must be ±2 times the reporting limit for values that are less than or equal to 5 times the reporting limit.

NA = not applicable.
RL = reporting limit.
RPD = relative percent difference.

Precision will be assessed based on the analyses of laboratory and field duplicates, and matrix spike duplicates. Precision in these samples will be evaluated based on their relative percent difference (RPD):

$$\text{RPD} = \frac{(MS - MSD)}{0.5(MS + MSD)} \text{ x } 100\%$$

Where: RPD = relative percent difference
MS = Matrix spike
MSD = Matrix spike duplicate

Specific MQOs for laboratory and field duplicates are defined by analytical method in Table 4-6.

4.3.2.3 Accuracy

Accuracy measures the bias of the measurement system. Sources of this error include the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and analysis. Data interpretation and reporting may also be significant sources of error. Typically, analytical accuracy is assessed through the analysis of spiked samples and may be stated in terms of percent recovery or the average (arithmetic mean) of the percent recovery. Blank samples are also analyzed to assess sampling and analytical bias (i.e., sample contamination). Background measurements similarly assess measurement bias.

Accuracy will be assessed based on analyses of method blanks, equipment rinsate blanks, matrix spikes (MS), and laboratory control samples (LCS). Accuracy in MS and LCS will be quantified based on percent recovery or the average (arithmetic mean) of the percent recovery. Percent recovery for MS will be calculated using the following equation:

$$\%R = \frac{(S - U)}{C_{sa}} \times 100\%$$

Where: %R = percent recovery
S = measured concentration in spike sample
U = measured concentration in unspiked sample
C_{sa} = actual concentration of spike added.

Percent recovery for LCS will be calculated using the following equation:

$$\%R = \frac{M}{T} \times 100\%$$

Where: %R = percent recovery
M = measured value

$$T = \text{true value}$$

Specific MQOs for MS and LCS are defined in Table 4-6 by analysis method.

4.3.2.4 Representativeness

Representativeness expresses the degree to which data represent a characteristic of a population, a parameter variation at a sampling point, or an environmental condition. Representativeness is a qualitative parameter, which is most concerned with proper design of the measurement program. Sample/measurement locations may be biased (judgmental) or unbiased (random or systematic). For unbiased schemes, the sampling must be designed not only to collect samples that represent conditions at a sample location, but also to select sample locations that represent the total area to be sampled. Sample representativeness will be ensured by employing consistent and standard sampling procedures.

4.3.2.5 Completeness

Completeness for sample collection is defined as the percentage of specified samples listed in the plan that are actually collected and analyzed. Completeness for acceptable data is defined as the percentage of acceptable data out of the total amount of data generated. The completeness goal shall be 90 percent. Acceptable data includes data that passes all QC criteria or data that may not pass all of the QC criteria but have appropriate corrective actions taken.

4.3.2.6 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set may be compared to another. Sample data should be comparable with other measurement data for similar samples and sample conditions. This goal is achieved through the use of standard techniques to collect and analyze samples. The results will be tabulated in standard spreadsheets to facilitate comparison with other study results and project PRGs.

4.3.2.7 Target Reporting Limits

The TRLs for soil and water metals analyses are listed in Table 4-6. The TRL is defined as the lowest concentration that needs to be reported for undiluted samples to obtain project objectives. The laboratory will try to achieve the lowest reporting limits possible for all measurements and will notify the Herrera QA manager if the reporting limits for the samples exceed the TRLs. If samples are diluted to qualify constituents present at high concentration levels or to reduce matrix interferences, the reporting limit will be calculated as the reporting limit for the particular matrix multiplied by the dilution factor. The actual matrix reporting limits for each sample will vary depending on the concentration of analytes present and the presence of any interference.

4.3.3 Quality Assurance Sample Collection Procedures

Two types of QA/QC samples will be collected during the field investigation activities: field duplicate and equipment rinsate samples:

- One field duplicate sample will be collected for surface water and will be analyzed for total recoverable metals and dissolved metals.
- One equipment rinsate blank sample will be collected of decontaminated sampling equipment and will be analyzed for total recoverable metals.

4.3.4 Sample Documentation and Custody

The possession and handling of each sample will be properly documented to promote timely, correct, and complete analysis for all required parameters. To promote sample integrity, each sample will be traceable from the point of collection through analysis and final disposition. Sample documentation and custody procedures are presented in Section 4.2.7.

4.3.5 Equipment Operation, Maintenance, Calibration, and Standardization

The procedures and frequency for field instrument operation, initial and continuing calibration verification, and maintenance requirements are described in the analytical methods or instrument manufacturer's calibration procedures. Calibration data will be recorded in the field logbook as will the source and method of preparation of the standard solutions used. Herrera will calibrate all field analytical equipment before it is shipped to the field, and daily, before and after use. All calibration standards will be prepared from commercially available NIST, EPA-traceable, or EPA-certified standards. The laboratory instrument operation, calibration, and maintenance procedures are described in the analytical method.

4.3.6 Analytical Procedures

The field and laboratory analytical methods that will be used are listed in Table 4-4. Laboratory analysis of samples collected during the RI will be completed by Energy Laboratories, Inc. (ELI) in Helena, Montana. ELI has established QA protocols that meet or exceed EPA guidelines. The EPA methods will be used whenever they are available for the target analyte.

4.3.7 Data Reduction, Validation, and Reporting

Herrera and the laboratory will validate all laboratory data by comparing the QC data to the criteria listed in the analytical method or in the National Functional Guidelines for Inorganic Data Review (EPA 2004). If data fail the review, the laboratory will be contacted and the data will be reanalyzed, qualified, or unqualified with an explanation. The quality of the data will be summarized in validation memos.

In addition, laboratory data packages will be provided for the chemistry data to allow independent data verification and validation. The data packages will consist of the sample results followed by a cover letter describing procedures used and analytical problems encountered, qualifiers used, reconstructed ion chromatogram (GC/MS), mass spectra of detected target compounds (GC/MS), chromatograms, quantification reports, and calibration data summaries. Dilution volumes, sample sizes, percent moisture, and surrogate recoveries will be presented on each summary sheet with the analytical results. A similar package is also assembled for each quality control sample (e.g., method blank).

The following types of data will be reviewed:

- Analytical laboratory summary reports including QC summary data for surrogates, method blanks, LCSs, and MS/duplicate samples. Acceptance and performance criteria will be developed from the current laboratory control limits even if those limits differ from the limits listed in Table 4-6.

- Calibration summary data will be checked to verify that all positive results for target compounds were generated under an acceptable calibration, as defined by the analytical method.

- Field QC results for blanks.

- Field data, such as sample identifications and sample dates, will be checked against the laboratory report.

Raw data files from the field and laboratory may not be reviewed unless there is a significant problem noted with the summary information.

After receipt from the laboratory, project data will be validated as described in the following section.

4.3.7.1 Data Reduction

In accordance with standard document control procedures, ELI will maintain on file the original copies of all data sheets and logbooks containing raw data, signed and dated by the responsible analyst. Separate instrument logs will also be maintained by the laboratory to enable a reconstruction of the run sequences for individual instruments.

The laboratory will store all residual samples as per their contract with DEQ. For the first 60 days after the laboratory receives the samples, samples and sample extracts will be stored in a refrigerator at 4°C. After that time, they may be stored at room temperature.

4.3.7.2 Evaluation of Completeness

The QA Manager will verify that the laboratory information matches the field information and that the following items are included in the data package:

- Chain-of-custody forms
- Case narrative describing any out-of-control events and summarizing analytical procedures
- Data report forms
- QA/QC summary forms
- Calibration summary forms
- Chromatograms documenting any QC problems.

If the data package is incomplete, the QA Manager will contact the laboratory, which must provide all missing information within 1 day.

Evaluation of Compliance

The actual data validation follows the procedures that are briefly outlined below:

- Review the data to check field and laboratory QC results to verify that holding times and acceptance and performance criteria were met, and to note any anomalous values
- Review chromatograms, mass spectra, and other raw data if provided as backup information for any apparent QC anomalies
- Ensure all analytical problems and corrections are reported in the case narrative and that appropriate laboratory qualifiers are added
- For any problems identified, review concerns with the laboratory, obtain additional information if necessary, and check all related data to determine the extent of the error
- Apply data qualifiers to the analytical results to indicate potential limitations on data usability.

Qualification of data will follow applicable method guidelines. If method guidelines exist, then applicable USEPA National and Regional Data Review guidelines will be used (EPA 2004).

Data Reporting

Data will be reported in standard units as described in the analytical methods. The laboratory project manager will be responsible for reviewing the laboratory report. The completed laboratory report will be approved by the laboratory project manager. The laboratory will provide all raw data necessary to fully validate the data. Each data package will include the following items:

- Case narrative including a statement of samples received, description of any deviation from standard procedures, explanation of any data qualifiers used, and any problems encountered during analysis.
- A QC summary report including applicable surrogate recoveries, MS and laboratory duplicate recoveries, method blank results, and laboratory control sample recoveries. This report must identify all QC outliers and describe their impact on data quality and usability.
- Chain-of-custody records.
- Reporting limits.
- Analytical instrument run logs.
- Analytical instrument raw data for samples, blanks, and standards.
- Initial calibration information.
- Continuing calibration information.
- Laboratory accuracy and precision limits.
- All values below reporting limits and above method detection limits.
- Date of analysis.

The final report will contain a QA/QC summary that discusses whether the final data meet the original project QA objectives. If the QA objectives are not met, the report will contain an explanation of the impact on the evaluation of the project objectives.

The project chemist will perform the following reporting functions:

- Alert the QA Manager to any QC problems, obvious anomalous values, or discrepancies between the field and laboratory data, and resolve any issues.

- Discuss QC problems in a data validation memo for each laboratory report.

- Review the laboratory electronic data deliverable (EDD) and electronic field data, enter the data qualifiers into the database, and prepare analytical data summary tables. The tables will summarize those samples and analytes for which detectable concentrations were exhibited as well as complete analytical summary tables. The tables will include field QC samples.

- At the completion of all field and laboratory efforts for site, the project chemist will prepare a data review/validation memorandum. The memorandum will summarize planned versus actual field and laboratory activities and data usability concerns.

4.3.8 Corrective Action Procedures

Corrective actions will be taken when any problems are identified in the program that affects product quality. The laboratory project manager and the Herrera QA manager, or their designees, are responsible for identifying the causes of the problems and developing a solution.

The cause of the problem must first be determined so that the effect of the problem on the overall program can be identified. The field team (and if necessary, the DEQ/MWCB project manager) will then develop a plausible corrective action. The effects of the action will be examined to determine whether the problem is addressed.

If the corrective action is initially successful, the laboratory project manager, or designee, will prepare a corrective action memorandum describing the corrective action, how and when it will be implemented, and the expected results. A copy of the memorandum will be sent to the Herrera project manager and QA manager and then to the DEQ/MWCB project manager. The laboratory project manager, or designee, will be responsible for implementing the corrective action and assessing its effectiveness. Procedures are presented below for correcting (1) problems detected during audits, (2) laboratory problems, and (3) data outside control limits.

4.3.8.1 Laboratory Corrective Actions

The laboratory QA manager will review laboratory procedures to identify conditions or procedures that may have an adverse impact on data quality. The QA manager will then assess the impact on the quality of the associated data, and then identify the corrective actions to be implemented. All conditions or procedures that may have an adverse impact on data quality will be included in the laboratory reports.

4.3.8.2 Data Outside Control Limits

The manner in which data outside of control limits are handled will depend on where the nonconformance is discovered. During data review in the laboratory, if QC checks fail to meet acceptance criteria, either the data will be flagged in accordance with standard EPA-defined data flags, or the nonconformance will be discussed in the case narrative. During the post-laboratory data validation, the data will be reviewed and assigned to one of the following three categories:

1. Valid-Unqualified—This category is used for all data that meet all QC criteria without any qualifier. These data are useful for any purpose and are not flagged.

2. Valid-Qualified—Data placed in this category are valid, but their usefulness may be limited in certain situations. These data may be qualified as "estimated," which is indicated by use of a "J" flag, or by the use of a specific flag that conveys information about the limitations of the data.

3. Invalid or Rejected—Data are considered to be invalid in cases such as failure to properly ice samples that require storage at 4°C during shipment. These data are flagged with an "R" and are considered to be unusable for any purpose.

Data will be validated using EPA guidance documents and the specific requirements of this QAPP. If certain data appear to be borderline between two categories, the data validator may seek the advice of the individuals cited in Section 1.3.1 as having a QA function.

4.4 Laboratory Analytical Plan

This LAP describes laboratory requirements for conducting the Forest Rose Mine Site RI. Laboratory QC samples will be used to evaluate the data precision, accuracy, representativeness, and comparability of the analytical results.

Analytical performance is monitored through QC samples and spikes, such as laboratory method blanks, QC check samples, matrix spikes, matrix spike duplicates, duplicate samples, and duplicate injections. All QC samples are evaluated on the basis of a laboratory batch. Two basic types of batches are used: the preparation batch and the run (i.e., analytical) batch. The preparation batch includes all samples processed as a unit during metals digestion or wet chemistry preparation. Preparation batches do not exceed 20 samples excluding associated QC samples. The QC samples associated with sample preparation include method blanks, laboratory control samples (LCS), matrix spikes, and duplicates. The run batch includes all samples analyzed together in the run sequence. The run sequence is typically defined by the analytical method. For some analyses, the run batch is equivalent to the preparation batch. The QC samples associated with the run sequence include calibration standards, instrument blanks, and reference standards.

Instances may arise where high sample concentrations, non-homogeneity of samples, or matrix interferences preclude achieving the detection limits or associated QC target criteria. In such instances, data will not be rejected a priori but will be examined on a case-by-case basis. The laboratory will report the reason for deviations from these detection limits or noncompliance with QC criteria in the case narrative.

4.4.1 Laboratory Method Blanks

A laboratory method blank is an analyte-free material processed in the same manner and at the same time as a project sample. The laboratory method blanks serve to demonstrate a contamination-free environment in the laboratory. The goal is for method blanks to be free of contamination. Low level contamination may be present, but must be less than the practical quantitation limit (PQL) as defined by the method standard operating procedure (SOP). If contamination is greater, the samples are reanalyzed. If contaminants are present in the method blank but not in project samples, no further action is required. All sources of contamination that are not common laboratory contaminants as defined in the method SOPs must be investigated as part of the corrective action process. Sample results must not be blank-subtracted unless specifically required by the analytical method.

4.4.2 Laboratory Control Sample

An LCS consists of a method blank spiked with target compounds of interest near the mid-point of the calibration range. The LCS is processed by the same sample preparation, standard addition, and analysis as the project samples. The recovery of target analytes in the LCS is an estimation of method accuracy.

LCS recovery must be within the control limits to demonstrate acceptable method performance. If the LCS recovery values are outside QC criteria for the target analytes, recovery values are significantly low, or the compounds were detected in the samples, then corrective action is required. After corrective action is complete, sample re-analysis is required for the failed parameters. For any deviations from the LCS control limits that cannot be resolved by sample re-analysis within holding times, the QC Manager must be notified immediately. If critical samples are affected, the Project Manager may determine that re-sampling is required.

4.4.3 Matrix Spike Sample

A matrix spike (MS) sample consists of a project sample split into two parts and processed as two separate samples in a manner identical to that of the rest of the samples. In addition to the regular addition of monitoring standards (internal standards, surrogate), spiking analytes are added to the sample aliquot. Generally, all method target analytes, if compatible, are added. A subset of target analytes may be used if indicated in the method SOP and approved during review of the SOP. An MS must be prepared for every batch of 20 samples (or fewer) for a given matrix if sufficient sample allows. Field and trip blanks, if collected, must not be chosen for spiking. The laboratory must analyze a site-specific MS sample for every batch that contains samples from the site, even if the batch contains samples from other sites.

MS recovery values are a measure of the performance of the method on the sample being analyzed. MS recovery values outside the control limits applied to the LCS indicate matrix effects. Sample clean-up procedures may be warranted for samples with severe matrix effects. The laboratory should notify the QC Manager of these instances to determine an appropriate corrective action.

4.4.4 Duplicate Sample

A duplicate sample consists of a set of two samples obtained in an identical manner from the same project sample. The collection of duplicate samples from a heterogeneous matrix requires homogenization to ensure that representative portions are analyzed. One sample per batch of 20 samples or fewer per matrix is analyzed in lieu of a laboratory duplicate.

The duplicate is prepared for methods that typically show concentrations of target analytes above MDLs, such as metals and wet chemistry analytes. The RPD values between the recovery values in the original and duplicate measure the precision of the analytical method on the actual project samples.

4.4.5 Other Laboratory QC Samples

The laboratory performs analysis of other QC samples or standards, depending on the analytical method. Standard QC samples or standards are documented in the specific method SOP. Method-specific QC samples or standards include internal standard spikes for gas chromatography/mass spectrometry (GC/MS) methods, post-digestion spikes and serial dilutions for metals analysis and interference check samples for inductively-plasma analysis. Results of all associated QC should be reported.

4.4.6 Analytical Methods

Analytical methods required for this project are summarized in Table 4-4.

4.5 Health and Safety Plan

The health and safety plan for RI activities at the Forest Rose Mine Site is attached as Appendix C.

4.6 Permitting Requirements

Permits will not be required in order to complete the RI or to conduct the site survey. Federal and state permits maybe required to complete reclamation activities in and around Dunkleberg Creek.

These requirements will be determined as part of the RI and will be presented in the Final RI Report.

4.7 Projected Reclamation Investigation Costs

Costs associated with completing the RI include preparing the RWP, field sampling, and generating the RI report. Laboratory analyses will be conducted by ELI in Helena, Montana. Borings will be completed by Boland Drilling from Great Falls, Montana. The projected costs for Herrera, ELI, and Boland Drilling are presented in Table 4-7. Both direct and indirect costs and project administration fees are provided for Herrera, not profit. Laboratory costs will be billed directly to DEQ/MWCB by ELI. The laboratory estimate is based on sample numbers reflected in Table 4-3; the ELI price estimate is provided in Appendix D. Site survey costs are not know at this time and will be in addition to the listed price. In total, the project RI costs will are estimated at $XX,XXX.

Table 4-7. Estimated reclamation investigation costs, Forest Rose Mine Site.

Contractor	Task Description	Cost
Herrera	Reclamation Work Plan	$11,378
	Onsite Reclamation Investigation	$10,211
	Reclamation Investigation Report	$13,753
	Subtotal	$35,342
Energy Laboratory	Analyze Field Samples Collected During RI	XX
Bolland Drilling	Drilling Borings	$9,710
	Total	

5.0 References

ASA. 1996. Methods of Soil Analysis, Part 3, Chemical Methods, Number 5 in the Soil Science Society of America Book Series. American Society of Agronomy. Madison, Wisconsin, 1390 p.

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APPENDIX A

1993 Hazardous Material Inventory

MONTANA DEPARTMENT OF STATE LANDS
ABANDONED MINE RECLAMATION BUREAU
HAZARDOUS MATERIALS INVENTORY
SITE SUMMARY

Mine/Site Name: Forest Rose
Legal Description: T 9N R 12W
Mining District: Dunkleburg
Latitude: N 46° 30' 29"
Longitude: W 113° 05' 21"
Land Status: Private/Public
Quad: Dunkleburg Creek
Inspectors: Bullock, Flammang, Clark
Organization: Pioneer Technical Services, Inc.

County: Granite
Section(s): NW 1/4, SE 1/4, Sec. 22
Mine Type: Hardrock/Pb, Zn, Ag
Primary Drainage: Clark Fork River
USGS Code: 17010202
Secondary Drainage: Dunkleburg Creek
Date Investigated: June 29, 1993
P.A. # 20-004

- The volume of tailings associated with this site was estimated to be approximately 23,000 cubic yards. The dam at the lower impoundment failed just prior to this investigation. The following elements were elevated at least three times background:

Arsenic: 330JX to 444JX mg/kg	Mercury: 0.342 to 0.377 mg/kg
Cadmium: 58.2J to 143J mg/kg	Lead: 690J to 6,8810J mg/kg
Copper: 404 to 563 mg/kg	Antimony: 28J to 49J mg/kg
Iron: 109,000J to 113,000J mg/kg	Zinc: 6,590J to 16,800J mg/kg

- The volume of waste rock associated with this site was estimated to be approximately 8,000 cubic yards. The following elements were elevated at least three times background:

Arsenic: 227 to 801JX mg/kg	Mercury: 0.648J to 2.93 mg/kg
Cadmium: 3.2J to 477J mg/kg	Lead: 242J to 60,400J mg/kg
Copper: 208 to 1,770 mg/kg	Antimony: 24J to 470J mg/kg
Iron: 75,700 to 164,000 mg/kg	Zinc: 2,840J to 51,500J mg/kg

- One discharging adit was identified at the site. No MCLs were exceeded in the adit discharge; however, acute and chronic aquatic life criteria were exceeded for zinc, and the chronic aquatic life criteria for cadmium were exceeded in the adit discharge.

- Three surface water and sediment samples were collected at the site from Dunkleburg Creek. One sample was collected from the toe of WR-1, to determine potential impacts from the waste rock and samples were collected both upstream and downstream from the site, proper. Observed releases to Dunkleburg Creek were documented for arsenic, copper, iron, and lead. The MCL/MCLG for antimony was exceeded in both upstream and downstream samples. The chronic aquatic life criteria exceedances for iron and lead were directly attributable to the site. Other aquatic life criteria were exceeded, but not directly attributable to this site. Dunkleburg Creek was very turbid at the time of the investigation due to a recent breach in the tailings impoundment.

- Potential safety hazards identified at the site included an open adit, 12 collapsing structures, and two unstable tailings dams.

Forest Rose PA# 20-004
AMRB HAZARDOUS MATERIALS INVENTORY
INVESTIGATOR: PIONEER - BULLOCK
INVESTIGATION DATE: 06/29/93

SOLID MATRIX ANALYSES

Metals in soils — Results per dry weight basis

FIELD ID	As (mg/Kg)	Ba (mg/Kg)	Cd (mg/Kg)	Co (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Fe (mg/Kg)	Hg (mg/Kg)	Mn (mg/Kg)	Ni (mg/Kg)	Pb (mg/Kg)	Sb (mg/Kg)	Zn (mg/Kg)	CYANIDE (mg/Kg)
20-004-SE-1	116 JX	65.8	14.8 J	11.1 J	19.9 J	125	45600 J	0.13	1370 J	34 J	1010 J	4 U	2040 J	NR
20-004-SE-2	51 JX	25.6	22 J	3 J	3.3 J	53.7	13700 J	0.1	1310 J	17 J	428 J	4 U	1270 J	NR
20-004-SE-3	67 JX	118	13.5 J	9.5 J	16.2 J	41.7	43200 J	0.049	819 J	34 J	2820 J	6 J	2230 J	NR
20-004-TP-1	336 JX	37.6	58.2 J	2 J	3.8 J	444	38800 J	0.342	2090 J	15 J	6810 J	49 J	7430 J	NR
20-004-TP-2	444 JX	15	143 J	11.2 J	4.4 J	563	109000 J	0.377	1720 J	28 J	1820 J	28 J	16800 J	NR
20-004-TP-3	330 JX	12.2	65.1 J	14.3 J	3.4 J	404	113000 J	0.052	1730 J	29 J	690 J	9 J	6590 J	NR
20-004-WR-1	227	13.1	40.9	8.6	2.9	208	39200	0.648 J	1110	29	4570	24 J	5660	NR
20-004-WR-3	801 JX	31.2	477 J	3.5 J	4 J	1770	75700 J	2.93	1760 J	15 J	60400 J	470 J	51500 J	NR
20-004-WR-4	350 JX	23.1	3.2 J	4 J	3 J	526	164000 J	0.934	165 J	16 J	242 J	7 J	2840 J	NR
BACKGROUND	17 JX	122	0.8 J	10.4 J	34.2 J	34.6	23500 J	0.06	1040 J	36 J	38 J	5 U	106 J	NR

U - Not Detected; J - Estimated Quantity; X - Outlier for Accuracy or Precision; NR - Not Requested

Acid/Base Accounting

FIELD ID	TOTAL SULFUR %	TOTAL SULFUR ACID BASE t/1000t	NEUTRAL. POTENT. t/1000t	SULFUR ACID BASE POTENT t/1000t	SULFATE SULFUR %	PYRITIC SULFUR %	ORGANIC SULFUR %	PYRITIC SULFUR ACID BASE t/1000t	SULFUR ACID BASE POTENT. t/1000t
20-004-TP-1	5.86	167	590	423	1.94	2.48	0.94	77.5	513
20-004-TP-2DUP	13.8	430	265	-165	<0.01	16	2.8	499	-234
20-004-TP-2	13.7	429	265	-163	<0.01	16	2.8	500	-235
20-004-TP-3	13.3	415	191	-224	<0.01	14.6	1.94	456	-265
20-004-TP-3DUP	13.3	416	186	-230	<0.01	14.5	1.96	453	-267
20-004-WR-1	4.76	149	355	206	3.31	0.09	1.36	2.81	352
20-004-WR-3	7.67	240	64.3	-175	2.71	2.89	2.07	90.3	-26
20-004-WR-4	6.63	207	-5.6	-213	0.06	4.95	1.62	155	-160

WATER MATRIX ANALYSES

Metals in Water — Results in ug/L

FIELD ID	As	Ba	Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Zn	HARDNESS CALC. (mg CaCO3/L)
20-004-GW-1	3 J	22.6 JX	4.1 J	9.7 U	6.83 U	4.1 J	113	0.038 U	35.5	12.7 U	3.86	30.7 U	1700	258
20-004-SW-1	6.45	82.2	3.7 J	7.63 JX	17.9	31.9	16100	0.038 U	453	24.2	68.7	23.8	474	358
20-004-SW-2	1.92	13.3	2.55 U	5.99 UX	8.83	1.43	104	0.038 U	7.47	9	9.13	18.3 U	374	199
20-004-SW-3	1.41	11.3	3.3 J	5.99 UX	5.27	5.7	54.5	0.038 U	6.07	8.78 U	1.73	19.4	346	175

U - Not Detected; J - Estimated Quantity; X - Outlier for Accuracy or Precision; NR - Not Requested

Wet Chemistry — Results in mg/l

FIELD I.D.	TOTAL DISSOLVED SOLIDS	CHLORIDE	SULFATE	NO3/NO2-N	CYANIDE
20-004-GW-1	309	< 5.0	78	0.1	NR
20-004-SW-1	448	< 5.0	160	0.07	NR
20-004-SW-2	250	< 5.0	77	< 0.05	NR
20-004-SW-3	224	< 5.0	50	0.06	NR

LEGEND

SE1 - Downstream of breached dam on tailings pond 3.
SE2 - At toe of waste rock dump 1.
SE3 - Approx. 400' upstream of end of waste rock dump 2.
TP1 - Composite of subsamples TP1A-A, 1A-B, 1A-C, 1A-D, 1B-A, 1B-B, 1B-C, 1B-D, 1B-E, and 1B-F.
TP2 - Composite of subsamples TP2A-A, 2A-B, 2A-C, 2B-A, 2B-B, and 2B-C.
TP3 - Composite of subsamples TP3A-A, 3A-B, 3B-A, 3B-B, and 3B-C.
WR1 - Composite of subsamples WR1A, 1B, 1C, 2A, and 2B
WR3 - Composite of subsamples WR3A, 3B, and 3C.
WR4 - Composite of subsamples WR4A and 4B
BACKGROUND - From the Jackson Park Mine (20-027-SS-1)
TP2DUP - Duplicate of sample 20-004-TP-2
TP3DUP - Duplicate of sample 20-004-TP-3
GW1 - Discharge from adit #1.
SW1 - Same as sample SE1.
SW2 - Same as sample SE2.
SW3 - SAme as sample SE3.

APPENDIX B

Forest Rose Mine Site Photographs

Forest Rose Mine Site
Photographic Log

Photo Number	Photo Description
1	Dunkleberg Creek looking S
2	Decant outlet structure and piping looking S
3	Looking S onto T1 dam failure
4	T1 decant outlet piping
5	T1 dam failure
6	T1 dam failure
7	T1 impoundment dam
8	T1 looking S
9	T2 looking S
10	Looking N onto T2
11	Looking N onto T2
12	Incised channel in T3
13	Incised channel at S end of T3
14	T3 dam failure
15	Mill working buildings
16	Mine adit
17	Mine adit
18	Repository site looking SW
19	Repository site looking W
20	Repository site looking NW

1

2

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9

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14

15

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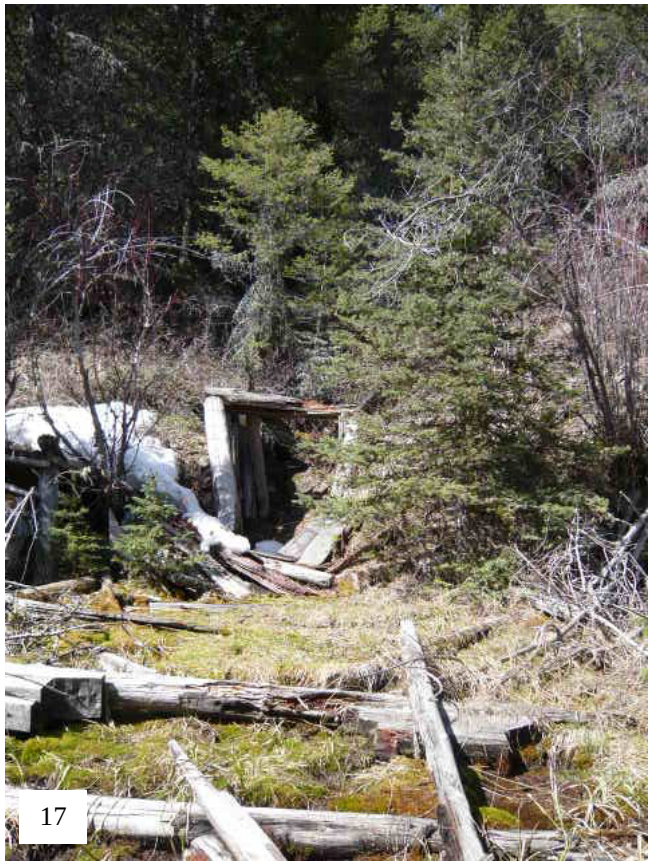
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APPENDIX C

Health and Safety Plan

SITE-SPECIFIC
HEALTH AND SAFETY PLAN

Forest Rose Mine
Granite County, Montana

Prepared for

MDEQ

May 2010

Health and Safety Plan
Review and Approval

Client: MDEQ
Site Name: Forest Rose Mine
Project Name: Forest Rose Mine
Project No.: 06-03425-070
Start Date: June 1, 2010
End Date: September 1, 2010
Plan Expiration Date: October 1, 2010
(Last day of expected fieldwork or no longer than 6 months).

The following individuals have reviewed this health and safety plan and have approved its use for the dates specified.

Bruce Carpenter		
Plan Completed by	Signature	Date
Kevin Houck		
Project Manager	Signature	Date
Peter Jowise		
Corporate Health & Safety Officer	Signature	Date
Bruce Carpenter		
Site Health & Safety Officer	Signature	Date

This Health and Safety Plan (HASP) is based on federal (29 CFR Part 1910.120), which address practices conducted at sites associated with hazardous substances. This HASP is applicable only to employees of Herrera Environmental Consultants, Inc. Consultants, subconsultants, and contractors other than Herrera working at this jobsite are responsible for the health and safety of their own employees and are required to develop their own health and safety plan. Other contractor personnel, who provide site-specific information, may review this HASP; however, Herrera assumes no responsibility or liability for the use of this document by other parties.

Due to the potential hazardous nature of this site and the activity occurring thereon, it is not possible to discover, evaluate, and provide protection for all possible hazards, which may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury at this site. The health and safety guidelines in this Plan were prepared specifically for this site based on site conditions, purposes, dates, and personnel specified, and must be amended if these conditions change. This HASP should not be used on any other site without prior research by trained health and safety specialists.

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Attachment 1 Injury/Exposure Report and Site Incident Report
Attachment 2 Daily Tailgate Health and Safety Meeting Form and Utility Clearance Log
Attachment 3 Personnel Training Certificates
Attachment 4 Air Monitoring Equipment Calibration/Check Log and Air Monitoring Log

Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
BTEX	benzene, toluene, ethylbenzene, and xylenes
CFR	Code of Federal Regulations
CPR	cardiopulmonary resuscitation
CSO	combined sewer overflow
ERP	Emergency Response Plan
ESCBA	escape self-contained breathing apparatus
FID	flame ionization detector
HASP	health and safety plan
HAZWOP	Hazardous Waste Operations
HEPA	high efficiency particulate air
IDLH	immediately dangerous to life and health
LEL	lower explosive limit
LFC	lowest feasible concentration
MDEQ	Montana Department of Environmental Quality
mg/m^3	milligrams per cubic meter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MSDS	Material Safety Data Sheet
NIOSH	National Institute of Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
OVA	organic vapor analyzer
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PEL	permissible exposure limit
PID	photoionization detector
PPE	personal protective equipment
PPL	personal protection level (A, B, C, D)
ppm	parts per million
REL	recommended exposure limit
SCBA	self-contained breathing apparatus
SHSO	site health and safety officer
STEL	short-term exposure limit
SVOC	semi-volatile organic compound
TLV	threshold limit value
TWA	time weighted average
VOC	volatile organic compound
U.S. EPA	United States Environmental Protection Agency
WWTP	wastewater treatment plant

Introduction

This site-specific health and safety plan applies to field work associated with sites that have either potential or documented release of hazardous substance(s) to the environment. Herrera expects that all employees, for company-approved field work or personal use, will follow safety procedures and regulations set forth in this safety plan.

Safety Policy

Herrera's Safety Policy is that health and safety of the staff is of paramount importance. Activities performed under potentially hazardous conditions shall be acknowledged and planned to mitigate personal injury. Herrera's Safety Policy shall apply during company-approved field work only.

Scope of Work and Site Description

Characterize the nature and extent of mine waste in tailings impoundment and waste rock areas at the Forest Rose Mine and Mill Complex. Sampling will also include surface water and sediment both upstream and downstream of the operations portion of the site.

Detailed Description of Specific Tasks Planned

List each separate task in order of progression:

	Task Description
Task 1.	Drill six soil borings with a track mounted auger rig to 50 feet and collect soil samples.
Task 2.	
Task 3.	

Potential Hazards Associated With Field Tasks

Potential Chemical Hazards

- Total metals contamination, including antimony, arsenic, cadmium, copper, iron, lead, manganese, mercury, silver, and zinc located within the tailings pile.

Potential Physical Hazards

- Drilling six soil borings using an auger drill rig

Potential Biological Hazards

- Working in remote forest where black bears are prevalent

Initial Site Entry

- Has this been performed by Herrera?

  Yes: ☒ No: ☐

  If yes, describe:

  Herrera conducted a site visit to view the mine site and potential drilling locations.

Hazardous Materials

- Will any hazardous materials (chemicals) be used on-site (including decontamination)?

  Yes: ☐ No: ☒

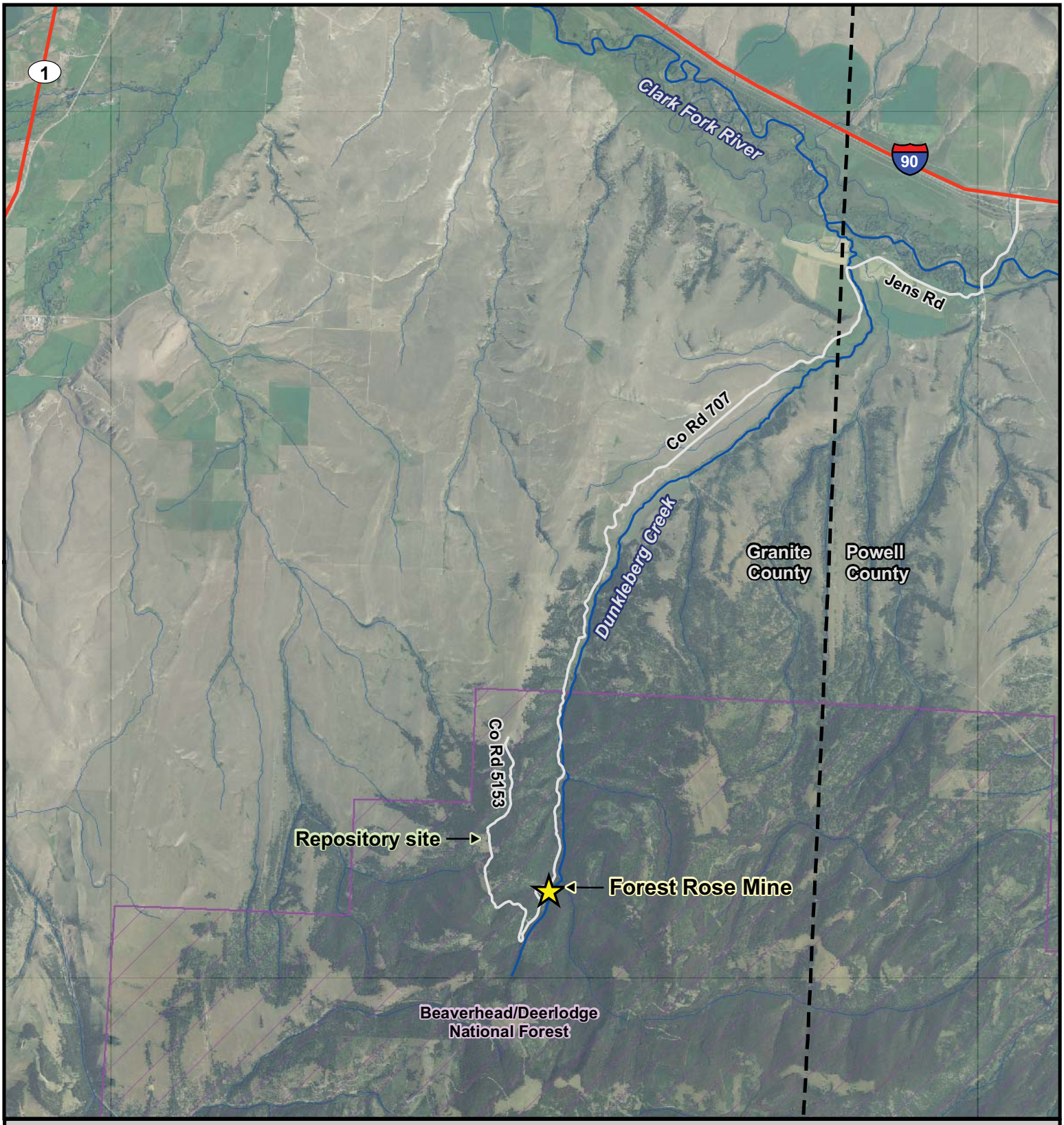
- Will any field work be done on a site with known or suspected release of hazardous materials?

  Yes: ☒ No: ☐

Site Status

- Site Status: Occupied?

  Yes: ☐ No: ☒



Legend

- Highway
- Road
- County boundary
- Stream
- National forest

Figure 1. Vicinity map, Forest Rose Mine.

N

0 3,000 6,000 12,000 Feet

HERRERA ENVIRONMENTAL CONSULTANTS

Aerial photograph: USDA, 2009

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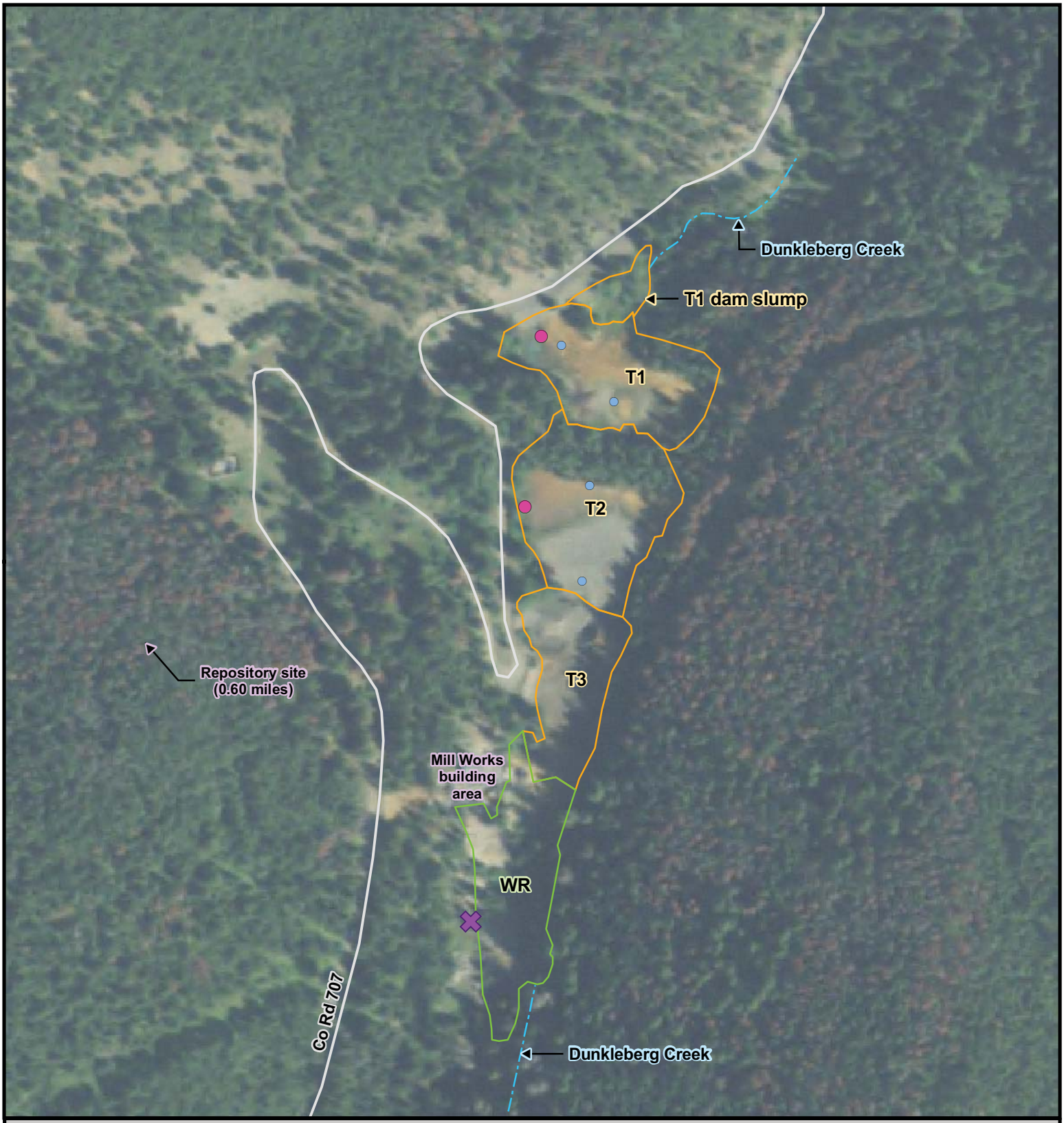

Legend

- T1 — Tailings impoundment
- WR — Waste Rock area
- Collapsed adit
- Road
- Stream
- Decant tower inlet
- Previous boring location

Figure 2. Site map, Forest Rose Mine.

N

0 100 200 400 Feet

HERRERA ENVIRONMENTAL CONSULTANTS

Aerial photograph: USDA, 2009

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Legend

Approximate repository boundary

Road

Figure 3. Site map, Forest Rose Mine site repository.

N

0 75 150 300 Feet

HERRERA ENVIRONMENTAL CONSULTANTS

Aerial photograph: USDA, 2009

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Site Control and Security

- Any site access requirements and special considerations?

  Yes: ☐ No: ☒

  If yes, describe:

- Work will be done in daylight hours?

  Yes: ☒ No: ☐

  If no, describe:

- Barricades, fencing, or other equipment to be used to mark the perimeter of the site?

  Yes: ☐ No: ☒

  If yes, describe:

- Require work area security (on- and off-hours) to be used?

  Yes: ☐ No: ☒

  If yes, describe:

Site Background Information

The mine began operation in the early 1880s to extract lead and silver. Tailings at the site were deposited into three impoundments below the mill along the creek bed. Waste rock was deposited upgradient of the tailings, also in the creek bed. Tailings and waste rock are approximately 50 feet deep in the center over the creek bed.

Post

Local Emergency and Project Telephone Numbers

Site Address and Phone Number

Site Address: Eleven miles S to SW of Interstate 90 on FDR 707.

Site Phone Number: NA

Local Emergency Phone Numbers

	Name	Telephone No.*
Hospital	St. Patrick Hospital, Missoula	(406) 543-7271
Ambulance	Drummond Volunteer Ambulance	(406) 288-3191
Police/Sheriff	Granite County Sheriff	(406) 288-3542
Fire	City of Drummond	(406) 288-3301
Other:	Emergency pager/cell phone	

* Include phone numbers other than “911”.

Project Personnel Phone Numbers

	Name	Telephone No.
Site Health and Safety Officer	Bruce Carpenter	(406) 721-4204 wk; (406) 544-9304 c
Project Manager	Kevin Houck	(406) 721-4204 wk; (406) 544-9304 c
Principal-in-Charge	Peter Jowise	(206) 441-9080 wk; (206) 780-5712 hm
Client Contact	Devin Clary	(406) 841-5029 wk
Corporate Health & Safety Officer	Peter Jowise	(206) 441-9080 wk; (206) 780-5712 hm
Other:		

MAPQUEST

Sorry! When printing directly from the browser your directions or map may not print correctly. For best results, try clicking the Printer-Friendly button.

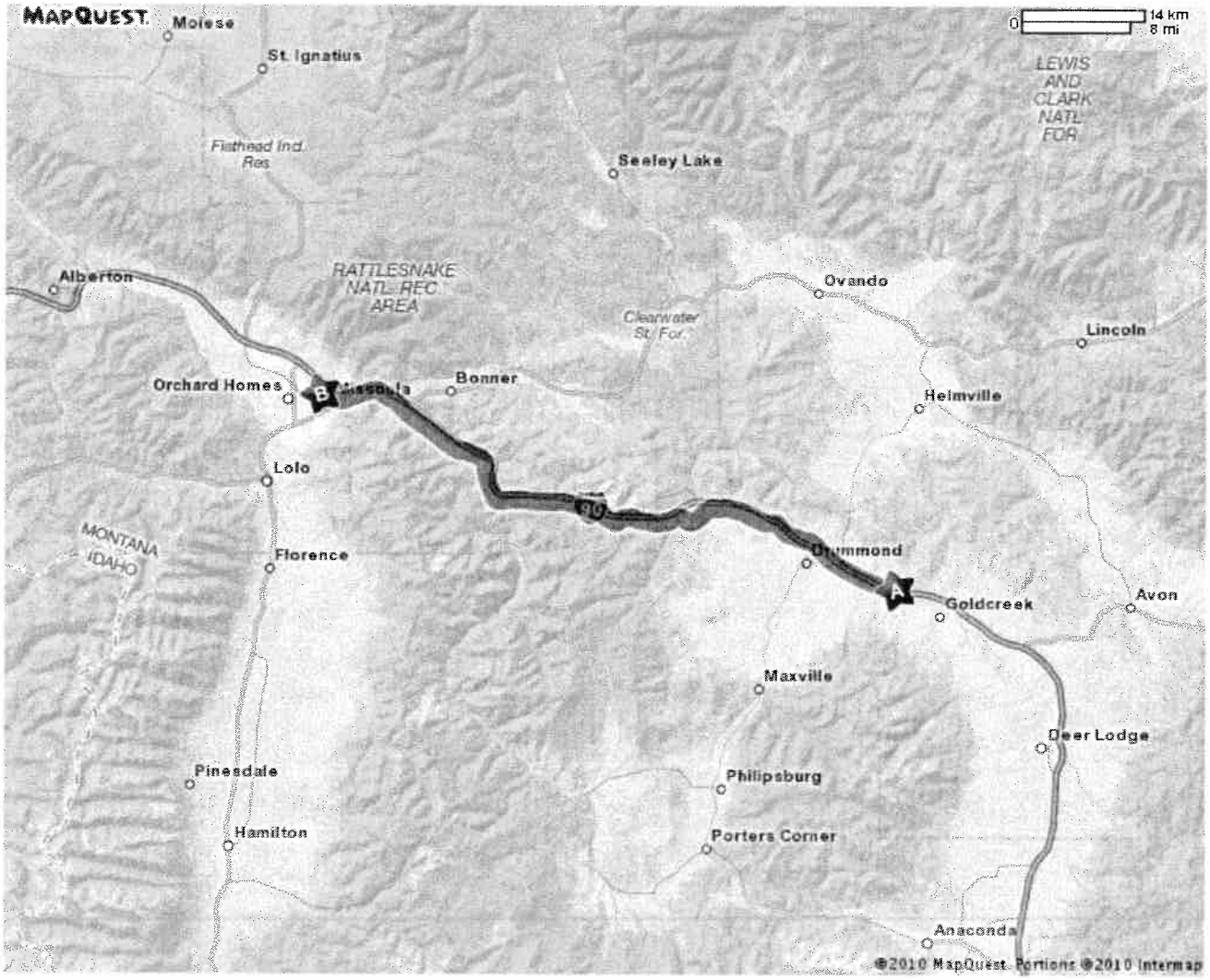
Starting Location

Jens, MT

Ending Location

500 W Broadway St
Missoula, MT 59802-4008

Total Travel Estimate: **50 minutes** / **58.24 miles** Fuel Cost: **Calculate**



Jens, MT Edit

1.	Start out going **WEST** toward **JENS RD**.	0.1 mi
2.	Turn **RIGHT** onto **JENS RD**.	0.1 mi
3.	Merge onto **I-90 W** via the ramp on the **LEFT** toward **MISSOULA**.	57.1 mi

Emergency Routes

Prior to field work, conduct a drive-by from the work area to the hospital to check for any obstacles (i.e., road closure due to construction, etc.) and change the emergency route(s) to the hospital accordingly.

Hospital Name:	St. Patrick Hospital
Hospital Address:	500 W Broadway St. Missoula, MT
Hospital Phone Number:	(406) 543-7271

Refer to the previous page for the Hospital Location and Route Map. The route from the onsite work area to the hospital is:

- Follow Dunkleberg Creek Road (FDR 707) approximately 11 miles to Interstate 90
- Head West on Interstate 90 at exit 162 (Jens exit) to Missoula
- Take Orange St. exit in Missoula (Exit 104)
- Turn left onto N Orange St
- Turn right onto W Broadway

Emergency Response Plan

Injury or Exposure

If an injury or exposure occurs, take the following actions:

- Get First Aid for the person immediately.
- Notify the Site Health and Safety Officer (SHSO). The SHSO is responsible for immediately notifying the Project Manager, and preparing and submitting an Injury/Exposure Report (Attachment 1) to the Corporate Health and Safety Officer within 24 hours, as well as notifying the employee's supervisor and Principal-in-Charge. If a subcontractor employee is injured, the Subcontractor Field Supervisor will also complete their own injury/exposure investigation and submit a copy of their report to the Corporate Health and Safety Officer as well.
- The SHSO will assume charge during a medical emergency.

Site Incident

If an incident (e.g., theft, car accident, property damage) occurs, take the following action:

- Notify the SHSO immediately. The SHSO is responsible for immediately notifying the Project Manager, and preparing and submitting a Site Incident Report (Attachment 1) to the Corporate Health and Safety Officer within 24 hours.

General Site Requirements and Background Information

Health and Safety Plan Organization and Responsibilities

Key Personnel

Herrera Principal-in-Charge:	Peter Jowise
Corp. Health & Safety Officer:	Peter Jowise
Herrera Project Manager:	Kevin Houck
Herrera Site Health and Safety Officer:	Bruce Carpenter
Herrera Field Personnel:	Gina Catarra (Lead)
	Bruce Carpenter
	Kevin Houck
	Sue Wall
Client Project Manager:	Devin Clary

Principal in Charge

The Principal in Charge provides a point of contact if the Project Manager cannot be accessed during emergency situations.

Project Manager

The Project Manager provides technical support to the Site Health and Safety Officer (SHSO) for health and safety decision-making. Prior to beginning onsite work, the Project Manager will ensure that employee training and medical clearance is current and up-to-date, and that site-specific safety and health concerns including but not limited to: traffic control, boat safety issues, diving issues, have been addressed prior to field work. It is the responsibility of the Project Manager or designate to take all reasonable steps to ensure that:

- Employee training is current and up-to-date
- Each participant is informed of the known risks and physical requirements
- Each participant is shown where remote communication devices are kept (e.g., satellite phone, mobile cell phone, radios)
- Each participant has read this HASP

- Has determined what safety clothing and equipment is appropriate for this project
- All company and personal equipment taken into the field is thoroughly checked for safety and in good working condition by a qualified person before it is used
- Each participant is instructed in field safety, wearing of safety clothing (e.g., chemical resistant PPE, high-visibility reflective clothing, etc.), and safe use of equipment
- Site-specific health and safety concerns (including but not limited to: known or suspected chemical hazards, etc.) have been addressed prior to field work

Site Health and Safety Officer

The Site Health and Safety Officer (SHSO) shall be responsible for coordinating emergency response measures during this project. All workers shall report to the SHSO in the event of an emergency. Within 24 hours of the end of fieldwork, the SHSO will submit the completed (signed) HASP to the Corporate Health and Safety Officer.

The SHSO will oversee the overall Plan. He/she has the authority to stop work or prohibit any personnel from working on the site at any time for not complying with any aspect of the Plan.

Field Lead

Depending on the activity (i.e., installation, monitoring, sampling, demobilization), one member of the field team will be designated as Field Lead for each field task. The Field Lead is responsible for preventing unauthorized entry onto the site, ensuring all appropriate equipment is available and ready for use, and knowing who is on-site at all times.

Subcontractor Field Supervisor

The Subcontractor Field Supervisor is responsible for implementing the Plan for his/her own employees.

All Onsite Personnel

Each person on the site has responsibility for their own health and safety, as well as assisting others in carrying out the Plan. Any person observed to be in violation of the Plan should be assisted in complying with the Plan, or reported to the Project Manager, the SHSO, or the Subcontractor Field Supervisor.

Any site personnel may shut down field activities if there is a real or perceived immediate danger to life or health.

Minimum Training, Immunization, and Medical Surveillance Requirements for Site Personnel

Training

All field workers have received health and safety training required by OSHA (29 CFR 1910.120), including some or all of the following:

- 40 Hazardous Waste Operations training (HAZWOP)
- 8 hrs. Annual HAZWOP Refresher training
- First Aid and CPR training
- Annual Respirator Fit Testing
- Hazard Communication Training Related to Biological Hazards in Sewer Work
- Confined Space Entry Training
- Annual Medical Clearance

Copies of personnel training certifications are presented in Attachment 3 of this HASP.

Medical Surveillance

The Herrera medical surveillance program is described in the corporate health and safety plan. In summary, all Herrera employees potentially exposed to hazardous substances or health hazards for 30 days or more a year will participate in the program. The medical surveillance program includes a determination of fitness for each individual to work in hazardous environments, including use of various levels of personal protective equipment. Medical examinations are conducted on a regular basis (usually annually) and each person's condition reviewed at that time. The Corporate Health and Safety Officer maintains medical records in a designated file and are available for review by each affected employee.

General Field Safety

The SHSO is responsible for establishing and coordinating procedures for evacuation of all onsite personnel, including non-Herrera personnel, prior to commencement of work. This plan will be reviewed at the site safety meeting conducted at the beginning of the first day of work (and at subsequent site safety meetings as warranted by changing conditions and addition of new site workers). A Daily Tailgate Health and Safety Meeting Form is to be completed and signed by all personnel who attended the site safety meetings (see Attachment 2).

In the event of a potential emergency, as determined by any onsite worker, the SHSO will be notified and all site personnel assembled at an area designated during the site safety meeting. The Project Manager, with the aid of the SHSO and other site workers, will decide the appropriate response depending onsite conditions.

General Field Safety Requirements

- Prior to working on-site, a general inspection of hazards will be made by the SHSO. SHSO is responsible for preventing unauthorized entry onto the site and for knowing who is on-site at all times.
- If an onsite command post is necessary, ensure that it is located upwind from source areas, given prevailing winds, and identify on the Site Map (page 3).
- Onsite field personnel must have a communication device (i.e., cell phone, satellite phone) capable of connecting to an emergency contact (i.e., Herrera office, local emergency service).
- Designate at least one vehicle for emergency use.
- High-visibility reflective safety vests, shirt, or jacket that is fluorescent yellow-green, orange-red, or red in color; steel-toed boots; and hard hats will be worn on construction sites, around heavy equipment, when working in or around traffic, or during hours of darkness.

Work Limitations and Restrictions

- Be aware of unstable soil conditions adjacent to excavation, steep slopes, or similar conditions.
- No eating or drinking is allowed in the work area.

- No smoking or lighting of matches or lighters is allowed in the work area.
- No rings, watches, bracelets, necklaces, or other jewelry that could trap chemical or biological contamination, or get caught in moving equipment.
- If respiratory protection is required, no facial hair present that would interfere with respirator fit.
- Employees will use the "buddy system," which requires at least two people, at all times in working in Level C PPE, working around heavy equipment, or working on a boat.

Hazard Identification

Hazards may exist in a number of forms on the site and shall be classified among three general categories: chemical, physical, and biological. The following list is meant to convey the general hazard classes that may be encountered on the site.

	Chemical Hazards		Physical Hazards		Biological Hazards
	Asbestos		Climatic Hazards		Coliform Bacteria
	Flammable Liquids/ Gases		Heavy Equipment Operations		CSO Effluent, Untreated Sewage, WWTP Sludges
X	Metals	**X**	Drilling Rigs		Hospital Waste
	PCBs		Heavy Lifting	**X**	Stinging/Poisonous Insects
	Pesticides/Herbicides	**X**	Falling Hazards		Bacterial/Viral Agents
	Petroleum Hydrocarbons		Confined Space Entry		Rodents/Vermin
	Volatiles		Electrical Hazards	**X**	Large Predatory Animals
	Semi-Volatiles		Explosives	**X**	Poisonous Snakes
	Toxic Liquids/Gases		Radioactive Isotopes		
	Dioxins/Furans		Traffic Hazards		
	Oxygen Deficiency		Water Hazards		
	Decontamination chemicals				

Potential Chemical Hazards

Chemical hazards will be evaluated both by visual examination of site conditions, as well as by use of monitoring equipment. Visual indications of potential chemical hazards include evidence of dead or dying vegetation, dead animals, discolored vegetation or soil, sheens on water, non aqueous liquids, etc. Monitoring equipment to be used at this site is discussed in under General Procedures for Air Monitoring section of this health and safety plan.

Regulatory Action Levels

The following table provides information regarding the relative toxicity of chemicals that may be found at the site based on established state or federal cleanup levels.

Petroleum Products			Volatiles		
Chemical	Matrix	Regulatory Action Level	Chemical	Matrix	Regulatory Action Level
None			None		

Semi-Volatiles			Metals		
Chemical	Matrix	Regulatory Action Level	Chemical	Matrix	Regulatory Action Level
None			Antimony	S	31 mg/kg
			Arsenic	S	0.39 mg/kg
			Cadmium	S	37 mg/kg
			Copper	S	2,900 mg/kg
			Iron	S	55,000 mg/kg
			Lead	S	400 mg/kg
			Manganese	S	1,800 mg/kg
			Mercury	S	23 mg/kg
			Silver	S	390 mg/kg
			Zinc	S	23,000 mg/kg

Pesticides/PCBs			Other		
Chemical	Matrix	Regulatory Action Level	Chemical	Matrix	Regulatory Action Level
None					

References: U.S. Region 9 Preliminary Remediation Goals.

Exposure Pathways and Permissible Exposure Limits (PELs)

The following is a list of potential exposure pathways, and the PELs and TWAs for chemical and biological hazards that may be encountered on the site. The potential exposure pathways are not limited to those listed. Acute systems of exposure along with odor thresholds and descriptions are given when that information is known. Odor thresholds are not exact and vary with susceptibility or sensitivity involved.

Predominant Potential Site Chemical Hazards

Chemical (or Class)	Exposure Limits (TWA)			Other Pertinent Limits	Warning Properties/ Description	Routes of Exposure Or Irritation	Acute Health Effects	Chronic Health Effects/Target Organs
	OSHA PEL	NIOSH REL	STEL					
Antimony	0.50 mg/ m^3	0.50 mg/m^3		IDLH = 50 mg/m^3	Silver-white, lustrous, hard, brittle solid; scale-like crystals; or a dark-gray lustrous powder	Inhalation, ingestion, skin and/or eye contact	Irritated eyes, respiratory system; cough, breathing difficulty, wheezing	Eyes, skin, respiratory system, central nervous system
Arsenic	0.010 mg/m^3	LFC Carcinogenic		IDLH = 5 mg/m^3 Carcinogenic CEILING (NIOSH) = 0.002 mg/m^3 (15 min.)	Silver-gray or tin-white, brittle, odorless solid as pure substance; in tailings not distinguishable	Inhalation, absorption, ingestion, skin and/or eye contact	Ulceration of nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin	[Potential occupational carcinogen] - Liver, kidneys, skin, lungs, lymphatic system (lung and lymphatic cancer)
Cadmium	0.005 mg/m^3	LFC Carcinogenic		IDLH = 9 mg/m^3 Carcinogenic	Silver-white, blue-tinged lustrous, odorless solid as pure substance; in tailings not distinguishable	Inhalation, ingestion	Pulmonary edema, breathing difficulty, cough, chest tightness; headache, chills, muscle aches; nauseous, vomiting, diarrhea; anosmia, emphysema, proteinuria, mild anemia	Carcinogen – Respiratory system, kidneys, prostate, blood (prostatic and lung cancer)
Copper (mist or dust)	1 mg/m^3	1 mg/m^3		IDLH = 100 mg/m^3	Reddish, lustrous, malleable, odorless solid as pure substance; in tailings not distinguishable	Inhalation, ingestion, skin and/or eye contact	Irritated eyes, respiratory system; cough, breathing difficulty, wheezing	[Potential occupational carcinogen] – Eyes, skin, respiratory system, liver, kidneys (increased risk with Wilson's disease); (lung, liver, and kidney damage)
Lead	0.050 mg/ m^3	0.050 mg/m^3		IDLH = 100 mg/m^3	Heavy, ductile, soft, gray solid as pure substance; in tailings not distinguishable	Inhalation, ingestion, skin and/or eye contact	Irritated eyes, weakness, exhaustion, insomnia, facial pallor, anorexia, weight loss, constipation, abdominal pain, colic, tremors, paralysis wrists and ankles, hypotension	Carcinogen – Eyes, gastrointestinal tract, central nervous system, blood, kidneys, gingival tissue
Manganese (dust or fume)	5 mg/ m^3 Carcinogen	1 mg/ m^3	3 mg/ m^3	IDLH = 500 mg/ m^3	A lustrous, brittle, silvery solid.	Inhalation, ingestion	Parkinson's, asthenia, insomnia, mental confusion, metal fume fever, dry throat, cough, tight chest, flu-like fever, low-back pain, vomiting, lassitude.	Respiratory system, kidneys, central nervous system, blood
Mercury		Vapor = 0.05 mg/m^3 [skin]		IDLH = 10 mg/m^3 CEILING (OSHA & NIOSH) = 0.1 mg/m^3 [skin]	Silver, white heavy odorless liquid as pure substance; in tailings not distinguishable	Inhalation, absorption ingestion, skin and/or eye contact	Irritated eyes, skin; cough , chest pain, breathing difficulty, bronchitis pneumonitis, tremors, insomnia, headache, irritability, indecision, weakness, exhaustion, salivation, gastrointestinal disturbances, anorexia, weight loss	Eyes, skin, respiratory system, central nervous system, kidneys

Chemical (or Class)	Exposure Limits (TWA)			Other Pertinent Limits	Warning Properties/ Description	Routes of Exposure Or Irritation	Acute Health Effects	Chronic Health Effects/Target Organs
	OSHA PEL	NIOSH REL	STEL					
Silver	0.01 mg/m^3	0.01 mg/m^3		IDLH = 10 mg/m^3	White, lustrous solid	Inhalation, ingestion, skin and/or eye contact	Pneumoconiousis (cough, dysp), digital clubbing, basal crackles, coronary pulmonale	Respiratory system, central nervous system
Zinc (zinc oxide)	5 mg/m^3 (respirable dust and fume) 15 mg/m^3 (total dust)	5 mg/m^3 (dust and fume)	10 mg/m^3	IDLH = 500 mg/m^3 CEILING (dust; NIOSH) = 15 mg/m^3	Odorless, white to brown metallic solid as pure substance; in tailings not distinguishable	Inhalation	Metal fume fever (chills, muscle ache, nausea, fever, dry throat, cough), weakness, exhaustion, metallic taste, headache, blurred vision, vomiting, malaise, tight chest, breathing difficulty, decreased pulmonary function	Respiratory system

PEL-TWA = Permissible Exposure Limit-Time Weighted Average (8 hours).
REL-TWA = Recommended exposure limit – time weighted average.
TLV-TWA = Threshold Limit Value-Time Weighted Average (8 hours).
STEL = Short Term Exposure Limit (15 minutes).
IDLH = Immediately Dangerous to Life or Health.
LFC = Lowest feasible concentration (no-effect exposure)
CEILING = Ceiling Limit (not to be exceeded, even instantaneously).

Carcinogenicity Status (ACGIH)
A1 - Confirmed human carcinogen
A2 - Suspected human carcinogen
A3 - Animal carcinogen
A4 - Not classified as a human carcinogen

References: ACGIH Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. 93-94.
NIOSH Pocket Guide to Chemical Hazards, U.S. Dept. of Health and Human Services, September 2005.
NIOSH Safety and Health Topic: Focus on Coal Mining – Safety Hazards, Health Hazards, and Mine Rescue, 2006.

General Procedures for Air Monitoring

When ambient air monitoring equipment is used as a general survey tool to indicate the presence of potential airborne contamination, it will be used prior to the beginning of work and periodically throughout the work period. When intrusive (i.e., ground breaking) work is performed, measurements are taken in the breathing zone. If measurements exceed action levels, work will be stopped and engineering controls will be implemented. The following air monitoring equipment will be used:

- **Mini-Ram particulate meter** – Monitors the level of airborne dust in the work area zone in milligrams per cubic meter (mg/m^3).

Air monitoring equipment shall be operated according to manufacturer's instructions and applied to site decision-making according to Herrera standard operating procedures (SOPs). An Air Monitoring Equipment Calibration/Check Log and Air Monitoring Log (Attachment 4) will be completed. Action levels for chemical monitoring are listed in the following table. These action levels are general guidelines derived from the U.S. EPA emergency response action levels and are minimum action levels to be observed during field work. However, field workers may don respiratory protection at any time if air quality is questionable.

Action Level Table for Chemical Monitoring

Monitoring Instrument	Chemical (or Class)	Action Level		Monitoring Frequency/ Location	Level For Respirator Use	Level For Work Stoppage
☒ Mini-Ram particulate meter	Metals	**General/Unknown:**	**Contaminant-Specific: Metals** Evaluate health and safety measures when dust levels exceed 0.711 mg/m^3	Continuous monitoring if visual observation indicates continued potential chemical presence. Signs of visible contamination and airborne dust shall be used as an indication of potential chemical presence.	When visible air-borne dust is present 0.711 mg/m^3 (value adjusted to reflect dust concentrations based on soil analytical results)	0.711 mg/m^3 (in Level D PPE)

Complete Air Monitoring Equipment Calibration/Check Log and Air Monitoring Log (Attachment 4).
Air monitoring will be performed during work that may cause air-borne dust. An action level of 0.711 mg/m^3 was calculated based on soil analytical result; if dust level exceed 0.711 mg/m^3 work will be stopped and engineering controls will be implemented.

Potential Physical Hazards

"X" if applicable	Hazards	Hazard Control Measures
X	Motor Vehicle Driving	▪ Drive defensively. ▪ If you need to place or receive a phone call, pull off the road to a safe location and stop the vehicle before using your cell phone. Allow voicemail to handle your calls. ▪ Be aware of weather and road conditions when driving (i.e., heavy rain, snow; large puddles in roadway, black ice). ▪ Driver and passengers must wear seatbelts.
	Weather Extremes	▪ Establish site-specific contingencies for severe weather situations. ▪ Provide for frequent weather broadcasts. ▪ Weatherize safety gear, as necessary (e.g., ensure eye wash units do not freeze, etc.) ▪ Identify special PPE needs. ▪ Discontinue work during severe weather.
X	Heat Stress	▪ Provide cool break area and adequate breaks. ▪ Provide cool non-caffeinated beverages. ▪ Promote heat stress awareness. ▪ Use active cooling devices (e.g., cooling vests) where specified.
X	Sunburn	▪ Apply sunscreen. ▪ Wear hats/caps and long-sleeve shirts.
	Cold Exposure	▪ Provide warm break area and adequate breaks. ▪ Provide warm non-caffeinated beverages. ▪ Promote cold stress awareness.
	Overhead utilities (describe):	▪ Identify/locate existing overhead utilities prior to work. ▪ Ensure that overhead utility lines are at least 15 feet away from project activities. ▪ Contact utility companies to confirm locations, as necessary. ▪ Complete Utility Clearance Log (Attachment 2)
	Underground utilities (describe):	▪ Identify/locate and mark existing underground utilities prior to work. ▪ Ensure that underground utility lines are at least 5 feet away from project activities. ▪ Contact utility companies to confirm locations, as necessary. ▪ Complete Utility Clearance Log (Attachment 2)

"X" if applicable	Hazards	Hazard Control Measures
	Heavy Equipment Operation	▪ Define equipment routes, traffic patterns, and site-specific safety measures. ▪ Maintain line of sight between equipment operators and ground personnel and that both are informed of proper hand signals and communication protocols prior to field operations. ▪ Ensure that lifting capacities, load limits, etc., are not exceeded. ▪ Ensure that field personnel do not work in close proximity to operating equipment.
X	Drilling (i.e., hollow-stem auger, push probe, etc.)	▪ Identify/locate underground utilities prior to drilling activities. Complete Utility Clearance Log (Attachment 2). ▪ Wear hard hat, steel-toe boots, and noise protection. ▪ Maintain line of sight between drillers and field personnel.
	Excavation/Trenching	▪ Ensure that any required sloping or shoring systems are approved as per 29 CFR 1926 Subpart P. ▪ Identify/locate underground utilities prior to excavation/trenching activities. Complete Utility Clearance Log (Attachment 2). ▪ Identify special PPE and monitoring needs if personnel are required to enter approved excavated areas or trenches. ▪ Maintain line of sight between equipment operators and personnel in excavations/trenches. ▪ Suspend or shut down operations at signs of cave in, excessive water, defective shoring, changing weather, or unacceptable monitoring results.
	Noise	▪ Establish noise level standards for onsite equipment and operations. ▪ Inform personnel of hearing protection requirements. ▪ Define site-specific requirements for noise monitoring.
	Compressed Gas Cylinders	▪ Use caution when moving or storing cylinders. ▪ A cylinder is a projectile hazard if it is damaged or its neck is broken. ▪ Store cylinders upright and secure them with chains or other means.
	Heights (scaffolding, ladders, etc.)	▪ Personal fall arrest system (i.e., full body harness, lanyards, anchor, etc.) is required by personnel when using powered elevated platforms. ▪ Discontinue work during severe weather (windy conditions more than 40 miles per hour). ▪ Identify special safety equipment needs (e.g., guardrails, safety nets, etc.). ▪ Eliminate impalement hazards below the work area. ▪ Use the buddy system, with one of the personnel serves as a safety monitor or "spotter," give verbal warning to personnel in elevated work area of possible fall hazards.

"X" if applicable	Hazards	Hazard Control Measures
X	Slips, trips, falls	▪ Be aware of obstacles, such as cords, tools, and other equipment that may be present on the ground in the work area. ▪ Identify and mark areas that are potentially slippery (e.g., wet or oily surfaces) with spray paint or flagging and walk around them. ▪ Use handholds. ▪ Wear boots with good traction. ▪ Other:
X	Holes, ditches, excavations	▪ Mark off the edge of holes, ditches, or excavations with barricades or flagging. ▪ Field personnel shall remain several feet back from the edge of the excavation. ▪ Provide for possible emergency egress (e.g., ladder, full body harness, tripod) if entering holes, ditches, or excavations is required. ▪ Use appropriate safety gear (e.g., lanyard) to minimize the potential of falling into holes, ditches, or excavations, if needed.
X	Steep grades	▪ Mark off the edge of the ravine with barricades or flagging.
	Confined space	▪ Ensure compliance with 29 CFR 1910.146. ▪ Complete a confined space entry form. ▪ Attach permit for confined space entry.
	Oxygen deficiency	▪ Monitor oxygen level in work zone. ▪ Do not enter area if oxygen level is less than 19.5%. ▪ Use SCBA if area has less than 19.5% oxygen.
	Electrical	▪ 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.
	Fire/Explosion	▪ Inform personnel of the locations(s) of potential fire/explosion hazards. ▪ Establish site-specific procedures for working and handling around flammables. ▪ Ensure that appropriate fire suppression equipment and systems are available and in good working order. ▪ Do not drive or park vehicles on dry vegetation during the dry season (April through October). ▪ Define requirements for intrinsically safe equipment. ▪ Identify special monitoring needs. ▪ Remove ignition sources from flammable atmospheres. ▪ Coordinate with local fire-fighting groups regarding potential fire/explosion conditions. ▪ Establish contingency plans and review daily with team members.

"X" if applicable	Hazards	Hazard Control Measures
	Traffic hazards	▪ Establish a traffic control plan; contact local agencies for permits. ▪ Wear bright orange reflective vests, hard hats, and steel-toed boots when working within or alongside traffic. ▪ Barricade off work area and provide traffic signs as necessary, to direct traffic away from work area.
	Water hazards (boats)	▪ Establish a Float Plan and conduct a Boater's Pre-Departure Checklist (Attachment) prior to departure. ▪ Wear an USCG-approved PFD at all times in boats less than 16 feet long. ▪ Take extra care entering and exiting boats. ▪ Be aware of adjacent boat traffic.
	Water hazards (streams)	▪ Wear an USCG-approved PFD if wading in deep water. ▪ Buddy system when working in streams. ▪ Wear boots or waders with good traction when wading instream. ▪ Maintain voice or visual contact with each team member. ▪ Each team member carries an audible alarm device.
	Other:	▪

Heat and Cold Stress

The SHSO will monitor weather broadcasts before the start of outdoor work each day, and more frequently as necessary. No work will be done outdoors during hazardous weather conditions (e.g., lightning storms).

For Heat Stress:

- For temperatures above 75°F, each person will take their pulse at rest. At breaks, the pulse should be less than 110 beats per minute after one minute. Before returning to work, the pulse should be no more than 10 beats greater than the resting pulse.

- If the air temperature is greater than 89°F, work should be done for 30 minutes with a rest break of 10 minutes for Level 'D'. For Level 'C', work should be done for 20 minutes, with a rest break of 10 minutes. At least 8 ounces (1 cup) of non-caffeinated drinks, such as cool potable water, Gatorade-type drink, or dilute fruit juice should be consumed at each rest break or at least 1 cup every 20 minutes. At least 1 quart of cool liquids per employee per one hour is to be readily accessible at all times.

- Work should stop if any of the following symptoms occur: muscle spasm and/or pain in the limbs or abdomen (heat cramps); weak pulse, heavy

sweating, dizziness, and/or fatigue (heat exhaustion); or rapid pulse, no sweating, nausea, dizziness, and/or confusion (heat stroke). Provide First Aid immediately.

- Use sunscreen on unprotected skin to protect against ultraviolet exposure as necessary.

For Cold Stress:

- For temperatures below 40°F, adequate insulating clothing must be worn. If the temperature is below 20°F, workers will be allowed to enter a heated shelter at regular intervals. Warm sweet drinks should be available. Coffee intake should be limited.

- No one should begin work or return to work from a heated shelter with wet clothes. Workers should be aware of signs of cold stress such as heavy shivering, pain in the fingers or toes, drowsiness, or irritability. Onsets of any of these signs are indications for immediate return to a heated shelter.

Noise

A noise hazard exists when working in the immediate vicinity of backhoe, drill rig, and other heavy machinery operations, as well as along busy roads and highways. In addition to the potential for hearing damage, noise may interfere with critical communication and recognition of other potential hazards at the work site, such as moving vehicles. To minimize potential injuries, field employees will utilize hearing protection devices, (ear plugs, headphones), as necessary, and maintain a high level of alertness at all times.

Buried/Overhead Utility Hazards

In addition to the direct hazards associated with drilling, excavation, and/or other invasive field activities, indirect hazards may also be present in the surrounding environment, such as buried and overhead utilities and soil gas. Explosion may result from damage to buried natural gas pipelines. Electrocution may occur from contact with buried or overhead electrical wires. Damage to these and other utilities during drilling, excavation, or other invasive field activities may also result in expensive repair work. To avoid potential injury and damage from these hazards, the Underground Utilities Locating Center shall be contacted at (800) 424-5555. Field personnel shall review all site plans prior to commencement of invasive field activities. When soil conditions permit, a hand auger or post-hole digger shall be used to inspect the upper five feet of a borehole prior to drilling or an area prior to excavating to verify that unmarked utilities are not present. Overhead areas shall be inspected to verify clearances when using backhoes or other heavy equipment that could reach and damage overhead structures, power lines, etc.

Potential Biological Hazards

Biological Hazard	Matrix
Stinging/Poisonous Insects	
Large Predatory Animals	
Poisonous Snakes	

Stinging Insect Allergies

Allergic Reaction Symptoms

The majority of stinging insects in the United States include bees, yellow jackets, hornets, and wasps (fire ants are also considered stinging insects, but are prevalent in the southeastern U.S.). The degree of allergy varies widely. Most people who are not allergic to insect stings generally experience localized pain, itching, swelling, and redness at the sting site (localized reaction). A single bite or sting may result in a localized reaction, but multiple bites or stings may lead to more severe allergic reactions (systemic reaction, where the entire body is affected). The most serious is called anaphylaxis, which can be life-threatening if left untreated immediately. Severe allergic reactions are suspected if a person experiences any of the following symptoms:

- Hives (intense itching at sites other than the sting site)
- Difficulty breathing and/or swallowing
- Hoarseness
- Swelling of the tongue
- Vomiting and/or nausea
- Dizziness and/or fainting

These reactions usually occur within minutes of the sting, but have been known to be delayed up to 24 hours. Persons who have allergic reactions to stinging insects will have a worsened reaction to every subsequent sting. Prompt treatment is essential and emergency help is often needed.

Field personnel who have severe allergic reactions to stinging insects should wear a Medic Alert bracelet or necklace describing their allergy. They should also be prepared when going into the field by carrying with them a bee sting kit (a doctor-prescribed self-injection device with enpinephrine [adrenaline]; i.e., Epi-Pen). **Inform team members of your allergy and on how to use the bee sting kit before heading out into the field.**

Avoid Getting Stung

The U.S. Department of Agriculture recommends the following:

- When walking single-file on a trail, allow enough space between the front person and the next person, so that if the front person disturbs an insect nest, the next person does not run into agitated insects.
- Avoid wearing brightly colored, white, or pastel clothing. Studies have found that bees find black color very irritating and blue is comforting to them.
- Don't use cosmetics, hairspray, perfume, or cologne, as well as insect repellant when in the field.
- Food odors attract insects, especially yellow jackets, so be alert when eating outdoors. Avoid open food, as in garbage cans, dumps, and open picnic areas.
- Avoid disturbing likely beehive sites, such as large trees, tree stumps, logs, and large rocks. Yellow jackets nest in the ground and in walls. Hornets and wasps often nest in bushes, trees, and under roofs. Use caution with unusual forms in walls and mounds on the ground.
- If a colony is disturbed, run and find cover as soon as possible. Running in zigzag pattern may be helpful.
- Cover as much of the head and face as possible, without obscuring vision, while running.
- Never stand still or crawl into a hole or other space with no way out.
- Do not slap at the bees. Bees are generally not aggressive and will usually not sting unless disturbed or injured.
- Once clear of stinging insects, remove stingers and seek medical care.

If Stung by a Stinging Insect:

1. Call emergency medical services if:
    - Field personnel have a history of severe reactions to insect stings
    - Experiencing any severe symptoms listed above
    - Multiple stings, even for persons not known to have allergic reactions

- Stung in the mouth or nose, even for persons not known to have allergic reactions to stings, since they can lead to swelling and interfere with breathing.

2. **Determine if the stinger is still present** (look for a small black dot at the sting site) and remove it immediately if is visible. Bee stingers are barbed stingers with a venom sac attached; it takes 2-3 minutes to release all of its venom, so prompt removal of the stinger can reduce the severity of the sting. Avoid removing the stinger by pinching it; otherwise, more venom is injected into the skin. Use a hard object like a credit card or blunt knife to swipe over the area to remove ("flick") the stinger. Wasps, yellow jackets, and hornets have stingers without barbs that are usually retracted upon stinging; these insects can sting people multiple times.

3. **Apply ice or cold packs** to the area to reduce the body's inflammatory response.

4. **Clean the area with soap and water**, then apply hydrocortisone cream to the site to decrease the severity of the reaction. Alternative treatments include applying a paste of meat tenderizer and water or baking soda and water.

5. **Administer an antihistamine,** such as Benadryl (diphenhydramine) and/or non-prescription pain relievers such as ibuprofen or acetaminophen.

Personal Protective Equipment Requirements

Level of Protection

- **Level B** – Self-contained breathing apparatus (SCBA) or supplied-air respirator with an escape bottle, chemically resistant suit.
- **Level C** – Full-face air-purifying respirator, chemically resistant PPE.
- **Level D** – No respiratory protection. Safety glasses, hard hat, steel-toe boots, long-sleeved shirt and pants. Hearing protection, gloves, and other PPE as required.

To protect workers from potential contaminants in sample media, protective clothing will be worn during sampling activities. Protective clothing will be discarded or decontaminated between uses.

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 performance specifications of the PPE. On-site monitoring results and other information obtained from on-site activities will be used to modify LOPs and PPE as necessary to ensure sufficient personnel protection.

Work Task Number	D	C	B	Modifications Allowed
1	**X**			
2				
3				

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

Personal Protective Equipment

All personnel who perform work on-site will be minimally required to meet the protective clothing and safety equipment requirements for Level D (minimum required PPE for Level D in the following table is marked by an '*'). Level D status will apply to fieldwork on the site unless the trigger mechanism(s) to Level C or B are activated. The SHSO must notify the Corporate Health and Safety Officer prior to work if Level 'C' or 'B' will be used.

PPE	Task 1	Task 2	Task 3	Task 4
* Safety glasses/goggles	**X**			
* Cotton coveralls/long-sleeved shirt and pants	**X**			
* Hard hat (required at drill locations)	**X**			
* Steel-toed safety boots (as per ANSI Z41)	**X**			
* Work gloves	**X**			
Neoprene safety boots (as per ANSI Z41)				
Solvex or nitrile gloves (for sample handling)	**X**			
Ear plugs/muffs (near drilling operation)	**X**			
Reflective safety vest				
Insulated coveralls				
Chemical resistant suit: ☐ Tyvek ☐ Saranex ☐ Other:				
Chemical resistant boots or boot covers				
Inner gloves: ☐ Cotton ☐ Nitrile ☐ Other:				
Outer gloves: ☐ Nitrile ☐ Neoprene ☐ Rubber ☐ Other:				
Full-face air-purifying respirator (APR)				
Cartridges: ☐ Organic vapors ☐ P100 (99.97% filter efficiency for particulates) ☐-GMA-P100 (organic vapors and particulates) ☐-GMB-P100 (acid gases and particulates) ☐ GMC-P100 (organic vapors, acid gases, particulates) ☐ GME-P100 (multiple gases and particulates) ☐ Other:				

PPE	Task 1	Task 2	Task 3	Task 4
Powered APR				
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				
10-minute Escape self-contained breathing apparatus (ESCBA)				

* represents minimum required PPE for Level D work (i.e., work on hazardous waste sites, construction sites, around heavy equipment, in or around traffic, or other physical hazardous conditions).

Safety Equipment

The safety equipment in the following table that are marked by an '*' shall be maintained onsite at all times. Use an 'X' to indicate safety equipment needed for each work task.

PPE	Work Task Number			
	Task 1	Task 2	Task 3	Task 4
* First-aid kit	X			
* Emergency eye wash	X			
* Fire extinguisher (Class A, B, C)	X			
Photoionization detector				
Flame ionization detector				
U.S. Coast Guard-certified fire extinguisher				
Visual distress signal (VDS), (flashlight or orange flag)				
Tripod/winch/full body harness				
Waterproof flashlight				
Small backpack first aid kit				
Walkie talkies				

* represents safety equipment that shall be maintained onsite at all times.

Decontamination

A personnel decontamination station shall be set up daily during all sampling activities. The location of the decontamination station may vary based on the location of sampling activities for that day. Some of the personnel protective clothing that may be used, such as Tyvek suits and gloves, are disposable and no decontamination required following use. The location of the decontamination station may vary based on the location of sampling activities for that day. The station shall include one or more of the following items:

- A bucket or tub with a Liquinox soap/water solution and a brush for scrubbing boots, rain gear, gloves, and other non-disposable PPE
- A second bucket or tub filled with tap or deionized water for rinsing
- A portable pump-type spray bottle or a tub containing tap or distilled water for final rinse

Following are the decontamination procedures that will be employed to prevent contamination of personnel and to prevent cross contamination of sampling equipment during the collection of samples.

Personnel Decontamination

Decon Solutions:	Liquinox detergent, tap water
Decon Method:	Remove and dispose of Tyvek, rain gear, or coveralls; clean boots (if muddy) with Liquinox solution and tap water; remove and dispose gloves; wash and rinse hands and face with soap and water.
Exposure Monitoring:	None
Level of Protection:	D
Location:	Support zone

Sampling Equipment Decontamination

Decon Solutions:	Liquinox detergent, distilled water
Decon Method:	Scrub with Liquinox/water solution, rinse with tap water, rinse with distilled water, air dry.

Exposure Monitoring:	None
Level of Protection:	D
Location:	Support zone

Heavy Equipment Decontamination

Decon Solutions:	High temperature, pressure washer
Decon Method:	Use high-temperature, pressure washer to clean hollow-stem auger sections and other downhole drilling equipment. Contain rinsates.
Exposure Monitoring:	None
Level of Protection:	D
Location:	Support zone

Waste Characteristics

Waste Generation

Waste Anticipated:

Yes: ☒ No: ☐

Waste Type	Description	Quantity
Solid	Soil cuttings	3 drums
Liquid	Decontamination water	100 gallons
Sludge		
Incidental	Used disposable gloves, paper towels,	
Other		

Packaging Requirements for Waste Material

Open head 55-gallon drum: NA

Plastic trash bag: incidental waste

Purge water shall be disposed onsite while cleaning the drilling and sampling equipment, soil cuttings will be spread adjacent to each borehole.

Disposal and/or Treatment Methods Proposed

Waste	Disposal and/or Treatment
Incidental waste	Disposed trash bag to the nearest dumpster as solid waste.

Employee Training, Immunization, and Medical Clearance

The following is a summary of training, immunization, and/or medical clearance information for personnel who will perform work on the site. Copies of personnel training certificates are presented in Attachment 3.

1. Name Bruce Carpenter Title Sr. Hydrogeologist Approved PPL _____

Field Responsibilities: Drilling oversight, soil sample collection

Training	Dates (Month/Year)
Current 8-Hour Refresher	10/09
40-Hour Hazardous Waste	12/87
Supervisor	2/90
First Aid; CPR	7/09; 7/09
Confined Space Entry	
Medical Clearance	
Immunization: Tetanus/Diptheria	
Other:	

2. Name Sue Wall Title Project Scientist Approved PPL _____

Field Responsibilities: Soil sample collection

Training	Dates (Month/Year)
Current 8-Hour Refresher	3/17/10
40-Hour Hazardous Waste	5/4/07
Supervisor	
First Aid; CPR	4/7/09; 4/7/09
Confined Space Entry	
Medical Clearance	
Immunization: Tetanus/Diptheria	
Other:	

3. Name Kevin Houck Title Project Manager Approved PPL _____

Field Responsibilities: Project Manager, soil sample collection

Training	Dates (Month/Year)
Current 8-Hour Refresher	
40-Hour Hazardous Waste	6/02
Supervisor	
First Aid; CPR	;
Confined Space Entry	
Medical Clearance	
Immunization: Tetanus/Diptheria	
Other:	

4. Name Gina Catarra Title Project Scientist Approved PPL _____

Field Responsibilities: Soil sample collection

Training	Dates (Month/Year)
Current 8-Hour Refresher	2/10
40-Hour Hazardous Waste	12/02
Supervisor	
First Aid; CPR	7/09; 7/09
Confined Space Entry	
Medical Clearance	
Immunization: Tetanus/Diptheria	
Other:	

Health and Safety Plan — Acknowledgement and Agreement Form

The following field personnel have read this health and safety plan and understand the potential and actual hazards present on the site and shall abide by its strictures.

Name	Signature	Company	Date
Name	Signature	Company	Date
Name	Signature	Company	Date
Name	Signature	Company	Date
Name	Signature	Company	Date
Name	Signature	Company	Date
Name	Signature	Company	Date
Name	Signature	Company	Date
Name	Signature	Company	Date

ATTACHMENT 1

Injury/Exposure Report
Site Incident Report

Injury/Exposure Report

(Attach additional documentation as necessary)

DATE OF INCIDENT: _____ CASE NO. _____ TIME OF DAY _____

EMPLOYEE NAME _____ DATE OF BIRTH _____

HOME ADDRESS _____ PHONE NO. _____

SEX MALE ___ FEMALE ___ AGE ___ JOB TITLE _____ SOCIAL SECURITY NO. _____

OFFICE LOCATION _____ DATE OF HIRE _____

WHERE DID INCIDENT OCCUR? (INCLUDE ADDRESS) _____

ON EMPLOYER'S PREMISES? YES ___ NO ___ PROJECT NAME/NO. _____

WHAT WAS EMPLOYEE DOING WHEN INCIDENT OCCURRED? (BE SPECIFIC) _____

HOW DID THE INCIDENT OCCUR? (DESCRIBE FULLY)

WHAT STEPS COULD BE TAKEN TO PREVENT SUCH AN INCIDENT?

OBJECT OR SUBSTANCE THAT DIRECTLY CAUSED INCIDENT? _____

DESCRIBE THE INJURY OR EXPOSURE _____

PART OF BODY AFFECTED _____

NAME AND ADDRESS OF PHYSICIAN _____

IF HOSPITALIZED, NAME AND ADDRESS OF HOSPITAL _____

LOSS OF ONE OR MORE DAYS OF WORK? YES ___ NO ___ IF YES, DATE LAST WORKED _____

HAS EMPLOYEE RETURNED TO WORK? YES ___ NO ___ IF YES, DATE RETURNED _____

DID EMPLOYEE DIE? YES ___ NO ___ IF YES, DATE _____

COMPLETED BY (PRINT) _____ EMPLOYEE SIGNATURE _____

(Supervisor or Site Health & Safety Officer

DATE _____

SIGNATURE _____ PIC SIGNATURE _____

DATE _____ DATE _____

This report must be completed by the employee's supervisor or Site Health and Safety Officer immediately upon learning of the incident. The completed report must be reviewed and signed by the Principal-in-Charge and transmitted to Corporate Health and Safety Officer within 24 hours of the incident, even if employee is not available to review and sign. Employee or employee's doctor must submit a copy of the doctor's report to Corporate Health and Safety Officer within 24 hours of the initial exam and any subsequent exams. For field injuries, submit a copy of the Health and Safety Plan.

Site Incident Report

(Attach additional documentation as necessary)

DATE OF INCIDENT: _____ TIME OF INCIDENT: _____

LOCATION OF INCIDENT: _____

PROJECT NAME: _____ PROJECT NO.: _____

TYPE OF INCIDENT* (CHECK THOSE THAT APPLY):

_____ "NEAR MISS" _____ VEHICLE ACCIDENT

_____ UNDERGROUND PROPERTY DAMAGE _____ FIRE

_____ ABOVE-GROUND PROPERTY DAMAGE _____ EVACUATION

_____ THEFT _____ REGULATORY AGENCY INSPECTION OR VIOLATION

_____ OTHER (DESCRIBE) _____

*SUBMIT COPY OF HEALTH AND SAFETY PLAN AND ATTACHMENTS FOR FIELD-RELATED INCIDENTS.

DESCRIPTION OF INCIDENT: _____

_____

CAUSE OF INCIDENT: _____

_____

ACTION TAKEN: _____

_____

FUTURE CORRECTIVE ACTION: _____

_____

ESTIMATED AMOUNT OF DAMAGE: _____

_____

_____	_____	_____
INVESTIGATOR NAME	SIGNATURE	DATE
_____	_____	_____
PRINCIPAL-IN-CHARGE	SIGNATURE	DATE

cc: Site Health and Safety Officer, Corporate Health and Safety Officer, and Human Resources within 24 hours of incident.

ATTACHMENT 2

Daily Tailgate Safety Meeting Form

Daily Tailgate Safety Meeting Form

FIRST DATE OF ACTIVITY: _____ TIME: _____ SITE LOCATIONS: _____

1. ☐ Discussed activities planned for the day
2. ☐ Individual activities are clear to each crew member
3. ☐ Chemical hazards discussed
   - a. ☐ Action levels are known and understood
   - b. ☐ Frequency and procedures for air monitoring are known and understood
4. ☐ Physical hazards discussed
   - a. ☐ Heat stress
   - b. ☐ Cold stress
   - c. ☐ Slip, trip, and fall hazards
   - d. ☐ Drilling operations
   - e. ☐ Overhead utilities
   - f. ☐ Underground utilities
   - g. ☐ Moving and emptying drums
   - h. ☐ Heavy equipment operations
5. ☐ Personal protective equipment (PPE) discussed
   - a. ☐ Head protection (hard hat)
   - b. ☐ Eye protection (safety glasses must have side shields)
   - c. ☐ Hearing protection (at all times when drill rig/heavy equipment operating, in close proximity to traffic)
   - d. ☐ Foot protection (steel toes and shanks for work boots)
   - e. ☐ Splash (solvent rinse)
   - f ☐ Gloves
     - i. ☐ Chemical hazard (diluting standards for GC)
     - ii. ☐ Environmental conditions (cold)
     - iii. ☐ Protection against cross-contamination (disposal after each use)
     - iv. ☐ Physical hazard (cut, puncture, and abrasion)
6. ☐ Decontamination procedures discussed
   - a. ☐ Drilling equipment
   - b. ☐ Sampling equipment
7. ☐ Emergency procedures discussed
   - a. ☐ Route to hospital from site locations(s) above
   - b. ☐ Evacuation procedures
   - c. ☐ Cellular phone, map to hospital, first aid kit, and eyewash with onsite geologist
8. ☐ Special conditions/procedures
   - a. ☐ Escort required
   - b. ☐ Locked gates, permits, passes, etc.
9. ☐ Questions/concerns addressed
10. ☐ Other:

Meeting attended by (sign and date for each day of work on site; **USE BACK IF ADDITIONAL SPACE IS REQUIRED**):

(Print Name)	(Signature)	(Date)

Meeting conducted by: _____ (Title) _____

DJ \\herrera\hecnet\missoula\projects\06-03425-070 to 7 forest rose mine\draft text\appendices\hasp appendix\attachment 2 - hazmat daily tailgate safety meeting-utility clearance log.doc (template: c:/document/hlthsfty/attachments/97attachment 2.doc)

Utility Clearance Log

PROJECT NAME: _____ DATE _____

PROJECT NUMBER: _____

"ONE-CALL" CONFIRMATION NUMBER AND DATE CONTACTED _____

"ONE-CALL" EXPIRATION DATE _____

SUBCONTRACTOR LOCATING FIRM AND INVOICE NUMBER _____

FACILITY CONTACT PERSON & TELEPHONE NUMBER _____

FACILITY DRAWINGS REVIEWED _____

VERBAL/WRITTEN SIGN-OFF OF CLEARANCE BY FACILITY CONTACT _____

PRESSURIZED LINES/SHUT-OFF VALVES IDENTIFIED* _____

UNDERGROUND UTILITIES/LINES IDENTIFIED* _____

_____

_____

UNDERGROUND UTILITIES/LINES MARKED ONSITE BY _____

OVERHEAD UTILITIES/LINES IDENTIFIED* _____

_____

_____

OVERHEAD UTILITIES/LINES MARKED ONSITE BY _____

*Mark on copy of facility drawing or site sketch in HASP.

Clearance Contact:

NAME (HERRERA EMPLOYEE ONLY)	SIGNATURE	DATE

Clearance Reviewed By:

NAME (HERRERA PROJECT MANAGER)	SIGNATURE	DATE

ATTACHMENT 3

Personnel Training Certificates

This is to Certify That

KEVIN HOUCK

Has met the requirements set-forth in OSHA 29 CFR 1910.120 For Hazardous Waste Operations and Emergency Response 8-hour Refresher training

TM

Instructor:
Mark Hlebichuk
Industrial Hygienist
CIEC, WRT, AMRS, CET

IHESS

March 18, 2009

800.995.4033 www.hazmat.net

Industrial Hygiene, Environmental & Safety Services, Inc.

Certificate of Completion

This is to certify that

Kevin Houck

has successfully completed the

40-HOUR
HAZARDOUS WASTE OPERATIONS AND
EMERGENCY RESPONSE TRAINING

In compliance with the

DEPARTMENT OF LABOR OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
(OSHA) 29 CFR 1910.120

Awarded this 13th day of June, 2002

Joe Ocken, CIH, CHMM, MHS
Corporate Director of H & S
Certificate # 020613-12-TG

ENVIROCON, INC.

Certificate of Completion

This is to certify that

Bruce A. Carpenter

has satisfactorily completed
8 hours of refresher training in

Hazardous Waste Operations And Emergency Response

to comply with the training requirements of
OSHA 29 CFR 1910.120

Certificate Number 104700

Instructor

ARGUS PACIFIC
TRAINING • CONSULTING

Oct 22, 2009
Date(s) of Training
Annual Refresher Required by: Oct 22, 2010

Argus Pacific, Inc. • 1900 W. Nickerson • Suite 315 • Seattle, Washington • 98119 • (206) 285.3373 • fax (206) 285.3927

GERAGHTY & MILLER, INC.
Environmental Services

This is to certify that

Bruce A. Carpenter

has completed the

8-Hour Hazardous Waste Operations and Emergency Response

Project Manager Health and Safety Training

as required by OSHA 1910.120 (e) (4)

Bellevue, WA
Location

2/13-14/90
Date

Mary G. Zell
Mary G. Zell
Regional Safety Manager

First National Bank Tower • 900 Massachusetts Street, Suite 600 • Lawrence, Kansas 66044 • (913) 841-7641

CPR Training Center, Inc. (206) 621-3560

Business First Aid

Until Help Arrives

HAS COMPLETED AN APPROVED FIRST AID CLASS INCLUDING ADULT 1 PERSON CPR
& additional courses as noted on the back of this card

Instructor L&I #J916A11903

7/29/11
Expiration Date

Environmental and Occupational Health Associates

This certifies that

Bruce A. Carpenter

has completed the course

Personal Protection on Hazardous Waste Sites

for 40 hours of classroom instruction.

E. A. Taylor

Elizabeth A. Taylor CIH
President

December 12, 1987
Date

Certificate of Completion

This is to certify that

Gina Catarra

has satisfactorily completed
8 hours of refresher training in

Hazardous Waste Operations And Emergency Response

to comply with the training requirements of
OSHA 29 CFR 1910.120

Certificate Number 106039

Instructor

ARGUS PACIFIC
TRAINING • CONSULTING

Feb 11, 2010
Date(s) of Training
Annual Refresher Required by: Feb 11, 2011

Argus Pacific, Inc. • 1900 W. Nickerson • Suite 315 • Seattle, Washington • 98119 • (206) 285.3373 • fax (206) 285.3927

ABAA
555

Responsive choking Adult and Child

Perform abdominal thrusts until the foreign object is expelled or the victim becomes unresponsive.

Unresponsive choking Adult/ Child/ infant

Open airway. Remove the object if you see it. Begin CPR. Each time the airway is open for rescue breaths, look foe an object in the victim's throat. If you see it, remove it. Do not blindly sweep your finger through an infant or child's throat.

Responsive Choking Infant

Give 5 blows/slaps between shoulder blades with enough force to expel the object.
Give 5 downward chest thrusts below the nipple line with enough force to expel the object
Repeat back blows and chest thrusts until the foreign object is expelled or the infant becomes unresponsive.

CPR Training Center, Inc. (206) 621-3560

HAS COMPLETED AN APPROVED FIRST AID CLASS
INCLUDING ADULT 1 PERSON CPR & additional courses as noted below.

- ☐ Child CPR
- ☐ Infant CPR
- ☐ Adult AED (Automated External Defibrillator)
- ☐ HIV/Bloodborne Pathogen Course: Meets WISHA/DSHS Guidelines WAC 296-62-08001 (b) (vii) (A-N) valid 1 year
- ☐ Emergency Oxygen Administration

(Knowledge and skill not assessed if crossed out)

CPR Training Center, Inc. (206) 621-3560

Business First Aid
Until Help Arrives

Gina Catarra

HAS COMPLETED AN APPROVED FIRST AID CLASS INCLUDING ADULT 1 PERSON CPR
& additional courses as noted on the back of this card

Instructor L&I #J916A11913

7/26/11
Expiration Date

Certificate of Completion

This is to certify that

Gina Catarra

has satisfactorily completed

40 hours of training in

Hazardous Waste Operations

in compliance with 29 CFR 1910.120 and WAC 296-62, Part P

THE NORTHWEST'S LEADING TRAINING ORGANIZATION

December 13, 2002

Lynda Nokkein

Training Coordinator

Prezant

Certificate # 02-4316

Conducted at:

Prezant Associates Seattle, WA

Prezant Associates, Inc. • 330 Sixth Avenue North, Suite 200 • Seattle, Washington 98109 • (206) 281-8858

Certificate of Completion

This certifies that

Susan Wall

Has Successfully completed

8 Hour HAZWOPER Refresher Training

Refresher certification does not necessarily indicate initial 24 or 40 Hour HAZWOPER certification

In Accordance With Federal OSHA Regulation 29 CFR 1910.120(e)

And all State OSHA and EPA Regulations As Well

Post-it® Fax Note 7671
To Kristin K.
Co./Dept.
Phone #
Fax #
Date 3/26
From Sue W.
Co.
Phone #
Fax #
# of pages ▶ 1

Julius P. Griggs
Julius P. Griggs
Instructor #892

100317528363
Certificate Number

3/17/2010
Issue Date

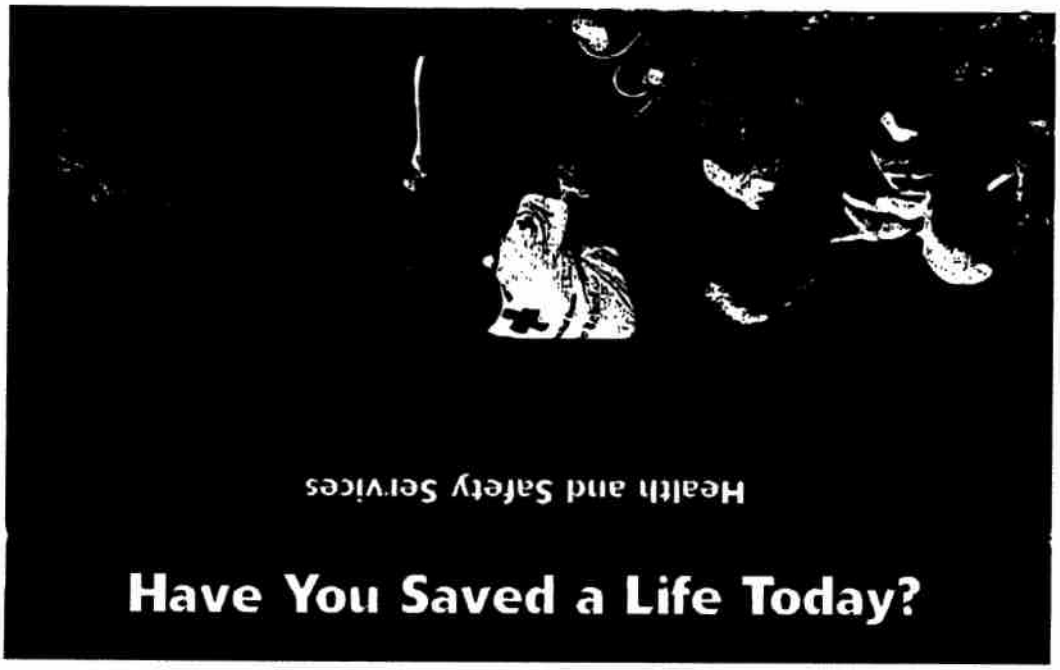
SAFETY UNLIMITED, Inc.
OSHA Compliant Safety Traiing Since 1993

690A East Los Angeles Ave Suite 180 Simi Valley, CA 93065
888-309-7233 * 805-306-8027 * 866-869-7097 (F)
www.safetyunlimited.com

Proof of initial certification and subsequent refresher training is NOT required to take refresher training
Want to be sure this certificate is valid? Visit safetyunlimited.com/verification

American Red Cross

Together, we can save a life



American Red Cross

Together, we can save a life

This recognizes that

Susan Wall
has completed the requirements for

CPR–Adult

conducted by

ARC of Montana
Date completed 4/7/2009
The American Red Cross recognizes this certificate as valid for 1 year(s) from completion date.

Post-it® Fax Note 7671	Date 4/23	# of pages ▶ 1
To Peter Jowise	From Sue W.	
Co./Dept.	Co.	
Phone #	Phone #	
Fax #	Fax #	

856677

This is to Certify That

Susan Wall

Has met the Forty (40) Hour Training requirements set-forth in OSHA 29 CFR 1910.120 For Hazardous Waste Operations and Emergency Response

IHESS
www.hazmat.net

Instructor:
Mark Hlebichuk
Industrial Hygienist
CIAQC, CIEC, RPIH, WRT, AMRT, CET

May 4, 2007

800.995.4033 www.hazmat.net

ATTACHMENT 4

Air Monitoring Equipment Calibration / Check Log and Air Monitoring Log

Air Monitoring Equipment Calibration/Check Log

Project Name: _____

Project Number: _____

Date	Instrument/ Model No.	Serial No.	Battery Check Ok?	Zero Adjust Ok?	Calibration Gas (ppm)	Reading (ppm)	Performed By	Comments

Air Monitoring Log*

Project Name: _____

Project Number: _____

Date	Time	Location	Source Area/ Breathing Zone	Instrument	Concentraions/ Units	Sampled By	Comments

***Notify the Health and Safety Manager immediately if a PEL, TLV, or other limit is exceeded.**

APPENDIX D

Cost Estimate