



ecology and environment, inc.

Global Environmental Specialists

720 Third Avenue, Suite 1700
Seattle, Washington 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

August 19, 2016

Brooks Stanfield, On-Scene Coordinator
United States Environmental Protection Agency
1200 Sixth Avenue, Mail Stop ECL-116
Seattle, Washington 98101

Re: Contract Number: EP-S7-13-07
Technical Direction Document Number: 16-07-0002
Final Cinnabar Mine Site-Specific Sampling Plan

Dear Mr. Stanfield:

Enclosed please find the final Site-Specific Sampling Plan for the Cinnabar Mine site, which is located near Yellow Pine, Idaho. If you have any questions regarding this submittal, please call me at (206) 920-1739

Sincerely,
ECOLOGY AND ENVIRONMENT, INC.

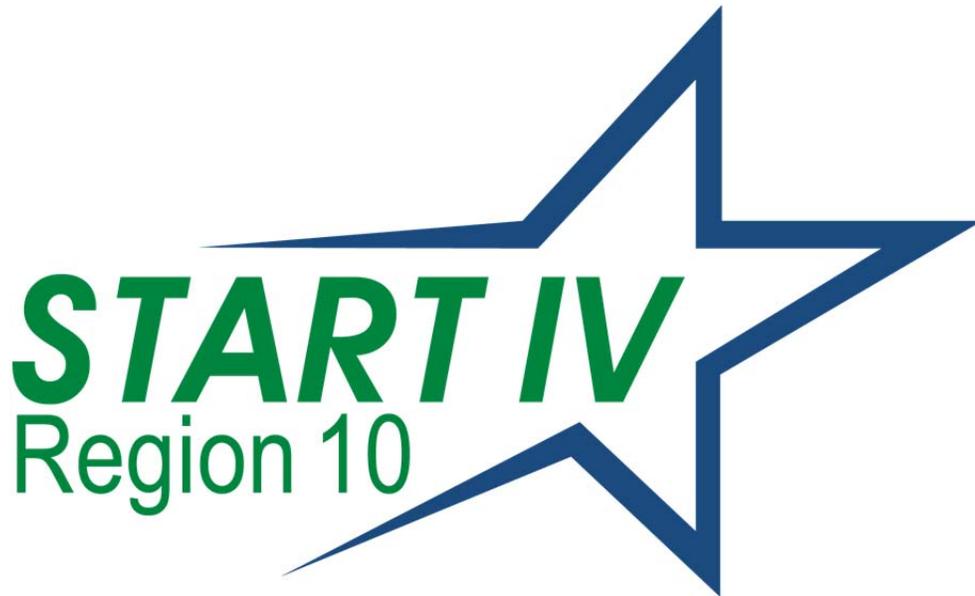
Steven G. Hall
START-IV Removal Team Leader

cc: Greg Weigel, On-Scene Coordinator, EPA, Boise, Idaho
Ken Marcy, Site Assessment Manager, EPA, Portland, Oregon
Jennifer Crawford, Regional Sample Control Coordinator, EPA, Seattle, Washington
Renee Nordeen, Project Manager, E & E, Seattle, Washington

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SITE-SPECIFIC SAMPLING PLAN

**Cinnabar Mine
Yellow Pine, Idaho
TDD: 16-07-0002**



Prepared for

Emergency Management Program
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue, Suite 900
Seattle, Washington 98101
Mail Stop ECL-133

Prepared by

Ecology and Environment, Inc.
720 Third Avenue, Suite 1700
Seattle, Washington 98104

August 2016

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Approvals

Title	Name	Signature	Date
On-Scene Coordinator	Brooks Stanfield		
	Greg Weigel		
Site Assessment Manager	Ken Marcy		
EMP Quality Assurance Coordinator	Kathy Parker		

Project Organization / Distribution List

Name and Title	Organization	E-Mail and Phone Number	Data Recipient	Final SSSP (pdf)
Brooks Stanfield On-Scene Coordinator	USEPA, Seattle, WA	Stanfield.brooks@epa.gov 206-553-4423	X	X
Greg Weigel On-Scene Coordinator	USEPA, Boise, ID	Weigel.greg@epa.gov 208-378-5573	X	X
Ken Marcy Site Assessment Manager	USEPA, Seattle, WA	Marcy.ken@epa.gov 206-553-6061	X	X
Kathy Parker, EMP Quality Assurance Coordinator	USEPA, Seattle, WA	Parker.kathy@epa.gov 206-553-0062		X
Donald M. Brown Region 10 QAM	USEPA, Seattle, WA	Brown.donaldm@epa.gov 206-553-0717		X
Jennifer Crawford Region 10 RSCC	USEPA, Seattle, WA	Crawford.jennifer@epa.gov 206-553-6261	X	X
Dhroov Shivjiani START-IV Program Manager	E & E, Seattle, WA	dshivjiani@ene.com 206-624-9537		X
Steve Hall START-IV Removal Team Leader	E & E Seattle, WA	shall@ene.com 206-920-10739		X
Linda Ader START-IV Site Assessment Team Leader	E & E Seattle, WA	lader@ene.com 206-406-3411		X
Mark Woodke START Quality Assurance Officer	E & E, Seattle, WA	mwoodke@ene.com 206-6924-9537	X (subcontract data only)	X
Renee Nordeen START Analytical Coordinator & Project Manager	E & E, Seattle, WA	rnordeen@ene.com 206-624-9537	X	X

Abbreviations List

Abbreviations	Definition
µg/L	micrograms per liter
CCCs	Criterion Continuous Concentrations
CLP	Contract Laboratory Program
cm	centimeter
CMCs	Criterion Maximum Concentrations
COC	Chain-of-Custody
CRQL	Contract Required Quantitation Limit
DOC	Dissolved Organic Carbon
DQI	Data Quality Indicators
DQO	Data Quality Objectives
E & E	Ecology and Environment, Inc.
EFSFSR	East Fork South Fork Salmon River
EPA	United States Environmental Protection Agency
IDHW	Idaho Department of Health and Welfare
IDTL	Initial Default Target Levels
MeHg	Methylmercury
MEL	Manchester Environmental Laboratory
mg/kg	milligrams per kilogram
MLR	Multiple linear regression
ng/L	nanograms per liter
NPL	National Priorities List
PA	Preliminary Assessment
PCBs	Polychlorinated Biphenyls
RML	Removal Management Level
RPD	Relative Percent Difference
RSCC	Regional Sample Control Coordinator
RSL	Regional Screening Level
SOP	Standard Operating Procedures
SOW	Statement of Work
SPLP	Synthetic Precipitation Leaching Procedure
SSSP	Site-Specific Sampling Plan
START	Superfund Technical Assessment and Response Team
TAL	Target Analyte List
TOC	Total Organic Carbon
USFS	United States Forest Service
USGS	United States Geological Survey
WER	Water Effect Ration
WQC	Water Quality Criteria

1. Introduction

The United States Environmental Protection Agency (EPA) has tasked Ecology and Environment, Inc. (E & E), under Superfund Technical Assessment and Response Team (START) contract number EP-S7-13-07, Technical Direction Document Number 16-07-0002, to conduct an Integrated Assessment at the Cinnabar Mine site which is located near Yellow Pine, Idaho.

This Site-Specific Sampling Plan (SSSP) has been prepared and will be used in conjunction with the Quality Assurance Plan for the Emergency Management Program (EPA 2010) and the START-IV Quality Assurance Project Plan (E & E 2013) for collecting samples during this project. A Site-Specific Data Management Plan is included in Attachment A.

2. Site Location and Background

Site Name	Cinnabar Mine
Site Location	Approximately 15 miles east of Yellow Pine, Idaho
Legal Description	Township 18 North, Range 10 East, Sections 6 and 7
Latitude	44.92111
Longitude	-115.287778
CERCLIS ID	ID980665160
Site ID	101T

2.1 Site Background

The Cinnabar Mine is located approximately 15 miles east of Yellow Pine, Idaho on Forest Service Road #374 in Valley County (Figure 2.1). The site encompasses approximately 50 acres within the 575 acres of patented claims comprising the Cinnabar Mine. The site is located within the Payette National Forest, adjacent to the Frank Church/River of No Return Wilderness Area to the north and east. Features at the site consist of (from north to south and west to east) the lowest tan tailings pile, the tailings pile which has been capped and seeded, the reconstructed west Fork Cinnabar Creek, former residential buildings, upper yellow tailings pile, a capped and seeded on-site landfill, two upper red tailings piles, Adit 1, remnants of a building of unknown use, remnants of the former mill building, the former dormitory buildings, the former cook house, concrete pads, an adit pond, and Adit 2 (Figure 2.2).

Water discharges from several mine adits and surface drainages above the site to West Fork Cinnabar Creek. West Fork Cinnabar Creek flows through the tailings piles in a diversion channel which was initially constructed in 1992 and reconstructed during the 1996 EPA Removal Action (discussed further below). West Fork Cinnabar Creek flows into Cinnabar Creek which flows into Sugar Creek below the mine site. Cinnabar Creek provides critical habitat for the Federal-listed threatened bull trout and Sugar Creek provides critical habitat for bull trout and the Federal-listed threatened steelhead. Sugar Creek flows approximately 2.6 miles to the confluence with East Fork South Fork Salmon River (EFSFSR) which provides habitat for the Snake River Spring and Summer Chinook salmon which is a Federal-listed threatened species.

Mercury mining operations began at Cinnabar Mine in 1921 and ceased in 1958. The deposit was discovered in 1902, with subsequent development commencing in 1921 under United Mercury Mines Company (also known as Hermes Mine). Production is reported to have been intermittent prior to 1930. In 1942, the mine was worked by Bonanza Mining, Inc., and then Holly Minerals took over during the 1950s. Historically, the ore processing was conducted on-site. The initial method used was to roast the ore, mercuric sulfide, or cinnabar with oxygen to produce free mercury vapor and sulfuric dioxide gas.

The mercury vapor was collected after cooling by flue condensers. Allegedly, this process was uncontrolled; during operations, elemental mercury could be collected from the walls and rain-gutters of the process buildings. A fire in 1956 destroyed the processing mill and the mill was subsequently rebuilt. The new mill processed ore using a method which coupled wet flotation with electro-separation. (E & E 1999).

Current conditions at the site include areas of tailings that are not covered with soil or vegetation. There is a concern that these exposed tailings may be subject to erosion into West Fork Cinnabar Creek which runs through the site. A remediation option under consideration involves adding organic material to the tailings to allow for a vegetation cover to develop. This would reduce erosive loading of high mercury content materials into the creek. However, this remediation option also has the potential to increase the amount of methylmercury (MeHg) produced at the site (discussed below). The formation of MeHg is of concern due to its increased toxicity and ability to bioaccumulate in biota relative to inorganic forms of mercury.

Mercury is methylated by anaerobic bacteria, with sulfate reducing bacteria being one of the main groups associated with this process (Ulrich et al. 2001); though other anaerobic bacteria have also been shown to methylate mercury as well (Warner et al. 2003). As such, mercury methylation is not expected to occur in soils and tailings that are unsaturated (i.e., contain oxygen in the pore space). The zones of MeHg production are expected to occur in sediment in the creek and/or wetland areas; and soils and tailings in the riparian zone that are seasonally or permanently saturated. Within these zones where anoxic conditions may occur, there are three main factors that likely govern the amount of MeHg produced: 1) the concentration of bioavailable inorganic mercury; 2) the concentration of labile organic carbon; and 3) the concentration of sulfate and sulfide. Bioavailable inorganic mercury is typically a small percentage of sediment total mercury (Marvin-DiPasquale et al. 2009). In general, mercury bound to the sediment/soil matrix is not considered bioavailable, whereas mercury in the porewater/dissolved phase is considered more bioavailable (Hsu-Kim et al. 2013; Schartup et al. 2014). Along similar lines, the quality of organic carbon and not just its total quantity can be an important factor governing its utilization by microbial communities (Burns et al. 2013; Marvin-DiPasquale et al. 2009; Schuster et al. 2008). Specific ultraviolet absorbance at 254 nanometer is a well-established and simple analytical technique used to measure the quality of dissolved organic carbon (DOC) and has been utilized in numerous mercury studies (Burns et al. 2013; Marvin-DiPasquale et al. 2009; Schuster et al. 2008; Shanley et al. 2008; Weishaar et al. 2003;).

The variables affecting mercury methylation rates are numerous, complex, and not entirely understood. As such, predicting future changes in mercury methylation as a result of remediation actions contain a fair degree of uncertainty. This proposed work will provide three lines of evidence to address the potential influence of organic matter on mercury methylation at the mine site: field-based measurements that include sediment and porewater samples; and laboratory-based mesocosm experiments where organic matter is added to tailings with mercury and associated measurements analyzed at specific intervals of time; and short-term incubations to determine sediment methylation rates using a stable isotope approach. This last component of the project is being funded and organized separately from the field and laboratory work described in this SSSP. .

The field-collected porewater measurement results will provide a measure of the sub-fraction of sediment total mercury that could be bioavailable for methylation. Because much of the total mercury in soils and sediments at mine sites is in insoluble mineral fractions, it is expected that the amount available in the filtered porewater phase (i.e., mercury that can be methylated) will be much smaller. If

this is the case at Cinnabar Mine, it would suggest that even with the addition of organic material to the site, only a small amount of the total mercury in soil/sediment may be in a form that is available to methylating bacteria.

2.2 Previous Site Investigations

The following investigations have been conducted in association with this site:

- EPA conducted a non-sampling inspection of the site in August 1979 and concluded that the site did not pose an environmental or public health threat.
- The Idaho Department of Health and Welfare (IDHW) and the Idaho Central District Health Department jointly performed an investigation at the site in September 1984. A total of 20 samples, including water, sediment, soil, drum, and biological samples were collected. Based on analytical results, the report concluded that the mine should be given a high priority for cleanup of toxic waste present at the site.
- In June 1985, the EPA Region 10 Emergency Response Team and the EPA Region 10 Technical Assistance Team jointly performed a preliminary removal site assessment. A total of 21 samples, including water, soil, sediment, diesel product, and air samples were collected and analyzed for mercury and polychlorinated biphenyls (PCBs). Several cleanup recommendations were made as a result of this investigation.
- On May 23, 1988 The United States Forest Service (USFS) Krassel Ranger District received notice of an oil spill on the EFSFSR. Pioneer Metals (who was leasing the mine at the time) reported a 120,000-gallon oil tank had a tap removed and a valve opened, releasing oil to the EFSFSR. Attempts to control the spill included diversion of snowmelt, construction of berms, and placement of absorbent materials around the tank. The USFS prepared a macro-invertebrate analysis report to document conditions in Cinnabar Creek in response to the spill and assess general water quality around the mine area. The report concluded that severe stress conditions were detected downstream in the ecosystem.
- In September 1991, the USFS conducted a site visit and collected five samples of water, tailings, and rock. The samples were analyzed for mercury, lead, and arsenic. The report recommended additional assessment and sampling be performed at the site.
- The USFS began a time-critical removal action at the site in September 1992, based on their August 1992 Request for Removal Action Memorandum. The action involved construction of a diversion ditch to divert Cinnabar Creek to a historic diversion channel.
- The USFS conducted a non-sampling Preliminary Assessment (PA) of the site in May 1993. The PA involved a site visit and review of existing data as the initial step in determining if the site was eligible for placement on the National Priorities List (NPL). The results of the PA concluded there was sufficient evidence that the site posed an environmental risk through the surface water migration pathway to recommend further investigation.
- In July 1994, the EPA conducted a Site Inspection as a result of the PA recommendations. A total of 15 soil and sediment samples were collected from on-site sources and downstream target locations. Although contamination was determined to be migrating from site sources to downstream targets, the isolation of the site and low human population in the surrounding area resulted in a determination of a minimal threat.
- In 1994, IDHW prepared a Water Quality Status Report as part of ongoing monitoring efforts and a study of water and habitat quality in the EFSFSR drainage and its tributaries. The focus of the report was Sugar Creek and Meadow Creek, both of which were impacted by Cinnabar Mine and the nearby Stibnite Mine. Recommendations from this investigation included routine monitoring

of surface waters and continued reclamation efforts at the mine sites to reduce migration of sediments via surface waters.

- In 1996, EPA conducted a time-critical removal action. Transformers containing PCBs and surrounding soil were removed. A retort, used to roast ore, was removed from Cinnabar Creek. In addition, sediment with elemental mercury was excavated from the creek. Asbestos insulation from boilers and drying ovens was removed. The PCBs, condenser stack and mercury-contaminated soil were all landfilled on-site in a lined cell. A leaking 120,000-gallon oil storage tank was cleaned and crushed. Two other oil storage tanks were emptied and cleaned. Approximately 40 cubic yards of oil-contaminated soil was removed and transported off-site for disposal. Cinnabar Creek was re-routed around the lower tailings piles which were regraded and covered with soil and woody debris, and seeded with grass for long-term stabilization.
- In August 1998, EPA conducted a time-critical removal action to address the remainder of the mercury-contaminated soil, to investigate an area of oil-contaminated soil, and to stabilize the upper tailings piles that were eroding into Cinnabar Creek.
- In 2004, EPA returned to the site to regrade the upper tailings pile and place seed mixture on the pile to discourage erosion of tailings into Cinnabar Creek. No samples were collected as part of this work. (E & E 2014)
- In 2011, the US Geological Survey (USGS) began collecting surface water samples from the EFSFSR River above Meadow Creek (station 13310800), Meadow Creek (background; station 13310850), EFSFSR at Stibnite (station 13311000), EFSFSR above Sugar Creek (station 13311250) and Sugar Creek above the confluence with EFSFSR (station 13311450). The samples were analyzed for total and dissolved metals and field parameters including temperature, pH, and specific conductivity. The samples were compared to EPA's National Recommended Aquatic Life Criteria fresh water criterion maximum concentrations (CMCs) for acute exposure and criterion continuous concentrations (CCCs) for chronic exposure. Total lead was detected above the chronic level in one sample collected in September 2011 from the Sugar Creek station above the confluence with EFSFSR and was also detected above the chronic level in one sample collected from EFSFSR at Stibnite Mine in May 2013. Total mercury was detected above the chronic level and acute level in one sample in May 2013 at the same station. Arsenic was not detected above either the acute or chronic levels in any of the samples collected. Concern was expressed that contamination may be leaching from the various tailings piles at Cinnabar Mine and impacting surface water and sediments in Cinnabar Creek, Sugar Creek, and the EFSFSR (USGS 2014a, 2014b, 2014c, 2014d, 2014e). Based on these concerns, EPA determined additional characterization of the tailings should be conducted.
- In August 2014, EPA, START, USFS, EPA's Environmental Response Team, and EPA Region 10 Emergency and Rapid Response Services Contractor conducted a site visit and collected samples to assess the current status of contamination at the site in support of a Removal Assessment. A total of 29 soil, surface water, and sediment samples were collected. Sample locations are provided on Figure 2.3. The surface water samples were analyzed for hardness and total and dissolved arsenic, lead, and mercury. The sediment samples were analyzed for total arsenic, lead, and mercury. The tailings samples were analyzed for synthetic precipitation leachate procedure (SPLP) arsenic, lead, and mercury. The investigation was designed to determine the potential for site contaminants to leach from the on-site yellow and red tailings piles to the adjacent West Fork Cinnabar Creek and to determine if these contaminants were likewise in the surface water and/or sediments of the downstream Cinnabar or Sugar Creeks. Sample results are provided in Tables 2.1, 2.2, and 2.3. The results of the investigation indicated the presence of site contaminants in some media above the selected screening criteria, specifically:

- SPLP metals results indicated that arsenic and mercury in the tailings pile were available to leach from the tailings at concentrations that exceed water quality criteria.
- Arsenic was not detected above the water quality criteria in any of the surface water samples collected. All mercury samples were below the reporting limit of 200 nanograms per liter (ng/L). However, applicable water quality criteria (WQC) for total mercury is now 12 ng/L (IDEQ 2016). Therefore, the method applied was not able to determine whether samples were above or below WQC for total mercury.
- Concurrent with the Removal Assessment in August 2014, USGS representatives collected surface water and sediment samples from streams, adits, and an on-site wetland. The USGS publication discussing this sampling effort has not yet been published (i.e., as of June 2016); however, the analytical results have been released. Additional samples were collected in June and July 2015. Sample locations are depicted on Figure 2.4. Sample results are presented in Tables 2.4, 2.5, and 2.6. For the purposes of this investigation, surface water samples were compared to CMCs and CCCs. Sediment samples were compared to recommended sediment quality guidelines for sediment quality standards and cleanup screening levels (Avocet 2011), and tailings and soil samples were compared to EPA Removal Management Levels (RMLs), EPA Regional Screening Levels (RSLs), and Idaho Initial Target Default Limits (IDTLs). Surface water sample results indicated that arsenic and lead did not exceed any of the water quality criteria for any of the samples collected; however most total mercury samples did exceed CCC values. Sediment sample results indicated that MeHg exceeded both screening criteria in seven of the samples collected. Mercury was detected at concentrations above both screening criteria in 10 of the samples collected. Only the samples collected above the confluence of Cinnabar Creek and Sugar Creek were below both screening criteria. Arsenic was detected at concentrations above the sediment quality standard but below the cleanup screening level in seven of the samples and at concentrations above both screening criteria in two of the samples. Lead was not detected above either screening criteria in any of the samples collected. Soil sample results indicated mercury above the RML and the IDTL in all of the samples collected. Arsenic was detected above the RSL and IDTL in two of the samples and above all screening criteria in three of the samples. Lead and MeHg were not detected above any of the screening criteria in any of the soil samples collected.

3. Project Schedule

The proposed schedule for the project is as follows:

Table 3.1 Proposed Project Schedule

Activity	Estimated Start Date	Estimated Completion Date	Comments
SSSP/SSDMP Submittal	6/10/16	8/18/16	
Mobilize to the site	8/21/16	8/22/16	
Sample collection activities	8/22/16	8/25/16	
Demobilize from the site	8/25/16	8/26/16	
Laboratory receipt of samples	8/27/16	8/29/16	
Laboratory Analysis	8/29/16	9/27/16	
Data Validation	9/20/16	10/25/16	

4. Sampling Objectives

The objectives of this sampling event include:

- Consider some potential near-term removal options that would reduce impacts to human health and the environment, including but not limited to vegetation of tailings.
- Determine if metals contamination is present at concentrations above site established cleaning criteria and/or background concentrations in the tailings piles, on-site adits, on-site wetland, and/or in downstream water bodies.
- Determine if the site is eligible for placement on the National Priorities List.
- Determine if shallow groundwater is contributing mercury contamination to on-site and downstream water bodies.

5. Data Use Objectives

Data that are generated will:

- Assist in determining the potential effectiveness of previously considered removal options.
- Be used to conduct agronomic analysis leading to recommendations for specific soil amendments that could support revegetation of tailings piles.
- Be compared with a background or reference sample.
- Be compared with an available reporting level.
- Allow for Multiple linear regression (MLR) analysis between MeHg (dependent variable), total mercury (co-variate), and total organic carbon (TOC; independent variable) will be performed in sediment samples to determine if there is a significant positive relationship between MeHg and TOC. MLR analysis will also be performed on porewater samples where sulfide and sulfate will be co-variates.
- Allow for comparison of water and tailings samples from the laboratory mesocosm using an independent t-test by EPA to determine if there is a significant difference in concentrations of MeHg between the populations of samples where organic amendments were applied compared to the population of un-amended materials. It is the hypothesis of the study that the amended population MeHg concentration will be significantly higher than the un-amended population.
- Assist in determining the presence or absence of hazardous substances at levels above an available reporting limit.
- Assist in determining the area of impact due to hazardous substances releases (i.e., horizontal and lateral extent).
- Be compared with site-specific action levels (e.g., EPA RSLs or EPA RMLs) as identified in SSSP tables 7.1, 7.2, and 7.3.

6. Conceptual Site Model

Potential contaminants of concern for the site, transport mechanisms, and potential receptors are provided in the table below.

Table 6.1 Conceptual Site Model

Contaminant	Transport Mechanism	Receptor
Target Analyte List (TAL) Metals including mercury and MeHg	Contaminants in soil, tailings, and/or ground water migrating to surface water bodies via overland flow and/or infiltration of precipitation	Environmental targets such as critical habitat for Federal-listed threatened species and wetlands.

7. Action Levels

Background samples will be collected for each of the media sampled for comparative purposes. In addition, samples will also be compared to the following criteria.

The following soil screening criteria will be considered in the evaluation of the soil analytical data and are compiled from the EPA RMLs for residential soils, the EPA RSLs for dermal, ingestion, and inhalation contact in residential soils, and IDTLs. In situations where the Contract Required Quantitation Limit (CRQL) is higher than the screening criteria, the CRQL will be used as the screening level. All soil screening criteria listed in Table 7.1 are provided in milligrams per kilogram (mg/kg).

Table 7.1 Soil Screening Criteria

Analyte Name	CAS Number	EPA RML	EPA RSL – Ingestion	EPA RSL – Dermal	EPA RSL - Inhalation	IDTL
Aluminum	7429-90-5	230,000				NA
Antimony	7440-36-0	94				4.77
Arsenic	7440-38-2	68	0.77	5.5	890	0.391
Barium	7440-39-3	46,000				896
Beryllium	7440-41-7	470			1,600	1.63
Cadmium	7440-43-9	210			2,100	1.35
Chromium (III)	16065-83-1	350,000				2130
Chromium (VI)	18540-29-9	30	0.31		16	7.9
Cobalt	7440-48-4	70			420	NA
Copper	7440-50-8	9,400				921
Iron	7439-89-6	160,000				NA
Lead	7439-92-1	400				49.6
Manganese	7439-96-5					223
Mercury	7439-97-6	33				0.00509
Methyl Mercury	22967-92-6	23				NA
Nickel	7440-02-0	4,600			15,000	59.1
Selenium	7782-49-2	1,200				2.03
Silver	7440-22-4	1,200				0.189
Thallium	7440-28-0	2.3				1.55
Vanadium	7440-62-2	1,200				NA
Zinc	7440-66-6	70,000				886

The following surface water screening criteria will be considered in the evaluation of the surface water analytical data which are compiled from the EPA’s National Recommended Aquatic Life Criteria and include CMCs and CCCs; and to Idaho WQC for the protection of aquatic life which also include CMCs and CCCs (IDEQ 2016). The WQC criteria require conversion factors based on hardness data. All surface water screening criteria are provided in micrograms per liter (µg/L).

Table 7.2 Surface Water Screening Criteria

Analyte Name	CAS Number	Freshwater CMC/Conversion Factor	Freshwater CCC/Conversion Factor	WQC CMC	WQC CCC
Aluminum	7429-90-5	750	87		
Antimony	7440-36-0				
Arsenic	7440-38-2	340/1.000	150/1.000	340	150

Analyte Name	CAS Number	Freshwater CMC/Conversion Factor	Freshwater CCC/Conversion Factor	WQC CMC	WQC CCC
Barium	7440-39-3				
Beryllium	7440-41-7				
Cadmium	7440-43-9	1.8/1.136672	0.72/1.101672	1.3 I	0.6 I
Chromium (III)	16065-83-1	570/0.316	74/0.860	570 I	74 I
Chromium (VI)	18540-29-9	16/0.982	11/0.962	16	11
Cobalt	7440-48-4				
Copper	7440-50-8			17 I	11 I
Iron	7439-89-6		1000		
Lead	7439-92-1	65/1.46203	2.5/1.46203	65 I	2.5 I
Manganese	7439-96-5				
Mercury	7439-97-6	2.1F/0.85 _G	0.012F/0.85 _G	2.1F _G	0.012F _G
Methyl Mercury	22967-92-6				
Nickel	7440-02-0	470	52	470 I	52 I
Selenium	7782-49-2		5.0	20 ^F	5 ^F
Silver	7440-22-4	3.2/0.85		3.4 ^I	
Thallium	7440-28-0				
Vanadium	7440-62-2				
Zinc	7440-66-6	120/0.978	120/0.986	120 ^I	120 I

Key:

- G = An aqueous MeHg value does not exist. Fish tissue based criteria is used to address MeHg in the water. The fish tissue criteria is 0.3 mg/kg.
- F = Criterion expressed as total recoverable (unfiltered) concentrations.
- I = Aquatic life criteria for these metals are a function of total hardness (mg/L as calcium carbonate), the pollutants water effect ration (WER) as defined in Subsection 210.03.c.iii and multiplied by an appropriate dissolved conversion factor as defined in Subsection 210.02. For comparative purposes only, the example values displayed in this table are shown as dissolved metal and correspond to a total hardness of one hundred (100) mg/L and a water effect ration of one (1.0).

The following sediment screening criteria will be considered in the evaluation of the sediment analytical data and are compiled from the *Draft Development of Benthic SQVs for Freshwater Sediments in Washington, Oregon, and Idaho* (Avocet 2011). All sediment screening criteria are provided in mg/kg.

Table 7.3 Sediment Screening Criteria

Analyte Name	CAS Number	SQS/SL1	SQS/SL2
Antimony	7440-36-0	0.3	12
Arsenic	7440-38-2	14	120
Cadmium	7440-43-9	2.1	5.4
Chromium	16065-83-1	72	82
Copper	7440-50-8	400	1200
Lead	7439-92-1	360	>1300
Mercury	7439-97-6	0.66	0.8
Nickel	7440-02-0	26	110
Selenium	7782-49-2	11	>20
Silver	7440-22-4	0.58	1.7
Zinc	7440-66-6	3200	>4200

In addition, the EPA staff will perform statistical analysis associated with the field collected porewater sampling and the laboratory-based mesocosm data. The statistical analysis will be completed using Statistica® (or equivalent) statistical software. The statistical parameters used and results will be summarized in a report prepared by EPA staff. The MLR will be used to assist the EPA with determining short-term decision regarding future removal actions at the site.

8. Monitoring Approach

No monitoring is anticipated for this project.

9. Sampling Approach

At the time of sampling, site-specific conditions (e.g., topography or visual evidence of contamination) will be evaluated and incorporated, when applicable, into the placement of sampling locations. Potential sample locations are depicted on Figure 9.1. Other conditions that may contribute to deviations from the projected sampling locations include new observations or information obtained in the field that warrant an altered sampling approach and difficulty in reaching a desired soil sampling depth caused by high density soil, obstructions, or limited access to a sampling location. E & E will discuss significant deviations from the planned sampling locations or the number of samples to be collected with the EPA On-Scene Coordinator and Site Assessment Manager prior to implementation. Any deviations will be documented on a Sample Plan Alteration Form.

Based on discussions with EPA, the following is a discussion of the planned sampling activities.

- **Tailings Piles:** There are numerous tailings piles at the site. The upper yellow and red tailings piles are partially in contact with the West Fork Cinnabar Creek. Up to 10 grab surface soil samples will be collected from the piles. Sample locations will be targeted to locations near the stream with placement of up to four of the locations on the outer edges of the piles to assist in estimating the volume of the pile. The surface soil samples will be analyzed for TAL metals including mercury and MeHg and up to six of the samples will be analyzed for agronomic parameters. In addition, potential migration of groundwater through the tailings pile may be impacting West Fork Cinnabar Creek. The depth to groundwater is unknown at the site. Up to six shallow groundwater samples may be collected. The locations of the samples will be immediately adjacent to the West Fork Cinnabar Creek. The groundwater samples will be analyzed for dissolved TAL metals including mercury, MeHg, and hardness.
- **Borrow Source:** A potential source of clean soil may be present at the site which could be used for future removal actions. Up to six surface soil samples will be collected and analyzed for total TAL metals including mercury and agronomic parameters.
- **Adits:** Three flowing adits are reported at the site. In order to determine if contamination is present at the adit and potentially migrating to downstream targets, co-located surface water sediment samples will be collected from each of the adits if located. The surface water samples will be analyzed for total and dissolved TAL metals including mercury, MeHg, and hardness. The sediment samples will be analyzed for total TAL metals including mercury, MeHg, TOC, and grain size.
- **Surface Water Bodies:** West Fork Cinnabar Creek, Cinnabar Creek, Sugar Creek, and Unnamed Tributary and wetlands are within and downstream of the site. Co-located surface water/sediment samples will be collected from the following water bodies. Up to 30 surface water and sediment sample locations are proposed. The surface water samples will be analyzed for total and dissolved TAL metals including mercury, and hardness. The sediment samples will be analyzed for total TAL metals including mercury, TOC, and grain size. Porewater will be

collected at 12 of the locations and analyzed for filtered (0.18 µm): mercury, MeHg, sulfide, OC, and sulfate

- **West Fork Cinnabar Creek:** West Fork Cinnabar Creek flows through the site. In order to determine if metals contamination is present in the Creek, up to 10 locations will be sampled from the site to the confluence with Cinnabar Creek. Six porewater samples will be collected from these locations.
 - **On-Site Wetland:** An on-site wetland is present near the eastern adit. In order to determine if metals contamination is present in the wetland, up to three grab samples will be collected. The samples will be collected at least 500 feet into the wetland. Porewater will also be collected from all of these locations.
 - **Cinnabar Creek:** In order to determine if contamination is migrating from the site to Cinnabar Creek, up to six sample locations will be sampled between the confluences with West Fork Cinnabar Creek and downstream to Sugar Creek. Porewater will be collected from three of these locations.
 - **Sugar Creek:** In order to determine if contamination is migrating from the site to Sugar Creek, up to five sample locations will be sampled on Sugar Creek from the confluence with Cinnabar Creek downstream. One sample location each will be from upstream and downstream of the confluence with the Unnamed Tributary.
 - **Unnamed Tributary:** An Unnamed Tributary is present on Sugar Creek. In order to determine if contamination is present on the tributary, one sample location will be sampled upstream of the confluence with Sugar Creek.
- **Background Samples:** For comparative purposes, background samples will be collected for the following media. The locations of the samples will be placed outside the expected influence of the site.
- **Tailings Pile/Borrow Source:** A background surface soil sample will be collected outside the influence of the site but within the same drainage basin. The sample will be analyzed for total TAL metals including mercury and MeHg.
 - **Adit:** A co-located surface water/sediment sample will be collected from a seep upgradient of the on-site adits. The water sample will be analyzed for total and dissolved TAL metals including mercury, MeHg, and hardness. The sediment samples will be analyzed for total TAL metals including mercury, MeHg, TOC, and grain size.
 - **Wetland:** A co-located surface water/sediment sample will be collected from a background wetland outside the influence of site sources. The surface water samples will be analyzed for total and dissolved TAL metals including mercury, MeHg, and hardness. The sediment samples will be analyzed for total TAL metals including mercury, MeHg, TOC, and grain size. A porewater sample will be collected from this location.
 - **West Fork Cinnabar Creek:** A co-located surface water/sediment sample will be collected upgradient of the site. The water sample will be analyzed for total and dissolved TAL metals including mercury, methyl mercury, and hardness. The sediment samples will be analyzed for total TAL metals including mercury, MeHg, TOC, and grain size. A porewater sample will be collected from this location.
 - **Cinnabar Creek:** A co-located surface water/sediment sample will be collected on Cinnabar Creek upgradient of the confluence with West Fork Cinnabar Creek. If groundwater samples are collected from the tailings piles, a sample will be collected adjacent to Cinnabar Creek at this location. The water sample will be analyzed for total and dissolved TAL metals including mercury, MeHg, and hardness. The sediment

samples will be analyzed for total TAL metals including mercury, MeHg, TOC, and grain size. Porewater will be collected from this location.

- **Sugar Creek:** A co-located surface water/sediment sample will be collected from Sugar Creek upgradient of the confluence with Cinnabar Creek. The water sample will be analyzed for total and dissolved TAL metals including mercury, MeHg, and hardness. The sediment samples will be analyzed for total TAL metals including mercury, MeHg, TOC, and grain size.

Each sample will be provided with a unique numerical identifier as assigned by the EPA Regional Sample Control Coordinator as well as a unique sample code. Samples being shipped to an EPA Contract Laboratory Program (CLP) laboratory will also be assigned a unique CLP sample number. The sample code system is designed to allow easy reference to the sample’s origin and type. The sample code key will not be provided to the laboratory.

Table 9.1 Sample Coding Key

Digits	Description	Code	Example
1,2	Sampling Area	AD	Adit
		BG	Background
		BS	Borrow Source Area
		CC	Cinnabar Creek
		SC	Sugar Creek
		TP	Tailings Pile
		UT	Unnamed Tributary
		WF	West Fork Cinnabar Creek
		WT	Wetland
3,4	Consecutive sample number	01	First number of sampling area
5,6(7)	Matrix Code	GWD	Groundwater Dissolved
		PW	Porewater
		SW	Surface Water
		SWD	Surface Water Dissolved
		SD	Sediment
		SS	Surface Soil

10. Sampling Methodology

The following Standard Operating Procedures (SOPs) and/or instrumentation manuals will be used during the project:

- Field Activity Logbook SOP;
- Sampling Equipment Decontamination SOP;
- Environmental Sample Handling, Packaging and Shipping SOP;
- Site Entry Procedures for Potentially Contaminated Sites SOP;
- Aquatic Sediment Sampling SOP;
- Surface and Shallow Subsurface Soil Sampling SOP; and
- Surface Water Sampling SOP.

10.1 Surface Soil Sampling

Surface soil (0 to 6 inches below ground surface) grab samples will be collected using dedicated plastic scoops. Collected material will be placed in a dedicated plastic bowl, thoroughly homogenized and placed into a pre-labeled sample container.

10.2 Surface Water Sampling

Surface water grab samples will be collected either by hand-dipping the sample container into the water, if possible, or by creating a funnel with a dedicated 1-liter polyethylene sample bottle with the bottom of the bottle removed. Sample will be preserved as required upon sample collection completion or as soon as practicable, and after filtration for dissolved matrix parameters. Dissolved samples will be 0.45µm filtered within 15 minutes of collection. At co-located surface water sediment locations, the surface water sample will be collected prior to the sediment sample. Samples will be collected from downstream to upstream to avoid potential cross-contamination of downstream sample locations.

10.3 Surface Sediment Sampling

Surface sediment samples (0 to 4 centimeters) will be collected using dedicated plastic scoops. Collected material will be homogenized thoroughly in dedicated plastic bowls. The sample material will be decanted of as much water as possible prior to placement into pre-labeled sample containers after allowing to settle when possible. At co-located surface water sediment locations, the surface water sample will be collected prior to the sediment sample. Samples will be collected from downstream to upstream to avoid potential cross-contamination of downstream sample locations.

10.4 Groundwater Sampling

Ground water samples will be collected from a temporary well point. Well points will be installed by hand-hammering a four foot metal rod into the ground. A well screen will be placed in the rod after groundwater has been encountered. The temporary well point will be allowed to stabilize for at least one hour. Dedicated Teflon-lined tubing will be placed in the hole and the sample will be collected directly into dedicated containers. Samples will be preserved as required upon sample collection completion or as soon as practicable. Dissolved metals samples will be 0.45µm filtered within 15 minutes of collection.

10.5 Porewater Sampling

Depending on the depth of water at the sample location, porewater samplers will be directly inserted into the sediment (shallow water scenario) or sediment will be removed from the creek (deep water scenario) using a core tube and then porewater will be extracted from the tube. Porewater samples will be collected and preserved in the field using Rhizon samplers, which includes an in-line 0.18 µm filter. All porewater samples are identified as 'filtered' samples instead of 'dissolved' since they do not meet the EPA-definition of the dissolved matrix (0.45 µm).

Currently, it is unclear how much (if any) sediment will be available for sampling in the streams, since it is a relatively high-energy head-water stream that may favor erosion over deposition. At locations where there is sediment present on the bottom of the stream that is at least 5 centimeters (cm) deep, a sample of the sediment will be collected using a core tube (pushed in by hand) and the sediment will be transferred to a clean plastic bowl after any overlying water has been removed via syringe. The Rhizon porewater sampler will be inserted into the sediment in the bowl for porewater extraction. Multiple core samples targeting 0-5 cm depths may need to be collected at a given location to result in sufficient

porewater volumes for analysis. The porous component of the Rhizon samplers are 5 cm in depth, which provides an operational constraint to obtaining finer resolution measurements. The removal of sediment from the streambed prior to porewater measurement is necessary to ensure that overlying water is not being sampled instead of porewater once a suction on the Rhizon sampler is applied. At locations where there is no sediment on the creek bottom, porewater will be collected in the riparian zone along the stream at the interface between the stream bank and the water. At these locations, the Rhizon sampler will be inserted directly into the soil/tailings at a depth of 5 cm below the surface.

10.6 Laboratory Mesocosm

A tailings material sample with a volume of 0.045 m³ (1.6 ft³), which equates to three full 5-gallon buckets of material, will be collected. Material will be placed in the 5-gallon buckets with a shovel. Details of the Laboratory Mesocosm study are provided in a separate document as Attachment B to this SSSP, and the number of samples obtained from this study are included in Table 9.2 of this document.

11. Data Quality

The project data quality objectives (DQOs) for the Cinnabar Mine IA are: 1) to acquire data that can be used to make decisions regarding the release and presence of on-site contamination related to former operations; 2) to characterize sources of contamination; 3) determine off-site migration of contaminants; 4) determine whether the site is eligible for placement on the NPL; and 5) document any threats or potential threats that the site poses to public health or the environment. To obtain data that will support this decision, valid data of known and documented quality must be provided and the following quality controls will be applied.

- The laboratory will provide definitive data. The data will be reviewed and assessed for representativeness, comparability, completeness, precision, and accuracy. Field and laboratory QC will be evaluated including laboratory surrogates, laboratory spikes and duplicates, and laboratory blanks.
- Laboratory QC samples (blanks, duplicates, and matrix spikes) will be analyzed to assess laboratory performance.
- Field blanks will be collected and analyzed to assess contamination for trace-level analyses (i.e., mercury).

The final data for the project will be used by the EPA to achieve project objectives. Standard laboratory reporting limits (MRLs, CRQLs) are acceptable as indicated in the analytical table.

The DQO process applied to this project follows that described in the document *Guidance on Systematic Planning Using the data Quality Objectives Process/G-4* (EPA 2006).

11.1 Data Quality

All samples collected under this SSSP will be analyzed using definitive analytical methods. All definitive analytical methods employed for this project will be methods that have been approved by the EPA. The data generated under this project will comply with the requirements for this data category as defined in *Data Quality Objectives Process for Superfund Interim Final Guidance* (EPA 1993).

11.2 Data Quality Indicators

The goals of data quality indicators (DQIs) representativeness, comparability, completeness, precision, and accuracy for this project were developed following guidelines presented in the EPA's *Guidance for Quality Assurance Plans, EPA QA/G-5* (EPA 2002).

The basis for assessing each element of data quality is discussed below as well as QA objectives for measurement of analytical data and QC guidelines for precision and accuracy. Other DQI goals are included in the individual SOPs as noted in Section 13 below and in the specified analytical methods or Laboratory Statement of Work (SOW).

11.2.1 Representativeness

Representativeness is a measure of the degree which data accurately and precisely represent a population, including a sampling point, a process condition, or an environmental condition. Representativeness is the qualitative term that should be evaluated to determine that measurements are made and physical samples are collected at locations in a manner resulting in characterizing a matrix or media. Subsequently, representativeness is used to ensure that a sampled population represents the target population and an aliquot represents a sampling unit. This SSSP will be implemented to establish representativeness for this project. Further, all sampling procedures documented in the SSSP will be followed to ensure the data are representative of the media sampled.

11.2.2. Comparability

Comparability is the qualitative term that expresses the measure of confidence that two data sets or batches can contribute to a common analysis and evaluation. Comparability with respect to laboratory analysis pertains to the method type comparison, holding times, stability issues, and aspects of overall analytical quantitation. The following items are determined when assessing data comparability:

- If two data sets or batches contain the same set of parameters;
- If the units used for each data set are convertible to a common metric scale;
- If similar analytical methods and QA were used to collect data for both data sets;
- If the analytical instruments used for both data sets have approximately similar detection levels; and
- If samples within data sets were selected and collected in a similar manner.

To ensure comparability of data collected during this sampling event to other data that was collected or may be collected in the future, standard collection and measurement techniques will be used.

11.2.3 Completeness

Completeness is calculated for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples. Completeness is calculated and reported for each method, matrix, and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results not rejected through data validation. The requirement for completeness is 90% for aqueous samples.

The following formula is used to calculate completeness:

$$\% \text{ completeness} = \frac{\text{number of valid results} \times 100}{\text{number of possible results}}$$

For any instances of samples that could not be analyzed for any reason (e.g., holding time violations in which re-sampling and analysis were not possible, and samples spilled or broken), the numerator of this calculation becomes the number of valid results minus the number of possible results not reported. For this sampling event, all samples are considered critical. Therefore, standard collection and measurement methods will be used to achieve the completeness goal.

11.2.4 Precision

Precision measures the reproducibility of measurements. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions.

Analytical precision is the measurement of the variability associated with duplicate (two) or replicated (more than two) analyses. The relative percent difference (RPD) between a field or “native” sample and the corresponding laboratory duplicate same determines the precision of the analytical method. If the RPD of the analytes in the laboratory duplicate analysis are within established control limits, the precision is within limits.

Total precision is the measurement of the variability associated with the entire sampling and analysis process. Total precision is determined by analysis of duplicate, replicate, and/or spiked samples and measures variability introduced by both the laboratory and field operations. Matrix duplicate spiked samples shall be analyzed to assess field and analytical precision, and the precision measurement is determine using the RPD between the duplicate sample results.

The following formula is used to calculate precision:

$$RPD = (100) \times \frac{(S1 - S2)}{(S1 + S2)/2}$$

Where:

S1 = original sample values

S2 = duplicate sample value

For this project, precision less than or equal to 35% RPD or in accordance with standard lab criteria (i.e. SOPs, SOW) will fulfill the DQOs.

11.2.5 Accuracy

Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systemic error. It reflects the total error associated with a measurement. Bias is the systematic or persistent distortion of a measurement process that causes error in one direction. Blanks, matrix spikes, laboratory control samples, and other reference materials are used to determine bias. A measurement is accurate when the value reported does not differ from the true value or known concentration of the spike and standard. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into a laboratory control sample, surrogate, or matrix spike sample to a control limit. Analysis of performance evaluation samples may also be used to provide additional information for assessing the accuracy of the analytical data produced. For this project, accuracy between 60% and 140% will fulfill the DQOs or in accordance with standard lab method criteria (i.e. SOPs, SOW).

11.2.6 Sensitivity

Sensitivity is the determination of the minimum concentration or attribute that can be measured by a Method Reporting Limit or Quantitation Limit. Methods selected for this project are expected to provide sufficient sensitivity to yield reporting limits that are below the lowest reference value for this study. In situations where the CRQL is higher than the screening criteria, the CRQL will be used as the screening level.

11.3 Quality Control Requirements

QC checks for sample collection will be accomplished by a combination of chain-of-custody (COC) protocols and laboratory QA procedures as prescribed in the sampling or analytical methods. No QC samples (i.e., double blind performance evaluation samples) are planned for this sampling event outside of the normal QA criteria outlined in the analytical methods. These QC samples include blanks (field and/or laboratory method), calibration verifications, spikes (matrix and blank), duplicates, interference check samples (for inorganics), and serial dilutions. Results from these samples will be compared to the QC requirements listed above. All analyses that will be performed at off-site fixed laboratories for this sampling event will produce definitive data. In accordance with the objectives outlined in this document and the QA levels defined by the EPA (1993), the EPA has defined the DQOs and has determined that the sampling and analyses performed under this sampling effort will conform to the definitive data without quantitative error and bias determination criteria.

One temperature blank consisting of a plastic vial of tap water will be included in each cooler shipped to the CLP analytical laboratories. Temperature blanks allow the laboratories to obtain a representative measurement of the temperature of samples enclosed in a cooler without disturbing the actual samples. The analytical laboratory will only measure the temperature of the blank. The temperature blank will not be analyzed for hazardous substances, will not be given a sample number, and will not be listed on the COC form. The temperature blank will be clearly labeled: TEMP BLANK. Temperature blanks are not required for shipments to EPA Region 10 Manchester Environmental Laboratory (MEL) since MEL staff measure the temperature of every cooler using a probe and/or calibrated infra-red gun for each sample.

12. Data Validation

Commercial laboratory data validation of E&E subcontracted data will be performed as listed in the EPA Region 10 ERU SOP 144E (Analytical Data Validation). The most current version of validation guidelines referenced in this document will be used. All MEL and CLP laboratory data validation will be performed in accordance with the technical specifications of the analytical methods and/or the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review* (EPA 2014).

Commercial (subcontracted) laboratory data validation will be performed by a START-IV chemist. Data will receive a minimum of Stage 2B evaluation (S2BVE), and 10% of the data will receive a minimum of a Stage 4 evaluation (S4VEM; EPA 2009).

CLP laboratory data will be validated in a three-week turnaround time by an EPA Region 10 QA chemist at 100% Stage 4 evaluation (S4VEM). A START-IV chemist will perform data assessment of each data package.

MEL data will be validated by MEL chemist's equivalent to a Stage 4 evaluation level (S4VM). A START-IV chemist will perform a Stage 1 verification of each data package.

The following qualifiers shall be used during data validation:

- J = The associated numerical value is an estimated quantity because the reported concentrations were less than the sample quantitation limits or because quality control criteria limits were not met.
- Q = Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.
- R = The sample results are rejected (analyte may or may not be present) due to gross deficiencies in quality control criteria. Any reported value is unusable. Resampling and/or reanalysis is necessary for verification.
- U = The material was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.
- UJ = The material was analyzed for but was not detected. The reported detection limit is estimated because QC criteria were not met.

The following bias qualifiers will be appended to J-estimated result qualifiers:

- H = High bias.
- K = Unknown bias.
- L = Low bias.
- Q = The result is estimated because the concentration is below the reporting limit.

13. Data Reporting

In accordance with the Region 10 Data Management Plan, all field data will be managed in accordance with a Site Specific Data Management Plan (Attachment A). Following collection, field data shall be processed to generate a Scribe compatible file, which will be imported into a Scribe database. Scribe datasets shall be published to Scribe.NET prior to completion of the project.

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Table 2.1 Surface Water Samples Analytical Results Summary

EPA Total Metals Sampled ID	14334303	14334333	14334336	14334300	14334306	14334312	14334315	14334318	14334323	14334326	14334309	14334331	14334321		
EPA Dissolved Metals Sample ID	14334304	14334334	14334337	14334301	14334307	14334313	14334316	14334319	14334324	14334327	14334310	14334332	14334322		
Total Metals CLP Sample ID	MJGXC2	MJGXE2	MJGXE4	MJGXC0	MJGXC4	MJGXC8	MJGXD0	MJGXD2	MJGXD6	MJGXD8	MJGXC6	MJGXE0	MJGXD4		
Dissolved Metals CLP Sample ID	MJGXC3	MJGXE3	MJGXE5	MJGXC1	MJGXC5	MJGXC9	MJGXD1	MJGXD3	MJGXD7	MJGXD9	MJGXC7	MJGXE1	MJGXD5		
Station Location	BG01SW	BG02SW	BG02SW ^(a)	CC01SW	CC02SW	CC03SW	CC04SW	CC05SW	CC06SW	CC07SW	SC01SW	AD01SW	CP01SW		
Description	Background			Cinnabar Creek						Sugar Creek		Adit	Adit Pond		
Hardness (milligrams per liter)															
Hardness			34.9	50	51	66.4	71.3	35.5	57.4	57.6	61.7	70.5	39.5	82	91.7
Total Metals (micrograms per liter)															
Arsenic			10.0 U	7.9 JQ	7.9 JQ	11.4	11.6	4.3 JQ	12.9	9.8 JQ	15.2	18.0	3.5 JQ	38.1	18.1
Calcium			12200	12400	12600	20900	22500	10300	17200	17800	17100	19300	13200	19500	25800
Lead			1.0 U	1.0 U	1.0 U	1.1	1.0 U	3.9							
Magnesium			1080 JQ	4640 JQ	4750 JQ	3420 JQ	3650 JQ	2350 JQ	3520 JQ	3180 JQ	4650 JQ	5400	1600 JQ	8060	6610
Mercury			0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.20 U	0.061 JQ	0.20 U	0.10 JQ	0.11 JQ	0.20 U	0.15 JQ	0.36
Dissolved Metals (micrograms per liter)															
Arsenic	340	150	2.8 JQ	6.7 JQ	6.8 JQ	9.6 JQ	10.5	3.3 JQ	13.6	14.8	18.7	17.9	4.7 JQ	42.4	16.4
Lead	20.2 - 58.8 ^d	0.79 - 2.29 ^e	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Mercury	1.4	0.77	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U

Note: Bold type indicates the sample result is above the Contract Required Quantitation Limit.
 (a) Duplicate Sample

Key:
 CCC = Criterion continuous exposure (chronic criteria), National Recommended Water Quality Criteria, Fresh Water, Aquatic Life Criteria (EPA 2009) and State of Idaho Water Quality Standards, Aquatic Life Criteria (IDAPA 58.01.02).
 CLP = Contract Laboratory Program.
 CMC = Criterion maximum concentration (acute criteria), National Recommended Water Quality Criteria, Fresh Water, Aquatic Life Criteria (EPA 2009) and State of Idaho Water Quality Standards, Aquatic Life Criteria (IDAPA 58.01.02).
 EPA = United States Environmental Protection Agency
 ID = Identification
 J = The associated numerical value is an estimated quantity.
 Q = Detected concentration is below the contract required quantitation limit but is above the method detection limit.
 U = The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

b Criterion is for dissolved concentration.
 c National Recommended Water Quality Criteria, Fresh Water, Aquatic Life Criteria (EPA 2009) and State of Idaho Water Quality Standards, Aquatic Life Criteria (IDAPA 58.01.02)
 d The freshwater criterion for lead is expressed as a function of the hardness for the respective sample. The criterion was calculated using the following equation: CMC (dissolved) = exp{mA [ln(hardness)]+ bA} (CF). The parameters used are specified in Appendix B-Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent (EPA 2009) and Idaho Water Quality Standards Subsection 210.c.ii (IDAPA 58.01.02).
 e The freshwater criterion for lead is expressed as a function of the hardness for the respective sample. The criterion was calculated using the following equation: CCC (dissolved) = exp{mC [ln (hardness)]+ bC} (CF) . The parameters used are specified in Appendix B-Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent (EPA 2009) and Idaho Water Quality Standards Subsection 210.c.ii (IDAPA 58.01.02).

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Table 2.2 Sediment Samples Analytical Results Summary

EPA Sample ID	14334305	14334335	14334338	14334302	14334308	14334314	14334317	14334320	14334325	14334328	14334311		
CLP Sample ID	MJGXB0	MJGXB8	MJGXB9	MJGXE6	MJGXB1	MJGXB3	MJGXB4	MJGXB5	MJGXB6	MJGXB7	MJGXB2		
Station Location	BG01SD	BG02SD	BG02SD ^(a)	CC01SD	CC02SD	CC03SD	CC04SD	CC05SD	CC06SD	CC07SD	SC01SD		
Description	TEC	PEC	Background				Cinnabar Creek				Sugar Creek		
Total Metals (milligrams per kilogram)													
Arsenic	9.79	33.0	10.5	102	113	113	188	90.2	217	262	207	520	49.7
Lead	35.8	128	7.2 JH	5.4 JH	4.9 JH	1.7 JH	2.1 JH	6.7 JH	4.6 JH	6.5 JH	7.0 JH	6.7 JH	7.8 JH
Mercury	0.18	1.06	0.015 JQ	18.3 JK	10.6 JK	20.4 JK	12.4 JK	4.3 JK	152 JK	80.1 JK	12.1 JK	54.4 JK	3.5 JK

Note: Bold type indicates the sample result is above the Contract Required Quantitation Limit.
 Highlight type indicates the sample result is above the screening criteria.
 (a) Duplicate Sample

Key:
 CLP = Contract Laboratory Program.
 EPA = United States Environmental Protection Agency.
 H = High bias.
 ID = Identification.
 J = The associated value is an estimated quantity.
 K = Unknown bias.
 PEC = Probable effect threshold.
 Q = Detected concentration is below the Contract Required Quantitation Limit but is above the Method Detection Limit.
 TEC = Threshold effect concentration.

Table 2.3 Tailings Pile Samples Analytical Results Summary

EPA Sample ID	Freshwater		14334329	14334330	14334339	14334340	14334341
Station Location	Freshwater		YT01SS	YT02	RT01	RT01 ^(a)	RT02
Description	CMC	CCC	Yellow Tailings		Red Tailings		
Synthetic Precipitation Leaching Procedure (µg/L)							
Arsenic	340	150	7.20	342	691	696	1630
Lead	65	2.5	0.28 JH	0.050 U	0.20 JH	0.42 JH	0.23 JH
Mercury	1.4	0.77	2.02	0.050 U	3.96	6.21	1.16

Note: Bold type indicates the sample result is above the method detection limit.
 Highlight type indicates the sample result exceeds one or more of the screening criteria.
 (a) Duplicate Sample
 Lead criteria is hardness dependent. A hardness value of 100 is assumed for these samples.

Key:
 CCC = Criterion continuous exposure.
 CLP = Contract Laboratory Program.
 CMC = Criterion maximum concentration.
 EPA = United States Environmental Protection Agency
 ID = Identification
 J = The identification of the analyte is acceptable; however, the reported value is an estimate.
 H = High bias.
 U = The analyte was not detected at or above the reported value.
 The associated value is either the sample quantitation limit or the sample detection limit.

Table 2.4 USGS Surface Water Sample Analytical Results

Location	Description	Date	LAT	LONG	Mercury ng/L	ethylmercu ng/L	Arsenic mg/L	Arsenic III mg/L	Lead mg/L
Freshwater CMC					1400	1700	0.34	0.34	0.065
Freshwater CCC					770	770	0.15	0.15	0.0025
Water Quality Criteria CMC						N/A	0.35	0.34	0.0655
Water Quality Criteria CCC						N/A	0.15	0.15	0.0025
Cinnabar Creek above Cinnabar mine site	Background	8/18/2014	44.9247	-115.2812	16	0.06	0.0033	-0.0003	-0.01
West Fk Cinnabar headwater	Background	6/26/2015	44.91861	-115.2908	-9999	-9999	0.0053	0.0009	-0.01
West tributary to Cinnabar Creek above mine site	Background	7/25/2015	44.91814	-115.2911	3.41	-0.04	0.0047	-0.0005	-0.01
East tributary to Cinnabar Creek above mine site	Background	7/25/2015	44.91856	-115.2874	7.5	-0.04	0.0092	-0.0005	-0.01
Spring #1 above Cinnabar mine site		6/26/2015	44.91359	-115.2907	-9999	-9999	0.0035	-0.0005	-0.01
Upper mine adit; Cinnabar site		7/25/2015	44.91848	-115.2903	30.6	-0.04	0.0215	0.0009	-0.01
Lower mine adit at Cinnabar mine site		8/19/2014	44.91986	-115.2887	46.5	0.14	0.0421	0.0008	-0.01
Wetland on Cinnabar tailings		8/19/2014	44.92079	-115.2885	24.5	0.07	0.089	0.0215	-0.01
W Fk Cinnabar Creek below Cinnabar mine site		8/19/2014	44.92252	-115.2873	31.5	7.3	0.0186	0.0083	-0.01
Cinnabar Creek immediately below mine site		7/25/2015	44.92254	-115.2873	50.1	0.06	0.0195	0.0009	-0.01
Cinnabar Creek above Sugar Creek		8/18/2014	44.95173	-115.2905	6.25	0.06	0.0115	-0.0003	-0.01
Cinnabar Creek above confluence with Sugar Creek		7/23/2015	44.9519	-115.292	35.6	0.1	0.0118	0.0007	-0.01
Sugar Creek above confluence with Cane Creek	Attribution	7/23/2015	44.95324	-115.2917	3.11	-0.04	0.0016	-0.0005	-0.01
Cane Creek above confluence with Sugar Creek	Attribution	7/23/2015	44.9534	-115.2921	2.92	-0.04	0.0023	-0.0005	-0.01
Sugar Creek above Cinnabar Creek		8/18/2014	44.95253	-115.2936	0.39	-0.04	0.0019	-0.0003	-0.01
Sugar Creek below road crossing		7/24/2015	44.94648	-115.3059	13.6	0.13	0.0053	0.0005	-0.01
Sugar Creek below road crossing		7/24/2015	44.94648	-115.3059	-9999	-9999	0.0055	0.0006	-0.01
Sugar Creek above West End Creek		7/24/2015	44.93863	-115.3201	12.4	0.12	0.0058	0.0007	-0.01
Sugar Creek above USGS 1331450		6/28/2015	44.93578	-115.3296	9.38	0.38	0.01	-0.0005	-0.01
EFSF Salmon above Sugar Creek		6/28/2015	44.93472	-115.3365	3	0.05	0.0641	0.0132	-0.01

Notes:

Sample time; 99:99 indicates time unavailable.

Negative values indicate results less than the detection limit (lower determination limit) of the analytical method. The absolute value of the negative number is the detection limit.

A value of -9999 means not analyzed or constituent not present.

Key:

N/A = Not applicable.

ng/L = nanograms per liter.

mg/L = milligrams per liter.

CMC = Acute exposure.

CCC = Chronic exposure.

Table 2.5

USGS Sediment Sample Results

Site Name	Description	LAT	LONG	Methylmercury ppb	Mercury ppm	Arsenic ppm	Lead ppm
Sediment Quality Standard	Level 1			0.66	0.66	14	360
Cleanup Screening Level	Level 2			0.8	0.8	120	>1300
Cinnabar Creek E Fk	Background	44.9247	-115.2812	7.57	102	6.3	9.49
Spring #1 above Cinnabar mine site	Background	44.91359	-115.2907	-9999	4.62	29	11.1
East tributary to Cinnabar Creek above mine site	Background	44.91856	-115.2874	2.1	1.74	38	2.52
Wetland sediment (pool)		44.92079	-115.2885	26	813	849	23.7
Cinnabar Creek below mine site.		44.92254	-115.2873	1.19	14.7	69.1	9.65
Cinnabar Creek below mine site		44.92252	-115.2873	2.98	169	137	7.64
Cinnabar Creek above sugar Creek		44.95173	-115.2905	4.33	160	96.9	5.54
Cinnabar Creek above confluence with Sugar Creek		44.9519	-115.292	8.21	149	103	5.92
Sugar Creek above confluence with Cane Creek	Attribution	44.95324	-115.2917	-0.17	0.02	8.8	15.6
Cane Creek above confluence with Sugar Creek	Attribution	44.9534	-115.2921	-0.17	0.07	10.5	11.7
Sugar Creek below Cinnabar Creek		44.95253	-115.2936	0.17	11.7	0.22	12.6
Sugar Creek below road crossing		44.94648	-115.3059	0.51	11.5	37.7	9.56
Sugar Creek above West End Creek		44.93863	-115.3201	0.55	9.65	26.7	9.75

Notes:

Negative values indicate concentrations less than the detection limit (lower determination limit) of the analytical method. The absolute value of the negative number is the detection limit.

A value of -9999 means not analyzed or constituent not present.

Yellow highlight indicates the sample result is above the SQS.

Orange highlight indicates the sample results is above the CSL.

Key:

ppb = parts per billion.

ppm = parts per million.

Table 2.6

USGS Tailings and Soil Sample Results

SiteName	LAT	LONG	Methylmercury ppb	Mercury ppm	Arsenic ppm	Lead ppm
EPA Removal Management Level			7800	11	35	400
EPA Regional Screening Level			7800	NA	5.5	NA
IDTL			NA	0.00509	0.391	49.6
lower floatation tailings	44.9212	-115.28844	11.9	1710	1030	7.55
upper floatation tailings	44.92117	-115.28809	12.3	1180	453	8.87
lower calcine tailings	44.92059	-115.28852	2.6	375	34.4	9
upper calcine talings	44.92022	-115.28903	0.37	520	10.5	9.31
Wetland soil	44.92079	-115.28846	48	1450	1140	11.1

Notes:

Yellow highlight indicates the sample results exceeds the Regional Screening Level and the Initial Default Target Level

Orange highlight indicates the samples results exceeds all criteria for which there is a value.

Key:

NA = Not Applicable.
 ppb = parts per billion.
 ppm = parts per million.

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Table 9.2 Sample Analysis Summary and QA/QC Analytical Summary and Fixed Laboratory Analytical Methods

Matrix	Proposed Laboratory	Analytical Parameters/Method Description/Detection Limits	Technical Holding Times	Sample Preservation (all 4°C ± 2°C)	Sample Containers/Lab QC Sample Containers	Number of Field Samples	Number of Lab QC Samples	Number of Field QC Samples	Total Number of Sample Containers
Soil/Sediment	CLP/MEL	TAL Metals ^f (no mercury)/EPA CLP SOW ISM02.3 (or current SOW) or EPA 3050B+6010B/6020A/ ICP-AES-MS/CRQL	180 days	N/A	1x8-ounce glass/ 1x8-ounce glass (Shared container)	50	3	3	53
	CLP/MEL	Mercury/EPA CLP SOW ISM02.3 (or current SOW) or EPA SW-846 7471B/CVAAS/CRQL	28 days	N/A		50	3	3	53
	Subcontract	Grain Size/ASTM D-422/Sieve and hydrometer/0.05 millimeter	N/A	N/A	2X8-ounce glass/N/A	34	N/A	N/A	68
	MEL	Total Organic Carbon/PSEP-TOC-M/20ug of C (~500 mg/kg)	28 days	N/A	1X8-ounce glass/N/A	34	N/A	N/A	34
	Subcontract	Methylmercury/Modified EPA 1630/CVAFS/1.0 µg/kg	180 days ^a	N/A	1x8-ounce glass/ N/A	44	N/A	N/A	44
	Subcontract	Agronomics (see attached testing parameters)	N/A	N/A	1X1-Liter zip-topped bag	6	N/A	N/A	6
Surface Water	CLP/MEL	TAL Total Metals ^f /EPA CLP SOW ISM02.3 (or current SOW) or EPA 3050B+6010B/6020A/ICP-AES-MS/CRQL	180 days	pH ≤ 2 with HNO ₃	1x1-liter polyethylene/ 2x1-liter polyethylene	34	2	4	38
	CLP/MEL	Hardness (calculated)/ISM02.3 (SM2340B)/ICP-AES/CRQL	180 days	Filter 0.45 µm within 15 minutes of collection; pH ≤ 2 with HNO ₃	1x1-liter polyethylene/ 2x1-liter polyethylene	34	2	4	38
	MEL	Total Mercury/EPA 1631E/CVAFS / 0.5 ng/L	90 days	HCl to pH <2	One 500 mL Teflon® or acid-cleaned glass or FPE-lined plastic bottle ^b	34	2	4	38
	MEL	Dissolved Methylmercury/ EPA 1630/CVAFS/0.05 ng/L	180 days	pH ≤ 2 with HCl Filter at 0.45 µm within 15 minutes of collection	One 500 mL Teflon® or acid-cleaned glass or FPE-lined plastic bottle ^b	34	4	4	38
	CLP/MEL	Hardness (calculated)/ISM02.3 (SM2340B)/ICP-AES/CRQL	180 days	Included in total TAL Metals container					
	CLP/MEL	TAL Dissolved Metals ^f (not mercury)/EPA CLP SOW ISM02.3 (or current SOW) or EPA 3050B+6010B/6020A/ ICP-AES-MS/CRQL	180 days	Filter 0.45 µm within 15 minutes of collection; pH ≤ 2 with HNO ₃	1x1-liter polyethylene/ 2x1-liter polyethylene	34	2	4	38
	MEL	Dissolved Mercury/EPA1 1631E/CVAFS/ 0.5 ng/L	90 days	Filter at 0.45 µm within 15 minutes of collection, pH ≤ 2 with HCl	1 x 500 mL Teflon® or acid-cleaned glass or FPE-lined plastic bottle ^b	34	2	4	38
Porewater	MEL	Filtered Mercury/EPA 1631E/CVAFS/0.5 ng/L	90 days	HCl to pH <2	1 x 250 mL Teflon® or acid-cleaned glass or FPE-lined plastic bottle ^b	12	1	2	14
	MEL	Filtered Methylmercury/ EPA 1630 CVAFS/0.05 ng/L	180 days	HCl to pH <2		12	1	2	14
	MEL	Filtered Sulfide/SM4500S ₂ / Colorimetry Photometry/0.1 to 20.0 mg-S ²⁻ /L	7 days	0.2 mL 2N Zn acetate	1 x 250 ml glass	12	1	2	14
	MEL	Filtered Organic Carbon/SM 5310B/Non-dispersive Infrared detection/1 mg/L	28 days	HCl or H ₂ SO ₄ to pH <2	2 x 40 mL glass or 250 mL amber glass	12	1	2	14
	MEL	Filtered Sulfate/EPA Method 300.0/0.3 mg/L	28 days	NA	1 x 250 ml plastic	12	1	2	14
Groundwater	MEL	Dissolved Methylmercury/ EPA 1630 CVAFS/0.05 ng/L	180 days	pH ≤ 2 with HCl Filter at 0.45 µm within 15 minutes of collection	One 500 mL Teflon® or acid-cleaned glass or FPE-lined plastic bottle ^b	6	1	2 ^c	8
	CLP/MEL	TAL Dissolved Metals ^f (no mercury)/EPA CLP SOW ISM02.3 (or current SOW) or EPA 3050B+6010B/6020A/ ICP-AES-MS/CRQL	180 days	Filter 0.45 µm within 15 minutes of collection; pH ≤ 2 with HNO ₃	1x1-liter polyethylene/ 2x1-liter polyethylene (Shared Container)	6	1	2 ^c	8
	CLP/MEL	Hardness (calculated)/ISM02.3 (SM2340B)/ICP-AES/CRQL	180 days	Filter 0.45 µm within 15 minutes of collection; pH ≤ 2 with HNO ₃		6	1	2	8
	MEL	Dissolved Mercury/EPA 1631E/CVAFS/0.5 ng/L	90 days	Filter at 0.45 µm within 15 minutes of collection, pH ≤ 2 with HCl	1 x 500 mL Teflon® or acid-cleaned glass or FPE-lined plastic bottle ^b	6	1	2 ^c	7
Mesocosm ^e – Leaching Surface Water	MEL	Mesocosm Leaching Water Field Sample	N/A	N/A	1 x 5-Gallon bucket	25	N/A	1	26

Matrix	Proposed Laboratory	Analytical Parameters/Method Description/Detection Limits	Technical Holding Times	Sample Preservation (all 4°C + 2°C)	Sample Containers/Lab QC Sample Containers	Number of Field Samples	Number of Lab QC Samples	Number of Field QC Samples	Total Number of Sample Containers
Mesocosm ^e – Tailings Soil/Sediment	MEL	Mesocosm Tailings Field Sample	N/A	N/A	5-gallon plastic bucket	3	N/A	N/A	3
Mesocosm - Porewater Experiment Samples	MEL	Filtered Mercury/EPA 1631E/CVAFS/0.5 ng/L	90 days	HCl to pH <2	1 x 250 mL Teflon [®] or acid-cleaned glass or FPE-lined plastic bottle ^b (shared container)	24	1	1	25
	MEL	Filtered Methylmercury/ EPA 1630 CVAFS/0.05 ng/L	180 days	HCl to pH <2		24	1	1	25
	MEL	Filtered Sulfide/SM4500S ₂ or test kit./ Colorimetry Photometry/0.1 to 20.0 mg-S ² /L	7 days	0.2 mL 2N Zn acetate	1 x 250 ml glass	24	1	1	25
	MEL	Filtered Organic Carbon/SM 5310B/Non-dispersive Infrared detection/1 mg/L	28 days	HCl or H ₂ SO ₄ to pH <2	2 x 40 mL glass or 250 mL amber glass	24	1	1	25
	MEL	Filtered Sulfate/EPA Method 300.0/0.3 mg/L	28 days	NA	1 x 250 ml plastic	24	1	1	25
Mesocosm – Tailings Soil/Sediment Experiment Samples	CLP/MEL	Mercury/ EPA 7471B/CVAAS/CRQL	28 days	N/A	1x8-ounce glass (shared)	6	1	N/A	6
	MEL	Total Organic Carbon/PSEP-TOC-M/20ug of C (~500 mg/kg)	28 days	N/A		6	1	N/A	6
	Subcontract	Methylmercury/Modified EPA 1630/CVAFS/1.0 µg/kg	180 days ^a	N/A	1x8-ounce glass/ N/A	6	N/A	N/A	6

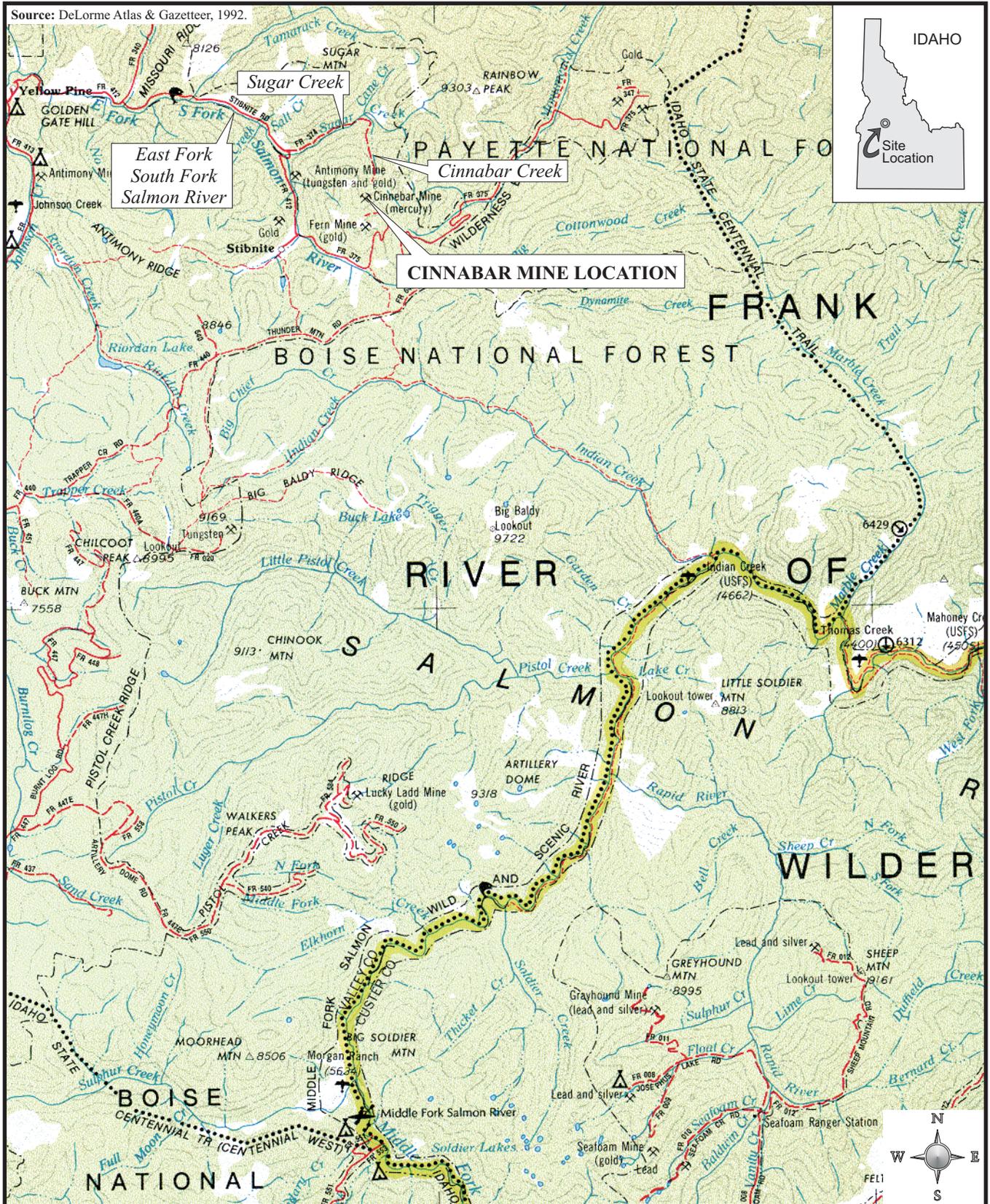
Notes:

- ^a Water holding times are notes for this analysis in the absence of soil technical holding times.
- ^b Sample containers for water methylmercury analysis will be supplied by the laboratory to ensure certification for cleanliness to the ng/L level.
- ^c Field QC sample for groundwater is a rinsate blank from the well screen. Field QC for all filtered matrices is a filter blank (both SW/GW dissolved 0.45µm and porewater Rhizon 0.18µm).
- ^d Samples filtered at 0.45µm are identified as “dissolved” water matrix (meeting EPA Definition of Dissolved); those filtered at a different pore size such as 0.18µm Rhizon porewater samples are identified as a “filtered” water matrix.
- ^e Field tailings and leaching water samples will be delivered to MEL under one sample ID each (multiple containers). These are the only samples arriving from the field; the rest of the samples indicated as mesocosm are those that will be generated during the experiment for analysis (see attachment A)
- ^f TAL metals are scheduled via ICP-AES based on site criteria with the following exceptions: ICP-MS soil for antimony, arsenic, silver, and thallium; ICP-MS water for cadmium, copper, lead, selenium, and silver

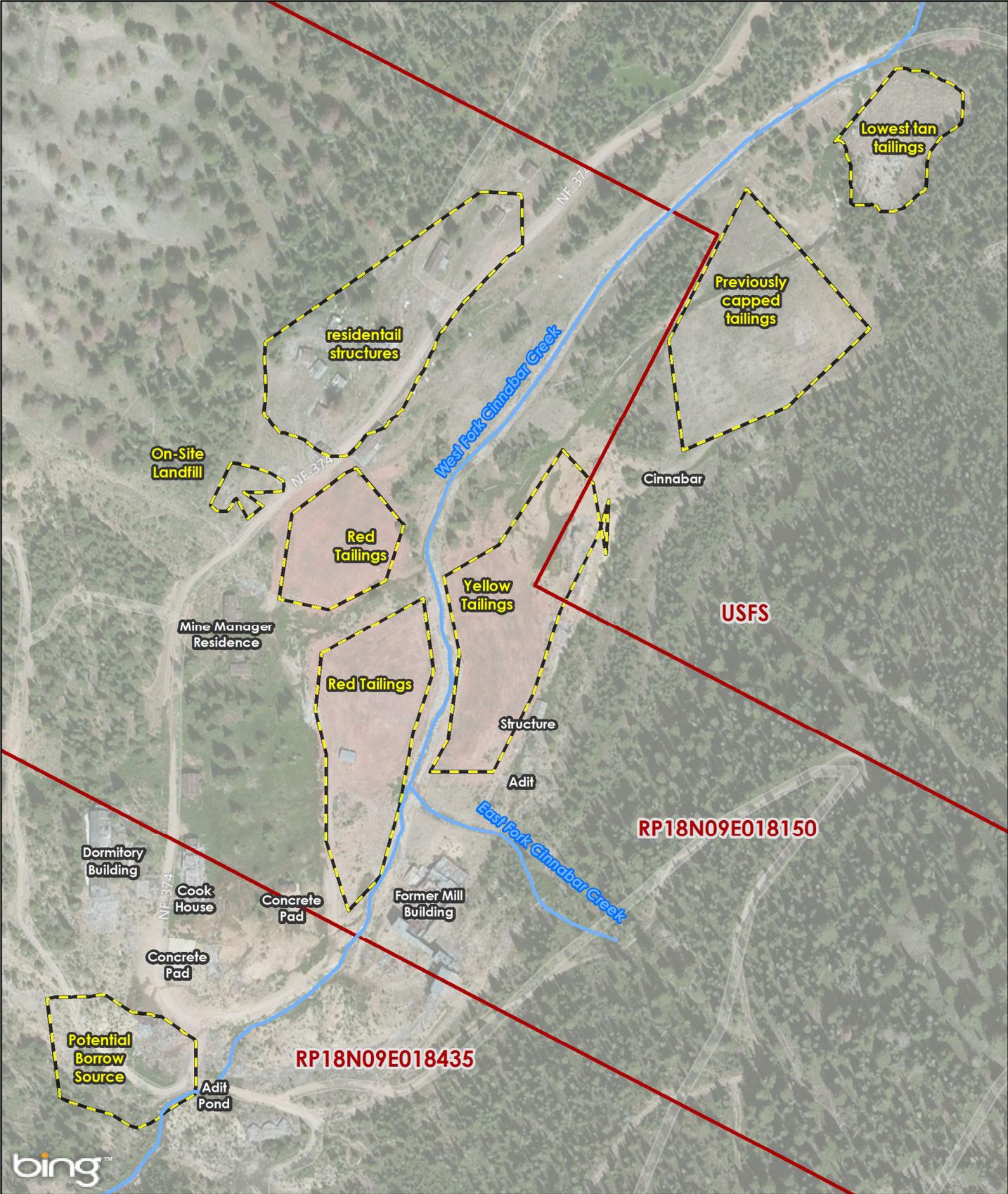
Key:

- ° C = Degrees Celsius
- µg/kg = Micrograms per kilogram
- µm = micrometer
- AES = Atomic Emission Spectrometer
- CLP = Contract Laboratory Program
- CRQL = Contract Required Quantitation Limit
- CVAA = Cold Vapor Atomic Absorption
- CVAFT = Cold-vapor Atomic Fluorescence Spectrometer
- EPA = United States Environmental Protection Agency
- FPE = Fluorinated Polyethylene
- H₂SO₄ = Sulfuric acid
- HCL= Hydrochloric acid
- HNO₃ = Nitric acid
- ICP = Inductively coupled argon plasma
- MEL = Manchester Environmental Laboratory
- mg/kg = milligrams per kilogram
- mg/L = milligrams per liter
- mg-S²/L =
- mm = Millimeter
- MS = Mass spectrometric detection
- MS/MSD = Matrix spike/matrix spike duplicate
- N/A = Not applicable
- ng/L = Nanograms per liter.
- PSEP = Puget Sound Estuary Program
- QC = Quality Control
- SOW = Statement of Work
- TAL = Target Analyte List
- TOC = Total Organic Carbon
- Zn = Zinc

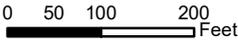
Source: DeLorme Atlas & Gazetteer, 1992.

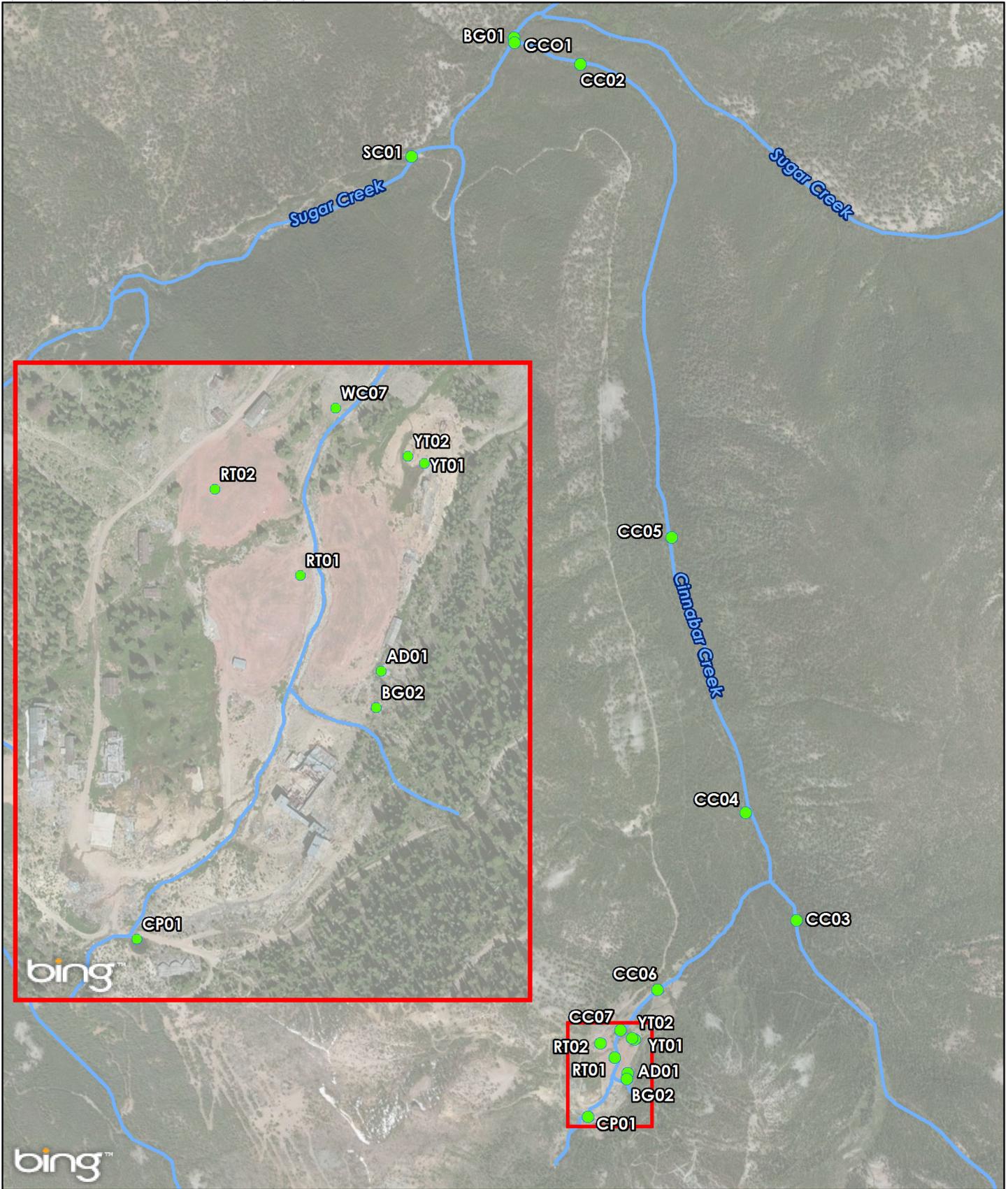


 <p>ecology and environment, inc. Global Environmental Specialists Seattle, Washington</p>	<p>CINNABAR MINE SITE Yellow Pine, Idaho</p>		<p>Figure 2.1 SITE VICINITY MAP</p>	
	<p>0 1.5 3 Approximate Scale in Miles</p>	<p>Date: 7-15-16</p>	<p>Drawn by: AES</p>	<p>10:START IV\14070008\fig 2-1</p>



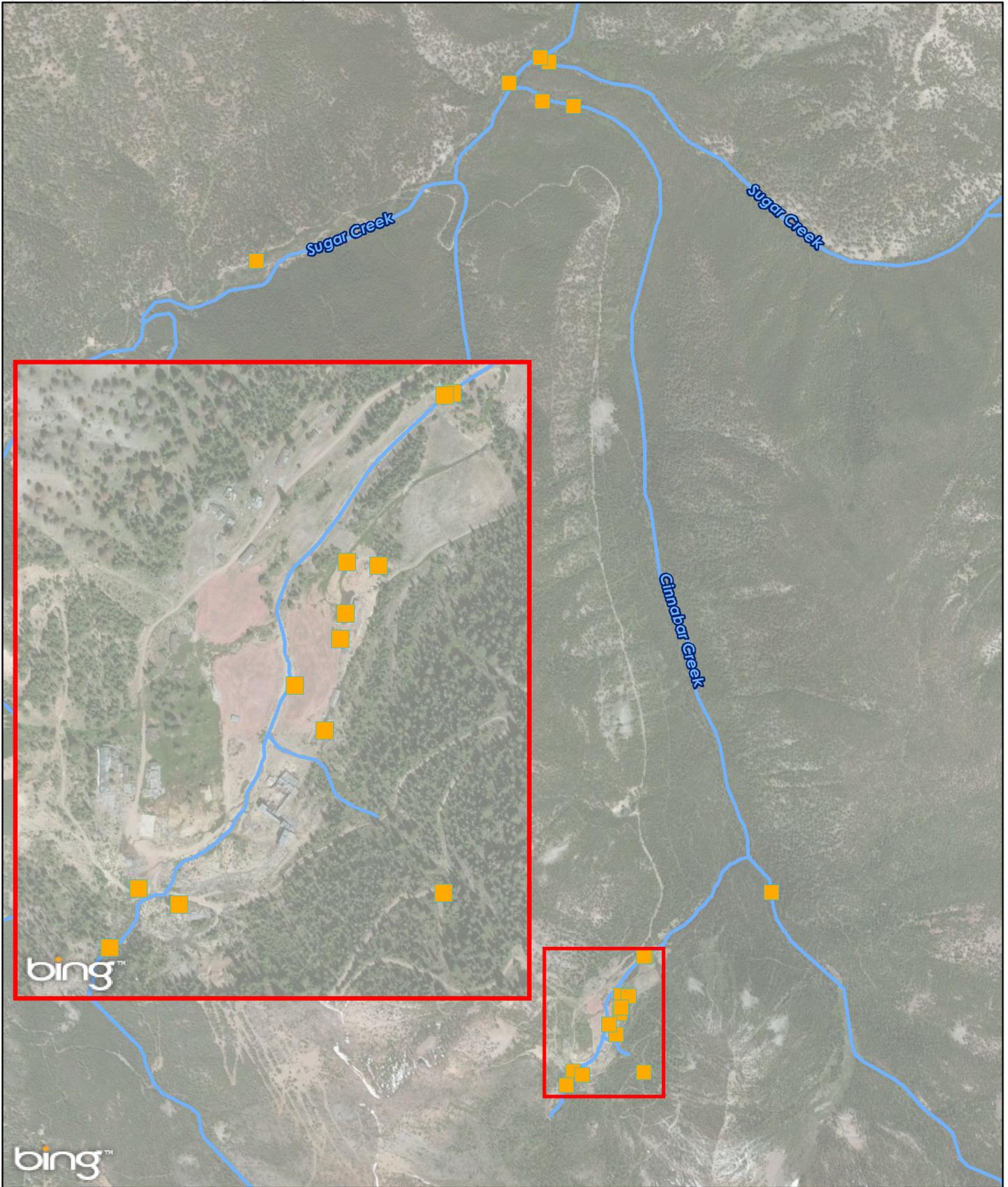
Parcel Boundary Source: Valley County, ID 2016, Imagery Source: 2016 Microsoft Bing

<p>  Site Features*  Parcel Boundary </p> <p><small>*Site Feature boundaries are approximate.</small></p>	<p>Figure 2.2 Parcel Boundary Cinnabar Mine Yellow Pine, Idaho</p>	<p>    ecology and environment, inc. <small>Global Environmental Specialists</small> </p>
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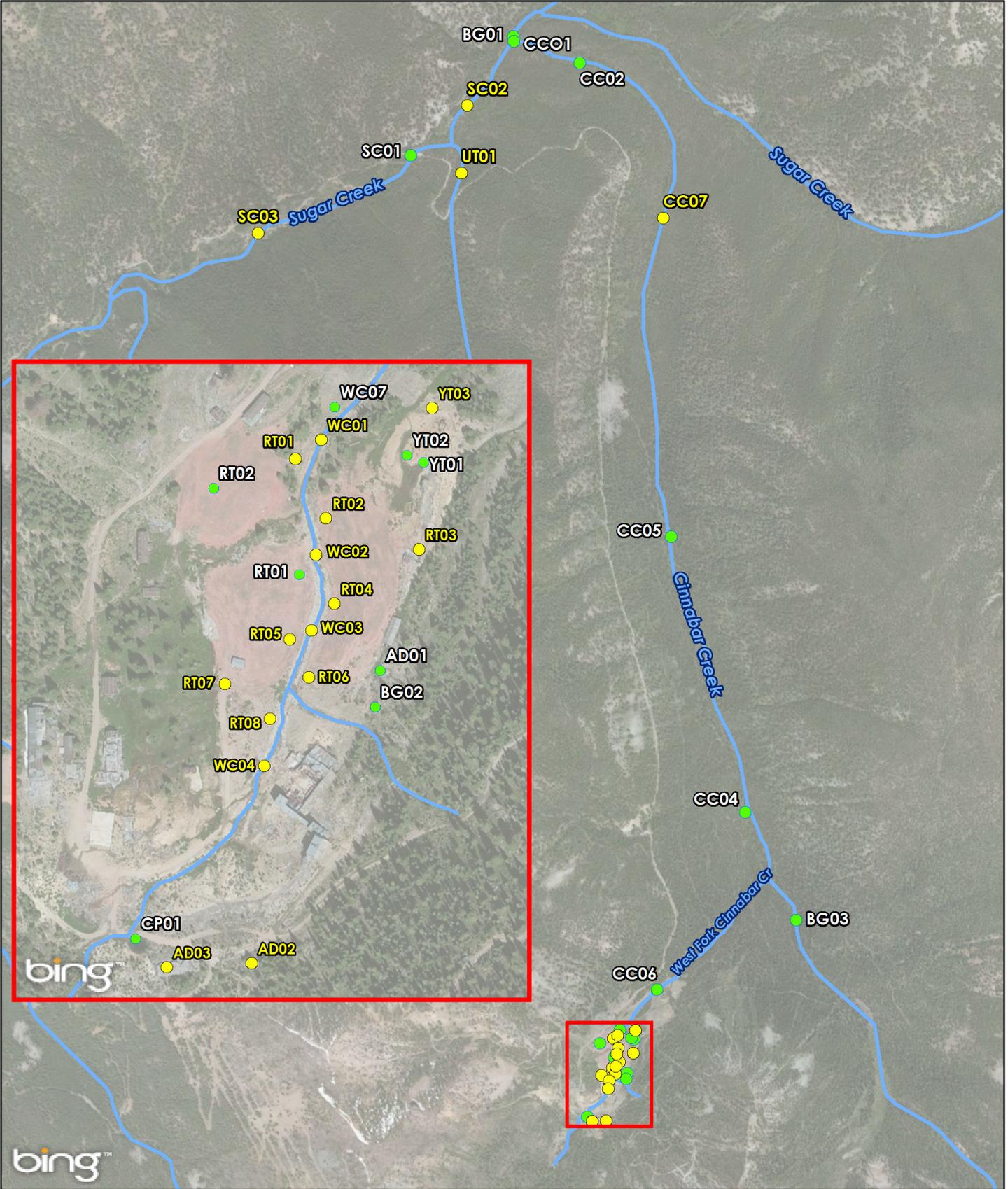
Imagery Source: 2014 Microsoft Bing

<p>● Sample Locations (Aug 2014)</p>	<p>Figure 2.3 Sample Locations Cinnabar Mine Yellow Pine, Idaho</p>	<p>↑ N 0 500 1,000 2,000 Feet</p> <p> ecology and environment, inc. Global Environmental Specialists</p>
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Imagery Source: 2014 Microsoft Bing

<p>■ USGS Sample Locations</p>	<p>Figure 2.4 USGS Sample Locations Cinnabar Mine Yellow Pine, Idaho</p>	<p>↑ N 0 500 1,000 2,000 Feet</p> <p> ecology and environment, inc. Global Environmental Specialists</p>
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Imagery Source: 2014 Microsoft Bing

<ul style="list-style-type: none"> ● Sample Locations (Aug 2014) ● Proposed Sampling Locations 	<p>Figure 9.1 August 2014 & Proposed Sample Locations Cinnabar Mine Yellow Pine, Idaho</p>	<div style="text-align: right;">  </div> <div style="text-align: right;"> <p>0 500 1,000 2,000 Feet</p> </div> <div style="text-align: right;">  <p>ecology and environment, inc. Global Environmental Specialists</p> </div>
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ATTACHMENT A

Site-Specific Data Management Plan

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10

1200 Sixth Avenue, Suite 900
Seattle, Washington 98101-3140

OFFICE OF ENVIRONMENTAL CLEANUP
EMERGENCY RESPONSE UNIT

Region 10 Site-Specific Data Management Plan

Project Name:	Cinnabar Mine Integrated Assessment	TDD Number/Site ID:	16-07-0002/101T
Author:	Renee Nordeen	Company:	Ecology & Environment, Inc.
Date Initiated:	July 15, 2016	Last Updated:	Click here to enter a date.

This data management plan (DMP) is intended to provide guidance for data collection by field personnel and subsequent data management activities. The data collection and management practices presented in this plan are designed to ensure data integrity and consistency for all data collection personnel and from operational period to the next. Listed in this DMP are data elements, data collection equipment, and data management processes, and end-use products appropriate for supporting the EPA On-Scene Coordinator (OSC). Electronic tools and files used during data management at the site may include a GPS with a data dictionary to gather site specific data, EDD files for laboratory results, an XRF database used to validate the data, field monitoring equipment (such as air monitoring equipment), a SCRIBE database to manage all field data and analytical results, and ArcGIS to manage geospatial data. Manual data entry or Excel spreadsheets will be used to incorporate field notes and historic data when electronic data is not available.

Planning:

DQO #	Decision
1.	Determine if metals contamination is present at concentrations above site established screening criteria and/or background concentrations in tailings piles, on-site adits, on-site wetlands, and/or in downstream water bodies. Screening criteria are provided in Section 7 of the SSSP.
	Estimate the volume of material in the tailings piles.
3	Determine if shallow groundwater is contributing mercury contamination to on-site and downstream water bodies. Screening criteria are provided in Section 7 of the SSSP.

Data Processing

The following table outlines the specific requirements for various data types being collected during the project.

DQO #	Data Stream	Required Information	Processing Instructions	Processing Frequency	Processing Responsibility	Storage Location	Final Output [format]
1,2,3	Site Documents	Site files, SSSP, SSDMP, logbook	File hard copies and electronic copies in indicated storage location	Beginning of project, and as needed	Project Manager	Digital: E & E Network , field storage Nordeen laptop Hard Copy: Site Doc Box	Site file deliverable
1,3	Scribe	Scribe .mdb As outlined in Attachment A1 of the Regional DMP Sample No., Sampler, Location, Sample depth to, sample depth from, matrix, collection method, sample type, analysis assigned, CLP sample ID	Publish to scribe.net daily Upload COCs to SMO portal for CLP samples	Daily	Sample Custodian	<u>\02 Execution\SCRIBE</u>	scribe.net Project ID: 2377 Scribe .mdb file
1,3	Digital Photos	Date, Device ID, Time, Direction, Description, Photographer	Photos will be exported from Filemaker Files and stored in site files	Daily	Project Manager	<u>\02 Execution\Photos</u>	Photos [.jpg], Photographic log [.xls]

DQO #	Data Stream	Required Information	Processing Instructions	Processing Frequency	Processing Responsibility	Storage Location	Final Output [format]
1,3	Sample Information	Sample No., Sampler, Location, Sample depth to, sample depth from, matrix, collection method, sample type	Sample information will be exported from Filemaker Files and imported into Scribe as outlined in the Regional DMP.	Daily	Sample Custodian	Scribe	Chain-of-Custody forms, labels, tabular reports, and/or maps
1,2,3	GPS	Location, latitude, longitude, date, time,	Data will be processed according to the GPS Data Processing SOP and uploaded into Scribe or will be exported from Filemaker Files and imported into Scribe	Conclusion of project	Project Manager and GIS Analyst	Data: Scribe Raw: \02_Execution\GIS	Tabular reports [.xls] and/or maps [.pdf]
1,3	Horiba	Location ID, date, time, pH, temperature, conductivity, dissolved oxygen, turbidity	Data will be downloaded and imported into Scribe as outlined in the Data Processing Guide	Daily	Project Manager	Data: Scribe Raw: 02\Executions\Monitoring Data\Horiba	Scribe .mdb file
1,3	Fixed Laboratory Data	As outlined in Attachment A1 of Regional DMP	As outlined in Attachment A5 of Regional DMP	As validated data is received	Data Coordinator	Data: Scribe Raw: \03. Analytical & QA\laboratory data	Edd
1,3	Avenza	Sample team, station location, latitude, longitude	Export /kml file daily and send to PM	Daily	Sample Team Leaders		.kml

All electronic files will be written to a CD-ROM or DVD and provided to the Task Monitor. Hard copy files will be assembled and provided to the Task Monitor. Hard copy files will include, but are not limited to logbooks and field forms.

Reporting Requirements

Reporting Task	Data Inputs	Deliverables Format	Frequency	Responsibility

Document Revision Summary

Revision	Date	Description of change
Initial Release (V 1.0)		Updated Format

ATTACHMENT B

Mesocosm Experiment Laboratory Analysis Component

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Cinnabar Mine IA SSSP Attachment A: Experimental Design

Laboratory Mesocosm experiment with carbon amended tailings

Background:

Objective: The purpose of this experiment is to assess the impact of adding organic material to tailings in laboratory mesocosms under saturated and unsaturated conditions.

Schedule / Roles and Responsibilities:

Primary Researcher: Chris Eckley, EPA OERA ESU. Responsible for all sample processing, experimental design, mesocosm sampling, and transshipment/delivery of the generated samples identified in Table 2 to the R10 lab or a subcontracted laboratory.

Project Manager: Brooks Stanfield (OSC), Greg Weigel (OSC), Ken Marcy (SAM). Responsible for...

Scribe project manager: Management of samples and resulting data created by the mesocosm experiment will be conducted by Ecology and Environment (continued from field sampling) or EPA staff. The tailings and leaching water will be assigned a R10 sample number and bottle codes for receipt at the lab from the field. Subsequently generated mesocosm samples will be assigned unique sample IDs to allow for analysis and reporting. R10 sample IDs will be assigned according to the week collected or generated. The Location will be used to identify the experimental source (i.e. time for exposure, control/matrix, etc).

Table 1. Experiment Project Tasks, Responsibility, and Schedule

Project Task	Responsible Party	Schedule range (with completion date)
Field collection of tailings, delivery to EPA R10 MEL	EPA – Chris Eckley and Brooks Stanfield	8/25-29/2016 (MEL Receipt)
Field collection of Leaching Water, delivery to EPA R10 MEL	EPA – Chris Eckley and Brooks Stanfield	
Tailings material homogenization, distribution to final experiment buckets	EPA - Chris Eckley	
Porewater sampling of the unsaturated tailings buckets T=0 and shipment/delivery to the labs	EPA - Chris Eckley	
Porewater sampling of the saturated tailings buckets T=1 and shipment/delivery to the labs	EPA - Chris Eckley	
Porewater sampling of the saturated tailings buckets T=2 and shipment/delivery to the labs	EPA - Chris Eckley	
Scribe project management for	??	

mesocosm experiment		
Mesocosm tailings material disposal post-experiment	E&E – Who?	

Field Activity

Collect 0.045m³ (1.6 ft³) of tailings materials from the red-tailings piles onsite at the Cinnabar Mine. This equates to three full 5-gallon buckets of material. Buckets will be hand delivered under custody to the Region 10 MEL by EPA project staff after the sampling event is concluded.

Leaching water will be collected by EPA from _____ to be used in the experimental buckets.

Approximately XXXX [UNITS] of leaching water will be needed, to be collected in [CONTAINERS type and size].

Laboratory Activity

The tailings material will be homogenized at the laboratory via hand mixing in a small child-size plastic disposable pool. The spread out material will be fractionally shoveled into six 3 gallon buckets by scooping an approximately equal amount of material in each bucket back and forth until all sample material has been distributed across all buckets. It is expected that each bucket will be at a depth of 15 cm (~50% full).

Unsaturated conditions simulation: 3 buckets will contain un-amended tailings and 3 buckets will contain tailings amended with ProGanics Biotic Soil Media. The amount of amendment added will be determined after agronomic analysis has performed and will be designed to emulate future remediation options.

Water will be added to all 6 buckets and immediately collected into sample containers from the porewater samplers with in-line 0.18um filtration. Excess water in the buckets following sample collection will be allowed to air dry from the tailings. This will be repeated again 15 days after the initial wetting. This experiment will test the potential for MeHg production in amended and un-amended tailings under un-saturated conditions. These conditions are expected to be representative of the majority of tailings at the Cinnabar mine site. Saturated conditions (described below) are expected to occur less frequently (spatially and temporally), but may result in higher MeHg production potential.

The leaching water used in the experiment will be sourced from a local headwater stream whose water chemistry is similar to that of precipitation. A sample of this water will be analyzed at the beginning of the project and with each wetting for the same chemical constituents as the porewater sampled from the buckets. For the unsaturated buckets, leaching water will be added to approximately the top surface of the soil until fully saturated without surface pooling.

Saturated conditions simulation: 3 buckets will contain un-amended tailings and 3 buckets will contain tailings amended with ProGanics Biotic Soil Media. The same buckets described above will be re-used for this component of the study, at the conclusion of the unsaturated conditions simulation.

The buckets will be filled with water to allow saturation of the tailings mixtures and to allow about 10-15 cm of overlying water above the tailing surface (i.e. the bucket will be filled until water is at the top of the bucket. Water will be collected from the porewater samplers at 2 time intervals: after 15 days and

after 30 days. At the termination of the experiments, a solid-phase sample will also be collected from each of the buckets.

Sample collection at two time periods (15 days and 30 days) is necessary since we do not know a priori the time period necessary for the development of redox conditions conducive to Hg methylation in the mesocosms. If we collect samples of water too soon, conditions favorable to sulfate reduction may not have developed within the mesocosms; however if we wait too long to collect samples then we could observe variations in the mesocosm conditions that are no longer representative of field conditions. An example of the latter would be a depletion of nutrient availability due to the closed nature of the system. By measuring at two time points, we can help ensure that we are able to capture at least one sample (though ideally two) that occur during optimal conditions for Hg methylation.

Sample collection:

Porewater sampling: A Rhizon porewater sampler (or equivalent) will be inserted into each of the buckets to allow collection of the porewater at time = zero. The Rhizon sampler includes an inline-filtration of 0.18um. As these are a different filtration size than the EPA definition for dissolved, the matrix will be identified throughout the experiment and resulting data as “filtered at 0.18um” or “filtered water” instead of “dissolved”.

Tailings sampling:

Data Review/Validation

All data generated by the Region 10 EPA laboratory is reviewed and verified equivalent to a 100% S4VEM (EPA, 2009 Data Validation Labelling Guidance). If preliminary data is provided to this project as expected, it is under the auspices that all preliminary data is unvalidated and therefore subject to change before released as final validated data.

Any subcontracted data is validated to 10% S4VEM and 90% S2BVE by Ecology and Environment.

Experiment Data Use

Overall, the results from these experiments will identify if MeHg concentrations are higher in the materials that have been amended with organic carbon under saturated and unsaturated conditions and will take into consideration other co-varying parameters in a mixed-effects analysis of covariance statistical test.

EPA staff will do all statistical analysis associated with the field collected porewater sampling and the laboratory-based mesocosm data. The statistical analysis will be completed using Statistica® (or equivalent) statistical software. The statistical parameters used and results will be summarized in a report prepared by EPA staff.

Matrix	Parameter	# Samples: T=0 ^b					# Samples: T = 1 ^c				# Samples: T = 2 ^d				total	Method ^e	Lab
		Unsaturated Conditions		Saturated Conditions		Rhizon Equip. Blank	Unsaturated Conditions		Saturated Conditions		Unsaturated Conditions		Saturated Conditions				
		Unamended	Amended ^a	Unamended	Amended		Unamended	Amended	Unamended	Amended	Unamended	Amended	Unamended	Amended			
Sediment	THg										0	0	3	3	6	EPA 7471B	EPA R10 MEL
Sediment	MeHg										0	0	3	3	6	EPA 1630- Modified	Contracted to _____
Sediment	TOC										0	0	3	3	6	PSEP-TOC	EPA R10 MEL
Pore Water Filtered	Filtered LL THg	3	3	0	0	1	3	3	3	3	0	0	3	3	25	EPA 1631E	EPA R10 MEL
Pore Water Filtered	Filtered MeHg	3	3	0	0	1	3	3	3	3	0	0	3	3	25	EPA 1630	EPA R10 MEL
Pore Water Filtered	Filtered Sulfide	3	3	0	0	1	3	3	3	3	0	0	3	3	25	SM 4500S - or test kit??	Contracted to _____
Pore Water Filtered	Filtered Organic Carbon	3	3	0	0	1	3	3	3	3	0	0	3	3	25	SM 5310B	EPA R10 MEL
Pore Water Filtered	Filtered Sulfate	3	3	0	0	1	3	3	3	3	0	0	3	3	25	EPA 300.0	EPA R10 MEL
Leaching Water Total	THg	1														EPA 1631E	EPA R10 MEL
Leaching Water Total	MeHg	1														EPA 1630	EPA R10 MEL
Leaching Water Total	Sulfide	1														SM 4500S	Contracted to _____
Leaching Water Total	DOC	1														SM 5310B	EPA R10 MEL
Leaching Water Total	Sulfate	1														EPA 300.0	EPA R10 MEL

^aAmendment = Proganics material

^bno T=0 for saturated bc it is effectively starting at T=1 - scenario if running on the same buckets

^cUnsaturated T=0 is defined as: air dry, as measured via weight compared to initial pre-wetted mesocosm tailings weight. Dry is defined as <5% moisture or less: final air dried within 5% of the original dry weight measured.

^dSaturated T = 2 is defined as 15 days from T=1.

^ePlease see SSSP table 9.2 for holding time, preservation, and container/volume requirements.