



## ecology and environment, inc.

Global Environmental Specialists

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October 31, 2018

Mr. Brooks Stanfield, On-Scene Coordinator  
United States Environmental Protection Agency, Region 10  
1200 Sixth Avenue, Mail Stop ECL-133  
Seattle, Washington 98101

**Re: Contract Number: EP-S7-13-07  
Task Order: 0030  
2018 Removal Site Evaluation Summary Report, Cinnabar Mine Site**

Dear Mr. Stanfield:

Enclosed please find the 2018 Removal Site Evaluation Summary Report 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) 624-9537.

Sincerely,

ECOLOGY AND ENVIRONMENT, INC.

Steven G. Hall  
START-IV Removal Team Leader

cc: Mark Longtine, START-IV Geologist, E & E, Seattle, Washington  
Tyler Chatriand, START-IV Engineer, E & E, Seattle, Washington

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**Cinnabar Mine Site**

**2018 Removal Site Evaluation  
Summary Report**

**Yellow Pine, Idaho**

**Contract Number EP-S7-13-07  
Task Order: 0030**

**October 2018**

**Prepared for:**

**United States Environmental Protection Agency  
1200 Sixth Avenue  
Seattle, Washington 98101**

**Prepared by:**

**Ecology and Environmental, Inc.  
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Seattle, Washington 98104**

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# Table of Contents

Section	Page
<b>1</b>	<b>Introduction ..... 1-1</b>
<b>2</b>	<b>Site Description and Background ..... 2-1</b>
2.1	Site Location ..... 2-1
2.2	Site Description & Background ..... 2-1
2.3	Previous Investigations and Removal Actions ..... 2-2
<b>3</b>	<b>2018 Field Events ..... 3-1</b>
3.1	May 2018 ..... 3-1
3.1.1	Surface Water Sampling ..... 3-1
3.1.2	Tailings Sampling ..... 3-2
3.1.3	Summary of Field Observations ..... 3-2
3.2	September 2018 ..... 3-4
<b>4</b>	<b>RSE Results ..... 4-1</b>
4.1	May 2018 Surface Water Results ..... 4-1
4.1.1	May 2018 Mercury Loadings Analysis ..... 4-1
4.2	Conceptual Site Model (CSM) Update ..... 4-3
4.3	Vegetation Study ..... 4-3
<b>5</b>	<b>Removal Alternative Update ..... 5-1</b>
<b>6</b>	<b>Summary and Conclusions ..... 6-1</b>
<b>7</b>	<b>References ..... 7-1</b>
<b>A</b>	<b>Photographs ..... A-1</b>
<b>B</b>	<b>Analytical Data ..... B-1</b>
<b>C</b>	<b>Vegetation Study ..... C-1</b>

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# List of Tables



<b>Table</b>		<b>Page</b>
4-1	Surface Water Samples Laboratory Analytical Results, May 2018 .....	4-5
4-2	Sample Location Flow Rate Summary .....	4-7
4-3	May 2018 Mercury Loadings.....	4-8

*This page intentionally left blank.*

# List of Figures

<b>Figure</b>		<b>Page</b>
2-1	Vicinity Map .....	2-5
2-2	Site Map .....	2-6
3-1	Sample Locations (Site Vicinity), May 2018 .....	3-7
3-2	Sample Locations (Site), May 2018.....	3-8
4-1	Unfiltered Total Mercury Loading Diagram.....	4-9
4-2	Filtered Total Mercury Loading Diagram.....	4-10
4-3	Conceptual Site Model For Aqueous Mercury Release And Transport At Cinnabar Mine And Downstream Surface Water Bodies .....	4-11
5-1	Preferred Limited Removal Action.....	5-3

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# List of Abbreviations and Acronyms

## Abbreviation Definition

%	percent
µg/g	micrograms per gram
µg/L	micrograms per liter
CCC	criterion continuous exposure for chronic exposure
cfs	cubic feet per second
CMC	criterion maximum concentrations for acute exposure
E & E	Ecology and Environment, Inc.
EFSFSR	East Fork of South Fork Salmon River
EPA	United States Environmental Protection Agency
ERRS	Emergency and Rapid Response Services (ERRS)
gpm	gallons per minute
IA	Integrated Assessment
IDEQ	Idaho Department of Environmental Quality
JL	estimated result with low bias
LLHg	Low-Level Mercury
mg/day	milligrams per day
ng/L	nanograms per liter
OSC	On-Scene Coordinator
PCB	Polychlorinated Biphenyls
lbs/acre	pounds per acre
RSE	Removal Site Evaluation
Site	Cinnabar Mine Site
START	Superfund Technical Assessment and Response Team
TAL	Target Analyte List
TCRA	time-critical removal action
TOC	Total Organic Carbon
TSS	Total Suspended Solids
USFS	United States Forest Service
USGS	United States Geological Survey

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# 1

## Introduction

Ecology and Environment, Inc. (E & E) was tasked by the United States Environmental Protection Agency (EPA) to provide technical support for completion of a Removal Site Evaluation (RSE) summary report at the Cinnabar Mine Site (Site) in anticipation of a potential removal action. The Site is located in Valley County near the town of Yellow Pine, Idaho. E & E completed the RSE activities under Task Order 30, which was issued under EPA Region 10 Superfund Technical Assessment and Response Team (START)-IV Contract number EP-S7-13-07. The purpose of the RSE was to update the conceptual site model (CSM) and refine removal alternatives for the Site.

Recent investigations since 2016 have depicted a Site that is a significant source of inorganic mercury to surface water, and one whose contributions of mercury to the stream system may be creating opportunities for methylation of inorganic mercury further downstream from the Site where conditions for methylation are more favorable. The specific goals and objectives for the RSE are described below:

- Observe the Site during peak runoff for evidence of increased turbidity, surface water flow pathways, and seasonal sources;
  - Deploy time-lapse cameras to document Site activities during peak runoff;
  - Collect and analyze water samples to characterize potential sources and calculate on- and off-Site stream loading of contaminant(s);
  - Collect tailings for use in agronomic greenhouse trials for potential revegetation;
- Observe the Site during late summer to evaluate Site access, borrow source material, and potential Site features for targeted removal activities; and
- Update the preferred removal alternative, in consultation with the EPA On-Scene Coordinator (OSC).

Completion of the RSE included reviewing Site information, coordinating two field events, collecting field samples for laboratory analysis, interpreting analytical results, calculating stream loading, updating the preferred removal alternative, and producing this report. This RSE Summary Report is organized as follows:

- Section 1, Introduction: Authority for performance of this work, goals for the project, and summary of the report contents;

- Section 2, Site Description and Background: Includes location and description information followed by a summary of previous investigations for the Site and surrounding areas;
- Section 3, 2018 Field Events:
  - May 2018: Summary of water sampling, stream flow measurements, tailings collection, camera deployment, and visual observations;
  - September 2018: Summary of borrow source investigation, stream channel assessment, wetlands observations, and vegetation collection;
- Section 4, RSE Results: Laboratory data, stream flow measurements, loading calculations, CSM update, greenhouse testing, and plant identification;
- Section 5, Removal Alternative Update: Revised removal alternative to revegetate and improve drainage in the saturated wetlands area;
- Section 6, Summary and Conclusions: Describes activities performed during the RSE and recommends steps for implementing the preferred alternative; and
- Section 7, References: An alphabetical listing of references cited throughout the text.

# 2

## Site Description and Background

This section describes the background of the Site including location, description, and previous investigations conducted at the Site and surrounding areas.

### 2.1 Site Location

Site Name:	Cinnabar Mine
CERCLIS Identification Number:	IDD980665160
Latitude:	44.919085
Longitude:	-115.290683
Point of measurement:	Concrete staging pad
Legal Description:	Township 18 North, Range 10 East, Sections 6 and 7
County:	Valley
Site Owner:	J.J. Oberbillig Estate; United States Forest Service

### 2.2 Site Description & Background

The Cinnabar Mine is located approximately 15 miles east of Yellow Pine, Idaho, on Forest Service Road #374 in Valley County, Idaho (Figure 2-1). The Site encompasses approximately 50 acres within the 575 acres of patented claims comprising the Cinnabar Mine. The 575 acres of land are on a mixture of privately owned lands and United States Forest Service (USFS) lands. The parcel boundaries are depicted on Figure 2-2, and while the majority of the Site is located on privately owned land, it appears that a portion of the upper yellow tailings pile and all of the lower tailings are located on land managed by USFS.

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 and the Boise National Forest to the south. Features at the Site include six tailings piles (designated as the lowest tan tailings pile, the tailings impoundment, three upper red tailings piles, and the upper yellow tailings pile), an area of ponded water in the northwest corner of the upper yellow tailings pile, three adits (designated as Adit 1, Adit 2, and Adit 3), an adit pond associated with Adit 2, a capped and seeded landfill, a former mill building, a former dormitory, a former cook house, two concrete pads, and former residential buildings. In addition, the West Fork of Cinnabar Creek and several intermittent tributaries run through the Site (Figure 2-2). Two tailings impoundments once existed at the Site on USFS land. The lower

## **2 Site Description and Background**

impoundment failed during high floods in 1965 and the upper impoundment structure, constructed in the 1950s, was approximately 18 feet tall with approximately five to six feet of tailings behind the impoundment (USFS 1996). This impoundment was later filled with tailings, and then capped and seeded in a previous removal action (Section 2.3). The remaining tailings piles are not presently capped (i.e., “bare” tailings).

Water discharges from several mine adits and surface drainages above the Site to West Fork Cinnabar Creek, which flows through the tailings piles in a diversion channel which was initially constructed in 1992 and reconstructed during a 1996 EPA Removal Action (E & E 1996). West Fork Cinnabar Creek continues into Cinnabar Creek which flows into Sugar Creek below the mine.

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. Mr. J.J. Oberbillig is listed as the president of the mine at the time it was incorporated in 1921 (Mitchell 2000). 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). A settlement between EPA and the J.J. Oberbillig estate was reached that set aside funds for future cleanup activities at the Site.

### **2.3 Previous Investigations and Removal Actions**

Numerous investigations by various parties have been conducted at the Site. Below is a limited description of the investigations based on available information. A more detailed description of previous investigations can be found in referenced documents, where available, or in the EPA 2016 Integrated Assessment (IA) Report (E & E 2017).

In 1979, EPA conducted a non-sampling inspection of the Site and concluded the Site did not pose an environmental or public health threat (EPA 1979).

In 1984, Idaho Department of Health and Welfare’s Division of Environment and the Central District Health Department conducted an investigation of the Site. Based on conditions noted at the site and sampling results, it was recommended the site be given a high priority for cleanup and stabilization of the tailings to prevent additional erosion into the creek. (Clark and Lappin 1984)

## 2 Site Description and Background

In 1985, EPA conducted a Preliminary Assessment at the Site to determine if polychlorinated biphenyl (PCB)-contaminated materials were present and continue to investigate mercury contamination in soil, sediment, surface water, and air matrices (Weston 1985).

In 1988, the USFS received a notice of an oil spill on the East Fork of the South Fork of the Salmon River (EFSFSR), which presumably resulted in a release of oil into Cinnabar Creek. The USFS completed a macroinvertebrate investigation downstream of the mine later that year (Weston 1994).

In 1991, the USFS sampled tailings behind an embankment on West Fork Cinnabar Creek for arsenic, lead, mercury, and zinc. Based on these results and conditions at the Site, a time critical removal action (TCRA) was recommended to construct a diversion ditch around the edge of the tailings and impoundment structure (USFS 1992; Weston 1994).

In 1992, the USFS conducted the TCRA recommended during the previous year, although it appears this work was performed solely on USFS land (USFS 1992; Weston 1994).

In 1993, USFS conducted a Preliminary Assessment at the Site to review existing data, conduct a Site visit, and assess surface water migration pathway(s) (E & E 1999).

In 1993, Idaho Department of Environmental Quality (IDEQ) prepared a Site Inspection Prioritization report for EPA to determine non-sampling data gaps, summarize information related to Hazard Ranking System requirements, and include a summary of the file reviews completed (IDEQ 1993).

In 1994, EPA conducted a Site Inspection at the Site and collected soil samples for TAL metals. Six analytes, including mercury and arsenic, were detected at significant concentrations with respect to background in the surface soil samples. The majority of the significant concentrations were detected from the mill sample (E & E 1999).

In 1996, EPA conducted a TCRA to create an on-Site landfill, remove two partially buried retorts from the West Fork Cinnabar Creek, stabilize the tailings impoundment, and stage oil-contaminated soil and the contents of approximately 50 drums of soda ash for off-Site disposal. Removal activities performed on USFS land included re-routing West Fork Cinnabar Creek and covering tailings pile(s). (E & E 1996; USFS 1996). A total of 84 samples were collected for analysis of PCBs and/or priority pollutant metals to document contaminant conditions at the conclusion of the removal (E & E 1996).

In 1998, EPA mobilized to the Site to address additional mercury contamination in soil below and adjacent to West Fork Cinnabar Creek and stabilize the upper tailings piles. Signs were posted at various locations around the Site to inform visitors of the potential contamination at the Site. Additionally, the temporary

## 2 Site Description and Background

road/bridge on Sugar Creek was removed during demobilization. A total of 22 soil samples were collected for field screening of mercury and arsenic. No samples were submitted for off-Site fixed laboratory analysis because removal action decisions were guided by the visible observation of mercury beads (E & E 1999).

In 2003, USFS performed a TCRA at the USFS owned portion of the Site to remove the remaining tailings along West Fork Cinnabar Creek and reshape the tailings impoundment to a 3:1 grade to improve surface water flow. The tailings impoundment covered with a geotextile liner and a minimum of 18 inches of topsoil, seed, and mulch. Rip rap was then placed along the stream to prevent erosion from high flows.

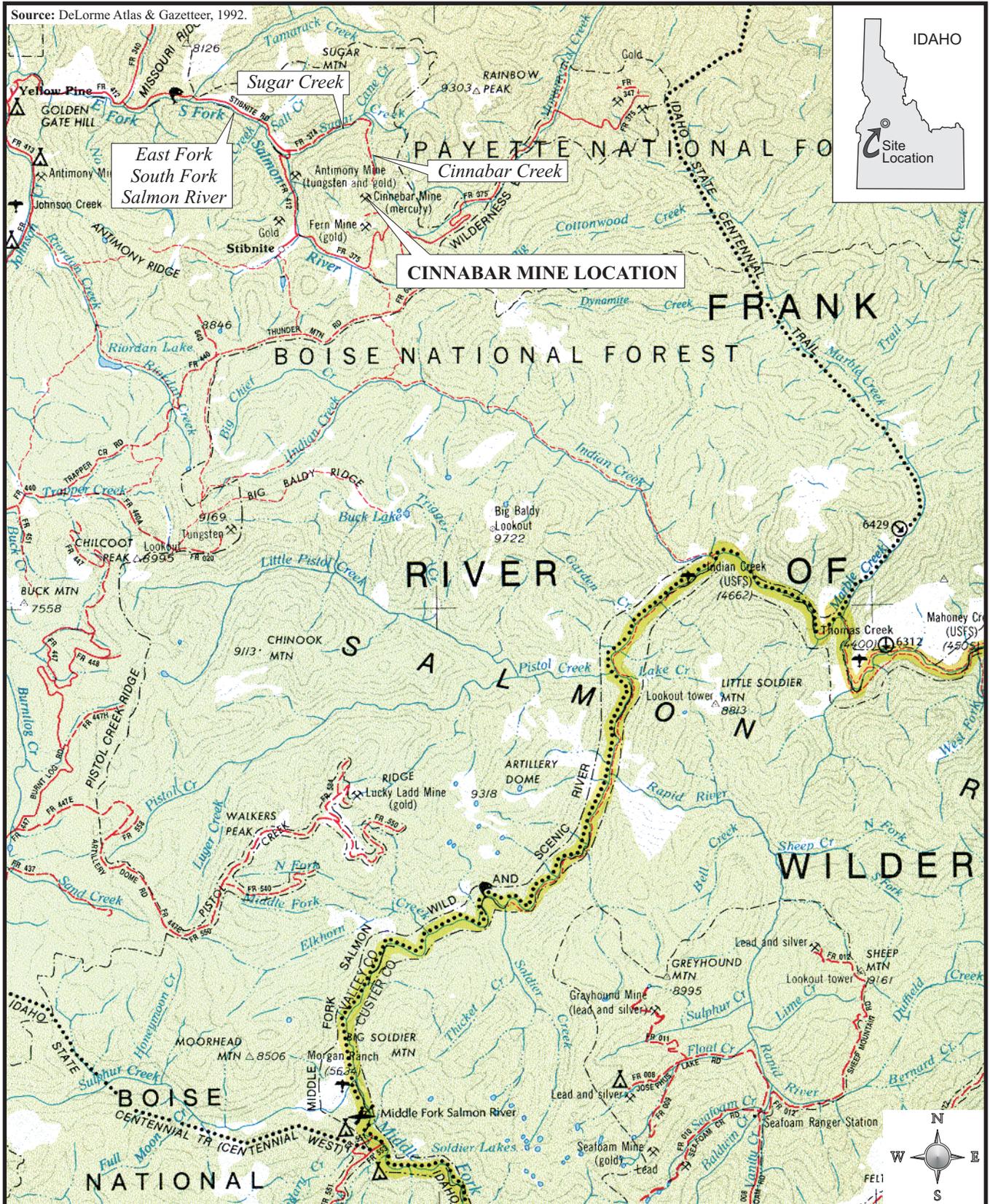
In 2004, EPA returned to the Site to regrade the upper red tailing pile and place seed mixture on the pile to reduce the risk of erosion of the tailings into West Fork Cinnabar Creek (E & E 2004).

In 2011, the United States Geological Survey (USGS) began sampling water quality stations in the EFSFSR watershed several miles downstream of the mine. Based in part on the elevated mercury concentration detected in the surface water sample from Sugar Creek above the confluence with the EFSFSR, concern was expressed that contamination may be migrating from the tailings piles at Cinnabar Mine and impacting surface water and sediments in Cinnabar Creek, Sugar Creek, and the EFSFSR.

In 2014, EPA performed a removal site evaluation to assess the relationship between elevated mercury in Sugar Creek and the tailings piles at Cinnabar Mine. A total of 29 samples (13 surface water, 11 sediment, and five surface soil) were collected. Concurrent with the EPA field event, representatives from USGS collected surface water and sediment samples from streams, adits, and an area of ponded water. Elevated mercury and arsenic concentrations were detected in surface water, sediment and soil matrices. Methylmercury observed in elevated concentrations in both surface water and sediment (E & E 2014).

In 2016, EPA performed an IA to determine if the Site posed an eminent threat or potential threat to human health or the environment and to determine whether the Site was eligible for placement on the National Priorities List. The IA field event included the collection of 155 samples of soil, sediment, and surface water media. The IA identified tailings piles and adits as sources. Targets included the Federal-listed threatened bull trout (*Salvelinus confluentus*) in Cinnabar Creek and Sugar Creek, and the Federal-listed threatened Steelhead (*Oncorhynchus mykiss*) in Sugar Creek, among others. The IA report included a CSM to describe the understanding of fate and transport of arsenic and mercury at the Cinnabar Mine Site and downgradient locations (E & E 2017).

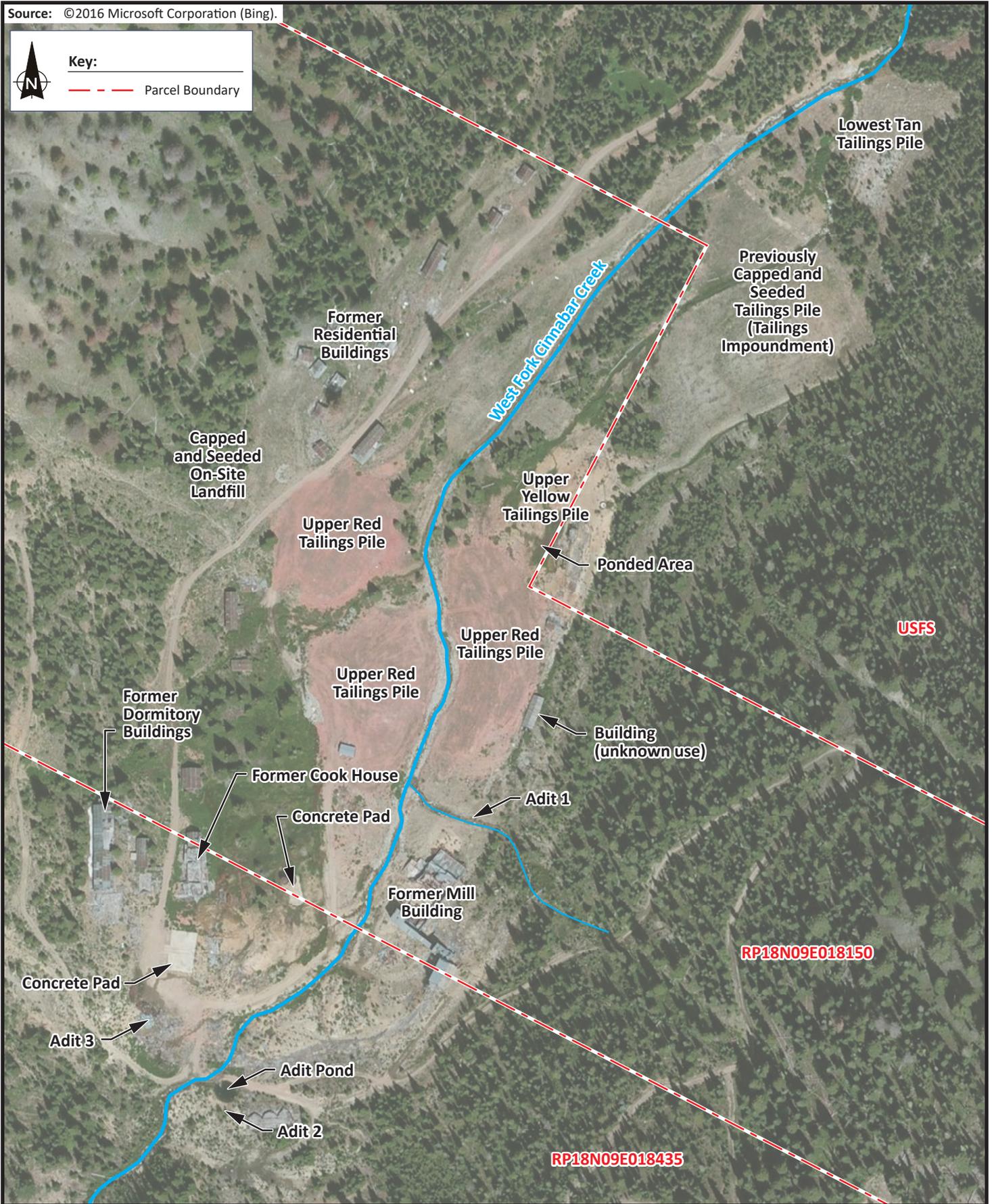
Source: DeLorme Atlas & Gazetteer, 1992.



 <p><b>ecology and environment, inc.</b> 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: 11-27-16</p>	<p>Drawn by: AES</p>	<p>10:START IV\14070008\fig 2-1</p>

**Key:**

 **Parcel Boundary**



 <p><b>ecology and environment, inc.</b> Global Environmental Specialists Seattle, Washington</p>	<p>CINNABAR MINE SITE Yellow Pine, Idaho</p>		<p>Figure 2-2 SITE MAP</p>		
	<p>0 100 200 Approximate Scale in Feet</p>		<p>Date: 10/19/18</p>	<p>Drawn by: AES</p>	<p>10:START-IV\TO-30-T1-SS1\fig 2-2</p>

# 3

## 2018 Field Events

Prior to the May 2018 EPA Field Event, a Sampling Plan Alteration Form was prepared to document planned sampling activities (E & E 2018). The Sampling Plan Alteration Form was based on the Site Specific Sampling Plan developed for the 2016 Cinnabar Mine IA Field Event (E & E 2016). The SPAF described the sampling strategy, sampling methodology, and analytical parameters used to investigate the Site. Photographs of the Site during the 2018 field activities are presented in Appendix A.

### 3.1 May 2018

The EPA mobilized to the Site along with START and Emergency and Rapid Response Services (ERRS) contractors on May 15, 2018. The first day's activities included surface water sampling along Sugar Creek. On the following day, EPA, START, and ERRS flew to the mine in a helicopter along with representatives from IDEQ. A helicopter was used to access the Site because the area contained a deep snowpack that impeded overland travel during peak snowmelt conditions. Activities performed on the second day included additional surface water sampling, stream channel measurements, tailings sampling, time-lapse camera deployment, and general field observations. The following paragraphs describe additional details regarding the May 2018 Field Event.

EPA was represented on Site by the OSC and a geochemist while START representatives included the project manager, hydrogeologist, geologist and engineer. Two ERRS representatives were on Site, including a response manager and laborer, to assist with logistics and provide historical context of previous removal activities on Site. Two IDEQ employees accompanied the trip to observe Site conditions during peak runoff conditions and meet with EPA to discuss future potential removal activities.

#### 3.1.1 Surface Water Sampling

Surface water samples were collected at 11 locations from Sugar Creek, Cinnabar Creek, West Fork Cinnabar Creek and the adits (Figures 3-1 and 3-2). One field blank was collected along with duplicates from a background sample location and one of the adits. Generally, each location was sampled for both unfiltered and filtered (i.e., dissolved) metals. Samples were submitted for the following analyses:

- Low-Level Mercury (LLHg): EPA 1631 (unfiltered and filtered)

- Target Analyte List (TAL) Metals: EPA 6010/6020 (unfiltered and filtered)
- Total Suspended Solids (TSS): SM 2540 (unfiltered only)
- Total Organic Carbon (TOC): EPA 9060 (unfiltered and filtered; four locations only)

Subcontract laboratories for the surface water samples included the following:

- Eurofins Frontier Global Sciences in Bothell, Washington for LLHg and TAL metals.
- GEL Laboratories in Charleston, South Carolina for TSS and TOC.

Surface water sampling began at the most downstream location and proceeded upstream throughout the sample event. Sample collection methods included hand-dipping each sample container into the water or via utilization of a peristaltic pump and tubing. Filtered samples were field-filtered using dedicated 0.45 micron filters as specified by the applicable method(s). Sampling for low-level mercury was performed in accordance with EPA Method 1669 Sampling Ambient Water for Trace Metals as referenced in EPA Method 1631E. Sample preservation was performed as required and as soon as practicable, and after filtration for filtered matrix parameters.

Surface water flow rates were measured or estimated at each sample location in order to evaluate contaminant loadings. Flow rates were measured using standard USGS stream gaging techniques and a Marsh McBirney Flo-Mate flow meter where feasible. Flow rates were estimated at sample locations that contained high and fast water that could not be measured safely, or where time did not allow for measurements. Flow rate determinations are discussed further in Section 4.1.1.

### **3.1.2 Tailings Sampling**

Tailings samples were also collected during the field event for greenhouse testing to assess suitability for revegetation. A total of six 5-gallon buckets of red-colored tailings were collected for assessment by Profile Products in Buffalo Grove, Illinois.

### **3.1.3 Summary of Field Observations**

In addition to surface water sampling activities, EPA, START, and ERRS performed a site walk and helicopter fly-over to evaluate various issues related to potential removal action alternatives, including access road conditions, tailings erosion, adit flows, seeps and springs, iron oxyhydroxide (aka “yellowboy”), and potential repository sites. A brief description of these observations are provided below.

Site Access. The field team walked up the Sugar Creek road to the ford crossing of Sugar Creek near the Cinnabar Creek confluence. The Sugar Creek road has several small tributary crossings over the road along with some landslide debris and one eroded stream cut that prohibits vehicle access to the ford. The stream cut would require armoring the stream bank with boulders and filling in the eroded

portion of the road, which would likely require permitting consultation with several agencies to complete. The bankfull width of the ford (i.e., the channel crossing) is approximately 50 feet wide, with a floodplain that is roughly 150 feet wide. A temporary, seasonal bridge could be installed as previously performed by the USFS to span the bankfull width during base flow condition. A permanent crossing would likely need to span the entire floodplain and would be at risk of annual flooding damage, and likely contains many permitting hurdles.

The Cinnabar Creek road is approximately 12 feet wide on average and contains one severe wash-out located 0.5 miles below the Site (i.e., the Cinnabar Creek road "pinch point"). This wash-out was previously stabilized with large wood supports; however, the supports have collapsed into the drainage below. A small dozer and excavator may be able to pass, but this road would need significant repairs to allow for vehicle access.

Tailings. The tailings piles did not show obvious signs of rills and gullies that are indicative of significant surface water erosion. In addition, water in the streams appeared relatively clear. These observations suggest that the tailings are relatively stable and are not actively eroding into the stream during spring snowmelt conditions.

Adits. Based on visual observations, Adits 2 and 3 appeared to be discharging at flow rates three to four times higher than observed in August 2016. However, the adits were covered in snow and some of the flow may be attributable to snowmelt and not groundwater. Adit 1 appeared to be flowing at a slightly higher flow rate than in August 2016. It was also discovered that Adit 1 does not flow through the seep in the yellow tailings; it flows to the north around the eastern edge of the lower reclaimed tailings area downstream of the mine site. Therefore, re-routing Adit 1 to the West Fork Cinnabar Creek further upstream may not eliminate the seep in the yellow tailings, although it may reduce the volume of water feeding it that could be infiltrating through the tailings. Re-routing Adit 1 would also require moving and grading a large volume of tailings that would require larger machinery.

Yellow tailings seep area. The seep in the yellow tailings contained open ponded water surrounded by deep snow. Just below the seep toward West Fork Cinnabar Creek, several additional seeps and springs were feeding a channel through the lower reclaimed tailings area. The flow rate in the channel was measured at 450 gallons per minute (gpm), but a water sample was not collected.

Iron oxyhydroxide (aka "yellowboy"). As noted in Section 6.1.1 of the IA report (E & E 2017), cinnabar (mercury sulfide) is the only prominent sulfide mineral at the site. Small amounts of pyrite (iron sulfide) and stibnite also are present. The paucity of pyrite and other sulfides, combined with the location of the cinnabar deposits in limestone and silicified limestone host rock, result in little or no development of acid rock drainage or acid mine drainage conditions. Nonetheless, the small amount of iron present in the rock and mine waste at the Site locally results

in the formation of iron oxyhydroxide precipitates, or “yellowboy,” in adit drainage and tailings-impacted drainage. This small amount of yellowboy, along with oxyhydroxides of aluminum and manganese, likely plays an important role in mercury transport in surface water at the site (see Section 4.2). Oxyhydroxides of iron, aluminum, and manganese, as well as other particulates such as clay, also likely play an important role in mercury groundwater transport (see IA report Section 6.4.3; E & E 2017). Iron oxyhydroxide (aka “yellowboy”) was visually evident in large seep areas in the upper mine site near the former cook house area; however, yellowboy was not visually observed in the West Fork Cinnabar Creek.

Repository. The two proposed repository locations that were identified in the 2016 IA Report were evaluated during a fly-over in the helicopter. The “on-site” repository, which would be constructed in the mine site basin, will come with many challenges regarding surface water and groundwater given the many seeps and intermittent tributaries. The potential “high and dry” repository location, above the Site, appeared to be a suitable location from the air; however, the road was difficult to evaluate due to snow cover but appeared to be wide enough for haul trucks and the switchbacks looks manageable. According to the Valley County parcel maps, the “high and dry” repository site appears to be located on land owned by the Oberbillig J Estate (Parcel #RP18N09E018435).

Time-lapse cameras. Four time-lapse cameras were deployed at the Site to capture photo-documentation of snowmelt and spring runoff events. Two of the cameras were recovered in July 2018; however, two of the cameras were found to be missing. Visual evidence of erosion (i.e., rills and gullies) in the upper red tailings piles was not observed in the time-lapse videos, and the West Fork Cinnabar Creek appeared to handle the high spring flows with no signs of instability or erosion.

### **3.2 September 2018**

On September 24, 2018 the EPA OSC and START engineer visited the Site to collect observations of features that were not visible during the previous snow-covered field event in May 2018. They also collected samples of vegetation from two locations to identify species with proven ability of tolerating conditions at the Site.

Beginning downstream of SC01, the team walked to the Site via the Sugar Creek road and Cinnabar Creek road. Sugar Creek was flowing at approximately 8 cubic feet per second (cfs) according to the USGS gaging station (USGS 2018). They evaluated a potential rock borrow source and verified the need for significant road improvements in order to cross Sugar Creek, access the borrow source, and transport borrow material to the Site. The OSC determined that the required effort to incorporate the borrow source into a potentially viable removal alternative was no longer under consideration.

Upon arriving at the Site, the team observed the surface water pathway(s) leading from the right-bank spring immediately downgradient of the yellow tailings seep. This spring flows across the tailings impoundment, across a rip rap tailings dam, and enters the West Fork Cinnabar Creek. The estimated flow rate was approximately 50 to 100 gpm. There appeared to be minimal value to armoring or reinforcing the pathway due to the slow velocity of surface water flow and the absence of visible erosion or incisement.

Visible discharge from Adit 2 was less than 5 gpm, although subsurface discharge was likely occurring through course matrix and pond located at the adit terminus. The Adit 1 discharge was approximately 15 to 30 gpm, and Adit 3 was estimated at 10 to 20 gpm. The team walked the Adit 3 discharge route toward the West Fork Cinnabar Creek to determine where it entered the creek in relation to sample location WF03 (from the May 2018 Field Event). As presented in Section 4, elevated mercury loadings were calculated in the section of West Fork Cinnabar Creek between sample locations WF05A and WF03. Global positioning system coordinates indicate that Adit 1 enters the West Fork Cinnabar Creek downstream of WF03 and therefore is not likely contributing to the elevated loadings observed at WF03.

The OSC determined that, of the alternatives currently under consideration, source control via revegetation presented the greatest potential value for reducing total mercury loading to surface water. The team proceeded to collect vegetation from two locations for identification to help reduce erosion of bare tailings (Section 4.2). The clippings collected from vegetation amongst the reclaimed tailings impoundment appeared vibrant and diverse, and the vegetation from the exposed red tailings included sparse grasses and shrubs.

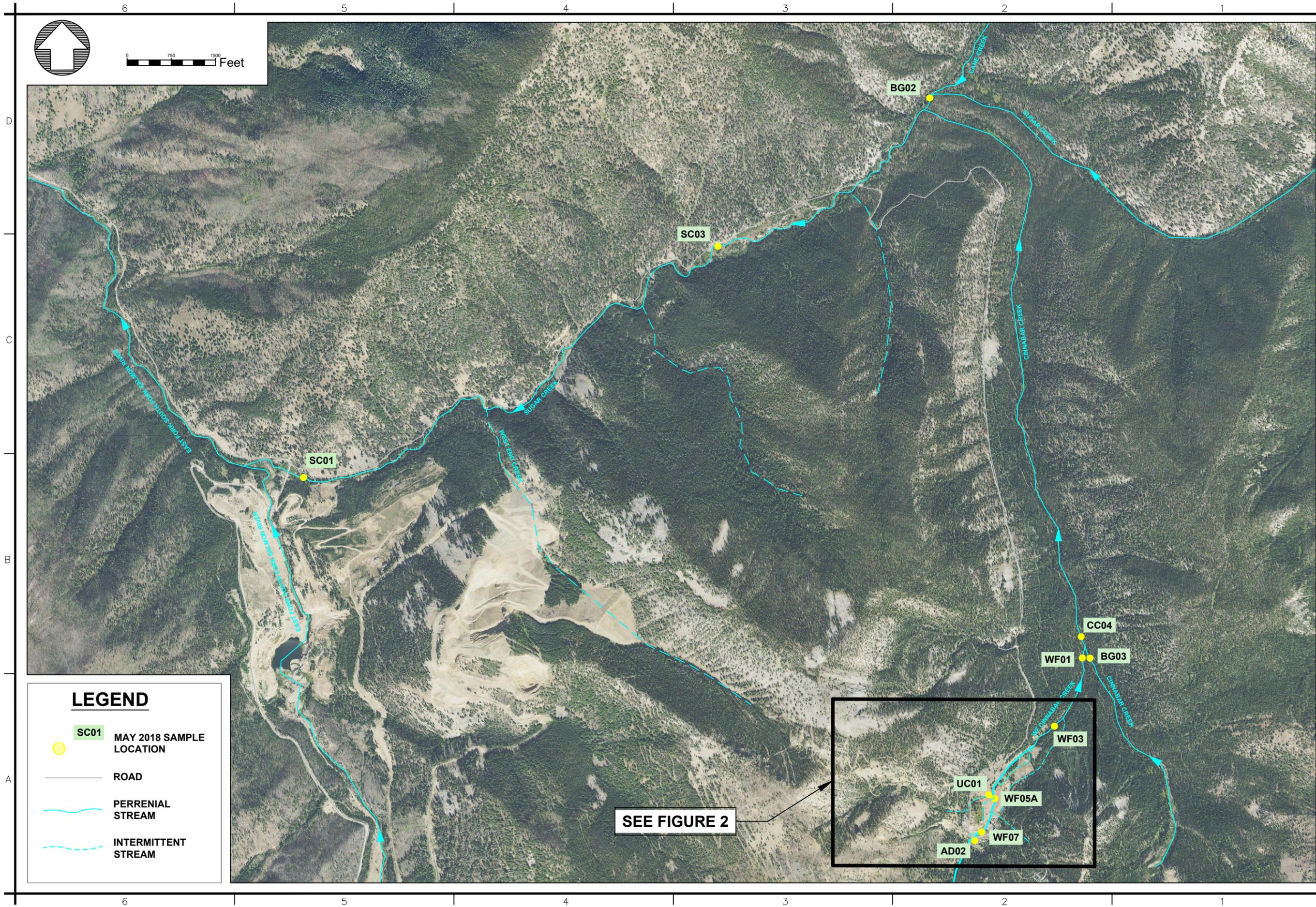
Other site observations included more surface water flow than anticipated, as described above, and many seeps and springs were emanating around the Site, including the yellow tailings seep area.



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0 750 1500 Feet



### LEGEND

- SC01 MAY 2018 SAMPLE LOCATION
- ROAD
- PERENNIAL STREAM
- INTERMITTENT STREAM

SEE FIGURE 2



Symbol	Description	Date	Approved
A	DRAFT - SAMPLE LOCATION MAP	08/29/18	

SIZE B  
IF SHEET IS LESS THAN 11"X17" IT IS REDUCED PRINT - SCALE REDUCED ACCORDINGLY  
ONE INCH

Designed by	Date	8/28/18
Drawn by	Spec. No.	16-07-0002
Reviewed by	P/W No.	
Approved by	File name	AS SHOWN
	Print date	
	Dwg. code	

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IDAHO  
VALLEY COUNTY  
CINNABAR MINE SITE  
YELLOW PINE, IDAHO  
VICINITY SAMPLE  
LOCATION MAP

FIGURE number:  
**3-1**

File: C:\Users\Chadwick\Documents\Projects\Cinnabar\000\Cinnabar.dwg 18-08-18 11:52:52am

6

5

4

3

2

1



0 200 400 Feet

D

C

B

A



### LEGEND

-  **WF03** MAY 2018 SAMPLE LOCATION
-  ROAD
-  PERRENIAL STREAM
-  INTERMITTENT STREAM



Symbol	Description	Date	Approved
A	DRAFT - SAMPLE LOCATION MAP	08/29/18	

**SIZE B**  
 IF SHEET IS LESS THAN 11"x17" IT IS REDUCED PRINT - SCALE REDUCED ACCORDINGLY  
 ONE INCH

Designed by	Date	8/29/18
Drawn by	TDD No.	16-07-0002
Reviewed by	PAM No.	
Approved by	File name	AS SHOWN
	Print date	
	Dwg code	

ecology and environment, inc.  
 Global Environmental Specialists  
 720 Third Avenue, Suite 1700  
 Seattle, Washington 98104  
 (206) 624-9537



IDAHO  
 VALLEY COUNTY  
 CINNABAR MINE SITE  
 YELLOW PINE, IDAHO  
**MINE SITE SAMPLE  
 LOCATION MAP**

FIGURE number:  
**3-2**

# 4

## RSE Results

### 4.1 May 2018 Surface Water Results

The May 2018 surface water analytical results and corresponding screening levels are summarized in Table 4-1. Analytical data reports and data validation memoranda are included in Appendix B. Screening levels include fresh water criterion maximum concentrations for acute exposure (i.e., CMC) and criterion continuous concentrations for chronic exposure (i.e., CCC) for the protection of aquatic life values from the State of Idaho Water Quality Criteria for Aquatic Life (IDAPA 58.01.02; IDEQ 2018). For total mercury, the freshwater CMC value of 1,400 nanograms per liter (ng/L) from EPA (EPA 2017) and the CCC value of 12 ng/L from the 2004 Idaho Water Quality Standards (IDAPA 58.01.02) have been used for the filtered fraction. For those metals with screening levels, most apply to the filtered fraction, although the CMC and CCC for selenium apply to the unfiltered fraction.

Unfiltered mercury concentrations ranged from 3.01 ng/L in sample BG02, which was collected from Sugar Creek above the confluence with Cinnabar Creek, to 2,870 ng/L for sample AD02, which was collected from Adit 2. Filtered mercury concentrations ranged from 2.05 ng/L in sample BG02 to 77.3 ng/L for sample AD02. Filtered mercury was detected above the CCC, but not the CMC, in all of the May 2018 surface water samples except BG02. The remaining analytes were not detected above the CCC or CMC in the May 2018 surface water samples.

The results of the field duplicates and other quality assurance samples are included in Appendix B. The results for the field duplicates were generally similar to the field sample results. However, for sample AD02, the unfiltered mercury concentration in the field sample (2,870 ng/L) was significantly different than the field duplicate (5,820 ng/L). The laboratory re-analyzed these samples to confirm the results (2,900 JL ng/L for the AD02 field sample, and 5,850 JL ng/L for the AD02 field duplicate). For the purpose of the mercury loading analysis discussed in the next section, START used the lower concentration of 2,870 ng/L from the original field sample.

#### 4.1.1 May 2018 Mercury Loadings Analysis

Mercury loadings were analyzed at each sample location to help identify primary sources of filtered and unfiltered total mercury in the Cinnabar Creek and Sugar Creek watersheds. Mercury loadings were calculated by multiplying the concen-

trations measured in each sample by the flow rate recorded at that sample location. Flow rates were measured at several locations using USGS stream gaging techniques and a Marsh McBirney Flo-Mate flow meter. However, flow rate measurements were not feasible at all sample locations due to safety concerns or time constraints during the field event. In these instances, flow rates were estimated using standard hydrology calculations (i.e., drainage area ratios) or visual estimates. Note that sample location SC01 is located near a USGS stream gage station that provides real-time flow measurements. As a result, flow rates for SC03 and BG02 were calculated using a ratio of their respective drainage areas in relation to SC01. Likewise, WF03 was calculated using a drainage area ratio applied to WF01. Table 4-2 displays the flow rates used in the loadings analysis and the method used to derive each flow value.

Mercury load values are provided in Table 4-3, in units of milligrams per day (mg/day). Additionally, loadings at each sample location are compared as a percentage of the total loadings observed in the most downstream sample location (SC01). For the purposes of this analysis, load values are assumed to be cumulative of all upstream sources. This approach aids in identifying where mercury is entering West Fork Cinnabar Creek, Cinnabar Creek, and Sugar Creek. A regional display of the calculated loadings is provided on Figure 4-1 (unfiltered mercury) and Figure 4-2 (filtered mercury).

Regionally in the Sugar Creek watershed, the May 2018 unfiltered total mercury loadings results (Figure 4-1 and Table 4-3) indicate that the existing Cinnabar Mine site (represented as WF03) was contributing less than 17 percent (%) of the unfiltered total mercury load observed at SC01 on May 15 and 16, 2018. Background sources BG02 and BG03 were contributing a combined 4% of unfiltered total mercury to SC01. Over 50% of the unfiltered total mercury load was occurring within Sugar Creek below the Cinnabar Creek confluence, most of which occurs between SC03 and SC01. This may be attributable to historical deposition of tailings and other mercury-bearing particulates in the Sugar Creek floodplain (i.e., within the stream bed and overbank areas) that is re-mobilized during high flows, and/or other unidentified sources downstream of Cinnabar Creek. The 1998 EPA Removal Action Report (E & E 1998) noted that, prior to the removal action, the Cinnabar Mine tailings were actively sloughing and eroding into the West Fork Cinnabar Creek and were likely transported downstream. It should be noted that the Cinnabar Mine tailings piles did not exhibit obvious signs of significant erosion (rills/gullies) during recent site visits in August 2016 (see IA Report Section 6.4.1; E & E 2017) and September 2018.

The filtered total mercury loadings results (Figure 4-2 and Table 4-3) indicate that the existing Cinnabar Mine site (WF03) contributed approximately 26% of the load at SC01, which is similar to the background sample BG03 located on Cinnabar Creek upstream of the West Fork confluence (29%). Also noteworthy is that an increase in the filtered total mercury loading value was recorded at SC03 (544%), which may also be attributable to historical deposition of tailings and/or other mercury-bearing particulates in the Sugar Creek floodplain, or other unidentified sources.

Locally at the Cinnabar Mine (upstream of WF03), there was an increase in unfiltered and filtered mercury loading in the West Fork Cinnabar Creek between WF05A and WF03. This may be attributable to entrainment of previously deposited tailings and/or other mercury-bearing particulates that are mobilized during high flows and/or the drainage from the reclaimed tailings impoundment, which was not sampled. It should be noted that the tailings impoundment drainage channel did not show obvious signs of erosion or incising during the May 2018 sample event or the September 2018 site walk.

Sample location WF07, which is located immediately downstream of the confluences of Adits 2 and 3 with West Fork Cinnabar Creek, contained relatively small loadings of unfiltered and filtered total mercury. While Adit 2 (AD02) contained an elevated load of unfiltered total mercury at its source, it discharges into a small pond that appears to provide for settlement of particulates prior to entering the West Fork above WF07. Adits 1 and 3 were not sampled in May 2018, but sample locations downstream of their respective confluences to the West Fork (WF07 and WF01) do not indicate they contributed significant mercury loads.

## **4.2 Conceptual Site Model (CSM) Update**

A CSM for contaminant fate and transport at the Site was presented in Section 6 of the IA report (E & E 2017). Results of the 2018 RSE were evaluated to refine the CSM for mercury release and transport at the Site. The sources, processes, and migration pathways expected to be of importance to mercury release and transport in surface water at the Site and downstream surface water bodies are presented graphically in Figure 4-3. The mercury sources and migration pathways and processes presented in Figure 4-3 are described in the sections of the IA report (E & E 2017) indicated in the figure. Additional information on mercury fate and transport sources, processes, and pathways commonly observed at mercury mine sites, likely including the Cinnabar Mine Site, is provided in Rytuba (2000) and Rytuba (2002).

## **4.3 Vegetation Study**

A bench scale test was performed on the red tailings samples in a research greenhouse to evaluate the feasibility of vegetating the tailings using an engineered soil amendment. This test is consistent with the methods used in the greenhouse studies performed on the yellow tailings samples as part of the 2016 IA Report (E & E 2017), which found that only one grass (tall fescue) sustained growth on the amended yellow tailings. The 2018 test was performed using the red tailings samples, which border a large portion of the West Fork Cinnabar Creek at the Site. The red tailings were amended with the engineered soil ProGanics™, fertilizers, and planted with a seed mix containing 60% intermediate wheatgrass, 30% tall fescue, and 10% red clover. Finally, a flexible growth media (Flexterra™) was placed on top of the amended soils, which were then irrigated regularly and monitored for seven weeks. The study indicated that the wheatgrass and red clover

started to die off after about 5 weeks, but the tall fescue performed very well. The results of the study are included in Appendix C.

Several plant samples were collected from the tailings during the September 2018 site walk. While the majority of the tailings are void of any plants and organic matter, there are some plants growing sparsely on the red tailings. Slender wheatgrass and russet buffaloberry were both identified on the red tailings. A type of bluegrass was also identified, but the exact species was inconclusive. It should be noted that slender wheatgrass was included in the 2017 greenhouse study, but it did not perform well.

Several plant species were also identified, or partially identified, growing on the reclaimed tailings impoundment, which is sustaining a lush and diverse vegetative cover. The species identified include arctic rush, field horsetail, a type of bluegrass, a type of brome, a currant, narrowleaf willow, Englemann spruce, and lodgepole pine.

Table 4-1 - Surface Water Samples Laboratory Analytical

Analyte	Station ID	Units	Idaho Water Quality Standards; Aquatic Life for Fresh Water (1)		SC01	SC03	BG02	CC04	BG03	WF01	WF03	WF05A	UC01	WF07	AD02											
	Geographic Area		CMC	CCC	Sugar Creek	Sugar Creek	Sugar Creek	Cinnabar Creek	Cinnabar Creek	West Fork Cinnabar Creek	West Fork Cinnabar Creek	West Fork Cinnabar Creek	Un-named Creek, Trib to WF Cinnabar Creek	West Fork Cinnabar Creek	Adit 2, Trib to WF Cinnabar Creek											
	Sample ID				18051001	18051003	18051025	18051005	18051007	18051011	18051013	18051017	18051019	18051021	18051029											
	Sample ID		18051002	18051004	18051026	18051006	18051008	NA	18051014	18051018	18051020	18051022	18051030													
	Method																									
<b>Unfiltered TAL Metals</b>																										
Aluminum	SW846 6010B	mg/L	--	--	0.123	0.102	0.103	0.105	0.151	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.118						
Antimony	SW846 6020A	mg/L	--	--	0.00101	0.001	U	0.001	U	0.00168	0.001	U	0.00444	0.00536	0.00472	0.00219	0.00518	0.00443	0.0043							
Arsenic	SW846 6020A	mg/L	--	--	0.00734	0.004	0.00207	0.0149	0.00215	0.0384	0.0476	0.0241	0.0104	0.0169	0.0508											
Barium	SW846 6020A	mg/L	--	--	0.0086	0.00717	0.00331	0.00715	0.0045	0.0119	0.0136	0.0123	0.00846	0.0101	0.0114											
Beryllium	SW846 6020A	mg/L	--	--	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U				
Cadmium	SW846 6020A	mg/L	--	--	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U				
Calcium	SW846 6010B	mg/L	--	--	10.9	JH	9.19	JH	7.58	JH	16.7	JH	10	JH	29.2	JH	29.9	JH	20.9	JH	8.62	JH	21.6	JH	12.7	JH
Chromium	SW846 6020A	mg/L	--	--	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U		
Cobalt	SW846 6020A	mg/L	--	--	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U		
Copper	SW846 6020A	mg/L	--	--	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U		
Iron	SW846 6010B	mg/L	--	--	0.156	0.132	0.109	0.111	0.111	0.0816	0.0885	0.112	0.0934	0.093	0.22											
Lead	SW846 6020A	mg/L	--	--	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U		
Magnesium	SW846 6010B	mg/L	--	--	1.84	1.13	0.813	3.72	2.31	6.19	6.8	6.38	3.69	6.04	4.08											
Manganese	SW846 6020A	mg/L	--	--	0.0047	0.00335	0.00215	0.00454	0.00533	0.00275	0.00404	0.00934	0.00326	0.00403	0.0204											
Nickel	SW846 6020A	mg/L	--	--	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.00181					
Potassium	SW846 6010B	mg/L	--	--	0.635	0.548	0.474	0.927	0.524	1.56	1.76	1.28	0.561	1.28	1.1											
Selenium	SW846 6020A	mg/L	0.02	0.005	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U		
Silver	SW846 6020A	mg/L	--	--	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U		
Sodium	SW846 6010B	mg/L	--	--	1.78	1.79	1.85	1.13	1.33	0.71	0.689	0.674	0.336	0.684	0.529											
Thallium	SW846 6020A	mg/L	--	--	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.00111					
Vanadium	SW846 6020A	mg/L	--	--	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U		
Zinc	SW846 6020A	mg/L	--	--	0.005	U	0.005	U	0.00783	0.00961	0.00784	0.005	0.00784	0.005	0.00574	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005		
<b>Unfiltered Low Level Mercury</b>																										
Mercury	EPA 1631	ng/L			214	108	3.01	186	105	253	850	195	268	94	2,870											
<b>Unfiltered General Chemistry</b>																										
Total Suspended Solids	SM 2540D	mg/L	NA	NA	5.1	3.85	1.5	JQ	1.03	JQ	1.19	U	0.7	JQ	0.9	JQ	0.8	JQ	3	1	JQ	5.11				
Total Organic Carbon	SW846 9060	mg/L	--	NA	--	--	1.65	--	--	--	--	--	1.05	1.13	0.82	JQ	--	--	--							
<b>Filtered TAL Metals</b>																										
Aluminum	SW846 6010B	mg/L	--	--	0.0934	0.0672	0.05	U	0.05	U	0.0973	--	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U				
Antimony	SW846 6020A	mg/L	--	--	0.00102	0.001	U	0.001	U	0.00168	0.001	U	--	0.00524	0.00449	0.00215	0.00504	0.00459								
Arsenic	SW846 6020A	mg/L	0.340	0.150	0.00695	0.00405	0.00213	0.015	0.00195	--	0.0448	0.0207	0.0094	0.016	0.0487											
Barium	SW846 6020A	mg/L	--	--	0.00799	0.00601	0.00288	0.00675	0.00422	--	0.0131	0.0115	0.00995	0.0104												
Beryllium	SW846 6020A	mg/L	--	--	0.001	U	0.001	U	0.001	U	0.001	U	--	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U			
Cadmium	SW846 6020A	mg/L	0.0008	H	0.0004	H	0.001	U	0.001	U	0.001	U	--	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U			
Calcium	SW846 6010B	mg/L	--	--	10.9	9.66	7.69	16.8	10.2	--	28.7	20.5	8.53	21.3	12.9											
Chromium	SW846 6020A	mg/L	0.345	H	0.045	H	0.001	U	0.001	U	0.001	U	--	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U			
Cobalt	SW846 6020A	mg/L	--	--	0.001	U	0.001	U	0.001	U	0.001	U	--	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U			
Copper	SW846 6020A	mg/L	0.017	0.011	0.001	U	0.001	U	0.001	U	0.001	U	--	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U			
Iron	SW846 6010B	mg/L	--	--	0.109	0.0969	0.0827	0.0784	0.104	--	0.0661	0.0687	0.065	0.0822	0.0729											
Lead	SW846 6020A	mg/L	0.033	H	0.001	H	0.001	U	0.001	U	0.001	U	--	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U			
Magnesium	SW846 6010B	mg/L	--	--	1.86	1.19	0.821	3.78	2.37	--	6.63	6.21	3.63	6.02	4.14											
Manganese	SW846 6020A	mg/L	--	--	0.00225	0.00164	0.001	U	0.00104	0.00186	--	0.001	U	0.00256	0.001	U	0.00286	0.00168								
Nickel	SW846 6020A	mg/L	0.279	H	0.031	H	0.001	U	0.001	U	0.001	U	--	0.001	U	0.001	U	0.001	U	0.001	U	0.00112				
Potassium	SW846 6010B	mg/L	--	--	0.651	0.56	0.475	0.94	0.537	--	1.71	1.27	0.544	1.29	1.13											
Selenium	SW846 6020A	mg/L	--	--	0.001	U	0.001	U	0.001	U	0.001	U	--	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U			
Silver	SW846 6020A	mg/L	0.001	H	--	--	0.001	U	0.001	U	0.001	U	--	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U			
Sodium	SW846 6010B	mg/L	--	--	1.85	1.85	1.91	1.15	1.37	--	0.666	0.66	0.327	0.677	0.566											
Thallium	SW846 6020A	mg/L	--	--	0.001	U	0.001	U	0.001	U	0.001	U	--	0.001	U	0.001	U	0.001	U	0.001	U	0.00102				
Vanadium	SW846 6020A	mg/L	--	--	0.001	U	0.001	U	0.001	U	0.001	U	--	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U			
Zinc	SW846 6020A	mg/L	0.070	H	0.070	H	0.005	U	0.005	U	0.005	U	--	0.005	U	0.005	U	0.005	U	0.00512	0.005	0.005	0.005			
<b>Filtered Low Level Mercury</b>																										
Mercury	EPA 1631	ng/L	1,400	12	12.1	77.2	2.05	49.4	54.9	--	75.3	72	43.7	61.4	77.3											
<b>Filtered General Chemistry</b>																										
Total Organic Carbon	SW846 9060	mg/L	--	NA	--	--	1.67	--	--	--	--	--	1.13	1.15	0.84	JQ	--	--	--							

**Table 4-1 - Surface Water Samples Laboratory Analytical**

Analyte	Station ID	Units	Idaho Water Quality Standards; Aquatic Life for Fresh Water (1)		SC01	SC03	BG02	CC04	BG03	WF01	WF03	WF05A	UC01	WF07	AD02
	Geographic Area		CMC	CCC	Sugar Creek	Sugar Creek	Sugar Creek	Cinnabar Creek	Cinnabar Creek	West Fork Cinnabar Creek	West Fork Cinnabar Creek	West Fork Cinnabar Creek	Un-named Creek, Trib to WF Cinnabar Creek	West Fork Cinnabar Creek	Adit 2, Trib to WF Cinnabar Creek
	Sample ID				18051001	18051003	18051025	18051005	18051007	18051011	18051013	18051017	18051019	18051021	18051029
	Sample ID				18051002	18051004	18051026	18051006	18051008	NA	18051014	18051018	18051020	18051022	18051030
	Method														

Notes: **Bold** = Detected

Shading = Sample concentration exceeds one or more WQC value.

**Key**

-- = not analyzed, or no screening level

CCC = Criteria Continuous Concentration

CMC = Criteria Maximum Concentration

H = Hardness-dependent water quality criterion for aquatic life, calculated for cadmium, chromium (III), lead, nickel, silver, and zinc. A total hardness value of 54.6 mg/L as CaCO3 is calculated based on the average values for Sugar Creek and Cinnabar Creek surface water samples.

J = The analyte was detected. The associated result is estimated.

mg/L = milligrams per liter

ng/L = Nanograms per liter

TAL = Target Analyte List

U = The analyte was analyzed for but not detected. The value provided is the method detection limit.

UJ = The analyte was analyzed for but not detected. The associated reporting limit is estimated.

**TABLE 4-2 - Sample Location Flow Rate Summary**

Sample Location	Flow Rate (cfs)	Method
AD02	0.22	Visual estimate
WF07	2.00	Visual estimate
WF05A	2.63	Measured
UC01	0.28	Measured
WF03	4.00	Visual estimate
WF01	5.25	Mass balance (CC04 minus BG03)
BG03	6.13	Measured
CC04	11.37	Measured
BG02	57.85	Drainage area ratio (.61*SC01)
SC03	80.94	Drainage area ratio (.85*SC01)
SC01	95.00	USGS Stream Gage Station 13311450

Key:

cfs = cubic feet per second

**TABLE 4-3 May 2018 Mercury Loadings**

Sample Location	Flow Rate (cfs)	Unfiltered Total Mercury			Filtered Total Mercury		
		Concentration (ng/L)	Load (mg/day)	% of Total (SC01)	Concentration (ng/L)	Load (mg/day)	% of Total (SC01)
AD02*	0.5	2,870	3,511	7.1%	77.3	95	3.4%
WF07*	2	94	460	0.9%	61.4	300	10.7%
WF05A	2.63	195	1,255	2.5%	72	463	16.5%
UC01	0.28	268	184	0.4%	43.7	30	1.1%
WF03*	4	850	8,318	16.7%	75.3	737	26.2%
WF01*	5.25	253	3,250	6.5%	NS	NS	NS
BG03	6.13	105	1,575	3.2%	54.9	823	29.3%
CC04	11.37	186	5,174	10.4%	49.4	1,374	48.9%
BG02*	58	3.01	427	0.9%	2.05	291	10.3%
SC03*	81	108	21,403	43.0%	77.2	15,299	544.0%
SC01	95	214	49,739	100.0%	12.1	2,812	100.0%

\* Flow rate is estimated or calculated (not measured).

Key:

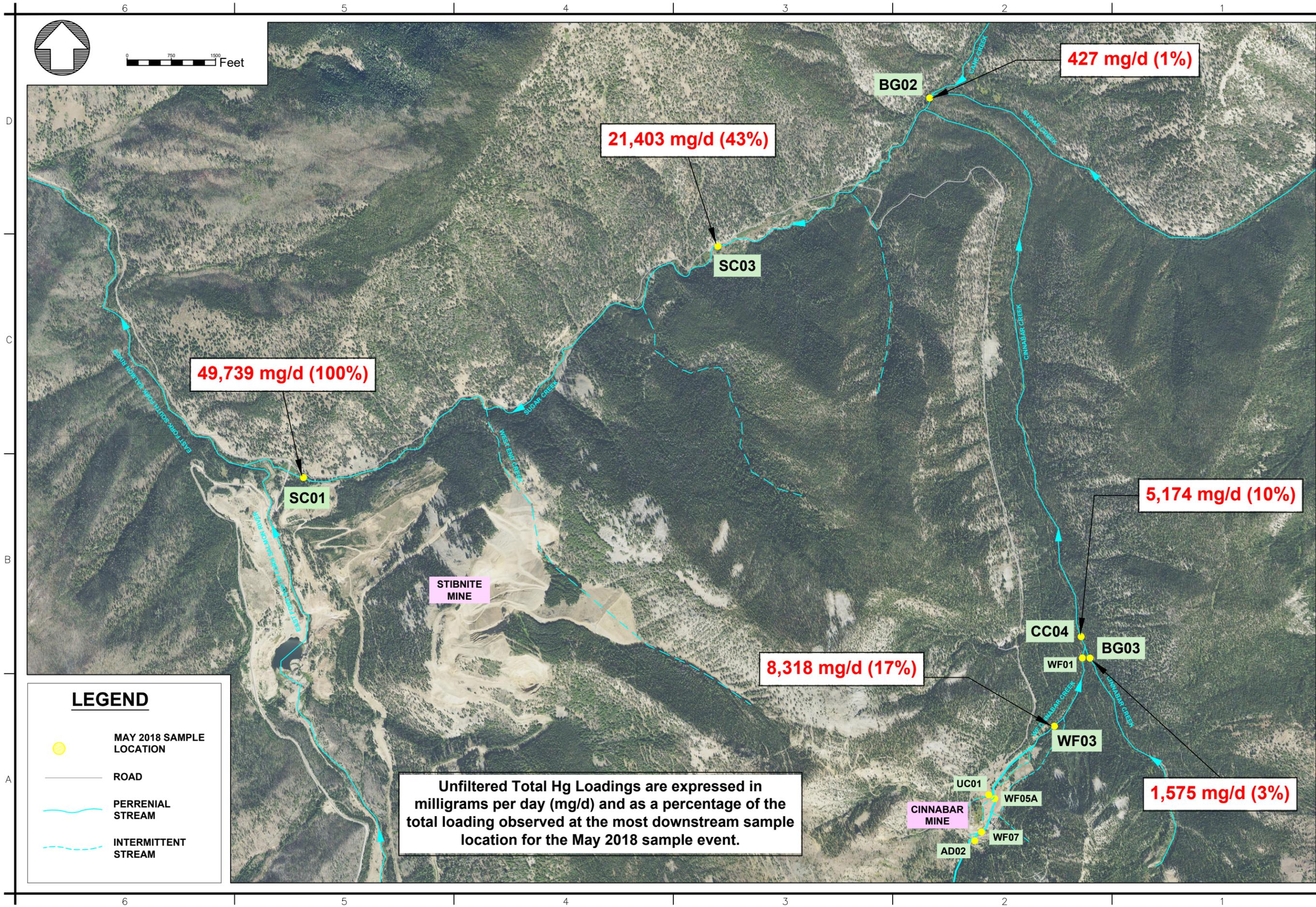
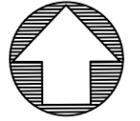
% = percent

cfs = cubic feet per second

mg/day = milligrams per day

ng/L = nanograms per liter

NS = not sampled



49,739 mg/d (100%)

21,403 mg/d (43%)

427 mg/d (1%)

5,174 mg/d (10%)

8,318 mg/d (17%)

1,575 mg/d (3%)

Unfiltered Total Hg Loadings are expressed in milligrams per day (mg/d) and as a percentage of the total loading observed at the most downstream sample location for the May 2018 sample event.

**LEGEND**

- MAY 2018 SAMPLE LOCATION
- ROAD
- PERENNIAL STREAM
- INTERMITTENT STREAM



Symbol	Description	Date	Approved
A	DRAFT - SAMPLE LOCATION MAP	08/29/18	

SIZE B  
IF SHEET IS LESS THAN 11"x17" IT IS REDUCED PRINT - SCALE REDUCED ACCORDINGLY  
ONE INCH

Designed by	8/28/18
Drawn by	TJC
Reviewed by	
Approved by	
File name	AS SHOWN
Plot date	
Plot scale	
Dwg code	

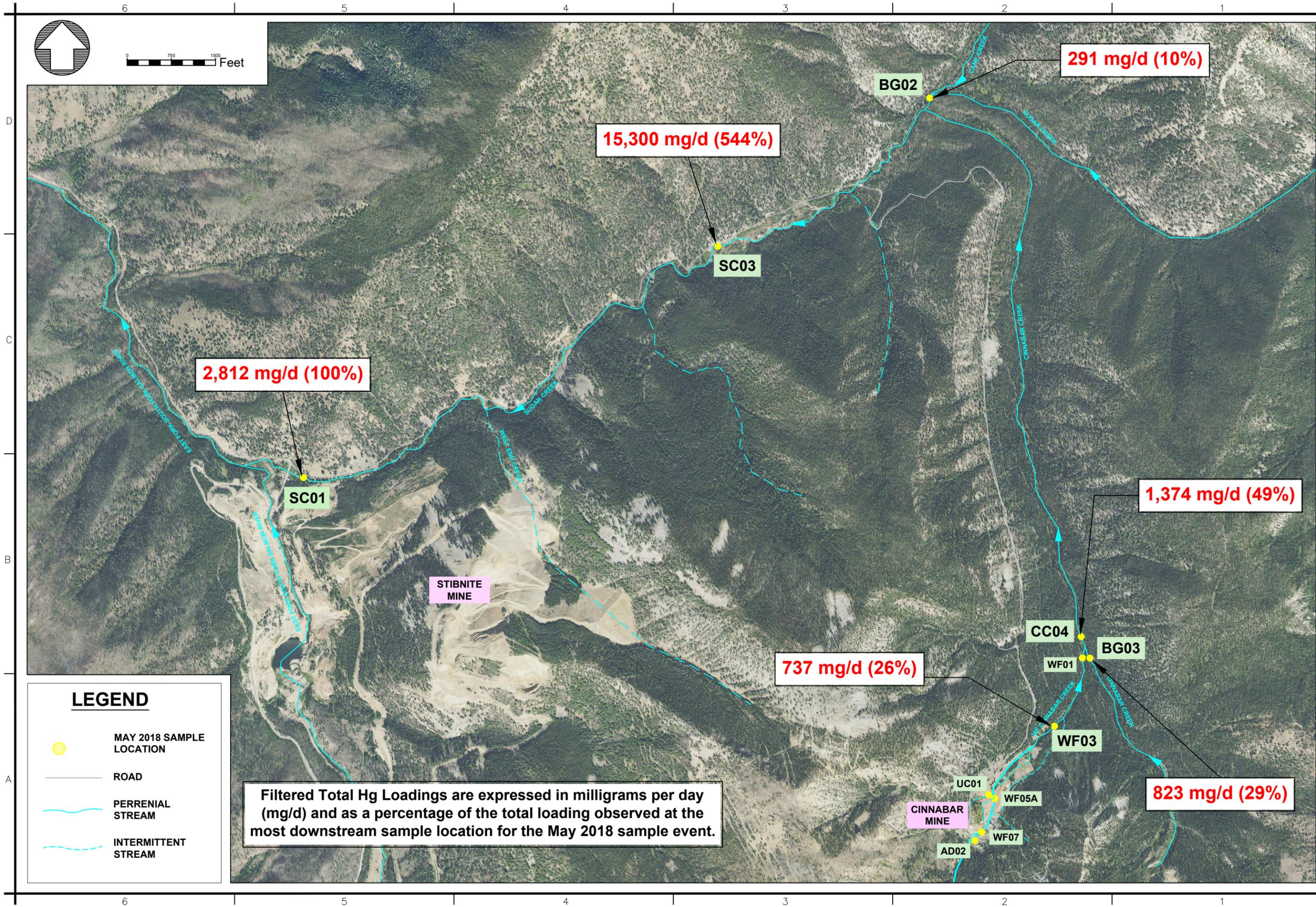
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Seattle, Washington 98104  
(206) 624-9537



IDAHO  
VALLEY COUNTY  
CINNABAR MINE SITE  
YELLOW PINE, IDAHO  
**UNFILTERED TOTAL HG  
LOADING DIAGRAM**

FIGURE number:  
**4-1**

File: C:\Users\Chadwick\Documents\Projects\Cinnabar\00\Cinnabar.dwg 28-Oct-18 05:13:28am



**2,812 mg/d (100%)**

**15,300 mg/d (544%)**

**291 mg/d (10%)**

**1,374 mg/d (49%)**

**737 mg/d (26%)**

**823 mg/d (29%)**

**Filtered Total Hg Loadings are expressed in milligrams per day (mg/d) and as a percentage of the total loading observed at the most downstream sample location for the May 2018 sample event.**

**LEGEND**

- MAY 2018 SAMPLE LOCATION
- ROAD
- PERENNIAL STREAM
- INTERMITTENT STREAM



Symbol	Description	Date	Approved
A	DRAFT - SAMPLE LOCATION MAP	08/29/18	

SIZE B  
IF SHEET IS LESS THAN 11"x17" IT IS REDUCED PRINT - SCALE REDUCED ACCORDINGLY  
ONE INCH

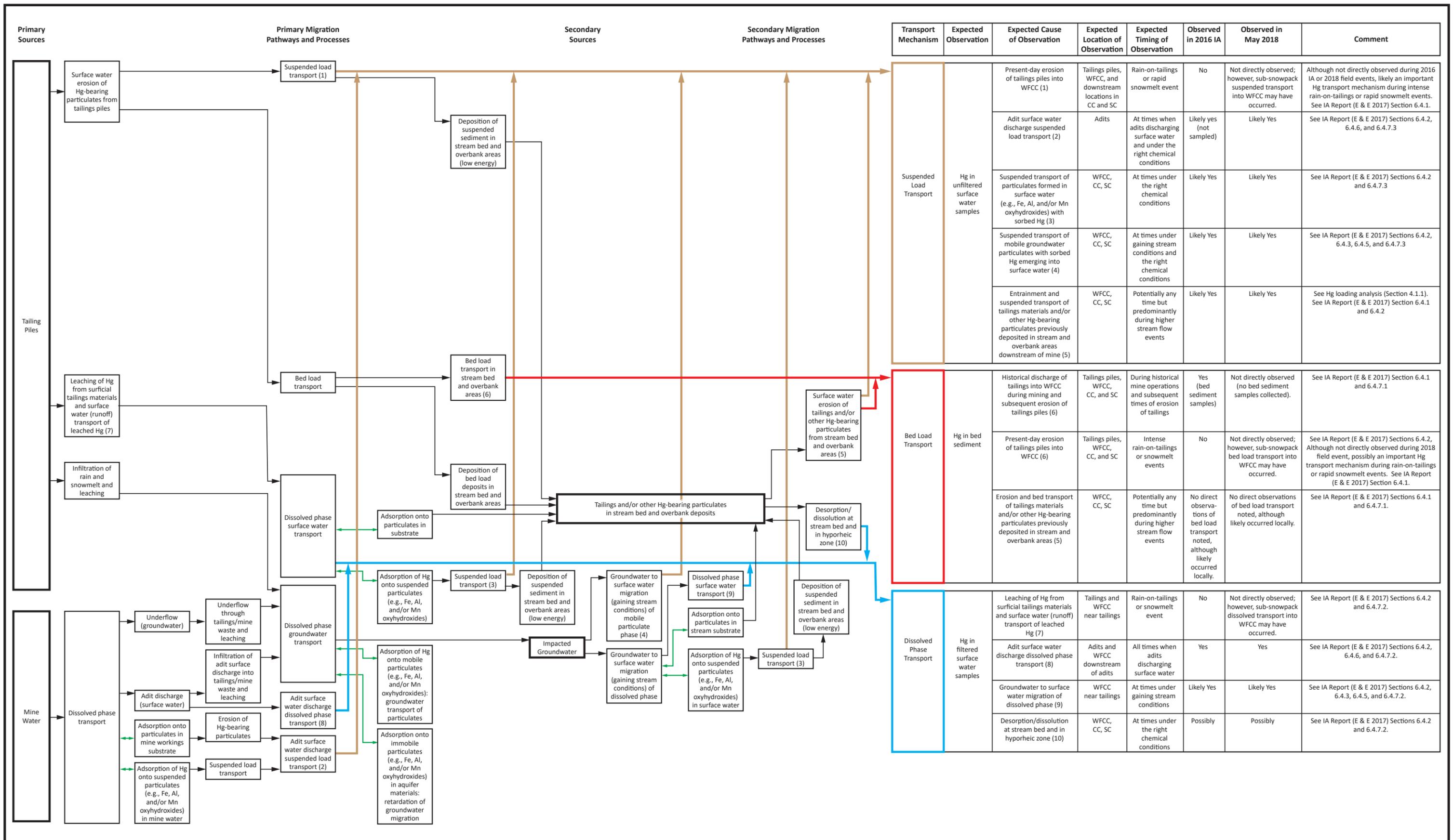
Designed by	Date	8/28/18
Drawn by	TDD No.	16-07-0002
Reviewed by	Spec. No.	
Approved by	PAM No.	
	File name	AS SHOWN
	Plot date	
	Doc code	

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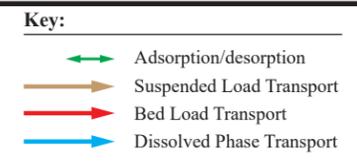


IDAHO  
VALLEY COUNTY  
CINNABAR MINE SITE  
YELLOW PINE, IDAHO  
**FILTERED TOTAL HG  
LOADINGS DIAGRAM**

FIGURE number:  
**4-2**



Transport Mechanism	Expected Observation	Expected Cause of Observation	Expected Location of Observation	Expected Timing of Observation	Observed in 2016 IA	Observed in May 2018	Comment
Suspended Load Transport	Hg in unfiltered surface water samples	Present-day erosion of tailings piles into WFCC (1)	Tailings piles, WFCC, and downstream locations in CC and SC	Rain-on-tailings or rapid snowmelt event	No	Not directly observed; however, sub-snowpack suspended transport into WFCC may have occurred.	Although not directly observed during 2016 IA or 2018 field events, likely an important Hg transport mechanism during intense rain-on-tailings or rapid snowmelt events. See IA Report (E & E 2017) Section 6.4.1.
		Adit surface water discharge suspended load transport (2)	Adits	At times when adits discharging surface water and under the right chemical conditions	Likely yes (not sampled)	Likely Yes	See IA Report (E & E 2017) Sections 6.4.2, 6.4.6, and 6.4.7.3
		Suspended transport of particulates formed in surface water (e.g., Fe, Al, and/or Mn oxyhydroxides) with sorbed Hg (3)	WFCC, CC, SC	At times under the right chemical conditions	Likely Yes	Likely Yes	See IA Report (E & E 2017) Sections 6.4.2 and 6.4.7.3
		Suspended transport of mobile groundwater particulates with sorbed Hg emerging into surface water (4)	WFCC, CC, SC	At times under gaining stream conditions and the right chemical conditions	Likely Yes	Likely Yes	See IA Report (E & E 2017) Sections 6.4.2, 6.4.3, 6.4.5, and 6.4.7.3
		Entrainment and suspended transport of tailings materials and/or other Hg-bearing particulates previously deposited in stream and overbank areas downstream of mine (5)	WFCC, CC, SC	Potentially any time but predominantly during higher stream flow events	Likely Yes	Likely Yes	See Hg loading analysis (Section 4.1.1). See IA Report (E & E 2017) Section 6.4.1 and 6.4.2
Bed Load Transport	Hg in bed sediment	Historical discharge of tailings into WFCC during mining and subsequent erosion of tailings piles (6)	Tailings piles, WFCC, CC, and SC	During historical mine operations and subsequent times of erosion of tailings	Yes (bed sediment samples)	Not directly observed (no bed sediment samples collected).	See IA Report (E & E 2017) Section 6.4.1 and 6.4.7.1
		Present-day erosion of tailings piles into WFCC (6)	Tailings piles, WFCC, CC, and SC	Intense rain-on-tailings or snowmelt events	No	Not directly observed; however, sub-snowpack bed load transport into WFCC may have occurred.	See IA Report (E & E 2017) Sections 6.4.2, 6.4.3, 6.4.5, and 6.4.7.3
		Erosion and bed transport of tailings materials and/or other Hg-bearing particulates previously deposited in stream and overbank areas (5)	WFCC, CC, SC	Potentially any time but predominantly during higher stream flow events	No direct observations of bed load transport noted, although likely occurred locally.	No direct observations of bed load transport noted, although likely occurred locally.	See IA Report (E & E 2017) Sections 6.4.1 and 6.4.7.1.
Dissolved Phase Transport	Hg in filtered surface water samples	Leaching of Hg from surficial tailings materials and surface water (runoff) transport of leached Hg (7)	Tailings and WFCC near tailings	Rain-on-tailings or snowmelt event	No	Not directly observed; however, sub-snowpack dissolved transport into WFCC may have occurred.	See IA Report (E & E 2017) Sections 6.4.2 and 6.4.7.2.
		Adit surface water discharge dissolved phase transport (8)	Adits and WFCC downstream of adits	All times when adits discharging surface water	Yes	Yes	See IA Report (E & E 2017) Sections 6.4.2, 6.4.6, and 6.4.7.2.
		Groundwater to surface water migration of dissolved phase (9)	WFCC near tailings	At times under gaining stream conditions	Likely Yes	Likely Yes	See IA Report (E & E 2017) Sections 6.4.2, 6.4.3, 6.4.5, and 6.4.7.2.
		Desorption/dissolution at stream bed and in hyporheic zone (10)	WFCC, CC, SC	At times under the right chemical conditions	Possibly	Possibly	See IA Report (E & E 2017) Sections 6.4.2 and 6.4.7.2.



CINNABAR MINE SITE  
Yellow Pine, Idaho

**Figure 4-3**  
**CONCEPTUAL SITE MODEL FOR AQUEOUS MERCURY RELEASE AND TRANSPORT AT CINNABAR MINE AND DOWNSTREAM SURFACE WATER BODIES**

Date: 10/26/18    Drawn by: AES    10:START-IV\TO-30-T1-SS1\fig 4-3

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# 5

## Removal Alternative Update

A large-scale removal action, such as Alternatives 3 (tailings consolidation and stream relocation) and 4 (full-scale removal options) described in the 2016 IA Report (E & E 2017), is not currently feasible given the access restrictions to the Cinnabar Mine Site. However, a limited removal action may be accomplished using minimal equipment that does not require access road improvements. The preferred limited removal action consists of establishing a vegetative cover on the yellow and red tailings piles, and draining the wetland that lies on the yellow tailings north of the mill area. While the tailings do not show significant signs of erosion such as rills and gullies, it is likely that some tailings are transported to the stream channel during heavy rain events via sheet flow. This is supported by the presence of lag gravel at the tailings surface, contrasting with the comparatively fine-grained nature of the underlying material, which is possibly being removed by erosion. Establishing a vegetative cover will reduce the volume of tailings entering the creek during these rain events and reduce the amount of precipitation that infiltrates the tailings piles. Additionally, draining the yellow tailings seep area will help minimize or eliminate methylmercury production that may be occurring in anoxic, ponded water on the yellow tailings. The conceptual layout of the preferred limited removal action is depicted in Figure 5-1 and described below.

Vegetative Cover. As detailed in the 2016 IA Report (E & E 2017), a successful vegetative cover requires adequate organic matter, nutrient levels, and biological activity that are typically provided in topsoil. Due to a lack of local topsoil borrow material and access limitations at the site, it is deemed impractical to import and apply topsoil on top of the tailings for vegetation growth. An alternative to importing topsoil is to apply an engineered soil media to the tailings prior to seeding. Engineered soils contain combinations of wood fibers, biopolymers, biochar, and other constituents that promote microbial activity that is essential for permanent vegetative cover, and can be applied hydraulically via helicopter or on the ground with small-scale equipment. A slow release fertilizer and design seed mix is added to the engineered soil media and applied to the tailings using a hydroseeder. A flexible growth medium is then applied in the same fashion on top of the engineered soil that combines chemical and mechanical bonding techniques to hold the growth medium in place and promote accelerated germination. A growth medium that provides up to 18 months of erosion control for seeds to germinate and establish root structure is recommended.

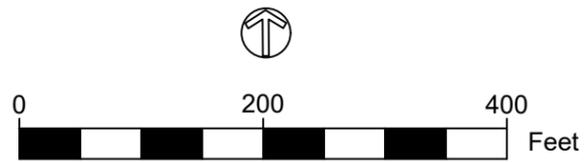
Bench scale greenhouse tests (Section 4.2) were performed on samples of the tailings to determine the feasibility of this alternative using the engineered soil media Proganics™. The results of the studies indicated that tall fescue grass seed, known as KY-31 (*loium arundinaceum*), germinates and sustains continued growth on the amended yellow and red tailings. The other grass species used in the tests did not perform well.

A potential disadvantage of a vegetative cover on mercury tailings is that it could provide a source of dissolved organic carbon, which may trigger methylmercury production within the tailings. EPA conducted a study (Eckley 2017) using multiple biotic soil amendments on tailings samples that measured methylmercury production under controlled, anoxic conditions. The samples amended with Biotic-Earth™ did not promote methylating microorganisms to the same extent that the other soil amendments did. While the bench scale greenhouse testing showed encouraging results using Proganics™, it may be beneficial to consider using Bio-Earth™ in order to minimize potential methylmercury production at the site. Final application rates for Bio-Earth™ that maximizes organic content for sustained plant growth while minimizing methylmercury production are to be determined by EPA staff.

The proposed vegetation cover consists of the following hydraulic application over 5.0 acres of bare tailings:

- 3,200 pounds per acre (lbs/acre) Bio-Earth Black™,
- 40 lbs/acre of tall fescue and slender wheatgrass seed (ratio to-be-determined),
- 120 lbs/acre of fertilizer (18-24-6), and
- 3,000 lbs/acre of high performance flexible growth media, such as Flexterra™.

Yellow Tailings Seep. The seep in the yellow tailings pile may be drained by constructing a small channel through the tailings leading from the wetland down to the tailings impoundment drainage channel (see Figure 5-1). Construction of the channel will require excavating approximately 50 cubic yards of tailings and shall be sufficiently deep to drain the wetland and prevent water from ponding. The channel shall be approximately 2 feet wide and 150 feet long. Side slopes above the channel should be graded no steeper than 2:1 and vegetated as described above. The channel shall be armored with turf reinforcement matting extending a minimum 2 feet beyond the edge of the channel, resulting in approximately 600 square feet of matting. The turf reinforcement matting shall contain a permissible shear stress value on bare (un-vegetated) soil of 3.0 pounds per square foot.



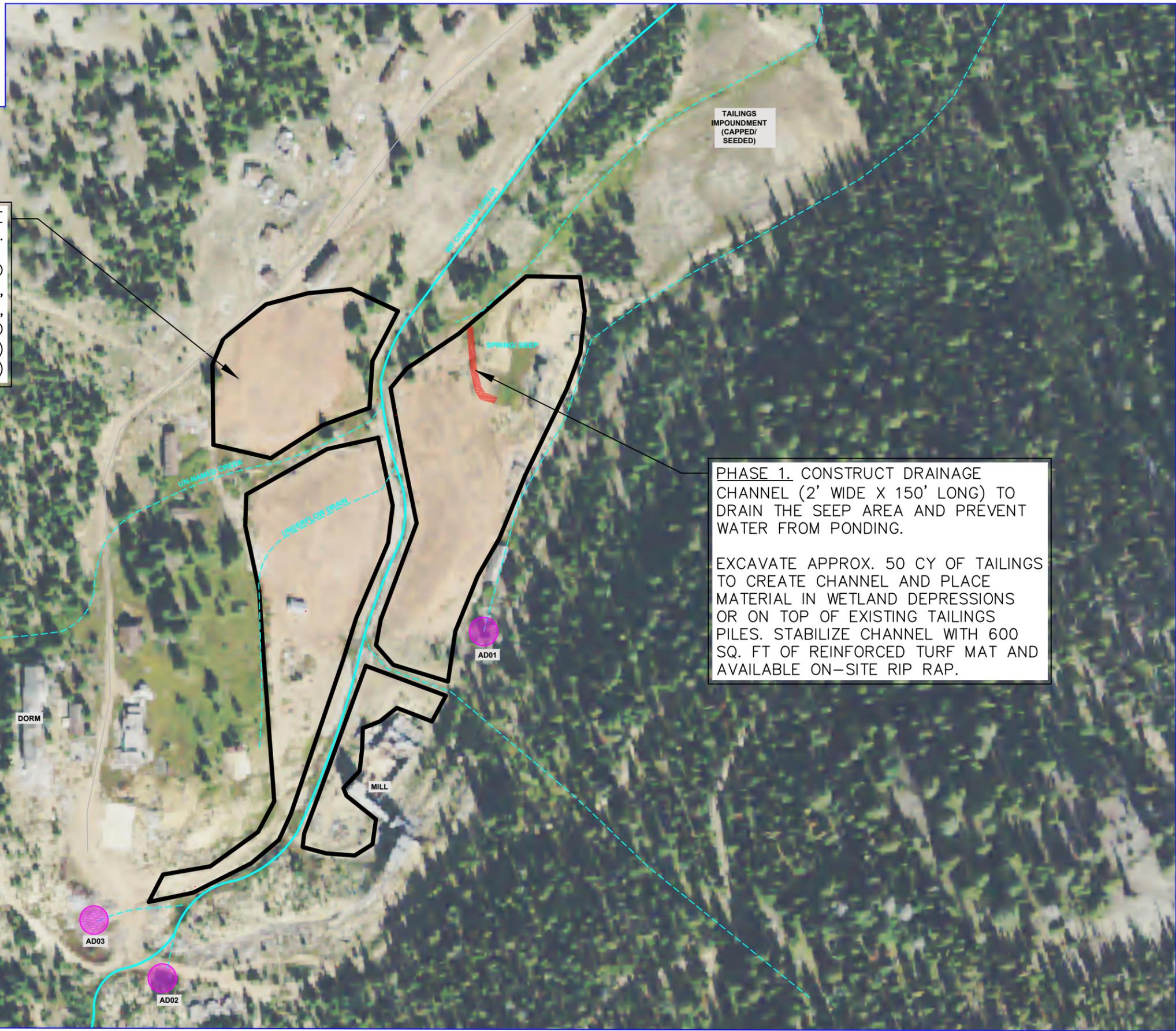
**PHASE 2. ESTABLISH VEGETATIVE COVER ON BARE TAILINGS.**  
 HYDRAULICALLY APPLY ENGINEERED SOIL MEDIA (3,200 LBS/AC), TALL FESCUE SEED (40 LBS/AC), FERTILIZER (120 LBS/AC), AND FLEXTERRA (3,000 LBS/AC) ON BARE TAILINGS (5.0 ACRES)

TAILINGS IMPOUNDMENT (CAPPED/SEEDED)

**PHASE 1. CONSTRUCT DRAINAGE CHANNEL (2' WIDE X 150' LONG) TO DRAIN THE SEEP AREA AND PREVENT WATER FROM PONDING.**  
 EXCAVATE APPROX. 50 CY OF TAILINGS TO CREATE CHANNEL AND PLACE MATERIAL IN WETLAND DEPRESSIONS OR ON TOP OF EXISTING TAILINGS PILES. STABILIZE CHANNEL WITH 600 SQ. FT OF REINFORCED TURF MAT AND AVAILABLE ON-SITE RIP RAP.

**LEGEND**

-  ADIT
-  ROAD
-  PERENNIAL STREAM
-  INTERMITTENT STREAM



Symbol	Description	Date	Approved
A			

**SIZE B**  
 IF SHEET IS LESS THAN 11"x17" IT IS REDUCED PRINT - SCALE REDUCED ACCORDINGLY  
 ONE INCH

Designed by	T. CHATRIAND	Date	9/25/18
Drawn by	TJC	TDD No.	
Reviewed by		PAM No.	
Approved by	WASHINGTON STATE DEPARTMENT OF ECOLOGY	File name	AS SHOWN
		Print date	
		Dwg code	

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 Seattle, Washington 98104  
 (206) 624-9537



IDAHO  
 VALLEY COUNTY  
 CINNABAR MINE SITE  
 YELLOW PINE, IDAHO  
 PREFERRED LIMITED  
 REMOVAL ACTION

FIGURE number:  
**5-1**

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# 6

## Summary and Conclusions

This RSE was completed to refine the Cinnabar Mine conceptual site model and establish a preferred limited removal action based on the alternatives provided in the 2016 IA Report. The RSE included a surface water sampling event in May 2018 to assess high flow conditions and a site walk in September 2018 to evaluate limited removal action alternatives.

Surface water samples collected in May 2018 were analyzed for unfiltered and filtered TAL metals, unfiltered and filtered TOC, and TSS. In summary, all but one surface water sample contained filtered total mercury concentrations above screening levels, while the remaining analytes were not detected above screening levels in any sample.

Mercury loadings were also evaluated as part of the May 2018 sampling event. The loadings analysis indicates that the Site was contributing approximately 17% of the unfiltered total mercury load and 26% of the filtered total mercury load observed at the terminus of Sugar Creek (SC01) on May 15 and 16, 2018. Over 50% of the unfiltered and filtered total mercury load was occurring within Sugar Creek below the Cinnabar Creek confluence, which may be attributable to historical deposition of tailings and other mercury-bearing particulates in the Sugar Creek floodplain that is re-mobilized during high flows, and/or other unidentified sources downstream of Cinnabar Creek.

Locally at the Cinnabar Mine Site, there was an increase in unfiltered and filtered mercury loading in the West Fork Cinnabar Creek below the red tailings piles that may be attributable in part to previously deposited tailings and/or other mercury-bearing particulates in the stream that are mobilized during high flows. The tailings piles did not exhibit obvious signs of significant erosion (i.e., rills and gullies); however, fine-grained tailings and other mercury-bearing particulates may be transported to the stream as suspended or bed load in sheet flow during heavy rain-on-tailings or rapid snowmelt events.

A large-scale removal action is not currently feasible given the access restrictions to the Cinnabar Mine Site. However, a limited removal action may be accomplished using minimal equipment that does not require access road improvements. The preferred limited removal action consists of establishing a vegetative cover



## **6 Summary and Conclusions**

on the bare tailings piles and draining the seep that lies on the yellow tailings north of the mill area. Establishing a vegetative cover will reduce the volume of tailings entering the creek during rain and rapid snowmelt events and reduce the amount of precipitation that infiltrates into the tailings piles. Additionally, draining the yellow tailings seep area will help reduce methylmercury production that may be occurring in anoxic, ponded water on the yellow tailings.

# 7

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**A**

**Photographs**

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Photo 1 Sample location SC01.

Direction: South Date: 5/15/18 Time: 15:11

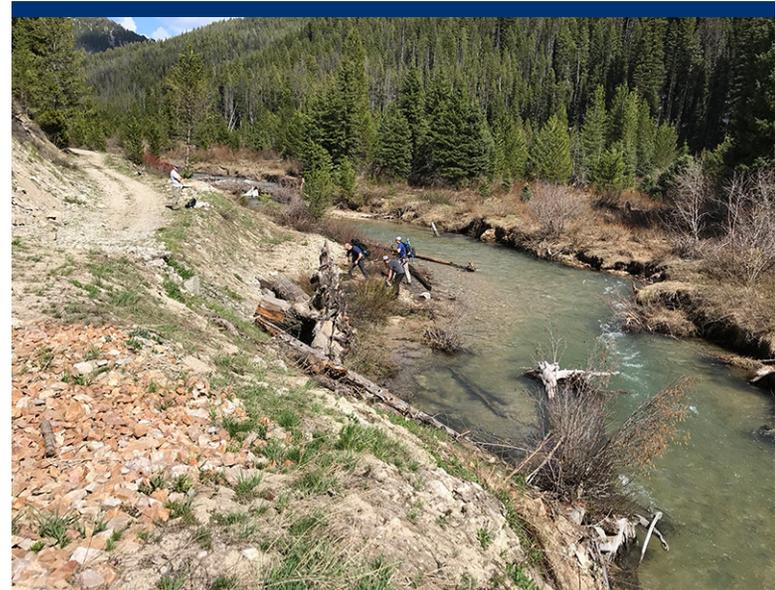


Photo 2 Sample location SC02.

Direction: East Date: 5/15/18 Time: 16:31



Photo 3 Sugar Creek road stream cut.

Direction: West Date: 5/15/18 Time: 16:58



Photo 4 Sugar Creek ford, former bridge location.

Direction: Southeast Date: 5/15/18 Time: 17:25

CINNABAR MINE SITE  
Yellow Pine, Idaho

TO Number: TO-31-T1-SS1



Photo 5 Sugar Creek ford, former bridge location.

Direction: North      Date: 5/15/18      Time: 09:12

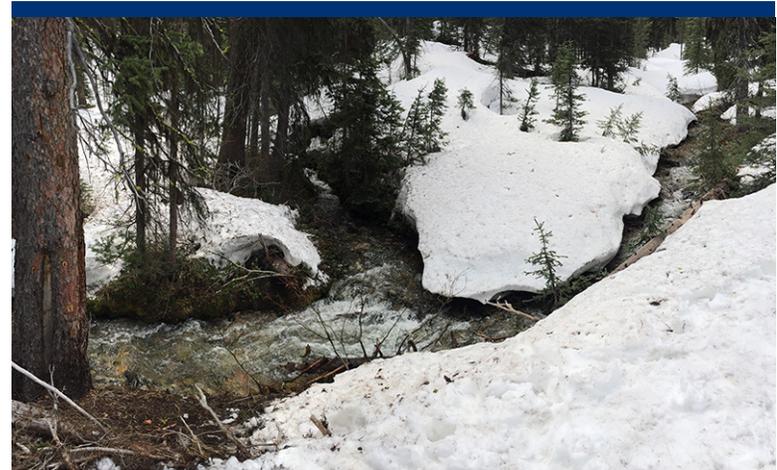


Photo 6 Cinnabar Creek and West Fork confluence (WF01).

Direction: South      Date: 5/16/18      Time: 12:16

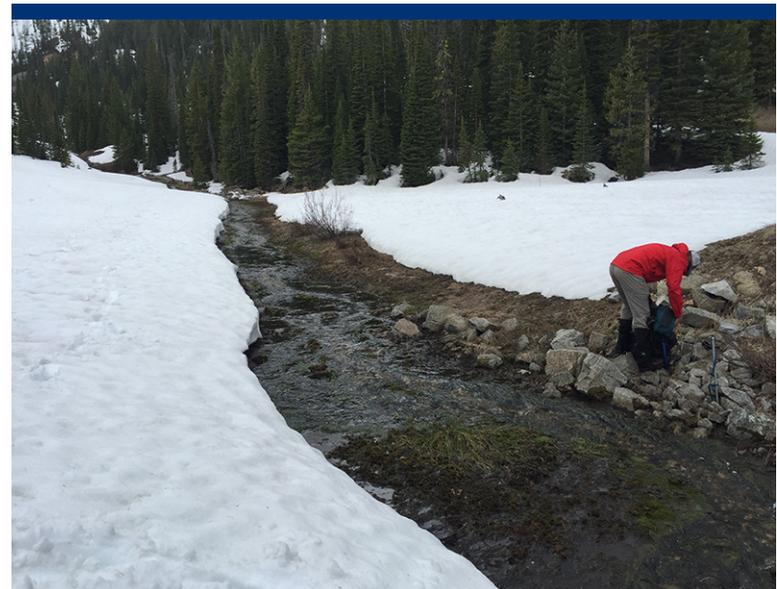


Photo 7 Drainage channel through tailings impoundment (reclaimed).

Direction: Southwest      Date: 5/16/18      Time: 14:29

CINNABAR MINE SITE  
Yellow Pine, Idaho

TO Number: TO-31-T1-SS1

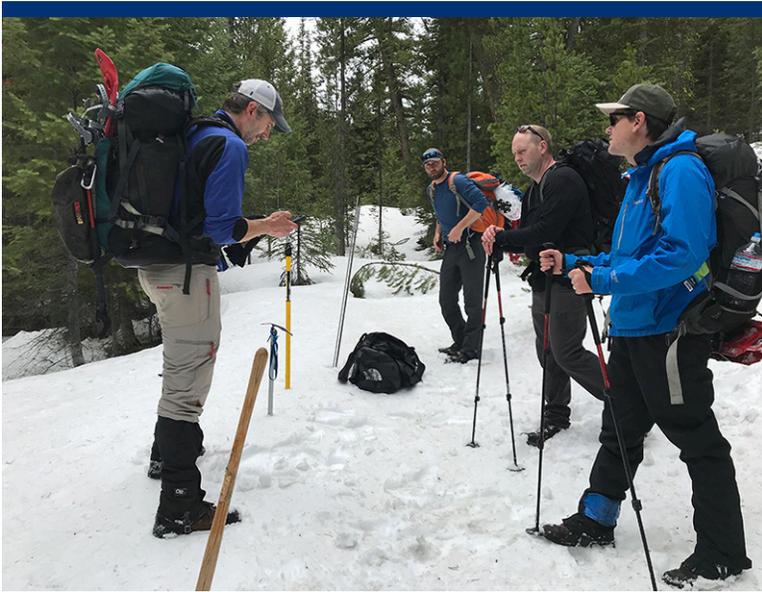


Photo 8 Sampling team members.

Direction: North Date: 5/16/18 Time: 10:20

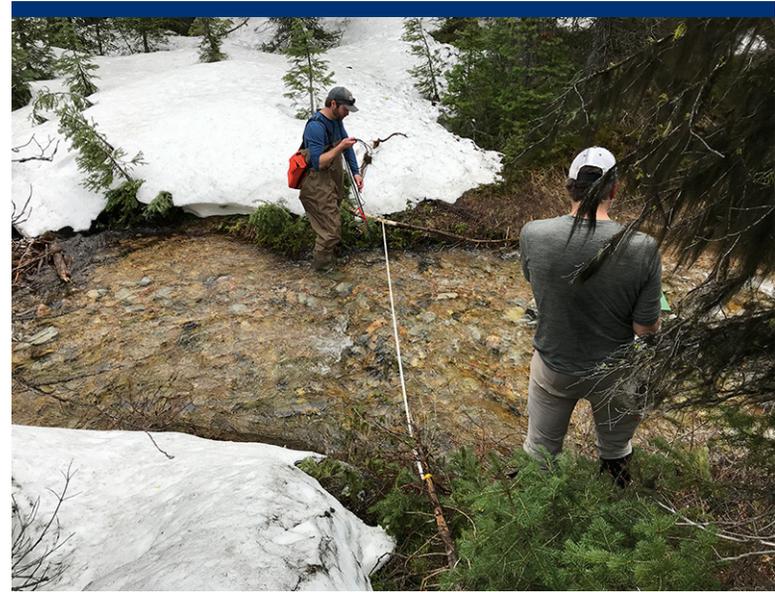


Photo 9 Stream gaging at CC04.

Direction: East Date: 5/16/18 Time: 10:52

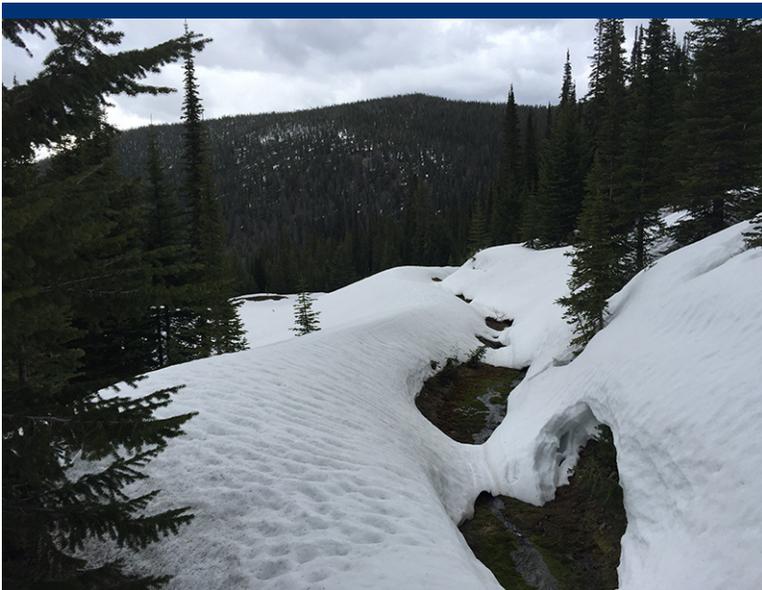


Photo 10 Adit 03 drainage channel.

Direction: North Date: 5/16/18 Time: 14:43

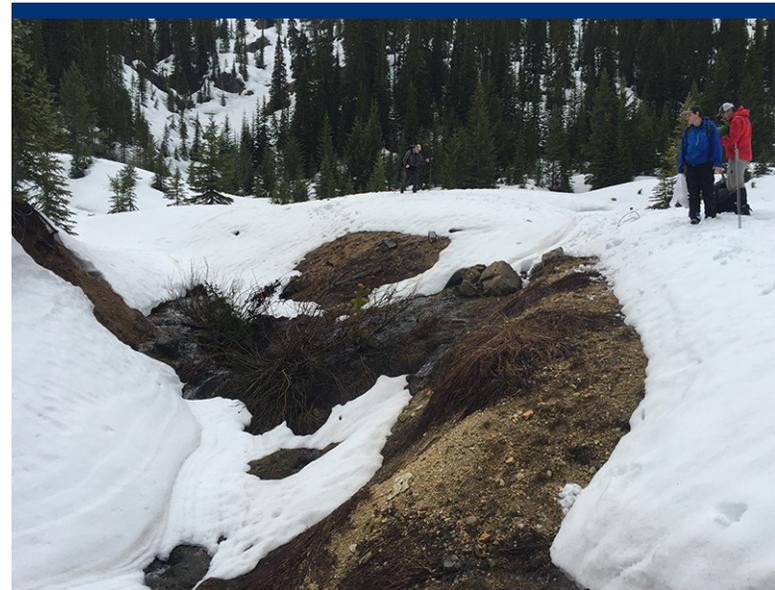


Photo 11 Sample location WF07 and Adit 03 confluence.

Direction: South Date: 5/16/18 Time: 15:33



Photo 12 Sample location BG03.

Direction: West Date: 5/16/18 Time: 11:32

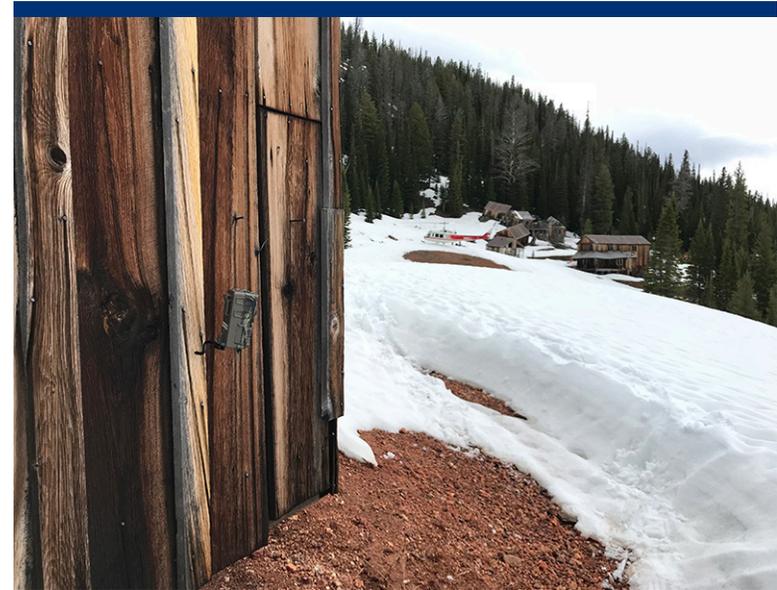
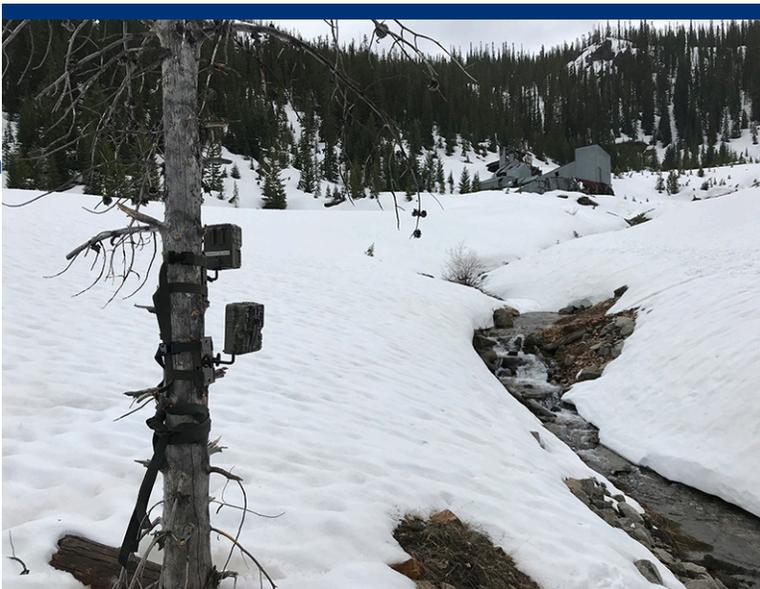


Photo 13 Time-lapse camera.

Direction: North Date: 5/16/18 Time: 14:44



cam

Photo 14 Time-lapse cameras.

Direction: South Date: 5/16/18 Time: 15:05

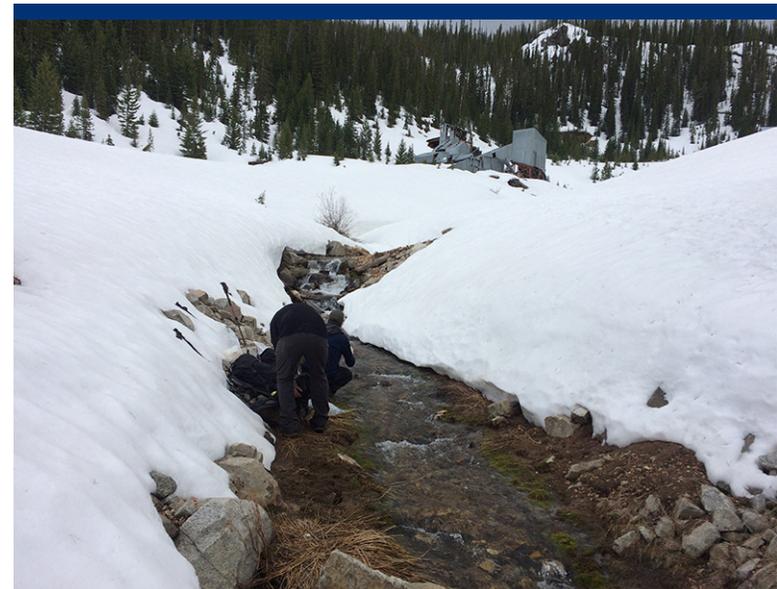


Photo 15 Sample location WF05A.

Direction: South Date: 5/16/18 Time: 13:57

CINNABAR MINE SITE  
Yellow Pine, Idaho

TO Number: TO-31-T1-SS1



Photo 16 Sample location Adit 02 (AD02).

Direction: South Date: 5/16/18 Time: 15:21

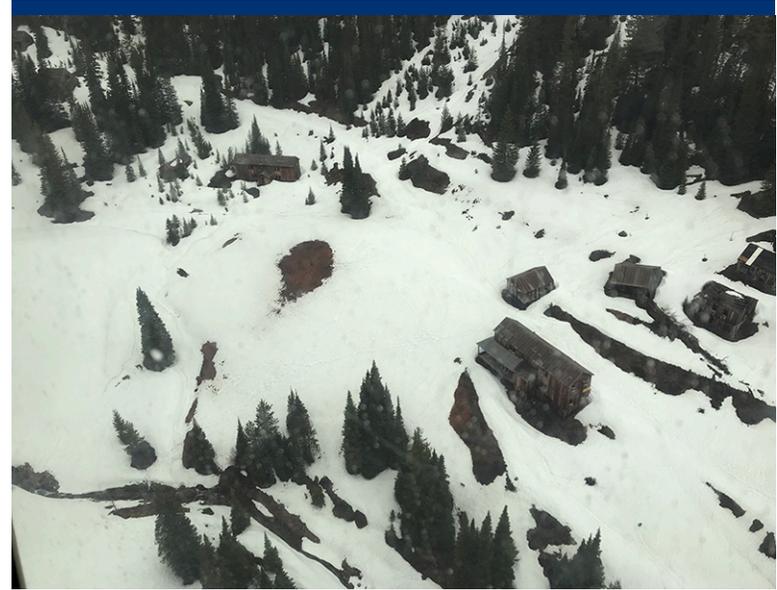


Photo 17 Cinnabar Mine Site.

Direction: Southwest Date: 5/16/18 Time: 16:00



Photo 18 Former rock borrow source.

Direction: Southeast Date: 9/24/18 Time: 10:41



Photo 19 Cinnabar Creek road wash-out.

Direction: North Date: 9/24/18 Time: 11:05



Photo 20 Drainage channel discharge from tailings impoundment.

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Direction: Southeast      Date: 9/25/18      Time: 11:58

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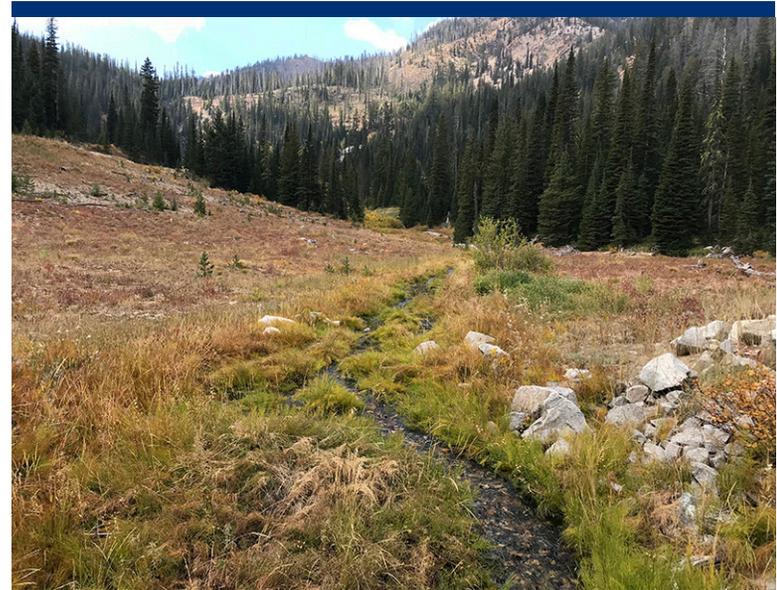


Photo 21 Drainage channel through tailings impoundment.

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Direction: South      Date: 9/26/18      Time: 11:59

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CINNABAR MINE SITE  
Yellow Pine, Idaho

TO Number: TO-31-T1-SS1



Photo 22 Spring flow path to tailings impoundment.

Direction: North      Date: 9/24/18      Time: 12:10



Photo 23 Red tailings piles and WF Cinnabar Creek.

Direction: South      Date: 9/24/18      Time: 12:19



Photo 24 Seep area in yellow tailings pile.

Direction: North      Date: 9/24/18      Time: 12:20

CINNABAR MINE SITE  
Yellow Pine, Idaho

TO Number: TO-31-T1-SS1



Photo 25 Adit 02 and WF Cinnabar Creek.

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Direction: Southwest      Date: 9/24/18      Time: 12:37

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Photo 26 Sugar Creek ford, former bridge location.

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Direction: Southeast      Date: 9/24/18      Time: 14:36

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**B**

**Analytical Data**

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# ecology and environment, inc.

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## MEMORANDUM

DATE: June 17, 2018

TO: Jake Moersen, START-IV Project Manager, E & E, Seattle, Washington

FROM: Mark Woodke, START-IV Chemist, E & E, Seattle, Washington *MW*

SUBJ: **Inorganic Data Quality Assurance Review, Cinnabar Mine 2018 Removal Site Evaluation, Yellow Pine, Idaho**

REF: TO: TO-30-T1-SS1 PAN: 1004530.0030.001.01

The data quality assurance review of 27 water samples (filtered and/or unfiltered) collected from the Cinnabar Mine 2018 Removal Site Evaluation site near Yellow Pine, Idaho, has been completed. Target Analyte List (TAL) metals (except mercury - EPA Methods 6010 and 6020) and low-level mercury (EPA Method 1631E) analyses were performed by Eurofins Frontier Global Sciences, Bothell, Washington and Eurofins Calscience, Inc., Garden Grove, California. All sample analyses were evaluated following EPA's Stage 2 and/or 4 Data Validation Manual Process (S2B/4VM).

The samples were numbered:

18051001	18051002	18051003	18051004	18051005
18051006	18051007	18051008	18051009	18051010
18051011	18051013	18051014	18051017	18051018
18051019	18051020	18051021	18051022	18051023
18051024	18051025	18051026	18051029	18051030
18051031	18051032			

### Data Qualifications:

#### 1. Sample Holding Times: Satisfactory.

The samples were collected between May 15 and 16, 2018, and were analyzed by July 6, 2018, therefore within the QC criteria of less than 6 months between collection, extraction, and analysis (28 days for mercury) except for two mercury reanalysis results. Associated sample results were qualified as estimated quantities with a low bias (JL or UJL).

#### 2. Initial and Continuing Calibration: Acceptable.

A minimum of one calibration standard and a blank were analyzed at the beginning of the ICP analysis sequence and after every 10 samples. No results were greater than 110% of the highest calibration standard. All ICP recoveries were within the QC limits. All AA recoveries were within QC limits and the initial calibration correlation coefficient was > 0.995.

#### 3. Blanks: Acceptable.

A preparation blank was analyzed for each 20 samples or per matrix per concentration level. Blanks were analyzed after each Initial or Continuing Calibration Verification. There were no detections

in any blanks that affected sample results.

**4. ICP Interference Check Sample: Acceptable.**

An Interference Check Sample (ICS) was analyzed at the beginning of each sequence or at least twice every 8 hours, whichever was more frequent. All applicable ICS (solution AB) results were within QC limits of 80% - 120% recovery.

**5. Matrix Spike Analysis: Satisfactory.**

A matrix spike analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. Spike recoveries were within the QC limits except the high calcium result associated with samples 18051003, 18051005, 18051011, 18051021, 18051001, 18051013, 18051017, 18051023, 18051025, 18051007, 18051009, 18051019, 18051029, and 18051031 (associated positive sample results were qualified as estimated quantities with a high bias [JH]).

**6. Duplicate Analysis: Acceptable.**

A laboratory duplicate and/or spike duplicate analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. All duplicate results were within QC limits.

**7. Laboratory Control Sample Analysis: Satisfactory.**

A Laboratory Control Sample (LCS) was analyzed per SDG per matrix. All LCS results were within the established control limits except silver with a high result; no qualifiers were applied as all associated sample results were less than the reporting limit.

**8. Overall Assessment of Data for Use**

A total of 1,219 results were validated in this data memorandum. A total of 13 sample results were qualified as estimated quantities (JH) based on spike accuracy outliers. A total of 2 sample results were qualified as estimated quantities (JL) based on holding time outliers. No sample results were qualified as estimated quantities based on incorrect sample containers, duplicate precision outliers, or sample temperature outliers. No sample results were rejected (R). The following potential contaminants of concern were detected in the laboratory blanks: mercury.

The reviewer used professional judgment to apply a single bias qualifier when more than one bias qualifier was applicable to an individual estimated sample result.

The overall usefulness of the data is based on the criteria outlined in the Site-Specific Sampling Plan and/or Sampling and Quality Assurance Plan, the analytical method(s), the EPA Region 10 Emergency Management Program SOG 144E Analytical Data Validation, and/or the Office of Emergency and Remedial Response Publication "National Functional Guidelines for Superfund Inorganic Methods Data Review, January 2018". Based upon the information provided, the data are acceptable for use with the above stated data qualifications.

Data Qualifiers and Definitions

H - The sample result is biased high.

J - The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

K - The bias of the sample is not known.

- L - The sample result is biased low.
- Q - Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.
- R - The data is rejected and unusable. The analyte may or may not be present in the sample.
- U - The analyte was analyzed for, but was not detected above the level of the reported 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.



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18051003

8E00806-01

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
<b>Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation</b>											
Mercury	108	0.83	5.00	ng/L	10	F805429	25-May-18	8E29005	25-May-18	EPA 1631E	

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18051004

8E00806-02

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
<b>Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation</b>											
Mercury	77.2	0.83	5.00	ng/L	10	F805429	25-May-18	8E29005	25-May-18	EPA 1631E	

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18051005

8E00806-03

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
<b>Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation</b>											
Mercury	186	0.83	5.00	ng/L	10	F805429	25-May-18	8E29005	25-May-18	EPA 1631E	

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18051006

8E00806-04

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
<b>Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation</b>											
Mercury	49.4	0.83	5.00	ng/L	10	F805429	25-May-18	8E29005	25-May-18	EPA 1631E	

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18051008

8E00806-05

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
<b>Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation</b>											
Mercury	54.9	0.83	5.00	ng/L	10	F805429	25-May-18	8E29005	25-May-18	EPA 1631E	

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18051011

8E00806-06

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
<b>Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation</b>											
Mercury	253	0.83	5.00	ng/L	10	F805429	25-May-18	8E29005	25-May-18	EPA 1631E	

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18051020

8E00806-07

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
<b>Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation</b>											
Mercury	43.7	0.83	5.00	ng/L	10	F805429	25-May-18	8E29005	25-May-18	EPA 1631E	

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18051021

8E00806-08

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
<b>Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation</b>											
Mercury	94.0	0.83	5.00	ng/L	10	F805429	25-May-18	8E29005	25-May-18	EPA 1631E	

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18051022

8E00806-09

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
<b>Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation</b>											
Mercury	61.4	0.83	5.00	ng/L	10	F805429	25-May-18	8E29005	25-May-18	EPA 1631E	

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18051001

8E00806-10

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
<b>Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation</b>											
Mercury	214	0.83	5.00	ng/L	10	F805429	25-May-18	8E29005	25-May-18	EPA 1631E	

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18051002

8E00806-11

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
<b>Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation</b>											
Mercury	12.1	0.83	5.00	ng/L	10	F805429	25-May-18	8E29005	25-May-18	EPA 1631E	

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18051013

8E00806-12

Analyte	Result	Detection	Reporting	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
		Limit	Limit								
<b>Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation</b>											
Mercury	850	8.34	50.0	ng/L	100	F805429	25-May-18	8E29005	25-May-18	EPA 1631E	

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18051014

8E00806-13

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
<b>Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation</b>											
Mercury	75.3	0.83	5.00	ng/L	10	F805429	25-May-18	8E29005	25-May-18	EPA 1631E	

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18051017

8E00806-14

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
<b>Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation</b>											
Mercury	195	0.83	5.00	ng/L	10	F805429	25-May-18	8E29005	25-May-18	EPA 1631E	

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18051018

8E00806-15

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
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Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation

Mercury	72.0	0.83	5.00	ng/L	10	F805489	23-May-18	8E31015	31-May-18	EPA 1631E	
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18051023

8E00806-16

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
<b>Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation</b>											
Mercury	ND	0.08	0.50	ng/L	1	F805489	23-May-18	8E31015	31-May-18	EPA 1631E	U

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18051025

8E00806-17

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
<b>Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation</b>											
Mercury	3.01	0.17	1.00	ng/L	2	F805489	23-May-18	8E31015	31-May-18	EPA 1631E	

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18051026

8E00806-18

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
<b>Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation</b>											
Mercury	2.05	0.08	0.50	ng/L	1	F805489	23-May-18	8E31015	31-May-18	EPA 1631E	

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18051007

8E00806-19

Analyte	Detection		Reporting		Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
	Result	Limit	Limit	Limit								

Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation

Mercury	105	0.83	5.00	ng/L	10	F805489	23-May-18	8E31015	31-May-18	EPA 1631E		
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18051009

8E00806-20

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
<b>Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation</b>											
Mercury	102	0.83	5.00	ng/L	10	F805489	23-May-18	8E31015	31-May-18	EPA 1631E	

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18051010

8E00806-21

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
<b>Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation</b>											
Mercury	53.0	0.83	5.00	ng/L	10	F805489	23-May-18	8E31015	31-May-18	EPA 1631E	

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18051019

8E00806-22

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
<b>Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation</b>											
Mercury	268	0.83	5.00	ng/L	10	F805489	23-May-18	8E31015	31-May-18	EPA 1631E	

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18051024

8E00806-23

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
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Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation

Mercury	0.13	JQ 0.08	0.50	ng/L	1	F805489	23-May-18	8E31015	31-May-18	EPA 1631E	<i>low</i>
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The results in this report only apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

*Maricris dela Rosa*

Maricris dela Rosa, Project Manager

*MW 6/7/18*



Frontier Global Sciences

11720 Northcreek Pkwy N, Suite 400  
Bothell, WA 98011  
425.686.1996 Phone  
425.686.3096 Fax

Ecology and Environment - Seattle 720 Third Avenue, Suite 1700 Seattle WA, 98104	Project: Hg 1631 and TAL Metals 6020 Project Number: 180514 Hg 1631 and TAL Metals 6020 Project Manager: Mark Woodke	Reported: 10-Jul-18 13:33
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18051029

8E00806-24

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
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Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation

Mercury	2870	8.34	50.0	ng/L	100	F805489	23-May-18	8E31015	31-May-18	EPA 1631E	
Mercury	2900	JL 8.34	50.0	ng/L	100	F806348	20-Jun-18	8F20017	20-Jun-18	EPA 1631E	

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*Maricris dela Rosa*

Maricris dela Rosa, Project Manager

*Mark Woodke*



Frontier Global Sciences

11720 Northcreek Pkwy N, Suite 400  
Bothell, WA 98011  
425.686.1996 Phone  
425.686.3096 Fax

Ecology and Environment - Seattle 720 Third Avenue, Suite 1700 Seattle WA, 98104	Project: Hg 1631 and TAL Metals 6020 Project Number: 180514 Hg 1631 and TAL Metals 6020 Project Manager: Mark Woodke	Reported: 10-Jul-18 13:33
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18051030

8E00806-25

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
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Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation

Mercury	77.3	0.83	5.00	ng/L	10	F805489	23-May-18	8E31015	31-May-18	EPA 1631E	
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*Maricris dela Rosa*

*MW 6/7/18*

Maricris dela Rosa, Project Manager



Frontier Global Sciences

11720 Northcreek Pkwy N, Suite 400  
Bothell, WA 98011  
425.686.1996 Phone  
425.686.3096 Fax

Ecology and Environment - Seattle 720 Third Avenue, Suite 1700 Seattle WA, 98104	Project: Hg 1631 and TAL Metals 6020 Project Number: 180514 Hg 1631 and TAL Metals 6020 Project Manager: Mark Woodke	Reported: 10-Jul-18 13:33
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18051031

8E00806-26

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
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Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation

Mercury	5820	33.4	200	ng/L	400	F805489	23-May-18	8E31015	31-May-18	EPA 1631E	
Mercury	5850	JL 33.4	200	ng/L	400	F806348	20-Jun-18	8F20017	20-Jun-18	EPA 1631E	

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*Maricris dela Rosa*

Maricris dela Rosa, Project Manager

*Mark Woodke*



Frontier Global Sciences

11720 Northcreek Pkwy N, Suite 400  
Bothell, WA 98011  
425.686.1996 Phone  
425.686.3096 Fax

Ecology and Environment - Seattle 720 Third Avenue, Suite 1700 Seattle WA, 98104	Project: Hg 1631 and TAL Metals 6020 Project Number: 180514 Hg 1631 and TAL Metals 6020 Project Manager: Mark Woodke	Reported: 10-Jul-18 13:33
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18051032

8E00806-27

Analyte	Result	Detection Limit	Reporting Limit	Units	Dilution	Batch	Prepared	Sequence	Analyzed	Method	Notes
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Sample Preparation: EFGS SOP2796 EPA 1631 Oxidation

Mercury	65.8	0.83	5.00	ng/L	10	F805489	23-May-18	8E31015	31-May-18	EPA 1631E	
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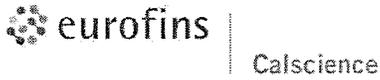
Eurofins Frontier Global Sciences, LLC

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*Maricris dela Rosa*

Maricris dela Rosa, Project Manager

*Mark Woodke*



Analytical Report

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3020A Total  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 1 of 19

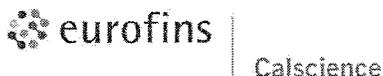
Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051003	18-05-1976-1-A	05/15/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 15:14	180525LA3

Parameter	Result	RL	DF	Qualifiers
Antimony	ND <i>M</i>	0.00100	1.00	U
Arsenic	0.00400	0.00100	1.00	
Barium	0.00717	0.00100	1.00	
Beryllium	ND	0.00100	1.00	U
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	ND <i>M</i>	0.00500	1.00	
Aluminum	0.102	0.0500	1.00	
Calcium	9.19 <i>JH</i>	0.100	1.00	
Iron	0.132	0.0500	1.00	
Magnesium	1.13	0.100	1.00	
Manganese	0.00335	0.00100	1.00	
Potassium	0.548	0.100	1.00	
Sodium	1.79	0.100	1.00	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

*MW 6/7/18*



### Analytical Report

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3020A Total  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 2 of 19

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051005	18-05-1976-3-A	05/16/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 15:51	180525LA3

Parameter	Result	RL	DF	Qualifiers
Antimony	0.00168	0.00100	1.00	
Arsenic	0.0149	0.00100	1.00	
Barium	0.00715	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND <i>new</i>	0.00100	1.00	
Zinc	0.00961	0.00500	1.00	
Aluminum	0.105 <i>JH</i>	0.0500	1.00	
Calcium	16.7	0.100	1.00	
Iron	0.111	0.0500	1.00	
Magnesium	3.72	0.100	1.00	
Manganese	0.00454	0.00100	1.00	
Potassium	0.927	0.100	1.00	
Sodium	1.13	0.100	1.00	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

*JW 6/7/18*

**Analytical Report**

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3020A Total  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 3 of 19

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051011	18-05-1976-6-A	05/16/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 15:53	180525LA3

Parameter	Result	RL	DF	Qualifiers
Antimony	0.00444	0.00100	1.00	
Arsenic	0.0384	0.00100	1.00	
Barium	0.0119	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	ND	0.00500	1.00	
Aluminum	ND <i>JH</i>	0.0500	1.00	
Calcium	29.2	0.100	1.00	
Iron	0.0816	0.0500	1.00	
Magnesium	6.19	0.100	1.00	
Manganese	0.00275	0.00100	1.00	
Potassium	1.56	0.100	1.00	
Sodium	0.710	0.100	1.00	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

*JWB 5-27-18*



### Analytical Report

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3020A Total  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 4 of 19

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051021	18-05-1976-8-A	05/16/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 15:56	180525LA3

Parameter	Result	RL	DF	Qualifiers
Antimony	0.00518	0.00100	1.00	
Arsenic	0.0169	0.00100	1.00	
Barium	0.0101	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	0.00574	0.00500	1.00	
Aluminum	ND	0.0500	1.00	
Calcium	21.6	0.100	1.00	
Iron	0.0930	0.0500	1.00	
Magnesium	6.04	0.100	1.00	
Manganese	0.00403	0.00100	1.00	
Potassium	1.28	0.100	1.00	
Sodium	0.684	0.100	1.00	

Return to Carbons

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

**Analytical Report**

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3020A Total  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 5 of 19

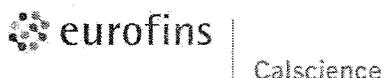
Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051001	18-05-1976-10-A	05/15/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 15:58	180525LA3

Parameter	Result	RL	DF	Qualifiers
Antimony	0.00101	0.00100	1.00	
Arsenic	0.00734	0.00100	1.00	
Barium	0.00860	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	ND	0.00500	1.00	
Aluminum	0.123	0.0500	1.00	
Calcium	10.9 JH	0.100	1.00	
Iron	0.156	0.0500	1.00	
Magnesium	1.84	0.100	1.00	
Manganese	0.00470	0.00100	1.00	
Potassium	0.635	0.100	1.00	
Sodium	1.78	0.100	1.00	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

*MW 6/7/18*



### Analytical Report

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3020A Total  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

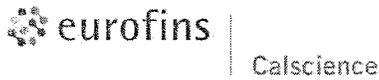
Page 6 of 19

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051013	18-05-1976-12-A	05/16/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 16:00	180525LA3

Parameter	Result	RL	DF	Qualifiers
Antimony	0.00536	0.00100	1.00	
Arsenic	0.0476	0.00100	1.00	
Barium	0.0136	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND <i>mm</i>	0.00100	1.00	
Zinc	0.00784	0.00500	1.00	
Aluminum	ND <i>mm</i>	0.0500	1.00	
Calcium	29.9 <i>JH</i>	0.100	1.00	
Iron	0.0885	0.0500	1.00	
Magnesium	6.80	0.100	1.00	
Manganese	0.00404	0.00100	1.00	
Potassium	1.76	0.100	1.00	
Sodium	0.689	0.100	1.00	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.



### Analytical Report

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3020A Total  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 7 of 19

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051017	18-05-1976-14-A	05/16/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 16:03	180525LA3

Parameter	Result	RL	DF	Qualifiers
Antimony	0.00472	0.00100	1.00	
Arsenic	0.0241	0.00100	1.00	
Barium	0.0123	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	ND	0.00500	1.00	
Aluminum	ND <i>MV</i>	0.0500	1.00	
Calcium	20.9 <i>JH</i>	0.100	1.00	
Iron	0.112	0.0500	1.00	
Magnesium	6.38	0.100	1.00	
Manganese	0.00934	0.00100	1.00	
Potassium	1.28	0.100	1.00	
Sodium	0.674	0.100	1.00	

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**Analytical Report**

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3020A Total  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 8 of 19

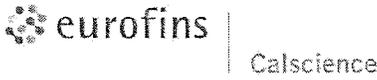
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18051023	18-05-1976-16-A	05/17/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 16:05	180525LA3

Parameter	Result	RL	DF	Qualifiers
Antimony	ND	0.00100	1.00	
Arsenic	ND	0.00100	1.00	
Barium	ND	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	ND	0.00500	1.00	
Aluminum	ND	0.0500	1.00	
Calcium	ND	0.100	1.00	
Iron	0.0711	0.0500	1.00	
Magnesium	ND	0.100	1.00	
Manganese	ND	0.00100	1.00	
Potassium	ND	0.100	1.00	
Sodium	ND	0.100	1.00	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

*MW 6/7/18*



Analytical Report

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3020A Total  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 9 of 19

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051025	18-05-1976-17-A	05/15/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 16:08	180525LA3

Parameter	Result	RL	DF	Qualifiers
Antimony	ND <del>mu</del>	0.00100	U	1.00
Arsenic	0.00207	0.00100		1.00
Barium	0.00331	0.00100		1.00
Beryllium	ND	0.00100	U	1.00
Cadmium	ND	0.00100		1.00
Chromium	ND	0.00100		1.00
Cobalt	ND	0.00100		1.00
Copper	ND	0.00100		1.00
Lead	ND	0.00100		1.00
Nickel	ND	0.00100		1.00
Selenium	ND	0.00100		1.00
Silver	ND	0.00100		1.00
Thallium	ND	0.00100		1.00
Vanadium	ND <del>mu</del>	0.00100		1.00
Zinc	0.00783	0.00500		1.00
Aluminum	0.103	0.0500		1.00
Calcium	7.58 JH	0.100		1.00
Iron	0.109	0.0500		1.00
Magnesium	0.813	0.100		1.00
Manganese	0.00215	0.00100		1.00
Potassium	0.474	0.100		1.00
Sodium	1.85	0.100		1.00

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

*MW 6/7/18*

## Analytical Report

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3020A Total  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 11 of 19

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051007	18-05-1976-19-A	05/16/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 16:10	180525LA3

Parameter	Result	RL	DF	Qualifiers
Antimony	<del>ND</del>	0.00100	1.00	U
Arsenic	0.00215	0.00100	1.00	
Barium	0.00450	0.00100	1.00	
Beryllium	ND	0.00100	1.00	U
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	0.00784	0.00500	1.00	
Aluminum	0.151	0.0500	1.00	
Calcium	10.0	0.100	1.00	JH
Iron	0.111	0.0500	1.00	
Magnesium	2.31	0.100	1.00	
Manganese	0.00533	0.00100	1.00	
Potassium	0.524	0.100	1.00	
Sodium	1.33	0.100	1.00	


  
 Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.





### Analytical Report

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3020A Total  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 13 of 19

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051009	18-05-1976-20-A	05/16/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 16:20	180525LA3

Parameter	Result	RL	DF	Qualifiers
Antimony	<del>ND</del>	0.00100	1.00	
Arsenic	0.00241	0.00100	1.00	
Barium	0.00460	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	0.00560	0.00500	1.00	
Aluminum	0.153	0.0500	1.00	
Calcium	10.2	0.100	1.00	
Iron	0.112	0.0500	1.00	
Magnesium	2.35	0.100	1.00	
Manganese	0.00712	0.00100	1.00	
Potassium	0.536	0.100	1.00	
Sodium	1.35	0.100	1.00	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

*MWB 7/16*

**Analytical Report**

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3020A Total  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

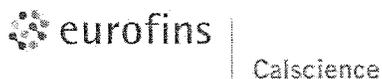
Page 14 of 19

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051019	18-05-1976-22-A	05/16/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 16:23	180525LA3

Parameter	Result	RL	DF	Qualifiers
Antimony	0.00219	0.00100	1.00	
Arsenic	0.0104	0.00100	1.00	
Barium	0.00846	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	ND	0.00500	1.00	
Aluminum	ND	0.0500	1.00	
Calcium	8.62	0.100	1.00	
Iron	0.0934	0.0500	1.00	
Magnesium	3.69	0.100	1.00	
Manganese	0.00326	0.00100	1.00	
Potassium	0.561	0.100	1.00	
Sodium	0.336	0.100	1.00	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.



### Analytical Report

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3020A Total  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 15 of 19

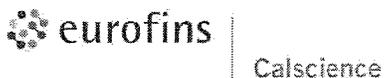
Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051029	18-05-1976-24-A	05/16/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 16:25	180525LA3

Parameter	Result	RL	DF	Qualifiers
Antimony	0.00443	0.00100	1.00	
Arsenic	0.0508	0.00100	1.00	
Barium	0.0114	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	0.00181	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	0.00111	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	ND	0.00500	1.00	
Aluminum	0.118	0.0500	1.00	
Calcium	12.7 JH	0.100	1.00	
Iron	0.220	0.0500	1.00	
Magnesium	4.08	0.100	1.00	
Manganese	0.0204	0.00100	1.00	
Potassium	1.10	0.100	1.00	
Sodium	0.529	0.100	1.00	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

*MW 6/7/18*



### Analytical Report

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3020A Total  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

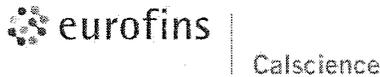
Page 16 of 19

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051031	18-05-1976-26-A	05/16/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 16:38	180525LA3

Parameter	Result	RL	DF	Qualifiers
Antimony	0.00441	0.00100	1.00	
Arsenic	0.0483	0.00100	1.00	
Barium	0.0110	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	0.00148	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	0.00106	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	0.00686	0.00500	1.00	
Aluminum	0.0740	0.0500	1.00	
Calcium	12.3	0.100	1.00	JH
Iron	0.149	0.0500	1.00	
Magnesium	3.99	0.100	1.00	
Manganese	0.0121	0.00100	1.00	
Potassium	1.06	0.100	1.00	
Sodium	0.520	0.100	1.00	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.



### Analytical Report

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3005A Filt.  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 1 of 15

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051004	18-05-1976-2-A	05/15/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 15:27	180525LA4F

Parameter	Result	RL	DF	Qualifiers
Antimony	<del>ND</del>	0.00100	1.00	
Arsenic	0.00405	0.00100	1.00	
Barium	0.00601	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	ND	0.00500	1.00	
Aluminum	0.0672	0.0500	1.00	
Calcium	9.66	0.100	1.00	
Iron	0.0969	0.0500	1.00	
Magnesium	1.19	0.100	1.00	
Manganese	0.00164	0.00100	1.00	
Potassium	0.560	0.100	1.00	
Sodium	1.85	0.100	1.00	

Return to Comments

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.



### Analytical Report

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3005A Filt.  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 2 of 15

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051006	18-05-1976-4-A	05/16/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 16:52	180525LA4F

Parameter	Result	RL	DF	Qualifiers
Antimony	0.00168	0.00100	1.00	
Arsenic	0.0150	0.00100	1.00	
Barium	0.00675	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	ND	0.00500	1.00	
Aluminum	ND	0.0500	1.00	
Calcium	16.8	0.100	1.00	
Iron	0.0784	0.0500	1.00	
Magnesium	3.78	0.100	1.00	
Manganese	0.00104	0.00100	1.00	
Potassium	0.940	0.100	1.00	
Sodium	1.15	0.100	1.00	

Return to Contents



RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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**Analytical Report**

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3005A Filt.  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 3 of 15

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051008	18-05-1976-5-A	05/16/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 16:55	180525LA4F

Parameter	Result	RL	DF	Qualifiers
Antimony	<del>ND</del>	0.00100	1.00	
Arsenic	0.00195	0.00100	1.00	
Barium	0.00422	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	<del>ND</del>	0.00500	1.00	
Aluminum	0.0973	0.0500	1.00	
Calcium	10.2	0.100	1.00	
Iron	0.104	0.0500	1.00	
Magnesium	2.37	0.100	1.00	
Manganese	0.00186	0.00100	1.00	
Potassium	0.537	0.100	1.00	
Sodium	1.37	0.100	1.00	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

*Handwritten signature*



### Analytical Report

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3005A Filt.  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

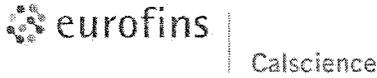
Page 5 of 15

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051020	18-05-1976-7-A	05/16/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 16:57	180525LA4F

Parameter	Result	RL	DF	Qualifiers
Antimony	0.00215	0.00100	1.00	
Arsenic	0.00940	0.00100	1.00	
Barium	0.00795	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	ND	0.00500	1.00	
Aluminum	ND <i>mw</i>	0.0500	1.00	
Calcium	8.53	0.100	1.00	
Iron	0.0650	0.0500	1.00	
Magnesium	3.63	0.100	1.00	
Manganese	ND <i>mw</i>	0.00100	1.00	
Potassium	0.544	0.100	1.00	
Sodium	0.327	0.100	1.00	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.



Analytical Report

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3005A Filt.  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 6 of 15

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051022	18-05-1976-9-A	05/16/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 17:00	180525LA4F

Parameter	Result	RL	DF	Qualifiers
Antimony	0.00504	0.00100	1.00	
Arsenic	0.0160	0.00100	1.00	
Barium	0.00996	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	0.00512	0.00500	1.00	
Aluminum	ND	0.0500	1.00	
Calcium	21.3	0.100	1.00	
Iron	0.0822	0.0500	1.00	
Magnesium	6.02	0.100	1.00	
Manganese	0.00286	0.00100	1.00	
Potassium	1.29	0.100	1.00	
Sodium	0.677	0.100	1.00	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

*Handwritten signature: Jmw 6/7/18*

**Analytical Report**

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3005A Filt.  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 7 of 15

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051002	18-05-1976-11-A	05/15/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 17:02	180525LA4F

Parameter	Result	RL	DF	Qualifiers
Antimony	0.00102	0.00100	1.00	
Arsenic	0.00695	0.00100	1.00	
Barium	0.00799	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	ND	0.00500	1.00	
Aluminum	0.0934	0.0500	1.00	
Calcium	10.9	0.100	1.00	
Iron	0.109	0.0500	1.00	
Magnesium	1.86	0.100	1.00	
Manganese	0.00225	0.00100	1.00	
Potassium	0.651	0.100	1.00	
Sodium	1.85	0.100	1.00	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

*MW 6/7/18*



**Analytical Report**

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3005A Filt.  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 8 of 15

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051014	18-05-1976-13-A	05/16/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 17:05	180525LA4F

Parameter	Result	RL	DF	Qualifiers
Antimony	0.00524	0.00100	1.00	
Arsenic	0.0448	0.00100	1.00	
Barium	0.0131	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	ND	0.00500	1.00	
Aluminum	ND <i>W</i>	0.0500	1.00	
Calcium	28.7	0.100	1.00	
Iron	0.0661	0.0500	1.00	
Magnesium	6.63	0.100	1.00	
Manganese	<del>ND</del> <i>W</i>	0.00100	1.00	
Potassium	1.71	0.100	1.00	
Sodium	0.666	0.100	1.00	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

*Mw 6/7/18*

**Analytical Report**

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3005A Filt.  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 9 of 15

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051018	18-05-1976-15-A	05/16/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 17:07	180525LA4F

Parameter	Result	RL	DF	Qualifiers
Antimony	0.00449	0.00100	1.00	
Arsenic	0.0207	0.00100	1.00	
Barium	0.0115	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	ND	0.00500	1.00	
Aluminum	ND <i>mm</i>	0.0500	1.00	
Calcium	20.5	0.100	1.00	
Iron	0.0687	0.0500	1.00	
Magnesium	6.21	0.100	1.00	
Manganese	0.00256	0.00100	1.00	
Potassium	1.27	0.100	1.00	
Sodium	0.660	0.100	1.00	

Return to Contents

**Analytical Report**

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3005A Filtr.  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 10 of 15

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051026	18-05-1976-18-A	05/16/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 17:10	180525LA4F

Parameter	Result	RL	DF	Qualifiers
Antimony	<del>ND</del>	0.00100	1.00	
Arsenic	0.00213	0.00100	1.00	
Barium	0.00288	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	ND	0.00500	1.00	
Aluminum	<del>ND</del>	0.0500	1.00	
Calcium	7.69	0.100	1.00	
Iron	0.0827	0.0500	1.00	
Magnesium	0.821	0.100	1.00	
Manganese	<del>ND</del>	0.00100	1.00	
Potassium	0.475	0.100	1.00	
Sodium	1.91	0.100	1.00	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

*MW 6/7/18*

**Analytical Report**

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3005A Filt.  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 11 of 15

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051010	18-05-1976-21-A	05/16/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 17:12	180525LA4F

Parameter	Result	RL	DF	Qualifiers
Antimony	ND <i>m</i>	0.00100	1.00	
Arsenic	0.00199	0.00100	1.00	
Barium	0.00436	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	ND <i>m</i>	0.00500	1.00	
Aluminum	0.108	0.0500	1.00	
Calcium	10.5	0.100	1.00	
Iron	0.105	0.0500	1.00	
Magnesium	2.42	0.100	1.00	
Manganese	0.00203	0.00100	1.00	
Potassium	0.552	0.100	1.00	
Sodium	1.41	0.100	1.00	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

*MWB*

**Analytical Report**

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3005A Filt.  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 12 of 15

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051024	18-05-1976-23-A	05/17/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 17:22	180525LA4F

Parameter	Result	RL	DF	Qualifiers
Antimony	ND	0.00100	1.00	
Arsenic	ND	0.00100	1.00	
Barium	ND	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	ND	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	ND	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	ND	0.00500	1.00	
Aluminum	ND	0.0500	1.00	
Calcium	ND	0.100	1.00	
Iron	0.0622	0.0500	1.00	
Magnesium	ND	0.100	1.00	
Manganese	ND	0.00100	1.00	
Potassium	ND	0.100	1.00	
Sodium	ND	0.100	1.00	

Picture to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

*MW 6/7/18*

**Analytical Report**

Eurofins Frontier Global Sciences, Inc.  
 11720 North Creek Parkway North, Suite 4  
 Bothell, WA 98011-8244

Date Received: 05/22/18  
 Work Order: 18-05-1976  
 Preparation: EPA 3005A Filt.  
 Method: EPA 6020  
 Units: mg/L

Project: 101T-002A

Page 13 of 15

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
18051030	18-05-1976-25-A	05/16/18 00:00	Aqueous	ICP/MS 03	05/25/18	05/29/18 17:24	180525LA4F

Parameter	Result	RL	DF	Qualifiers
Antimony	0.00459	0.00100	1.00	
Arsenic	0.0487	0.00100	1.00	
Barium	0.0104	0.00100	1.00	
Beryllium	ND	0.00100	1.00	
Cadmium	ND	0.00100	1.00	
Chromium	ND	0.00100	1.00	
Cobalt	ND	0.00100	1.00	
Copper	ND	0.00100	1.00	
Lead	ND	0.00100	1.00	
Nickel	0.00112	0.00100	1.00	
Selenium	ND	0.00100	1.00	
Silver	ND	0.00100	1.00	
Thallium	0.00102	0.00100	1.00	
Vanadium	ND	0.00100	1.00	
Zinc	ND	0.00500	1.00	
Aluminum	ND	0.0500	1.00	
Calcium	12.9	0.100	1.00	
Iron	0.0729	0.0500	1.00	
Magnesium	4.14	0.100	1.00	
Manganese	0.00168	0.00100	1.00	
Potassium	1.13	0.100	1.00	
Sodium	0.566	0.100	1.00	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

*MWA 7-10*



# ecology and environment, inc.

Global Environmental Specialists

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

## MEMORANDUM

DATE: June 19, 2018

TO: Jake Moersen, START-IV Project Manager, E & E, Seattle, Washington

FROM: Mark Woodke, START-IV Chemist, E & E, Seattle, Washington *MW*

SUBJ: **Data Quality Assurance Review, Cinnabar Mine 2018 Removal Site Evaluation, Yellow Pine, Idaho**

REF: TO: TO-30-T1-SS1 PAN: 1004530.0030.001.01

The data quality assurance review of 11 water samples collected from the Cinnabar Mine site located in Yellow Pine, Idaho, has been completed. Total Suspended Solids (TSS; Standard Method 2540D) and Total Organic Carbon (TOC; EPA Method 9060A) analyses were performed by GEL Laboratories, LLC, Charleston, South Carolina. All sample analyses were evaluated following EPA's Stage 2B and/or 4 Data Validation Electronic and/or Manual Process (S2B/4VE/M).

The samples were numbered:

18051001	18051003	18051005	18051007	18051009
18051011	18051021	18051025	18051026	18051029
18051031				

### Data Qualifications:

The samples were maintained at  $< 6^{\circ}\text{C}$ . The samples were collected between May 15 and 16, 2018, and were analyzed by May 22, 2018, for TSS and by May 25, 2018, for TOC. All samples were analyzed within QC holding time limits of less than 28 days between collection and TOC analysis for preserved samples and less than 7 days between collection and TSS analysis.

#### TSS

There were no detections in the method blank. The duplicate result was within QC limits. Laboratory control sample (LCS) and LCS duplicate (LCSD) results were within QC limits.

#### TOC

All initial calibration correlation coefficients were greater than 0.999. The initial and continuing calibration verification results were within QC limits. There were no detections in the method, initial calibration, or continuing calibration blanks. The duplicate result was within QC limits. The LCS and post spike recoveries were within QC limits.

In the reviewers' professional judgment, all sample results were acceptable except as noted.

A total of 20 results were validated in this data memorandum. No sample results were qualified as estimated quantities (J) based on duplicate precision outliers, spike accuracy outliers, holding time

outliers, incorrect sample containers, or sample temperature outliers. No sample results were rejected (R). No potential contaminants of concern were detected in the blanks.

The reviewer used professional judgment to apply a single bias qualifier when more than one bias qualifier was applicable to an individual estimated sample result.

The overall usefulness of the data is based on the criteria outlined in the Site-Specific Sampling Plan and/or Sampling and Quality Assurance Plan, the analytical method(s), and/or the EPA Region 10 Emergency Management Program SOG 144E Analytical Data Validation. Based upon the information provided, the data are acceptable for use with the above stated data qualifications.

#### Data Qualifiers and Definitions

- H - The sample result is biased high.
- J - The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
- K - The bias of the sample is not known.
- L - The sample result is biased low.
- Q - Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.
- R - The data is rejected and unusable. The analyte may or may not be present in the sample.
- U - The analyte was analyzed for, but was not detected above the level of the reported 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.

# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
Address : 720 Third Avenue  
Suite 1700  
Seattle, Washington 98104  
Contact: Mr. Mark Woodke  
Project: Site 101T

Client Sample ID: 18051001 Project: ECOL00118  
Sample ID: 450566001 Client ID: ECOL008  
Matrix: Surface Water  
Collect Date: 15-MAY-18 15:25  
Receive Date: 19-MAY-18  
Collector: Client

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Solids Analysis												
SM 2540D Total Suspended Solids (TSS) "As Received"												
Total Suspended Solids		5.10	0.570	2.50	mg/L			KLP1	05/22/18	1053	1766482	1

The following Analytical Methods were performed:

Method	Description	Analyst	Comments
1	SM 2540D		

### Notes:

Column headers are defined as follows:

DF: Dilution Factor                      Lc/LC: Critical Level  
DL: Detection Limit                      PF: Prep Factor  
MDA: Minimum Detectable Activity      RL: Reporting Limit  
MDC: Minimum Detectable Concentration      SQL: Sample Quantitation Limit



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## Certificate of Analysis

Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
Address : 720 Third Avenue  
Suite 1700  
Seattle, Washington 98104  
Contact: Mr. Mark Woodke  
Project: Site 101T

Client Sample ID: 18051003 Project: ECOL00118  
Sample ID: 450566002 Client ID: ECOL008  
Matrix: Surface Water  
Collect Date: 15-MAY-18 16:40  
Receive Date: 19-MAY-18  
Collector: Client

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Solids Analysis												
SM 2540D Total Suspended Solids (TSS) "As Received"												
Total Suspended Solids		3.85	0.594	2.60	mg/L			KLP1	05/22/18	1053	1766482	1

The following Analytical Methods were performed:

Method	Description	Analyst	Comments
1	SM 2540D		

### Notes:

Column headers are defined as follows:

DF: Dilution Factor                      Lc/LC: Critical Level  
DL: Detection Limit                      PF: Prep Factor  
MDA: Minimum Detectable Activity      RL: Reporting Limit  
MDC: Minimum Detectable Concentration      SQL: Sample Quantitation Limit



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## Certificate of Analysis

Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
 Address : 720 Third Avenue  
 Suite 1700  
 Seattle, Washington 98104  
 Contact: Mr. Mark Woodke  
 Project: Site 101T

Client Sample ID: 18051005	Project: ECOL00118
Sample ID: 450566003	Client ID: ECOL008
Matrix: Surface Water	
Collect Date: 16-MAY-18 10:50	
Receive Date: 19-MAY-18	
Collector: Client	

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Solids Analysis												
SM 2540D Total Suspended Solids (TSS) "As Received"												
Total Suspended Solids	JQ	1.03	0.588	2.58	mg/L			KLP1	05/22/18	1053	1766482	1

The following Analytical Methods were performed:

Method	Description	Analyst	Comments
1	SM 2540D		

**Notes:**

Column headers are defined as follows:

- |                                       |                                |
|---------------------------------------|--------------------------------|
| DF: Dilution Factor                   | Lc/LC: Critical Level          |
| DL: Detection Limit                   | PF: Prep Factor                |
| MDA: Minimum Detectable Activity      | RL: Reporting Limit            |
| MDC: Minimum Detectable Concentration | SQL: Sample Quantitation Limit |

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## Certificate of Analysis

Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
Address : 720 Third Avenue  
Suite 1700  
Seattle, Washington 98104  
Contact: Mr. Mark Woodke  
Project: Site 101T

Client Sample ID: 18051007 Project: ECOL00118  
Sample ID: 450566004 Client ID: ECOL008  
Matrix: Surface Water  
Collect Date: 16-MAY-18 11:40  
Receive Date: 19-MAY-18  
Collector: Client

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
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### Solids Analysis

SM 2540D Total Suspended Solids (TSS) "As Received"

Total Suspended Solids		<del>1.19</del> <del>5.21</del>	1.19	U	5.21	mg/L		KLP1	05/22/18	1053	1766482	1
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The following Analytical Methods were performed:

Method	Description	Analyst	Comments
1	SM 2540D		

### Notes:

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

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## Certificate of Analysis

Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
 Address : 720 Third Avenue  
 Suite 1700  
 Seattle, Washington 98104  
 Contact: Mr. Mark Woodke  
 Project: Site 101T

Client Sample ID: 18051009	Project: ECOL00118
Sample ID: 450566005	Client ID: ECOL008
Matrix: Surface Water	
Collect Date: 16-MAY-18 11:40	
Receive Date: 19-MAY-18	
Collector: Client	

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Solids Analysis												
SM 2540D Total Suspended Solids (TSS) "As Received"												
Total Suspended Solids	JQ	1.60	0.570	2.50	mg/L			KLPI	05/22/18	1053	1766482	1

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	SM 2540D	

**Notes:**

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

5/5/18 WMA

MWA 6/1/18

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## Certificate of Analysis

Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
Address : 720 Third Avenue  
Suite 1700  
Seattle, Washington 98104  
Contact: Mr. Mark Woodke  
Project: Site 101T

Client Sample ID: 18051011 Project: ECOL00118  
Sample ID: 450566006 Client ID: ECOL008  
Matrix: Surface Water  
Collect Date: 16-MAY-18 12:00  
Receive Date: 19-MAY-18  
Collector: Client

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Solids Analysis												
SM 2540D Total Suspended Solids (TSS) "As Received"												
Total Suspended Solids	JQ	0.700	0.570	2.50	mg/L			KLP1	05/22/18	1053	1766482	1

The following Analytical Methods were performed:

Method	Description	Analyst	Comments
1	SM 2540D		

### Notes:

Column headers are defined as follows:

DF: Dilution Factor                      Lc/LC: Critical Level  
DL: Detection Limit                      PF: Prep Factor  
MDA: Minimum Detectable Activity      RL: Reporting Limit  
MDC: Minimum Detectable Concentration      SQL: Sample Quantitation Limit



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## Certificate of Analysis

Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
Address : 720 Third Avenue  
Suite 1700  
Seattle, Washington 98104  
Contact: Mr. Mark Woodke  
Project: Site 101T

Client Sample ID: 18051021 Project: ECOL00118  
Sample ID: 450566007 Client ID: ECOL008  
Matrix: Surface Water  
Collect Date: 16-MAY-18 15:00  
Receive Date: 19-MAY-18  
Collector: Client

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Solids Analysis												
SM 2540D Total Suspended Solids (TSS) "As Received"												
Total Suspended Solids	J	1.00	0.633	2.78	mg/L			KLPI	05/22/18	1053	1766482	1

The following Analytical Methods were performed:

Method	Description	Analyst	Comments
1	SM 2540D		

### Notes:

Column headers are defined as follows:

DF: Dilution Factor                      Lc/LC: Critical Level  
DL: Detection Limit                      PF: Prep Factor  
MDA: Minimum Detectable Activity      RL: Reporting Limit  
MDC: Minimum Detectable Concentration      SQL: Sample Quantitation Limit

*Handwritten signature: MW 6/1/18*

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## Certificate of Analysis

Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
 Address : 720 Third Avenue  
 Suite 1700  
 Seattle, Washington 98104  
 Contact: Mr. Mark Woodke  
 Project: Site 101T

Client Sample ID: 18051025	Project: ECOL00118
Sample ID: 450566008	Client ID: ECOL008
Matrix: Surface Water	
Collect Date: 15-MAY-18 17:35	
Receive Date: 19-MAY-18	
Collector: Client	

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Solids Analysis												
SM 2540D Total Suspended Solids (TSS) "As Received"												
Total Suspended Solids	J	1.50	0.570	2.50	mg/L			KLP1	05/22/18	1053	1766482	1

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	SM 2540D	

**Notes:**

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

JMW 6/1/18

# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
 Address : 720 Third Avenue  
 Suite 1700  
 Seattle, Washington 98104  
 Contact: Mr. Mark Woodke  
 Project: Site 101T

Client Sample ID: 18051025	Project: ECOL00118
Sample ID: 450566009	Client ID: ECOL008
Matrix: Surface Water	
Collect Date: 15-MAY-18 17:35	
Receive Date: 19-MAY-18	
Collector: Client	

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Carbon Analysis												
SW846 9060A Total Organic/Inorganic Carbon "As Received"												
Total Organic Carbon #1		1.64	0.330	1.00	mg/L	1	TSM	05/25/18	1700	1766893		1
Total Organic Carbon #2		1.64	0.330	1.00	mg/L	1						
Total Organic Carbon #3		1.65	0.330	1.00	mg/L	1						
Total Organic Carbon #4		1.69	0.330	1.00	mg/L	1						
Total Organic Carbon Average		1.65	0.330	1.00	mg/L	1						

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	SW846 9060A	

**Notes:**

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

M 6/9/18

# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
Address : 720 Third Avenue  
Suite 1700  
Seattle, Washington 98104  
Contact: Mr. Mark Woodke  
Project: Site 101T

Client Sample ID: 18051026 Project: ECOL00118  
Sample ID: 450566010 Client ID: ECOL008  
Matrix: Surface Water  
Collect Date: 16-MAY-18 17:35  
Receive Date: 19-MAY-18  
Collector: Client

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Carbon Analysis												
SW846 9060A Total Organic/Inorganic Carbon "As Received"												
Total Organic Carbon #1		1.67	0.330	1.00	mg/L		1	TSM	05/25/18	1915	1766893	1
Total Organic Carbon #2		1.67	0.330	1.00	mg/L		1					
Total Organic Carbon #3		1.66	0.330	1.00	mg/L		1					
Total Organic Carbon #4		1.68	0.330	1.00	mg/L		1					
Total Organic Carbon Average		1.67	0.330	1.00	mg/L		1					

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	SW846 9060A	

### Notes:

Column headers are defined as follows:

DF: Dilution Factor  
DL: Detection Limit  
MDA: Minimum Detectable Activity  
MDC: Minimum Detectable Concentration  
Lc/LC: Critical Level  
PF: Prep Factor  
RL: Reporting Limit  
SQL: Sample Quantitation Limit



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## Certificate of Analysis

Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
Address : 720 Third Avenue  
Suite 1700  
Seattle, Washington 98104  
Contact: Mr. Mark Woodke  
Project: Site 101T

Client Sample ID: 18051029 Project: ECOL00118  
Sample ID: 450566011 Client ID: ECOL008  
Matrix: Surface Water  
Collect Date: 16-MAY-18 15:30  
Receive Date: 19-MAY-18  
Collector: Client

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Solids Analysis												
SM 2540D Total Suspended Solids (TSS) "As Received"												
Total Suspended Solids		5.11	0.620	2.72	mg/L			KLP1	05/22/18	1053	1766482	1

The following Analytical Methods were performed:

Method	Description	Analyst	Comments
1	SM 2540D		

### Notes:

Column headers are defined as follows:

DF: Dilution Factor Lc/LC: Critical Level  
DL: Detection Limit PF: Prep Factor  
MDA: Minimum Detectable Activity RL: Reporting Limit  
MDC: Minimum Detectable Concentration SQL: Sample Quantitation Limit

17-10-18

MW 6/1/18

# GEL LABORATORIES LLC

2040 Savage Road Charleston, SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
Address : 720 Third Avenue  
Suite 1700  
Seattle, Washington 98104  
Contact: Mr. Mark Woodke  
Project: Site 101T

Client Sample ID: 18051031 Project: ECOL00118  
Sample ID: 450566012 Client ID: ECOL008  
Matrix: Surface Water  
Collect Date: 16-MAY-18 15:30  
Receive Date: 19-MAY-18  
Collector: Client

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Solids Analysis												
SM 2540D Total Suspended Solids (TSS) "As Received"												
Total Suspended Solids	J	2.47	0.613	2.69	mg/L			KLP1	05/22/18	1053	1766482	1

The following Analytical Methods were performed:

Method	Description	Analyst	Comments
1	SM 2540D		

### Notes:

Column headers are defined as follows:

DF: Dilution Factor  
DL: Detection Limit  
MDA: Minimum Detectable Activity  
MDC: Minimum Detectable Concentration  
Lc/LC: Critical Level  
PF: Prep Factor  
RL: Reporting Limit  
SQL: Sample Quantitation Limit





# ecology and environment, inc.

Global Environmental Specialists

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

## MEMORANDUM

DATE: June 19, 2018

TO: Jake Moersen, START-IV Project Manager, E & E, Seattle, Washington

FROM: Mark Woodke, START-IV Chemist, E & E, Seattle, Washington *MW*

SUBJ: **Data Quality Assurance Review, Cinnabar Mine 2018 Removal Site Evaluation, Yellow Pine, Idaho**

REF: TO: TO-30-T1-SS1 PAN: 1004530.0030.001.01

The data quality assurance review of 10 water samples collected from the Cinnabar Mine site located in Yellow Pine, Idaho, has been completed. Total Suspended Solids (TSS; Standard Method 2540D) and Total Organic Carbon (TOC; EPA Method 9060A) analyses were performed by GEL Laboratories, LLC, Charleston, South Carolina. All sample analyses were evaluated following EPA's Stage 2B and/or 4 Data Validation Electronic and/or Manual Process (S2B/4VE/M).

The samples were numbered:

18051013	18051014	18051015	18051016	18051017
18051018	18051019	18051020	18051023	18051024

### Data Qualifications:

The samples were maintained at  $< 6^{\circ}\text{C}$ . The samples were collected between May 16 and 17, 2018, and were analyzed by May 23, 2018, for TSS and by May 26, 2018, for TOC. All samples were analyzed within QC holding time limits of less than 28 days between collection and TOC analysis for preserved samples and less than 7 days between collection and TSS analysis.

#### TSS

There were no detections in the method blank. The duplicate result was within QC limits. Laboratory control sample (LCS) and LCS duplicate (LCSD) results were within QC limits.

#### TOC

All initial calibration correlation coefficients were greater than 0.999. The initial and continuing calibration verification results were within QC limits. There were no detections in the method, initial calibration, or continuing calibration blanks. The duplicate result was within QC limits. The LCS and post spike recoveries were within QC limits.

In the reviewers' professional judgment, all sample results were acceptable except as noted.

A total of 54 results were validated in this data memorandum. No sample results were qualified as estimated quantities (J) based on duplicate precision outliers, spike accuracy outliers, holding time

outliers, incorrect sample containers, or sample temperature outliers. No sample results were rejected (R). No potential contaminants of concern were detected in the blanks.

The reviewer used professional judgment to apply a single bias qualifier when more than one bias qualifier was applicable to an individual estimated sample result.

The overall usefulness of the data is based on the criteria outlined in the Site-Specific Sampling Plan and/or Sampling and Quality Assurance Plan, the analytical method(s), and/or the EPA Region 10 Emergency Management Program SOG 144E Analytical Data Validation. Based upon the information provided, the data are acceptable for use with the above stated data qualifications.

#### Data Qualifiers and Definitions

- H - The sample result is biased high.
- J - The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
- K - The bias of the sample is not known.
- L - The sample result is biased low.
- Q - Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.
- R - The data is rejected and unusable. The analyte may or may not be present in the sample.
- U - The analyte was analyzed for, but was not detected above the level of the reported 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.

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## Certificate of Analysis

Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
Address : 720 Third Avenue  
Suite 1700  
Seattle, Washington 98104  
Contact: Mr. Mark Woodke  
Project: Site 101T

Client Sample ID: 18051013 Project: ECOL00118  
Sample ID: 450574001 Client ID: ECOL008  
Matrix: Surface Water  
Collect Date: 16-MAY-18 12:55  
Receive Date: 19-MAY-18  
Collector: Client

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Solids Analysis												
SM 2540D Total Suspended Solids (TSS) "As Received"												
Total Suspended Solids	J	0.900	0.570	2.50	mg/L			KLP1	05/23/18	1312	1766492	1

The following Analytical Methods were performed:

Method	Description	Analyst	Comments
1	SM 2540D		

### Notes:

Column headers are defined as follows:

DF: Dilution Factor                      Lc/LC: Critical Level  
DL: Detection Limit                      PF: Prep Factor  
MDA: Minimum Detectable Activity      RL: Reporting Limit  
MDC: Minimum Detectable Concentration      SQL: Sample Quantitation Limit





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Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
 Address : 720 Third Avenue  
 Suite 1700  
 Seattle, Washington 98104  
 Contact: Mr. Mark Woodke  
 Project: Site 101T

Client Sample ID: 18051014	Project: ECOL00118
Sample ID: 450574003	Client ID: ECOL008
Matrix: Surface Water	
Collect Date: 16-MAY-18 12:55	
Receive Date: 19-MAY-18	
Collector: Client	

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Carbon Analysis												
SW846 9060A Total Organic/Inorganic Carbon "As Received"												
Total Organic Carbon #1		1.13	0.330	1.00	mg/L	1	TSM	05/25/18	2046	1766893		1
Total Organic Carbon #2		1.14	0.330	1.00	mg/L	1						
Total Organic Carbon #3		1.13	0.330	1.00	mg/L	1						
Total Organic Carbon #4		1.13	0.330	1.00	mg/L	1						
Total Organic Carbon Average		1.13	0.330	1.00	mg/L	1						

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	SW846 9060A	

**Notes:**

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

5-25-18

Mw 6/1/18

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Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
Address : 720 Third Avenue  
Suite 1700  
Seattle, Washington 98104  
Contact: Mr. Mark Woodke  
Project: Site 101T

Client Sample ID: 18051015 Project: ECOL00118  
Sample ID: 450574004 Client ID: ECOL008  
Matrix: Surface Water  
Collect Date: 16-MAY-18 12:55  
Receive Date: 19-MAY-18  
Collector: Client

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Carbon Analysis												
SW846 9060A Total Organic/Inorganic Carbon "As Received"												
Total Organic Carbon #1		1.04	0.330	1.00	mg/L	1	TSM		05/25/18	2130	1766893	1
Total Organic Carbon #2		1.04	0.330	1.00	mg/L	1						
Total Organic Carbon #3		1.04	0.330	1.00	mg/L	1						
Total Organic Carbon #4		1.07	0.330	1.00	mg/L	1						
Total Organic Carbon Average		1.05	0.330	1.00	mg/L	1						

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	SW846 9060A	

### Notes:

Column headers are defined as follows:

DF: Dilution Factor  
DL: Detection Limit  
MDA: Minimum Detectable Activity  
MDC: Minimum Detectable Concentration  
Lc/LC: Critical Level  
PF: Prep Factor  
RL: Reporting Limit  
SQL: Sample Quantitation Limit



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## Certificate of Analysis

Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
Address : 720 Third Avenue  
Suite 1700  
Seattle, Washington 98104  
Contact: Mr. Mark Woodke  
Project: Site 101T

Client Sample ID: 18051016 Project: ECOL00118  
Sample ID: 450574005 Client ID: ECOL008  
Matrix: Surface Water  
Collect Date: 16-MAY-18 12:55  
Receive Date: 19-MAY-18  
Collector: Client

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Carbon Analysis												
SW846 9060A Total Organic/Inorganic Carbon "As Received"												
Total Organic Carbon #1		1.01	0.330	1.00	mg/L	1	TSM	05/25/18	2215	1766893		1
Total Organic Carbon #2		1.07	0.330	1.00	mg/L	1						
Total Organic Carbon #3		1.05	0.330	1.00	mg/L	1						
Total Organic Carbon #4		1.05	0.330	1.00	mg/L	1						
Total Organic Carbon Average		1.05	0.330	1.00	mg/L	1						

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	SW846 9060A	

### Notes:

Column headers are defined as follows:

DF: Dilution Factor  
DL: Detection Limit  
MDA: Minimum Detectable Activity  
MDC: Minimum Detectable Concentration  
Lc/LC: Critical Level  
PF: Prep Factor  
RL: Reporting Limit  
SQL: Sample Quantitation Limit

MW 6/1/18

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Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
Address : 720 Third Avenue  
Suite 1700  
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Contact: Mr. Mark Woodke  
Project: Site 101T

Client Sample ID: 18051017 Project: ECOL00118  
Sample ID: 450574006 Client ID: ECOL008  
Matrix: Surface Water  
Collect Date: 16-MAY-18 14:00  
Receive Date: 19-MAY-18  
Collector: Client

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Solids Analysis												
SM 2540D Total Suspended Solids (TSS) "As Received"												
Total Suspended Solids	J Q	0.300	0.570	2.50	mg/L			KLP1	05/23/18	1312	1766492	1

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	SM 2540D	

### Notes:

Column headers are defined as follows:

DF: Dilution Factor                      Lc/LC: Critical Level  
DL: Detection Limit                      PF: Prep Factor  
MDA: Minimum Detectable Activity      RL: Reporting Limit  
MDC: Minimum Detectable Concentration      SQL: Sample Quantitation Limit



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## Certificate of Analysis

Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
Address : 720 Third Avenue  
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Contact: Mr. Mark Woodke  
Project: Site 101T

Client Sample ID: 18051017 Project: ECOL00118  
Sample ID: 450574007 Client ID: ECOL008  
Matrix: Surface Water  
Collect Date: 16-MAY-18 14:00  
Receive Date: 19-MAY-18  
Collector: Client

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Carbon Analysis												
SW846 9060A Total Organic/Inorganic Carbon "As Received"												
Total Organic Carbon #1		1.10	0.330	1.00	mg/L	1	TSM	05/25/18	2325	1766893		1
Total Organic Carbon #2		1.12	0.330	1.00	mg/L	1						
Total Organic Carbon #3		1.14	0.330	1.00	mg/L	1						
Total Organic Carbon #4		1.16	0.330	1.00	mg/L	1						
Total Organic Carbon Average		1.13	0.330	1.00	mg/L	1						

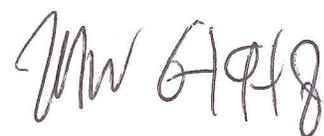
The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	SW846 9060A	

### Notes:

Column headers are defined as follows:

DF: Dilution Factor  
DL: Detection Limit  
MDA: Minimum Detectable Activity  
MDC: Minimum Detectable Concentration  
Lc/LC: Critical Level  
PF: Prep Factor  
RL: Reporting Limit  
SQL: Sample Quantitation Limit



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Company : Ecology and Environment, Inc.  
 Address : 720 Third Avenue  
 Suite 1700  
 Seattle, Washington 98104  
 Contact: Mr. Mark Woodke  
 Project: Site 101T

Client Sample ID: 18051018	Project: ECOL00118
Sample ID: 450574008	Client ID: ECOL008
Matrix: Surface Water	
Collect Date: 16-MAY-18 14:00	
Receive Date: 19-MAY-18	
Collector: Client	

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Carbon Analysis												
SW846 9060A Total Organic/Inorganic Carbon "As Received"												
Total Organic Carbon #1		1.13	0.330	1.00	mg/L	1	TSM	05/26/18	0011	1766893		1
Total Organic Carbon #2		1.14	0.330	1.00	mg/L	1						
Total Organic Carbon #3		1.18	0.330	1.00	mg/L	1						
Total Organic Carbon #4		1.14	0.330	1.00	mg/L	1						
Total Organic Carbon Average		1.15	0.330	1.00	mg/L	1						

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	SW846 9060A	

**Notes:**

Column headers are defined as follows:

- |                                       |                                |
|---------------------------------------|--------------------------------|
| DF: Dilution Factor                   | Lc/LC: Critical Level          |
| DL: Detection Limit                   | PF: Prep Factor                |
| MDA: Minimum Detectable Activity      | RL: Reporting Limit            |
| MDC: Minimum Detectable Concentration | SQL: Sample Quantitation Limit |

*Mark Woodke*

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## Certificate of Analysis

Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
Address : 720 Third Avenue  
Suite 1700  
Seattle, Washington 98104  
Contact: Mr. Mark Woodke  
Project: Site 101T

Client Sample ID: 18051019 Project: ECOL00118  
Sample ID: 450574009 Client ID: ECOL008  
Matrix: Surface Water  
Collect Date: 16-MAY-18 14:15  
Receive Date: 19-MAY-18  
Collector: Client

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Solids Analysis												
SM 2540D Total Suspended Solids (TSS) "As Received"												
Total Suspended Solids		3.00	0.570	2.50	mg/L			KLP1	05/23/18	1312	1766492	1

The following Analytical Methods were performed:

Method	Description	Analyst	Comments
1	SM 2540D		

### Notes:

Column headers are defined as follows:

DF: Dilution Factor                      Lc/LC: Critical Level  
DL: Detection Limit                      PF: Prep Factor  
MDA: Minimum Detectable Activity      RL: Reporting Limit  
MDC: Minimum Detectable Concentration      SQL: Sample Quantitation Limit

*Handwritten signature: MW 6/1/18*

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Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
 Address : 720 Third Avenue  
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 Seattle, Washington 98104  
 Contact: Mr. Mark Woodke  
 Project: Site 101T

Client Sample ID: 18051019	Project: ECOL00118
Sample ID: 450574010	Client ID: ECOL008
Matrix: Surface Water	
Collect Date: 16-MAY-18 14:15	
Receive Date: 19-MAY-18	
Collector: Client	

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Carbon Analysis												
SW846 9060A Total Organic/Inorganic Carbon "As Received"												
Total Organic Carbon #1	J	0.803	0.330	1.00	mg/L	1	TSM	05/26/18	0056	1766893		1
Total Organic Carbon #2	J	0.822	0.330	1.00	mg/L							
Total Organic Carbon #3	J	0.830	0.330	1.00	mg/L							
Total Organic Carbon #4	J	0.824	0.330	1.00	mg/L							
Total Organic Carbon Average	J	0.820	0.330	1.00	mg/L							

The following Analytical Methods were performed:

Method	Description	Analyst Comments
I	SW846 9060A	

**Notes:**

Column headers are defined as follows:

- |                                       |                                |
|---------------------------------------|--------------------------------|
| DF: Dilution Factor                   | Lc/LC: Critical Level          |
| DL: Detection Limit                   | PF: Prep Factor                |
| MDA: Minimum Detectable Activity      | RL: Reporting Limit            |
| MDC: Minimum Detectable Concentration | SQL: Sample Quantitation Limit |

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## Certificate of Analysis

Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
Address : 720 Third Avenue  
Suite 1700  
Seattle, Washington 98104  
Contact: Mr. Mark Woodke  
Project: Site 101T

Client Sample ID: 18051020 Project: ECOL00118  
Sample ID: 450574011 Client ID: ECOL008  
Matrix: Surface Water  
Collect Date: 16-MAY-18 14:15  
Receive Date: 19-MAY-18  
Collector: Client

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Carbon Analysis												
SW846 9060A Total Organic/Inorganic Carbon "As Received"												
Total Organic Carbon #1	J	0.848	0.330	1.00	mg/L	1	TSM	05/26/18	0141	1766893		1
Total Organic Carbon #2	J	0.835	0.330	1.00	mg/L	1						
Total Organic Carbon #3	J	0.853	0.330	1.00	mg/L	1						
Total Organic Carbon #4	J	0.841	0.330	1.00	mg/L	1						
Total Organic Carbon Average	J	0.844	0.330	1.00	mg/L	1						

The following Analytical Methods were performed:

Method	Description	Analyst	Comments
1	SW846 9060A		

### Notes:

Column headers are defined as follows:

DF: Dilution Factor  
DL: Detection Limit  
MDA: Minimum Detectable Activity  
MDC: Minimum Detectable Concentration  
Lc/LC: Critical Level  
PF: Prep Factor  
RL: Reporting Limit  
SQL: Sample Quantitation Limit



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## Certificate of Analysis

Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
Address : 720 Third Avenue  
Suite 1700  
Seattle, Washington 98104  
Contact: Mr. Mark Woodke  
Project: Site 101T

Client Sample ID: 18051023 Project: ECOL00118  
Sample ID: 450574012 Client ID: ECOL008  
Matrix: Surface Water  
Collect Date: 17-MAY-18 09:00  
Receive Date: 19-MAY-18  
Collector: Client

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
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### Solids Analysis

SM 2540D Total Suspended Solids (TSS) "As Received"

Total Suspended Solids	U	<i>NA</i>	0.570	2.50	mg/L			KLP1	05/23/18	1312	1766492	1
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The following Analytical Methods were performed:

Method	Description	Analyst	Comments
1	SM 2540D		

### Notes:

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit



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## Certificate of Analysis

Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
 Address : 720 Third Avenue  
 Suite 1700  
 Seattle, Washington 98104  
 Contact: Mr. Mark Woodke  
 Project: Site 101T

Client Sample ID: 18051023	Project: ECOL00118
Sample ID: 450574013	Client ID: ECOL008
Matrix: Surface Water	
Collect Date: 17-MAY-18 09:00	
Receive Date: 19-MAY-18	
Collector: Client	

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Carbon Analysis												
SW846 9060A Total Organic/Inorganic Carbon "As Received"												
Total Organic Carbon #1	U	ND	0.330	1.00	mg/L		1	TSM	05/26/18	0226	1766893	1
Total Organic Carbon #2	U	ND	0.330	1.00	mg/L		1					
Total Organic Carbon #3	U	ND	0.330	1.00	mg/L		1					
Total Organic Carbon #4	U	ND	0.330	1.00	mg/L		1					
Total Organic Carbon Average	U	ND	0.330	1.00	mg/L		1					

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	SW846 9060A	

**Notes:**

Column headers are defined as follows:

- |                                       |                                |
|---------------------------------------|--------------------------------|
| DF: Dilution Factor                   | Lc/LC: Critical Level          |
| DL: Detection Limit                   | PF: Prep Factor                |
| MDA: Minimum Detectable Activity      | RL: Reporting Limit            |
| MDC: Minimum Detectable Concentration | SQL: Sample Quantitation Limit |

*Mr. Woodke*

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## Certificate of Analysis

Report Date: June 1, 2018

Company : Ecology and Environment, Inc.  
 Address : 720 Third Avenue  
 Suite 1700  
 Seattle, Washington 98104  
 Contact: Mr. Mark Woodke  
 Project: Site 101T

Client Sample ID: 18051024	Project: ECOL00118
Sample ID: 450574014	Client ID: ECOL008
Matrix: Surface Water	
Collect Date: 17-MAY-18 09:00	
Receive Date: 19-MAY-18	
Collector: Client	

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Carbon Analysis												
SW846 9060A Total Organic/Inorganic Carbon "As Received"												
Total Organic Carbon #1	U	ND	0.330	1.00	mg/L		1	TSM	05/26/18	0441	1766893	1
Total Organic Carbon #2	U	ND	0.330	1.00	mg/L		1					
Total Organic Carbon #3	U	ND	0.330	1.00	mg/L		1					
Total Organic Carbon #4	U	ND	0.330	1.00	mg/L		1					
Total Organic Carbon Average	U	ND	0.330	1.00	mg/L		1					

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	SW846 9060A	

**Notes:**

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

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**Vegetation Study**

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# **Profile Products**

## **Research and Development**

# **Idaho EPA Mine Trial 2.0**

# Idaho EPA Mine Trial 2.0



Evaluate plant growth response in Cinnabar soil treated with ProGanics and biological additives.

# Trial Specification

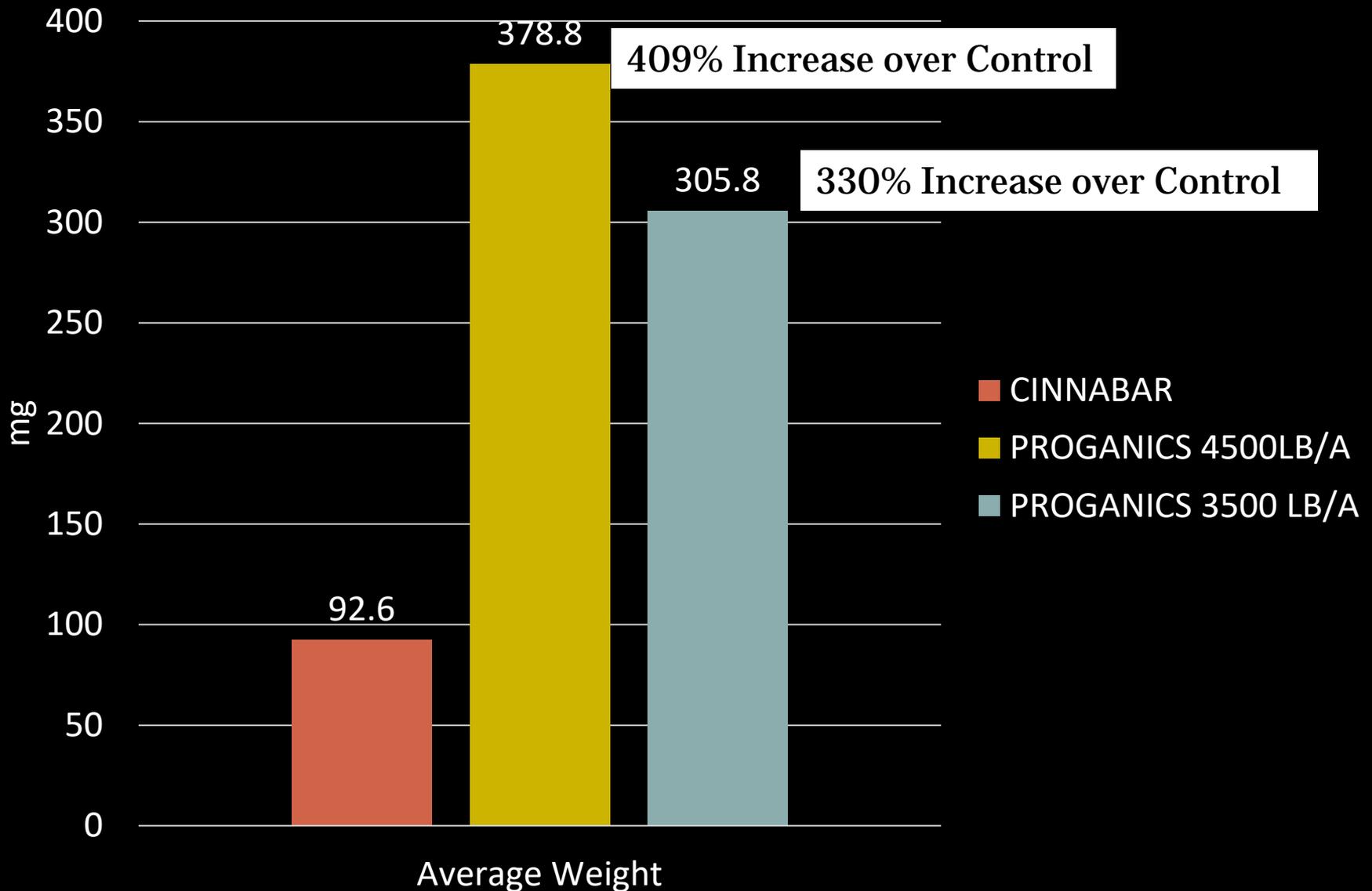
- Plot Size:
  - 4" Container
- Trial Duration:
  - 7 Weeks
- Installation:
  - 6-21-18
- Harvest:
  - 8/9/18
- Replications:
  - 5
- Lighting:
  - No Supplemental Lighting
- Randomization:
  - Complete Randomized Design
- Irrigation:
  - 100mls clear water four times weekly (400mls/week)
- Species:
  - See next slide – 40 lb/acre
- Fertilizer:
  - 1lb Nitrogen/1000sqft (18-24-6 granular fertilizer)
- Greenhouse Climate:
  - Near Cooling Pads (see climate data)

# Treatments

Seed	Quantity/Pot
Intermediate Wheat Grass	4
Tall Fescue	7
Medium Red Clover	4

#	Treatment	Application Rate
1	CONTROL: CINNABAR	N/A
2	ProGanics	4500 lb/acre
	JUMPSTART	3.75 gal/acre
	BIOPRIME	120 lb/acre
	FLEXTERRA	3000 lb/acre
3	PROGANICS	3500 lb/acre
	JUMPSTART	1.25 gal/acre
	BIOPRIME	40 lb/acre
	FLEXTERRA	3000 lb/acre

# Average Dry Weight at Harvest



# Week 1



Cinnabar Soil

ProGanics 4500 lb/acre

ProGanics 3500 lb/acre



Cinnabar Soil

ProGanics 4500 lb/acre

ProGanics 3500 lb/acre

# Week 3



Cinnabar Soil

ProGanics  
4500 lb/acre

ProGanics  
3500 lb/acre



Cinnabar Soil

ProGanics  
4500 lb/acre

ProGanics  
3500 lb/acre

# Week 5



Cinnabar Soil

ProGanics  
4500 lb/acre

ProGanics  
3500 lb/acre



Cinnabar Soil

ProGanics  
4500 lb/acre

ProGanics  
3500 lb/acre

# Week 7



Cinnabar Soil

ProGanics  
4500 lb/acre

ProGanics  
3500 lb/acre



Cinnabar Soil

ProGanics  
4500 lb/acre

ProGanics  
3500 lb/acre

# Cinnabar Soil



Week 1



Week 3



Week 5



Week 7

# Cinnabar Soil with ProGanics 4500 lb/A



Week 1



Week 3



Week 5



Week 7

# Cinnabar Soil with ProGanics 3500 lb/A



Week 1



Week 3



Week 5



Week 7

# Die Back in Cinnabar Soil



Die back appeared limited more by species than by treatment. Across all treatments Indeterminate Wheat Grass and Medium Red Clover showed die back where Fescue did not. This die back began around week 5-6

# Die Back in Cinnabar Soil with ProGanics 4500lb/A



Intermediate Wheat Grass



Medium Red Clover

# Die Back in Cinnabar Soil with ProGanics 3500lb/A

Fescue  
(Healthy  
Appearance)

Medium Red  
Clover (showing  
die back)



Intermediate  
Wheat Grass  
(Showing Die  
Back)

# Discussion

- Good differentiation in performance versus the control for both ProGanics treatments.
- The fescue species showed no toxicity issues.
- It appears that with this soil, there are still some toxicity issues with two of the plant species as there was discoloration/die back in the clover and wheat grass beginning in week 5
- This may be attributed to the elevated aluminum levels or possibly the arsenic levels
  - Not confident Al is the problem since soil pH was above 6.5
  - More likely arsenic...?

<u>Client ID</u>	<u>Spectra #</u>	<u>Analyte</u>	<u>Result</u>	<u>Units</u>
Cinnabar Mine Testing	1	SPLP Aluminum	7.19	mg/L
Cinnabar Mine Testing	1	SPLP Antimony	0.057	mg/L
Cinnabar Mine Testing	1	SPLP Arsenic	2.46	mg/L
Cinnabar Mine Testing	1	SPLP Barium	0.078	mg/L
Cinnabar Mine Testing	1	SPLP Beryllium	< 0.001	mg/L
Cinnabar Mine Testing	1	SPLP Boron	0.694	mg/L
Cinnabar Mine Testing	1	SPLP Cadmium	< 0.003	mg/L
Cinnabar Mine Testing	1	SPLP Chromium	0.192	mg/L
Cinnabar Mine Testing	1	SPLP Cobalt	< 0.005	mg/L
Cinnabar Mine Testing	1	SPLP Copper	< 0.006	mg/L
Cinnabar Mine Testing	1	SPLP Lead	< 0.025	mg/L
Cinnabar Mine Testing	1	SPLP Magnesium	0.994	mg/L
Cinnabar Mine Testing	1	SPLP Manganese	0.129	mg/L
Cinnabar Mine Testing	1	SPLP Molybdenum	< 0.005	mg/L
Cinnabar Mine Testing	1	SPLP Nickel	< 0.015	mg/L
Cinnabar Mine Testing	1	SPLP Selenium	< 0.025	mg/L
Cinnabar Mine Testing	1	SPLP Silver	< 0.007	mg/L
Cinnabar Mine Testing	1	SPLP Strontium	0.013	mg/L
Cinnabar Mine Testing	1	SPLP Thallium	< 0.025	mg/L
Cinnabar Mine Testing	1	SPLP Vanadium	< 0.015	mg/L
Cinnabar Mine Testing	1	SPLP Zinc	1.21	mg/L
Cinnabar Mine Testing	1	SPLP Mercury	0.0472	mg/L