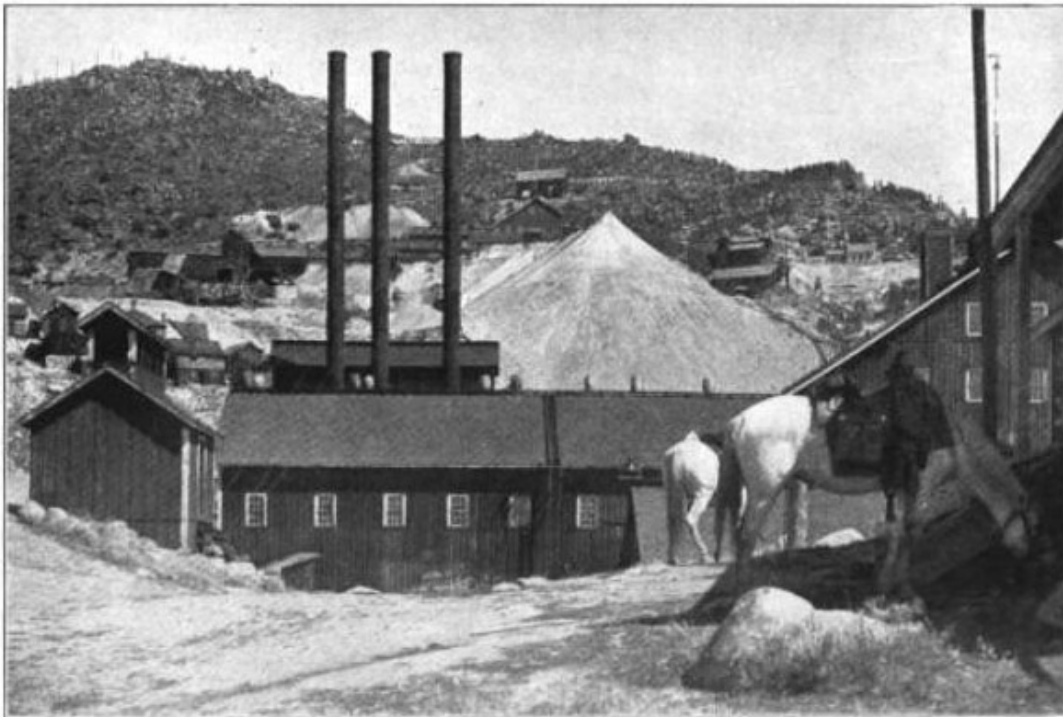




**Final –
Addendum to Flint Creek Planning Area
Sediment and Metals TMDLs and Framework
Water Quality Improvement Plan**



B. GRANITE-BIMETALLIC MINE, SHOWING WEATHERING OF GRANITE.

May 2015

*Steve Bullock, Governor
Tom Livers, Director DEQ*



(The cover image is Plate VII B from: Geology and Ore Deposits of the Philipsburg Quadrangle Montana, United States Geologic Survey Professional Paper 78, by W.H. Emmons and F.C. Calkins. 1913.)

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TABLE OF CONTENTS

Acronym List	v
Document Summary	1
1.0 Project Overview.....	3
1.1 Water Quality Impairments and TMDLs Addressed by this Document.....	3
1.2 What this Document Contains.....	4
2.0 Douglas Creek Watershed Description & Source Assessment.....	5
2.1 Douglas Creek Watershed Description	5
2.2 Douglas Creek Metals Sources.....	6
2.2.1 Geology	6
2.2.2 Historic Mining.....	7
2.2.3 Current Metals Production	8
3.0 Montana Water Quality Standards.....	9
3.1 Stream Classifications and Designated Beneficial Uses.....	9
3.2 Numeric and Narrative Water Quality Standards.....	10
4.0 Defining TMDLs and Their Components	10
4.1 General Description of TMDLs and Their Components	10
4.2 Implementing TMDL Allocations.....	11
5.0 Metals TMDL Components	12
5.1 Effects of Excess Metals on Beneficial Uses.....	12
5.2 Stream Segments of Concern	12
5.3 Water Quality Data and Information Sources	12
5.4 Water Quality Targets.....	13
5.4.1 Target	13
5.4.2 Metals Evaluation Framework	13
5.4.3 Data Compilation and Comparison to Targets.....	14
5.5 Loading Evaluation and Source Assessment.....	15
5.6 TMDL and Allocations	16
5.6.1 Antimony TMDL for Douglas Creek (MT76E00_100).....	16
5.6.2 Antimony Allocations for Douglas Creek (MT76E00_100).....	17
5.7 Seasonality and Margin of Safety	18
5.7.1 Seasonality	19
5.7.2 Margin of Safety.....	19
5.8 Uncertainty and Adaptive Management	19

6.0 Water Quality Improvement Plan..... 21

 6.1 Water Quality Restoration Objectives 21

 6.2 Montana DEQ and Other Agency Roles 21

 6.3 Metals Restoration Strategy for Mining Sources..... 22

 6.3.1 Superfund Authority in the Douglas Creek watershed 22

 6.3.2 The Surface Mining Control and Reclamation Act (SMCRA)..... 23

 6.3.3. Other Historical Mine Remediation Programs..... 23

 6.4 Restoration Approaches by Source Category 24

 6.5 Potential Funding Sources 24

 6.5.1 Section 319 Nonpoint Source Grant Program 24

 6.5.2 Future Fisheries Improvement Program..... 24

 6.5.3 Watershed Planning and Assistance Grants 24

 6.5.4 Resource Indemnity Trust/Reclamation and Development Grants Program..... 25

 6.5.5 Other Funding Sources..... 25

7.0 Monitoring for Effectiveness 25

8.0 Stakeholder and Public Participation..... 25

 8.1 Participants and Roles..... 26

 8.1.1 Montana Department of Environmental Quality..... 26

 8.1.2 U.S. Environmental Protection Agency..... 26

 8.1.3 TMDL Advisory Group 26

 8.1.4 Area Landowners 26

 8.2 Response to Public Comments 27

9.0 References 27

APPENDICES

Appendix A - Location of mining-related features and water quality sample sites

Appendix B - Cleanup/Restoration and Funding Options for Mine Operations or Other Sources of Metals Contamination

ATTACHMENT

Analytical Results Report for a CERCLA Site Inspection Philipsburg Mining Area (Douglas Creek) Near Philipsburg, Granite County, Montana

LIST OF TABLES

Table DS-1. Completed Metals TMDL Contained in this Document.....	2
Table 1-1. Water Quality Impairment Causes for the Flint Creek TPA Addressed within this Document....	4
Table 3-1. Impaired Waterbodies and Their Impaired Designated Uses in the Flint Creek TPA	10
Table 5-1. DEQ and EPA Antimony Data (Values in Bold Exceed the Target).....	14
Table 5-2. Douglas Creek Example Antimony TMDL, Allocations, and Required Reduction.....	18
Table 6-1. Priority Abandoned Mine sites in the Douglas Creek watershed.....	23

LIST OF FIGURES

Figure 1-1. Douglas Creek and streams with approved TMDLs in the Flint Creek TPA	3
Figure 2-1. Topography of the Douglas Creek watershed	5
Figure 2-2. Property ownership within the Douglas Creek watershed.....	6
Figure 2-3. Example analysis of ore from the Bimetallic mine (Emmons and Calkins, 1913, page 204)	7
Figure 2-4. Mining-related features in the Douglas Creek watershed	8
Figure 4-1. Illustration of TMDL components and the TMDL development process.....	11
Figure 5-1. Location of mining-related features and water quality sites	13
Figure 5-2. Antimony water quality data	15
Figure 5-3. Plot of antimony TMDL versus streamflow	17

ACRONYM LIST

Acronym	Definition
AML	Abandoned Mine Lands
ARCO	Atlantic Richfield Company
ARM	Administrative Rules of Montana
BLM	Bureau of Land Management (Federal)
BMP	Best Management Practices
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CWA	Clean Water Act
DEQ	Department of Environmental Quality (Montana)
DNRC	Department of Natural Resources & Conservation (Montana)
EPA	Environmental Protection Agency (U.S.)
FWP	Fish, Wildlife & Parks (Montana)
GIS	Geographic Information System
LA	Load Allocation
MCA	Montana Code Annotated
MOS	Margin of Safety
MPDES	Montana Pollutant Discharge Elimination System
NHD	National Hydrography Dataset
NPL	National Priorities List
NRDP	Natural Resource Damage Program (Montana Dept. of Justice)
OSM	Office of Surface Mining Reclamation and Enforcement
PMA	Philipsburg Mining Area
RIT/RDG	Resource Indemnity Trust/Reclamation and Development Grants Program
SMCRA	Surface Mining Control & Reclamation Act
TMDL	Total Maximum Daily Load
TPA	TMDL Planning Area
UCFRB	Upper Clark Fork River Basin
USFS	United States Forest Service
USGS	United States Geological Survey
WLA	Wasteload Allocation
WRP	Watershed Restoration Plan

DOCUMENT SUMMARY

This document presents a Total Maximum Daily Load (TMDL) for one stream in the Flint Creek TMDL planning area: Douglas Creek (**Figure 1-1**). There are two streams named Douglas Creek in the Flint Creek TMDL planning area; this report focusses on the one south of Phillipsburg (assessment unit ID: MT76E003_100). This document is presented as an addendum to the 2012 TMDL document *Flint Creek Planning Area Sediment and Metals TMDLs and Framework Water Quality Improvement Plan* (Montana Department of Environmental Quality, 2012a). The parent document will hereto forward be referenced as “DEQ, 2012a”. This addendum contains one TMDL addressing a metals impairment that was not addressed in the parent document (Montana Department of Environmental Quality, 2012a). The antimony impairment was not identified until January 2014, although the water quality data on which the impairment determination is based were collected in support of the parent document (Montana Department of Environmental Quality, 2012a).

The Montana Department of Environmental Quality (DEQ) develops TMDLs and submits them to the U.S. Environmental Protection Agency (EPA) for approval. The Montana Water Quality Act requires DEQ to develop TMDLs for streams and lakes that do not meet, or are not expected to meet, Montana water quality standards. A TMDL is the maximum amount of a pollutant a waterbody can receive and still meet water quality standards. TMDLs provide an approach to improve water quality so that streams and lakes can support and maintain their state-designated beneficial uses.

The Flint Creek TMDL planning area (TPA) encompasses an area of approximately 500 square miles in western Montana, and lies almost entirely in Granite County with a small portion in Deer Lodge County. The Flint Creek watershed originates in the Flint Creek Mountains to the east, the Pintler Mountains to the south, and the Sapphire and John Long Mountains to the west. Flint Creek drains from Georgetown Lake and bisects two large agricultural valleys, the Philipsburg Valley and the Drummond Valley, which are separated by a narrow bedrock canyon. Flow in Flint Creek is seasonally augmented from a trans-basin diversion in the East Fork of Rock Creek. Approximately 2,200 residents reside within the Flint Creek TPA. Philipsburg (pop. 911) and Drummond (pop. 315) are the largest towns. Other population centers include Hall and Maxville. Land ownership in the Flint Creek TPA is primarily private and U.S. Forest Service (Beaverhead-Deer Lodge National Forest), with a small amount of land managed by Bureau of Land Management (BLM) or the State of Montana. Private lands are located predominantly in the lower areas where wide, low-gradient valleys are conducive to agriculture and development.

The Douglas Creek watershed extends over approximately 6.4 square miles southeast of Phillipsburg. The watershed is steep and forested, although small timber cuts are evident on aerial photographs. The watershed is drained by Douglas Creek and its tributary, Frost Creek. Elevations range from 8,041 feet above sea level on the top of Granite Mountain to approximately 5,120 feet at the mouth of Douglas Creek. There are limited tracts of federal land, both United States Forest Service (USFS) and Bureau of Land Management (BLM). The majority of the Douglas Creek watershed (84%) is privately owned, due to extensive historic mining activity. While there are many historic mines in the watershed, the Granite-Bimetallic is the largest and most historically significant (Montana Department of Environmental Quality, 2009).

The scope of this addendum is limited to the antimony impairment identified for Douglas Creek. The waterbody, impairment cause, and impaired use are summarized below in **Table DS-1**.

Table DS-1. Completed Metals TMDL Contained in this Document

Waterbody and Location Description	TMDL Prepared	TMDL Pollutant Category	Impaired Use
Douglas Creek, from headwaters to where stream ends, T7N R14W S25	Antimony	Metals	Drinking Water

The assessment unit for Douglas Creek was based upon the National Hydrography Dataset (NHD), which depicts Douglas Creek expiring in the alluvial fan south of Philipsburg. However, Douglas Creek flows to Flint Creek, via natural channel and ditch diversions. As of this writing, DEQ is pursuing corrections to both the NHD and DEQ’s assessment unit description. Douglas Creek is shown flowing to Flint Creek in all figures in this document. The flowline is based upon recent aerial photographs.

Antimony TMDL

One antimony TMDL is provided for Douglas Creek. The parent document (Montana Department of Environmental Quality, 2012a) contains arsenic, cadmium, copper, iron, lead, mercury, and zinc TMDLs for Douglas Creek, but at the time those TMDLs were prepared, the antimony impairment had not been identified. Data collected in 2007, 2008, 2009, and 2011 verified the antimony impairment for Douglas Creek and this impairment was added to the 303(d) list in 2014.

This document establishes an antimony water quality target of 5.6 µg/L, based on the human health standard. The antimony TMDL for any given streamflow may be calculated as:

$$\text{TMDL in pounds/day} = (\text{flow in cubic feet/second}) * 5.6 \mu\text{g/L} * 0.0054$$

This document quantifies metals loads from natural background (geologic) sources and abandoned mining sources. The antimony TMDL for Douglas Creek therefore includes the following terms:

$$\text{TMDL}_{\text{Douglas}} = \text{WLA}_{\text{ABDM}} + \text{LA}_{\text{natural}}$$

TMDLs are based on the most stringent water quality target and the streamflow. The TMDL applies to any point along the waterbody and therefore protects uses along the entire stream. Necessary reductions in antimony loads range from 20% to 0%. Reductions are not required under low flow conditions, as no antimony standard exceedances were identified during low flows. Reductions will mostly depend upon abandoned mine cleanup activities. State and federal programs, as well as potential funding resources to address metals sources are summarized in **Section 9.0** of the parent document.

Water Quality Improvement Measures

Implementation of most water quality improvement measures described in this plan will depend on state or federal agency abandoned mine cleanup actions.

A flexible approach to most TMDL implementation activities may be necessary as more knowledge is gained through implementation and future monitoring. The plan includes a monitoring strategy designed to track progress in meeting TMDL objectives and goals and to help refine the plan during its implementation.

1.0 PROJECT OVERVIEW

This document is an addendum to the 2012 TMDL document *Flint Creek Planning Area Sediment and Metals TMDLs and Framework Water Quality Improvement Plan* (Montana Department of Environmental Quality, 2012a). This addendum includes an analysis of water quality data and establishes a TMDL for antimony in Douglas Creek. The location of Douglas Creek relative to the Flint Creek TMDL Planning area is shown in **Figure 1-1**.

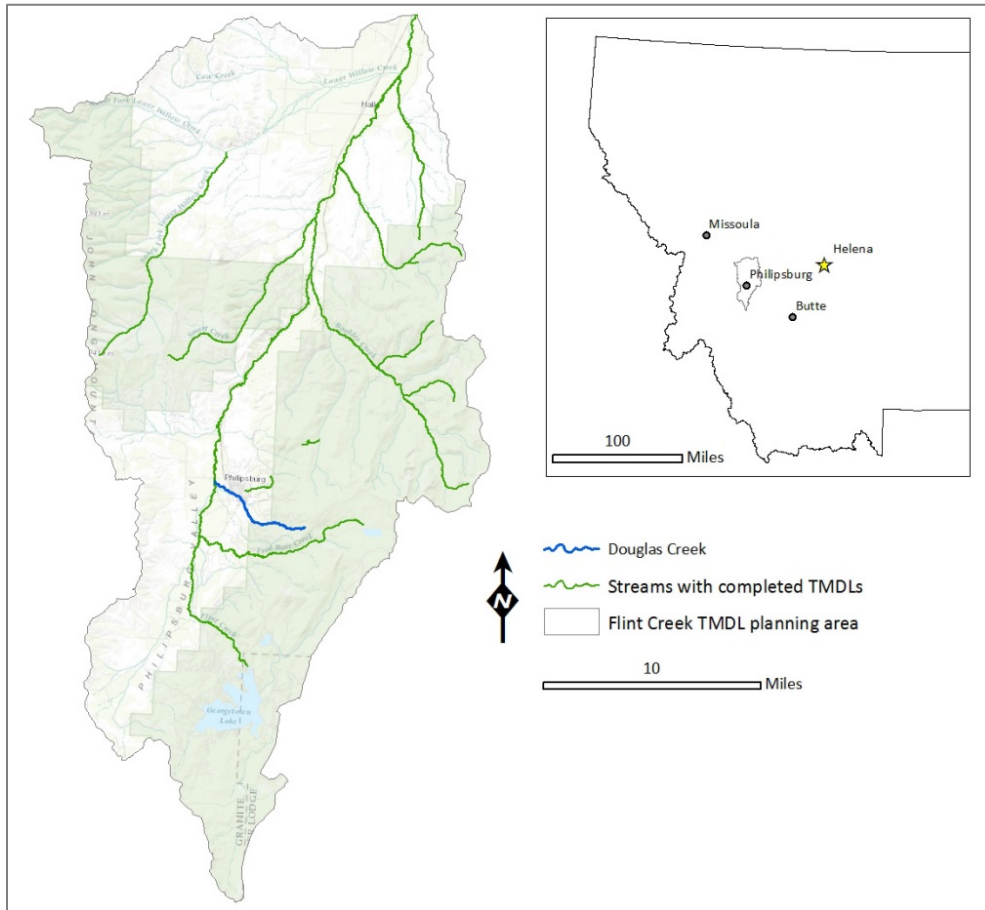


Figure 1-1. Douglas Creek and streams with approved TMDLs in the Flint Creek TPA

1.1 WATER QUALITY IMPAIRMENTS AND TMDLS ADDRESSED BY THIS DOCUMENT

Table 1-1 below identifies the impairment cause from the “2014 Water Quality Integrated Report” (Montana Department of Environmental Quality, 2014) that is addressed in this document.

One antimony TMDL is provided for Douglas Creek (**Table 1-1**). The parent document (Montana Department of Environmental Quality, 2012a) contains arsenic, cadmium, copper, iron, lead, mercury, zinc, and sediment TMDLs for Douglas Creek, but at the time those TMDLs were prepared, the antimony impairment had not been identified. Data collected in 2007, 2008, 2009, and 2011 established the antimony impairment for Douglas Creek and this impairment was added to the 303(d) list in 2014.

Table 1-1. Water Quality Impairment Causes for the Flint Creek TPA Addressed within this Document

Waterbody and Location Description*	Waterbody ID	Impairment Cause	Pollutant Category	Impairment Cause Status	Included in 2014 Integrated Report
Douglas Creek, from headwaters to where stream ends, T17N R14 W S25	MT76E003_100	Antimony	Metals	Antimony TMDL completed	Yes

* All waterbody segments within Montana’s Water Quality Integrated Report are indexed to the National Hydrography Dataset. The NHD description for Douglas Creek is incorrect, as it flows to Flint Creek. DEQ is in the process of updating this description.

1.2 WHAT THIS DOCUMENT CONTAINS

This document addresses all of the required components of a TMDL and includes an implementation and monitoring strategy. The TMDL components are summarized within the main body of the document. Additional technical details are contained in the appendices. In addition to this introductory section, this document includes:

Section 2.0 Douglas Creek watershed description:

Describes the physical characteristics and social profile of the watershed.

Section 3.0 Montana Water Quality Standards:

Discusses the water quality standards that apply to Douglas Creek.

Section 4.0 Defining TMDLs and Their Components:

Defines the components of a TMDL and how each is developed.

Sections 5.0 Metals TMDL Components:

This section includes (a) a discussion of the affected waterbody and the pollutant’s effect on designated beneficial uses, (b) the information sources and assessment methods used to evaluate stream health and pollutant source contributions, (c) water quality targets and existing water quality conditions, (d) the quantified pollutant loading from the identified sources, (e) the determined TMDL for the waterbody, (f) the allocations of the allowable pollutant load to the identified sources.

Section 6.0 Water Quality Improvement Plan:

Discusses water quality restoration objectives and a strategy to meet the TMDL.

Section 7.0 Monitoring for Effectiveness:

Describes a water quality monitoring plan for evaluating the long-term effectiveness of the TMDL and pollutant allocations presented in this document.

Section 8.0 Public Participation & Public Comments:

Describes other agencies and stakeholder groups who were involved with the development of this plan and the public participation process used to review the draft document. Addresses comments received during the public review period.

2.0 DOUGLAS CREEK WATERSHED DESCRIPTION & SOURCE ASSESSMENT

Please refer to the watershed description in the parent document for an overview of physical, ecological, and social context of the Flint Creek TPA (Montana Department of Environmental Quality, 2012a). Selected attributes of the Douglas Creek watershed are summarized below.

2.1 DOUGLAS CREEK WATERSHED DESCRIPTION

The Douglas Creek watershed extends over approximately 6.4 square miles southwest of Phillipsburg. The watershed is steep and forested, although small timber cuts are evident on aerial photographs. The watershed is drained by Douglas Creek and its tributary, Frost Creek. Elevations range from 8,041 feet above sea level on the top of Granite Mountain to approximately 5,120 feet at the mouth of Douglas Creek (**Figure 2-1**).

Douglas Creek flows approximately 5.43 miles to Flint Creek. The creek is diverted into a wooden flume for about 0.6 miles around reclaimed Bimetallic Mill tailings (**Attachment A**).

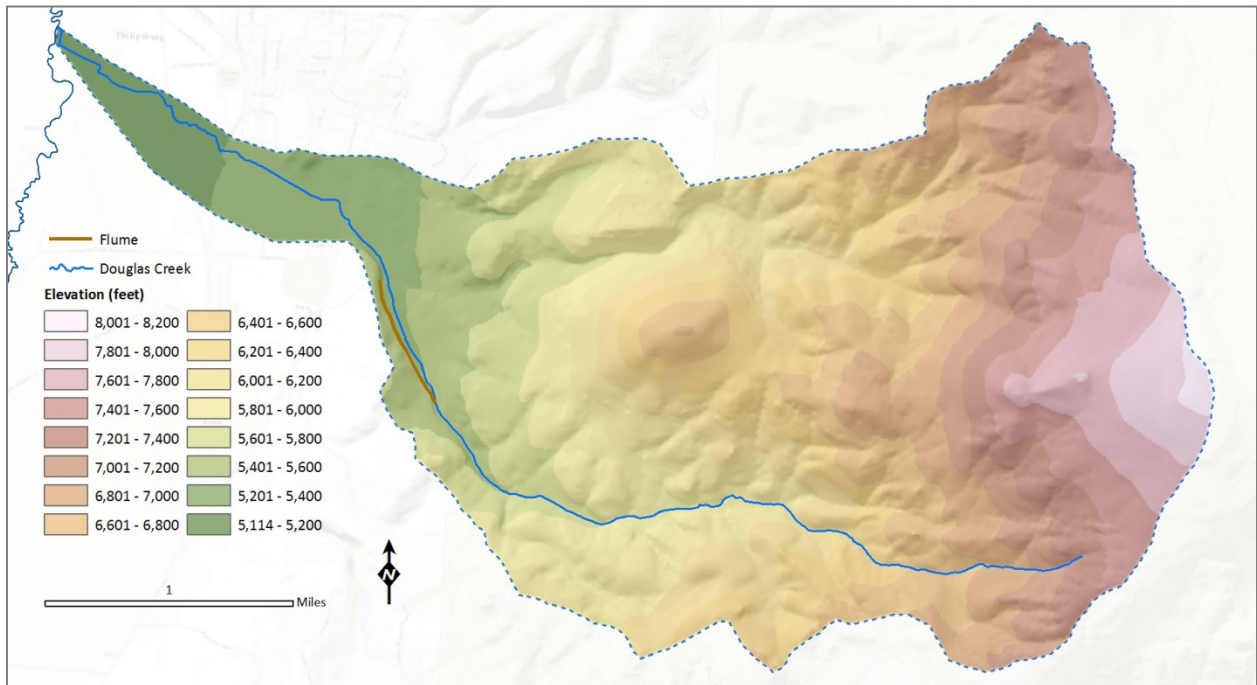


Figure 2-1. Topography of the Douglas Creek watershed

There are limited tracts of federal land, both USFS and US BLM. The majority of the Douglas Creek watershed (84%) is privately owned, due to the extensive historic mining activity (**Figure 2-2**).

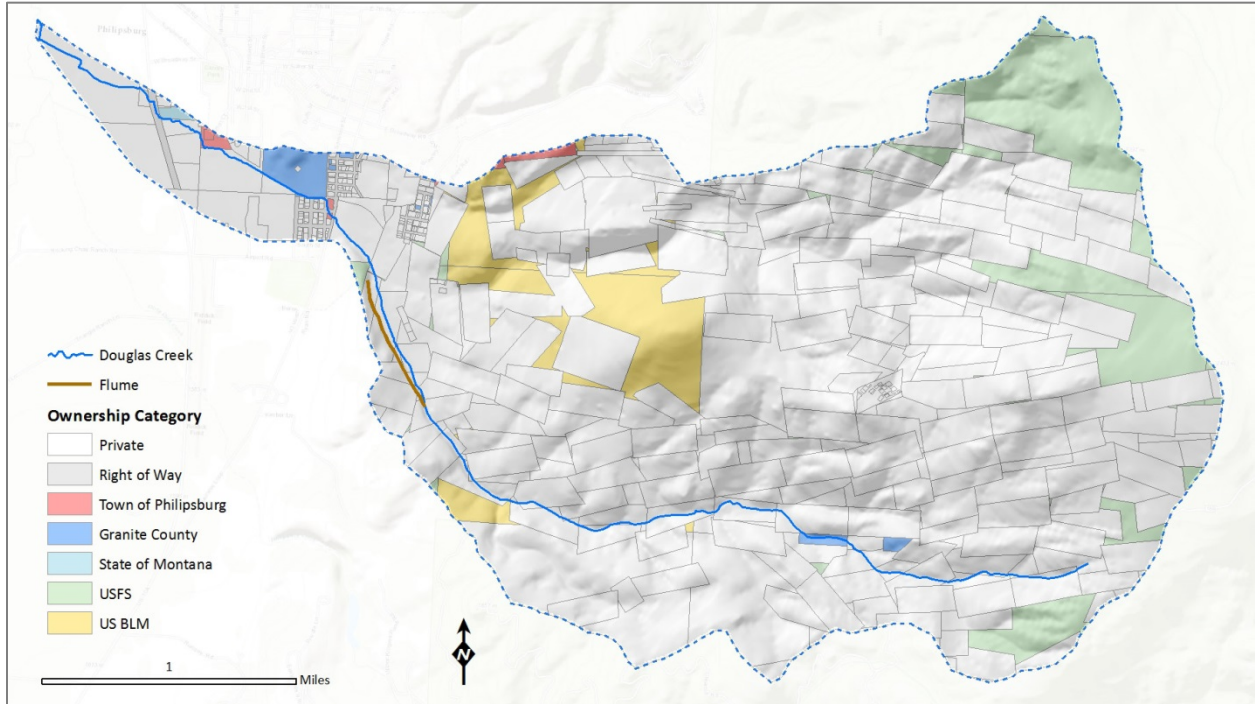


Figure 2-2. Property ownership within the Douglas Creek watershed

2.2 DOUGLAS CREEK METALS SOURCES

Identified metals sources in the Douglas Creek watershed include the native geology and sites related to historic mining activity that expose these rocks to accelerated weathering.

2.2.1 Geology

Antimony is a natural component of the local geology. The lode mines in the Douglas Creek watershed worked veins that were noted for antimony-bearing minerals, particularly stibnite and tetrahedrite (Emmons and Calkins, 1913; Sanford et al., 1917; Emmons, 1917; Prinz, 1967; Koschmann and Bergendahl, 1968). The antimony-bearing minerals are generally confined to veins within the granitic rocks of the Philipsburg batholith (Prinz, 1967). An example analysis of ore from the Bimetallic mine is provided below in **Figure 2-3**, taken from Emmons and Calkins (1913). The percent antimony (Sb) is reported as 0.13%.

Analysis of mill run, Bimetallic mill, Jan. 29, 1905.

[E. E. Blumenthal, analyst.]

SiO ₂	75.70
Fe.....	4.30
S.....	4.40
Mn.....	1.71
Pb.....	1.20
Zn.....	.85
Cu.....	.14
MgO.....	.5
As.....	.21
Sb.....	.13
Na.....	.11
K.....	.06
CaO.....	.1
Au and Ag.....	.12
Silver.....	.36.12 ounces.
Gold.....	\$1.60

Figure 2-3. Example analysis of ore from the Bimetallic mine (Emmons and Calkins, 1913, page 204)

As antimony is naturally present in some of the mineralized zones, it is likely that low concentrations of antimony were present in Douglas Creek prior to the onset of mining. However, mining and milling ore results in exponentially-greater rates of weathering (and subsequent loading to surface water). Mine workings expose mineral-rich rock to (near) atmospheric conditions, and mine workings function as drains for groundwater in overlying rock. This increases the flow of water through veins and fractures. Water within mines washes over exposed rock much faster than native groundwater flows through undisturbed rock. Water draining from mine adits transports metals and other constituents to the surface, and sometimes to surface water. Milling ore into fine particles increases the surface area to volume ratio. Mill tailings on the surface are exposed to rain, snowmelt, and surface water, and constitute another mining-related metals source. See Stiller (2000) for an accessible but in-depth overview of environmental issues related to historic metals mining.

2.2.2 Historic Mining

The lode mines in the Douglas Creek watershed were notable producers of silver and gold. The Granite Mountain Mine was for a time the most productive silver mine in the US (Emmons and Calkins, 1913). Although precious metals production largely ceased by the middle of last century, the district was the only domestic source of natural dry cell battery grade manganese oxide. The district became an important source of manganese oxide during World War I, and production continued into the 1960s (Prinz, 1967). The history of mining in the Philipsburg area, and the Douglas Creek watershed in particular, is long and fascinating, and well-summarized in DEQ’s abandoned mine historic narratives (Montana Department of Environmental Quality, 2009).

Montana’s abandoned mine lands (AML) program has identified nine priority abandoned mine sites in the watershed, shown below in **Figure 2-4** (Pioneer Technical Services, Inc., 1995). Two of these are near the ghost town of Granite: Granite Mountain and Bimetallic/Old Red. Several priority abandoned mine sites related to these two mines are located on the Douglas Creek valley bottom: Douglas Creek waste areas and extensive waste from Bimetallic Mill. Still other priority sites are located in or near Frost Creek, a tributary to Douglas Creek: Algonquin, Little Gem, Trout, Wenger #2 (refer to Appendix A, Figure A-18 in the parent document). The Douglas Creek tunnel (referred to as the Granite Drain in the parent document) is a long adit that was opened in 1896 to simplify working the consolidated Granite

Mountain and Bimetallic Mines. This adit drains metals-laden water from the Granite-Bimetallic workings to Douglas Creek (Montana Department of Environmental Quality, 2012a) (**Attachment A**).

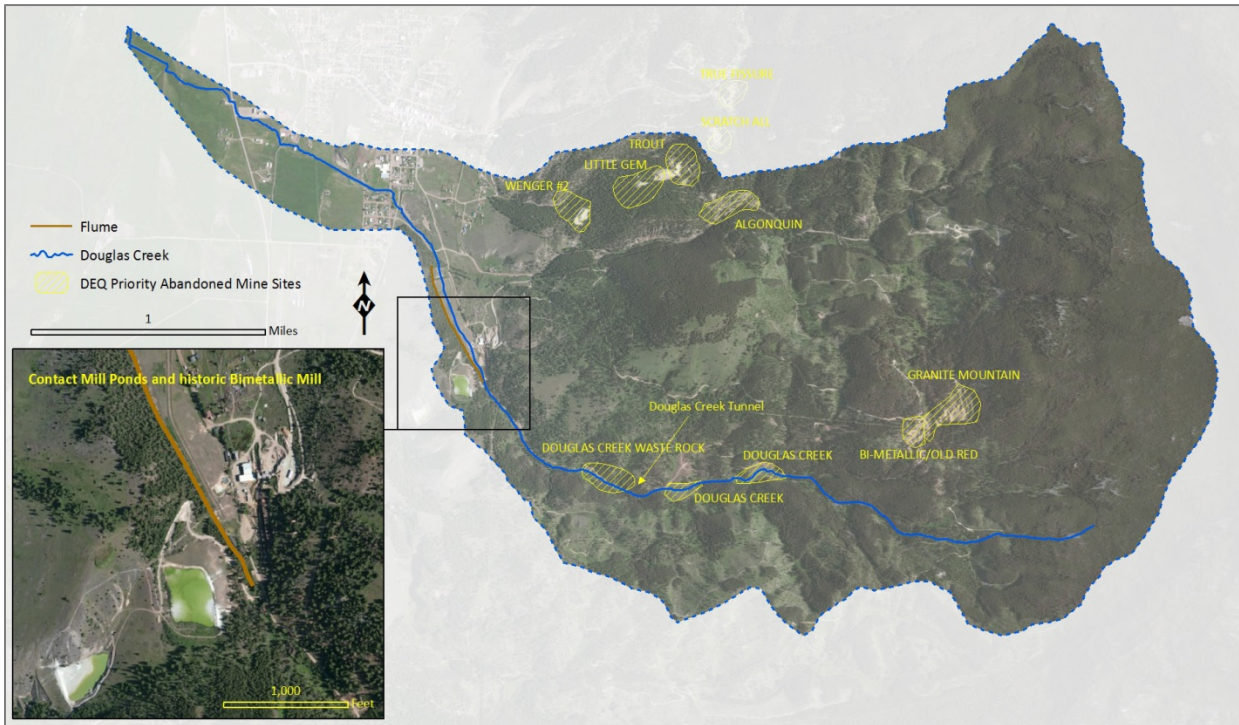


Figure 2-4. Mining-related features in the Douglas Creek watershed

In 2000, Montana DEQ reclaimed the Douglas Creek Tailings priority site by placing the tailings in lined repositories and covering them with a geomembrane. This effort also moved the stream to flow around the repositories. Historic Bimetallic Mill tailings cover an area of about 600,000 square feet near the mouth of the Douglas Creek valley and may have been partially reclaimed in the 1980s as a condition of the original Contact Mill permit (Montana Department of Environmental Quality, 2012a). Little information can be found about this reclamation effort. The stream enters a wooden flume for diversion around a portion of the Bimetallic Mill tailings.

The US EPA is investigating the Philipsburg Mining Area (PMA) for inclusion on the National Priority List (aka Superfund). Douglas Creek is one potential site under consideration for listing (CERCLIS ID MTD980666523). A preliminary assessment was completed in 2010 (URS Operating Services, Inc., 2010), and a site investigation report was completed in 2012. The site investigation report is attached to this document as **Attachment A**.

2.2.3 Current Metals Production

As of December 9, 2014, there are no active Montana Pollutant Discharge Elimination System (MPDES) permits that discharge to Douglas Creek. Two groundwater discharge permits are held by the Contact Mining Company near Douglas Creek. The facility has two tailings impoundments, one of which is located in Douglas Creek watershed. The Contact Mill is a 500-600 ton per day floatation mill that began operation in the 1970s (**Attachment A**). It operates on a contract basis, and is not associated with a specific mine. The mill does not discharge surface water to Douglas Creek or its tributaries. However, operational activities at the site have the potential to release impounded water and tailings, as was

noted in the EPA's site investigation when field staff observed tailings slurry overflowing the tailings dam towards Douglas Creek (**Attachment A**). The mill pond does represent a potential groundwater to surface water pathway for metals loading. Groundwater monitoring near this operation began in 2011 to assure this potential source meets conditions in adherence to the combined wasteload allocation provided in the parent document (Section 6.5.3.4 in the parent document (Montana Department of Environmental Quality, 2012a). Montana DEQ noted that the ponds are not lined and likely discharge to groundwater, while the operators contend the ponds have self-sealed through deposition of 'slimes', the silt-sized fraction of mill tailings (Montana Department of Environmental Quality, 2012a). No antimony data are available from this operation.

3.0 MONTANA WATER QUALITY STANDARDS

The federal Clean Water Act (CWA) provides for the restoration and maintenance of the chemical, physical, and biological integrity of the nation's surface waters so that they support all designated uses. Water quality standards are used to determine impairment, establish water quality targets, and to formulate the TMDLs and allocations.

Montana's water quality standards and water quality standards in general include three main parts:

1. Stream classifications and designated uses
2. Numeric and narrative water quality criteria designed to protect designated uses
3. Nondegradation provisions for existing high-quality waters

Montana's water quality standards also incorporate prohibitions against water quality degradation as well as point source permitting and other water quality protection requirements.

Nondegradation provisions are not applicable to the TMDL developed within this document because of the impaired nature of Douglas Creek. The water quality standard that applies to this document is reviewed briefly below. More detailed descriptions of Montana's water quality standards may be found in the Montana Water Quality Act (75-5-301,302 Montana Code Annotated), and Montana's Surface Water Quality Standards and Procedures (Administrative Rules of Montana (ARM) 17.30.601-670).

3.1 STREAM CLASSIFICATIONS AND DESIGNATED BENEFICIAL USES

Waterbodies are classified based on their designated uses. All Montana waters are classified for multiple uses. Douglas Creek is classified as a B-1 stream. For a B-1 classification, the 'B' denotes the specific level of protection applied to uses and the '1' denotes the suitability for growth and propagation of salmonid fishes and associated aquatic life. Waters classified as B-1 are to be maintained suitable for:

- Drinking culinary, and food processing purposes, after conventional treatment
- Bathing, swimming and recreation
- Growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers
- Agriculture and industrial water supply

While some waterbodies might not actually be used for a designated use (e.g., drinking water supply), the state still requires that the quality of these waterbodies be maintained suitable for that designated

use. Douglas Creek is not currently used as a drinking water source. However, Douglas Creek is not capable of supporting that use due to the antimony impairment.

DEQ’s water quality assessment methods are designed to evaluate the most sensitive uses for each pollutant, thus ensuring protection of all designated uses. For streams in western Montana, the most sensitive use is commonly aquatic life. This is the case for other identified impairments to Douglas Creek, for which there are approved TMDLs (Montana Department of Environmental Quality, 2012a). However, there are no aquatic life standards for antimony, and therefore the human health standard is the most sensitive use considered in this document (**Table 3-1**).

Table 3-1. Impaired Waterbodies and Their Impaired Designated Uses in the Flint Creek TPA

Waterbody and Location Description	Waterbody ID	Impairment Cause	Impaired Use
Douglas Creek, headwaters to where stream ends, T7N R14W S25	MT76E003_100	Antimony	Drinking water

3.2 NUMERIC AND NARRATIVE WATER QUALITY STANDARDS

Section 3.2 of the parent document (Montana Department of Environmental Quality, 2012a) provides a summary of Montana’s numeric and narrative water quality standards and the differences between them. A numeric standard based on the human health criterion of 5.6 µg/L is applied to the antimony TMDL covered by this document.

4.0 DEFINING TMDLS AND THEIR COMPONENTS

A Total Maximum Daily Load (TMDL) is a tool for meeting water quality standards and is based on the relationship between pollutant sources and water quality conditions. More specifically, a TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive from all sources and still meet water quality standards.

Pollutant sources fall into one of two categories: point sources or nonpoint sources. Point sources are discernible, confined and discrete conveyances, such as pipes, ditches, wells, or containers, from which pollutants are being, or may be, discharged. All other pollutant loading sources are considered nonpoint sources. Nonpoint sources are diffuse and are typically associated with runoff, streambank erosion, most agricultural activities, atmospheric deposition, and groundwater seepage. Naturally occurring background loading is a type of nonpoint source.

4.1 GENERAL DESCRIPTION OF TMDLS AND THEIR COMPONENTS

Section 4.0 in the parent document (Montana Department of Environmental Quality, 2012a) provides an introductory description of the TMDL components with more detailed description of the TMDL process and components in **Sections 4.1** through **4.4**. The reader should refer to those sections for more detail. **Figure 4-1** below provides a graphical summary of the TMDL process and components. **Figure 4-1** shows multiple point and nonpoint source allocations; however, composite allocations may be used in some cases where data is limited. Composite wasteload or load allocations provide stakeholders with flexibility in addressing sources, allowing them to choose where to focus remediation or restoration efforts.

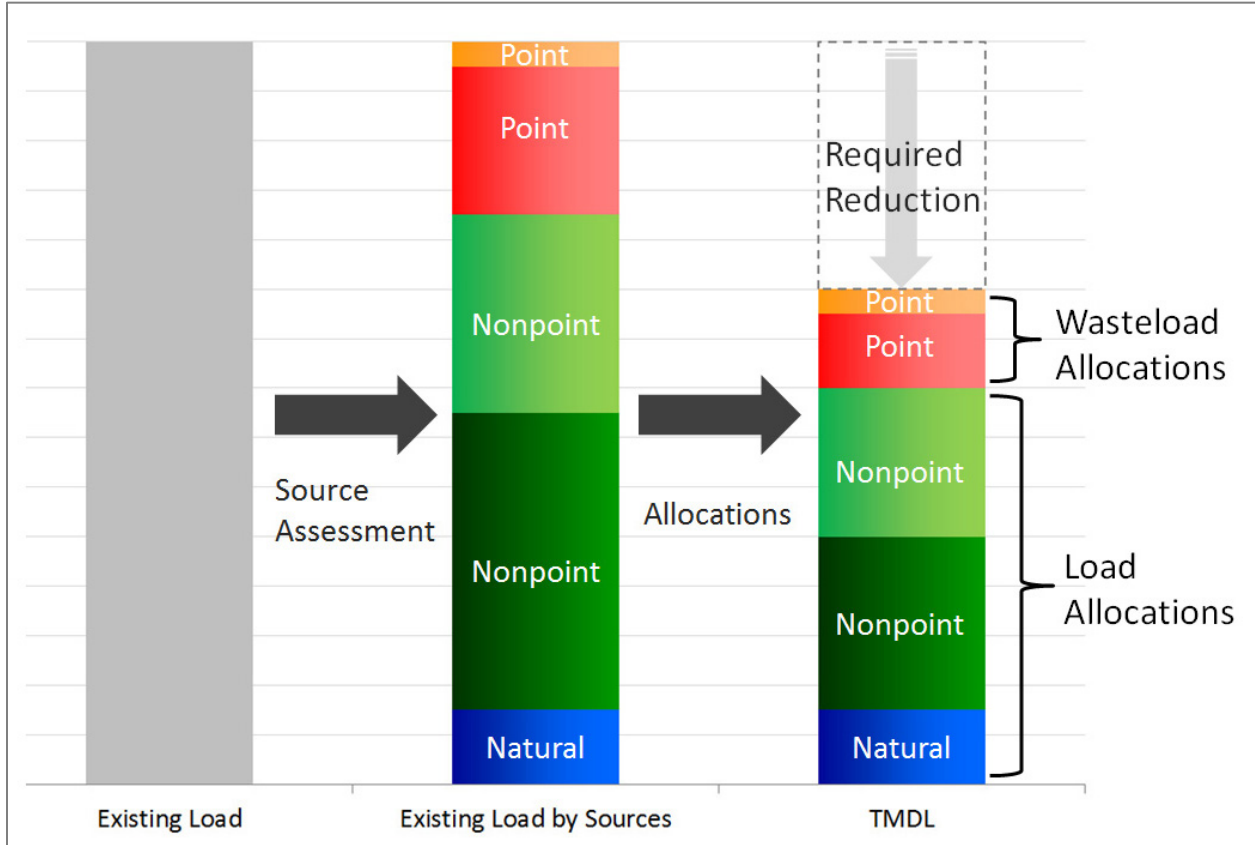


Figure 4-1. Illustration of TMDL components and the TMDL development process.

4.2 IMPLEMENTING TMDL ALLOCATIONS

The CWA and Montana state law (Section 75-5-703 of the Montana Water Quality Act) require wasteload allocations (WLAs) to be incorporated into appropriate discharge permits, thereby providing a regulatory mechanism to achieve load reductions from point sources. There are currently no permitted point source surface water discharges in the Douglas Creek watershed. Point sources related to Superfund sites and operated under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) are not subject to permit requirements under the CWA. However, the performance goals of CERCLA operations are adopted from the same water quality standards provided under the CWA. Although this scenario does not currently apply, it is possible that future Superfund operations may result in point source discharges managed under CERCLA (e.g. the Douglas Creek tunnel). Nonpoint source reductions linked to load allocations (LAs) are not required by the CWA or Montana statute, and are primarily implemented through voluntary measures.

DEQ uses an adaptive management approach to implement TMDLs to ensure that water quality standards are met over time (outlined in **Section 9.0** of the parent document (Montana Department of Environmental Quality, 2012a). This includes a monitoring strategy and an implementation review that is required by Montana statute (see **Section 9.2** of the parent document (Montana Department of Environmental Quality, 2012a). TMDLs may be refined as new data become available, land uses change, remediation goals are met, or new sources are identified.

5.0 METALS TMDL COMPONENTS

This addendum to the Flint Creek TMDL document (Montana Department of Environmental Quality, 2012a) document focuses on antimony as a cause of water quality impairment in Douglas Creek. As antimony is a metal, this section describes: (1) the mechanisms by which metals impair beneficial uses, (2) the specific stream segment of concern, (3) the presently available data pertaining to antimony impairment in the watershed, (4) the various contributing sources of antimony based on recent data and studies, and (5) the antimony TMDL and allocations.

5.1 EFFECTS OF EXCESS METALS ON BENEFICIAL USES

Waterbodies with elevated metals concentrations can impair support of numerous beneficial uses including aquatic life, coldwater fisheries, drinking water, and agriculture. Within aquatic ecosystems, elevated concentrations of heavy metals can have a toxic, carcinogenic, or bio-concentrating effect on biota. Likewise, humans and wildlife can suffer acute and chronic effects from consuming water or fish with elevated metals concentrations. Because elevated metals concentrations can be toxic to plants and animals, high metals concentrations in irrigation or stock water may affect agricultural uses. Antimony is classified as a human health toxin in Montana's Numeric Water Quality Standards (Montana Department of Environmental Quality, 2012).

5.2 STREAM SEGMENTS OF CONCERN

This document addresses one waterbody segment and metal-related impairment cause identified on the 2014 Montana 303(d) List: antimony in Douglas Creek (**Figure 1-1**). The assessment unit for Douglas Creek was based upon the National Hydrography Dataset (NHD), which depicts Douglas Creek expiring in the alluvial fan south of Philipsburg. However, Douglas Creek flows all the way to Flint Creek, via natural channel and ditch diversions. As of this writing, DEQ is pursuing corrections to both the NHD and DEQ's assessment unit description. In this document, Douglas Creek is shown flowing to Flint Creek in all figures. The flowline is based upon recent aerial photographs.

5.3 WATER QUALITY DATA AND INFORMATION SOURCES

Information sources for evaluating the location and magnitude of antimony sources in Douglas Creek are largely the same as those used for metals in the parent document (Montana Department of Environmental Quality, 2012a) with the addition of the EPA's Superfund site investigation (**Attachment A**). The water quality data used are from DEQ's previous TMDL investigation and from EPA's site investigation. The primary information sources used are academic and professional papers, published Geographic Information System (GIS) data, available water quality data, and aerial photos. The water quality data are summarized below in **Section 5.4.3 (Table 5-1)**. GIS data included the DEQ High Priority Abandoned Hardrock Mine sites, the DEQ Abandoned Hardrock Mines database, the DEQ Active Hardrock Mine sites, and permitted point sources (i.e., Montana Pollutant Discharge Elimination System permits). As stated in **Section 2.0**, there are no permitted point sources of surface water discharge in the Douglas Creek watershed. Water quality sample sites are shown below in **Figure 5-1**. A larger version of this figure is provided as **Appendix A**.

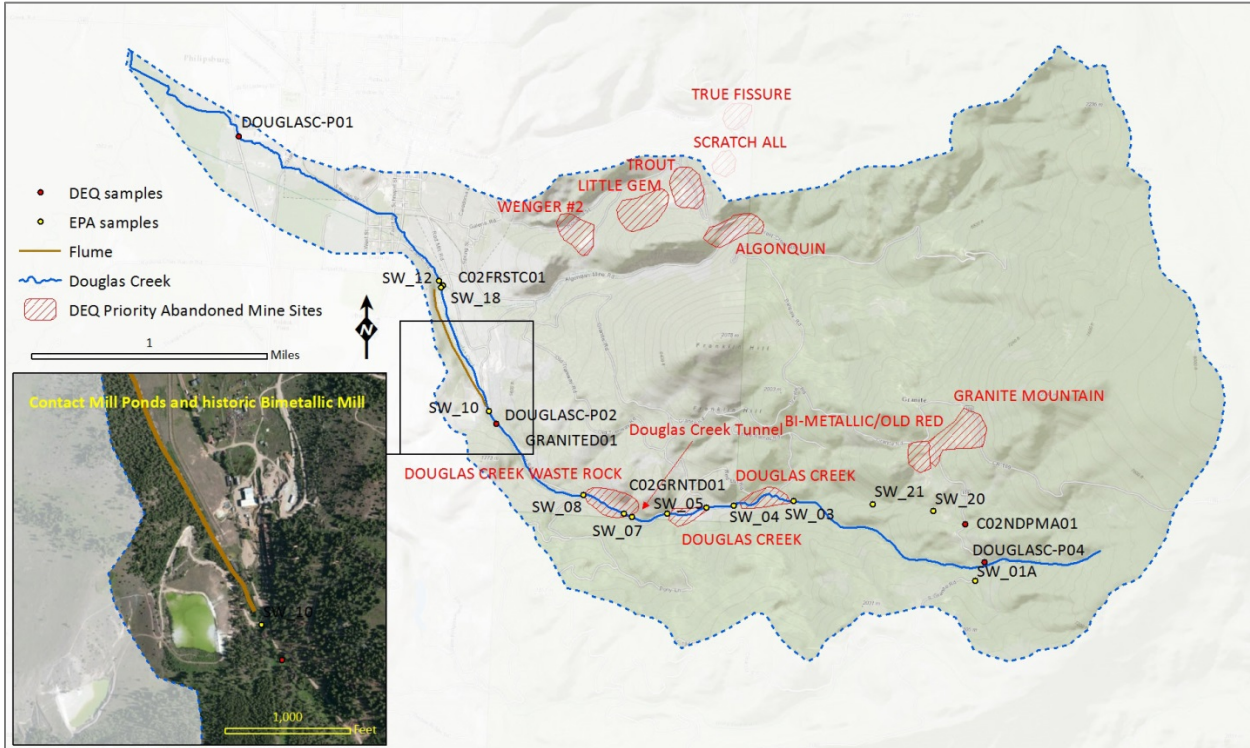


Figure 5-1. Location of mining-related features and water quality sites

5.4 WATER QUALITY TARGETS

DEQ adopts the most stringent applicable water quality standard as the water quality target for TMDL development. The water quality data described in **Section 5.3** were compiled and compared to the target value described below.

5.4.1 Target

By protecting the most sensitive use, DEQ ensures that all uses are protected. There are no aquatic life standards for antimony. Therefore, the numeric human health standard is adopted as the water quality target for antimony in Douglas Creek. The human health standard is 5.6 µg/L, total recoverable (Montana Department of Environmental Quality, 2012). The antimony standard does not vary according to water hardness unlike some metals. From this point forward in this addendum, the term “target” is used interchangeably with the numeric human health standard of 5.6 µg/L.

5.4.2 Metals Evaluation Framework

A TMDL is developed for antimony if the data support an impairment determination. This metals impairment determination depends on target compliance, the presence of human sources, and dataset size as follows.

- If the waterbody is considered not impaired, a TMDL will not be developed if the water quality target is not exceeded and the sample size is at least eight.
- If the waterbody is considered impaired, a TMDL will be developed if data are not in compliance with the aquatic life target, and human sources are identified. This scenario does not apply in this document, as there are no aquatic life standards for antimony.

- If a waterbody is considered impaired, a TMDL will be developed if there is a single exceedance of the human health standard.

5.4.3 Data Compilation and Comparison to Targets

DEQ collected antimony data from seven sites in 2007, 2008, and 2009 to support TMDL development. EPA collected water chemistry data from 14 sites during high flow conditions in 2011. Results are shown in **Table 5-1**. DEQ data are total recoverable metals; EPA data are total metals. The two fractions are sufficiently similar for the EPA data to be used for source assessment. Six of the 17 samples from Douglas Creek exceed the target concentration of 5.6 µg/L. Antimony is confirmed as a cause of impairment to Douglas Creek, and an antimony TMDL is developed.

Table 5-1. DEQ and EPA Antimony Data (Values in Bold Exceed the Target)

Sample Site	Location	Sample Date	Flow (cfs)	Antimony (µg/L)
Data from DEQ TMDL investigation (2007-2009). Concentrations are of total recoverable metals.				
DOUGLASC-P01	Douglas Creek	7/8/2008	3.31	<5.0
DOUGLASC-P01	Douglas Creek	6/2/2009	5.1	7.0
DOUGLASC-P01	Douglas Creek	8/18/2009	2.28	3.0
DOUGLASC-P02	Douglas Creek	8/23/2007	0.73	5.0
DOUGLASC-P04	Douglas Creek	8/29/2007	0.50	<1.0
C02FRSTC01	Frost Creek upstream of Douglas Creek	6/9/2009	7.7	1.0
C02GRNTD01	Granite Drain at discharge point	6/9/2009	6.7	4.0
GRANITD01	Granite Drain	8/18/2009	6.57	5.0
C02NDPMA01	New Departure mine adit downstream of road	6/9/2009	7.6	<1.0
Data from EPA site investigation (2011). Concentrations are of total metals.				
SW_01A	South Branch Douglas Creek background	June 2011	-	2.0
SW_03	Douglas Creek immediately downstream of the Granite Mountain/Bi-Metallic/Old Red tailings and waste rock	June 2011	-	4.4
SW_04	Douglas Creek immediately downstream of the Douglas Creek east tailings	June 2011	-	4.7
SW_05	Douglas Creek immediately upstream of the Douglas Creek west tailings	June 2011	-	4.7
SW_06	Douglas Creek immediately downstream of the Douglas Creek west tailings	June 2011	-	4.9
SW_07	Douglas Creek immediately upstream of the discharge from the Granite Mountain/Bi-Metallic/Old Red adit	June 2011	-	7.2
SW_08	Douglas Creek immediately downstream of the discharge from the Granite Mountain/Bi-Metallic/Old Red adit, and upstream of the Douglas Creek waste rock pile	June 2011	-	6.7
SW_09	Douglas Creek immediately downstream of the Douglas Creek waste rock	June 2011	-	6.7
SW_10	Douglas Creek immediately upstream of the Contact Mill east tailings impoundment	June 2011	-	7.3
SW_12	Douglas Creek downstream of the historical Bi-Metallic Mill tailings	June 2011	-	6.9
SW_19	Douglas Creek below confluence with Frost Creek	June 2011	-	4.3

Table 5-1. DEQ and EPA Antimony Data (Values in Bold Exceed the Target)

Sample Site	Location	Sample Date	Flow (cfs)	Antimony (µg/L)
SW_20	Douglas Creek above Granite Mountain and Bi-Metallic/Old Red	June 2011	-	4.3
SW_21	Douglas Creek below Granite Mountain and Bi-Metallic/Old Red PPE	June 2011	-	5.1
SW_18	Frost Creek above confluence with Douglas creek	June 2011	-	4.2

A flow meter was not available during EPA’s June 2011 investigation. Flow in Douglas Creek was high, estimated at ~30 cfs (**Attachment A**).

Antimony data concentrations detected in surface water samples are shown below in **Figure 5-2**. This figure includes data from both DEQ and EPA investigations. Concentrations exceeding the target are plotted in purple; concentrations below the target are plotted in green. Non-detect results are plotted in grey.

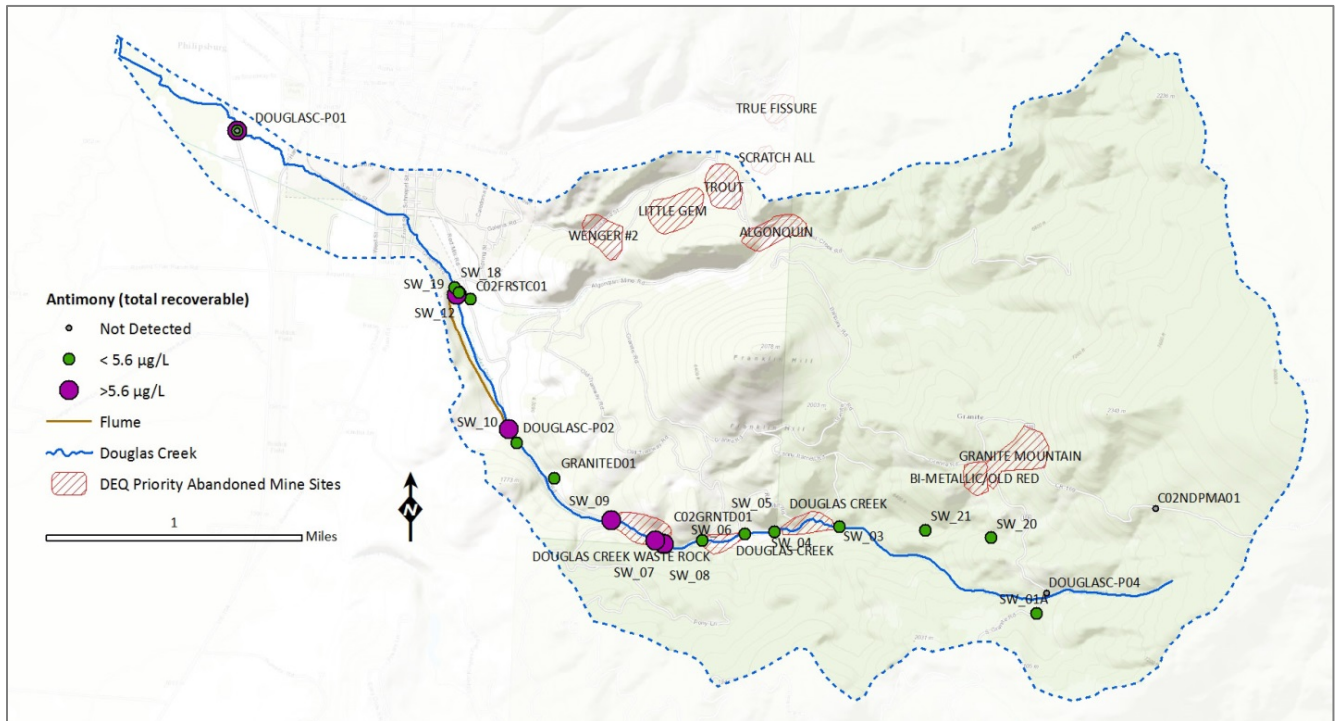


Figure 5-2. Antimony water quality data

5.5 LOADING EVALUATION AND SOURCE ASSESSMENT

DEQ data did not include any exceedances of the antimony target above site DOUGLASC-P01, located at the Highway 1 crossing. However, the EPA site investigation reported multiple exceedances of the antimony target as far upstream as the Douglas Creek tunnel (located between sites SW-07 and SW_08). DEQ’s samples were collected under both high and low flow regimes. The single exceedance identified by DEQ was collected under high flow conditions. All of EPA’s site investigation samples were collected during higher-than-average high flows in June 2011. The high flows were attributed to higher-than-average snowfall the preceding winter (**Attachment A**) and the surface runoff and stream scouring

associated with this spring snowmelt probably explain the higher antimony concentrations reported by EPA. No target exceedances were identified under low-flow conditions.

Water quality exceedances are clustered lower in the watershed, despite potential sources of metals higher in the Douglas Creek drainage, such as waste rock from the Granite and Bimetallic mines located upslope of the stream. In particular, they occur in the vicinity of the Douglas Creek tunnel and downstream. However, sample SW_07 was collected just upstream of the Douglas Creek tunnel and had an antimony concentration of 7.2 µg/L. This suggests that diffuse sources of antimony (upslope waste rock, smaller waste rock piles, or even reclaimed tailings) may all contribute minor antimony loads that cumulatively cause exceedance of the target by this point in the stream. These sources are consistent with loading pathways that cause target exceedances only during runoff conditions. Therefore, although numerous potential antimony sources are identified, the data do not currently provide enough resolution to identify specific contributions from individual sources.

The EPA's site investigation identified a background concentration of antimony in Douglas Creek of 2.0 µg/L (total metals fraction). This sample was collected from the south branch of Douglas Creek (SW_01A), where there are no identified mining influences upstream. The site investigation report reports an antimony background concentration of 2.0 µg/L (Tables 8 and 9; Figure 4; **Attachment A**). Given that it appears that problems occur during high flow, a background concentration of 2.0 µg/L is appropriate for this TMDL. Note that the background concentration of 0.54 µg/L reported in **Attachment A**, Table 1 is an erroneous value that was discarded due to quality control issues (Robert Parker, personal e-mail with Eric Sivers, 2015).

5.6 TMDL AND ALLOCATIONS

5.6.1 Antimony TMDL for Douglas Creek (MT76E00_100)

Based on the antimony water quality target of 5.6 µg/L, the TMDL for any given streamflow may be calculated as:

$$\text{TMDL in pounds/day} = (\text{flow in cubic feet/second}) * 5.6 \text{ } \mu\text{g/L} * 0.0054$$

The TMDL has a linear relationship to streamflow, and this can be expressed graphically as shown below in **Figure 5-3**.

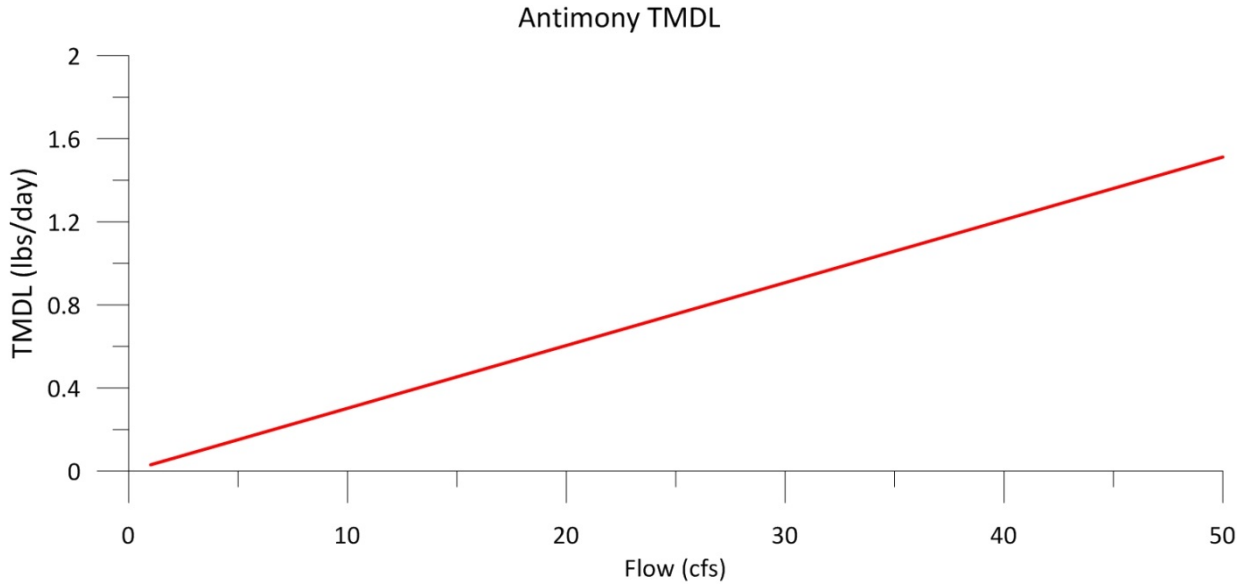


Figure 5-3. Plot of antimony TMDL versus streamflow

5.6.2 Antimony Allocations for Douglas Creek (MT76E00_100)

As discussed in **Section 4.0**, the total allowable load must be allocated to all contributing sources. The allocation components of a TMDL include: a wasteload allocation (WLA), a load allocation (LA), and a margin of safety (MOS). WLAs are allowable pollutant loads that are assigned to permitted and non-permitted point sources. LAs are allowable pollutant loads assigned to nonpoint sources and may include the pollutant load from naturally occurring sources, as well as human-caused nonpoint loading. TMDLs must also take into account uncertainties in the relationship between loads and the receiving water quality by incorporating a MOS. These elements are combined in the following equation:

$$\text{TMDL} = \sum \text{WLA} + \sum \text{LA} + \text{MOS}$$

WLA = Wasteload allocation = allocation for point sources

LA = Load allocation = allocation for nonpoint sources and naturally occurring background

MOS = Margin of safety or an accounting of uncertainty about the relationship between metals loads and receiving water quality

The MOS can be implicit, explicit, or a combination of both to account for the uncertainties within TMDL development. For this addendum, DEQ is applying an implicit MOS based on conservative TMDL development assumptions discussed further in **Section 5.7**. Where an implicit MOS is applied, the MOS in the above TMDL equation is equal to zero.

Natural background concentrations of antimony are not believed to contribute significantly to water quality impairment. Naturally occurring sources are provided a load allocation (LA_{natural}) in pounds/day based on the estimated naturally occurring metals concentration of 2.0 $\mu\text{g/L}$ and streamflow. This load allocation is calculated according to the following formula:

$$LA_{\text{natural}} = 2.0 \mu\text{g/L} \times \text{flow in cubic feet per second} \times 0.0054$$

The major antimony sources in the Douglas Creek watershed are related to abandoned and inactive mining sites. Although prominent abandoned/inactive mines have been investigated (**Sections 2.2** and

5.5), data are insufficient to provide allocations for each individual abandoned mine feature. Furthermore, the nature of Montana’s abandoned mining legacy is such that many small non-permitted point sources (adits, seeps, tailings piles, etc.) may be scattered throughout a watershed. Finally, the Philipsburg Mining Area is being considered for inclusion on the National Priority List (aka Superfund) and individual WLAs assigned to specific sources may unnecessarily complicate future CERCLA activities. Therefore a composite wasteload allocation (WLA_{ABDM}) for abandoned mining sources is provided in pounds/day to any and all metals sources related to abandoned or inactive mines. This composite wasteload allocation approach recognizes that abandoned mine remediation is best pursued in an adaptive manner that balances remediation costs with achievable load reductions within each watershed. Conceptually, this composite WLA is defined as the allowable load remaining after the natural background load ($LA_{natural}$) is accounted for. The WLA_{ABDM} is calculated as the difference between the TMDL and the load allocation to naturally-occurring sources:

$$WLA_{ABDM} = TMDL_{Douglas} - LA_{natural}$$

Therefore, the antimony TMDL equation for Douglas Creek (MT76E003_100) is as follows:

$$TMDL_{Douglas} = WLA_{ABDM} + LA_{natural}$$

An example TMDL using DEQ data from June 27, 2009 at DOUGLASC-P01 is provided below:

$$TMDL_{Douglas} = 5.6 \mu\text{g/L} \times 5.1 \text{ cfs} \times 0.0054 = 0.154 \text{ lbs/day}$$

$$0.154 \text{ lbs/day} = [0.099 \text{ lbs/day} (WLA_{ABDM}) + 0.055 \text{ lbs/day} (LA_{natural})]$$

Example high and low flow TMDLs are presented below in **Table 5-2**. Both examples are based on DEQ sampling data from 2009. The examples are based on measured concentrations of 7 $\mu\text{g/L}$ (high flow) and 3 $\mu\text{g/L}$ (low flow) total recoverable antimony. In this example, a 20% reduction in antimony loading is necessary in order to meet the TMDL under high flow conditions. No reduction is required under low flow conditions. Percent reduction is calculated by dividing the difference between the existing load and the TMDL by the existing load. It is equivalent to the same percent reduction that would be required to meet the target concentration. Based on the results presented within **Table 5-1**, the 20% reduction represents a typical required reduction under conditions where the target (and thus the TMDL) is exceeded.

Table 5-2. Douglas Creek Example Antimony TMDL, Allocations, and Required Reduction

Site	Flow (cfs)	TMDL _{Douglas} (lbs/day)	WLA _{ABDM} (lbs/day)	LA _{natural} (lbs/day)	Existing Load (lbs/day)	Required Reduction
DOUGLASC-P01	5.1	0.154	0.099	0.055	0.193	20%
DOUGLASC-P01	2.28	0.069	0.044	0.025	0.037	0%

5.7 SEASONALITY AND MARGIN OF SAFETY

All TMDL documents must consider the seasonal variability (seasonality) on water quality impairment conditions, TMDLs and allocations. TMDL development must also incorporate a margin of safety to account for uncertainties in pollutant sources and other watershed conditions, and ensure (to the degree practicable) that the TMDL components and requirements are sufficiently protective of water quality and beneficial uses. This section describes the considerations of seasonality and an MOS in the Douglas Creek antimony TMDL development process.

5.7.1 Seasonality

Seasonality addresses the need to ensure year round beneficial-use support. Seasonality is addressed in this document as follows:

- Metals concentrations and loading conditions are evaluated for varying flow conditions that occur during the different seasons of the year.
- Metals TMDLs incorporate streamflow as part of the TMDL equation.
- The antimony target applies year round.
- Example targets, TMDLs, and load reduction needs are developed for high and low flow conditions. The TMDL equation incorporates all potential flow conditions that may occur during any season

5.7.2 Margin of Safety

The MOS is to ensure that TMDLs and allocations are sufficient to sustain conditions that will support beneficial uses. The antimony TMDL incorporates an implicit MOS. The implicit MOS is applied by using multiple conservative assumptions throughout the TMDL development process and is addressed by the following:

- DEQ's assessment process includes a mix of high and low flow sampling since variable metals sources and pathways can lead to elevated metals loading during high and/or low flow stream conditions.
- The lowest or most stringent numeric water quality standard is used for TMDL target and impairment determination. This ensures protection of all designated beneficial uses.
- Target attainment, refinement of allocations, and TMDL-development decisions are all based on an adaptive management approach that relies on future monitoring and assessment for updating planning and implementation efforts.
- The composite allocation approach ensures that the TMDL accounts for all metals sources, even any as-yet unidentified sources.

5.8 UNCERTAINTY AND ADAPTIVE MANAGEMENT

Uncertainties in the accuracy of field data, applicable target value, source assessment, loading calculations, and other considerations are inherent when assessing and evaluating environmental variables for TMDL development. While uncertainties are an undeniable fact of TMDL development, mitigation and reduction of uncertainties through adaptive management approaches is a key component of ongoing TMDL implementation and evaluation. Uncertainties, assumptions, and considerations are addressed throughout this document and point to the need to refine analysis, conduct further monitoring, and address unknowns in order to develop a better understanding of impairment conditions and the processes that affect impairment. For instance, additional water quality sampling under high flow conditions may help refine the source assessment.

Adaptive management is predicated on the premise that targets, TMDLs, allocations, and the analyses supporting them are not static, but are processes subject to modification and adjustment as new information and relationships are understood. The adaptive management process allows for continual feedback on the progress of restoration activities and status of beneficial uses. It provides the flexibility to refine targets or allocations as necessary to ensure protection of the resource or to adapt to new information concerning target or allocation achievability.

In order to achieve the antimony TMDL and water quality target of 5.6 µg/L, significant sources of antimony loading must be addressed via abandoned mine remediation efforts, in addition to all reasonable land, soil, and water conservation practices. DEQ recognizes that in spite of all reasonable efforts, attainment of the antimony water quality target may not be possible due to the potential presence of unalterable human-caused sources. For this reason, an adaptive management approach will be used to evaluate target attainment. Under this adaptive management approach, antimony in Douglas Creek will ultimately fall into one of the three categories identified below:

- Implementation of remediation activities resulting in full target attainment;
- Implementation of remediation activities fails to result in target attainment due to underperformance or ineffectiveness of restoration actions. Under this scenario the waterbody remains impaired and will require further remediation efforts. The target may or may not be modified based on additional information, but conditions still exist that require additional load reductions to support beneficial uses and meet applicable water quality standards. This scenario would require some form of additional, refocused remediation work.
- Implementation of remediation activities fails to result in target attainment, but target attainment is deemed unachievable even though all applicable remediation activities have been completed. Under this scenario, site-specific water quality standards, reclassification of the waterbody, and/or a modification of DEQ's metals assessment methodology may be necessary. This would then lead to a new target (and TMDL) for antimony, and the new target could either reflect the existing conditions at the time or the anticipated future conditions associated with the restoration work that has been performed.

The Philipsburg Mining Area site (CERCLIS ID MTD980666523) is a candidate for listing on the National Priorities List (NPL). To date, federal investigations have included a preliminary assessment (URS Operating Services, Inc., 2010) and a site investigation (**Attachment A**). The EPA may continue to do additional characterization and remediation work in the watershed, in cooperation and consultation with the local watershed group (Granite Headwaters) and DEQ (Robert Parker, personal e-mail with Eric Sivers, 2015). The Abandoned Mines Section of DEQ's Remediation Division leads abandoned mine restoration projects funded by provisions of the Surface Mine Reclamation and Control Act of 1977. DEQ's Federal Superfund Bureau (also in the Remediation Division) provides technical and management assistance to EPA for remedial investigations and cleanup actions at NPL mine sites in federal-lead status.

DEQ acknowledges that construction or maintenance activities related to reclamation and remediation may result in short term increases in surface water metals concentrations. For any activities that occur within the stream or floodplain, all appropriate permits should be obtained before commencement of the activity. Federal and State permits necessary to conduct work within a stream or stream corridor are intended to protect the resource and reduce, if not completely eliminate, pollutant loading or degradation from the permitted activity. The permit requirements typically have mechanisms that allow for some short term impacts to the resource, as long as all appropriate measures are taken to reduce impacts to the least amount possible.

Stream restoration design should incorporate local geomorphology and hydrology to identify a channel form and design that is appropriate for the setting and rapidly achieves equilibrium.

6.0 WATER QUALITY IMPROVEMENT PLAN

Resource development (historical mining) is the primary source of metals impairment to Douglas Creek. This section describes an overall strategy for attaining antimony water quality standards in this stream. The strategy includes general measures for reducing loading from significant metals pollutant sources and would apply adaptive management (**Section 5.8**) for adjusting restoration plans in response to monitoring results and advances in reclamation technology. Refer to Section 8 in the parent document (Montana Department of Environmental Quality, 2012a) for improvement plan details related to other pollutants.

6.1 WATER QUALITY RESTORATION OBJECTIVES

The general water quality goal of this TMDL document is to provide technical guidance for recovery of drinking water use support to Douglas Creek. The components of this guidance are:

- Specified water quality targets for antimony,
- An assessment of major metal pollutant sources, and
- A general restoration strategy for metal-impaired waters.

The parent document (Montana Department of Environmental Quality, 2012a) provided guidance for recovery of aquatic life beneficial-use support. However, as discussed in **Section 3.1**, there are no aquatic life standards for antimony, and the human health standard is the appropriate water quality target.

6.2 MONTANA DEQ AND OTHER AGENCY ROLES

Successful restoration requires collaboration among private landowners, government land managing agencies, and other interested stakeholders. Stakeholders in the Flint Creek TPA include:

- Region 8 EPA
- DEQ Federal Superfund Bureau
- DEQ Abandoned Mine Lands Section
- Douglas Creek area landowners
- Beaverhead-Deerlodge National Forest
- Bureau of Land Management
- Granite Headwaters
- Granite County Conservation District
- Granite County
- Town of Philipsburg

In addition to DEQ mine remediation programs, DEQ provides technical and financial assistance for stakeholders interested in improving water quality. DEQ also administers programs that fund water quality improvement and pollution prevention projects. The DEQ collaborates with interested participants to develop locally-driven watershed restoration plans (WRPs) that are guided by established TMDLs. Although the DEQ often does not conduct pollutant reduction projects directly, DEQ is a valuable contact for locating potential funding sources for nonpoint source pollution control.

Other organizations and non-profits that may provide technical assistance, funding, and outreach services include Montana Water Center, University of Montana Watershed Health Clinic, Montana State University Extension Water Quality Program, and Montana Trout Unlimited. Specific agency and stakeholder roles relevant to restoration strategy components in Douglas Creek are described in the following sections.

6.3 METALS RESTORATION STRATEGY FOR MINING SOURCES

Metal mining is the principal human-caused source of excess metals loading in Douglas Creek. Federal and state government agencies have funded most of the investigation and reclamation associated with past mining completed to date. Statutory mechanisms and corresponding government agency programs will continue to have the leading role for future restoration. Restoration of metals sources is typically conducted under state and federal cleanup programs. Rather than a detailed discussion of specific Best Management Practices (BMPs), this section describes general restoration programs and funding sources applicable to mining sources of metals loading. Past efforts have produced abandoned mine site inventories with enough descriptive detail to prioritize the properties contributing the largest metals loads. Additional monitoring needed to further describe impairment conditions and loading sources is addressed in the **Section 7.0** framework monitoring plan.

A number of state and federal regulatory programs continue to address water quality problems from past metal mining, milling, and refining impacts. The statutes that have authorized and funded water quality restoration projects and investigations targeting mining sources in the Douglas Creek watershed include:

- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA),
- The Surface Mining Control and Reclamation Act of 1977 (SMCRA)

6.3.1 Superfund Authority in the Douglas Creek watershed

Congress passed the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in 1980. CERCLA established that parties responsible for releasing hazardous substances could be held liable for subsequent remediation. CERCLA created a tax on the petroleum and chemical industries. Funds generated by the tax went into a trust fund known as the “Superfund”, which became the commonly used name for the CERCLA program. The purpose of the fund was to pay for government cleanup when no responsible party could be identified and compelled to perform or pay for remediation. The trust fund expired at the end of 1995 and CERCLA activities without a potentially responsible party are now paid for with general appropriated funds. Information about the CERCLA program is available from a database known as CERCLIS (the Comprehensive Environmental Response, Compensation, and Liability Information System).

CERCLA addresses cleanup on sites, such as historic mining areas, where there has been a release, or threat of a release of hazardous substances. Sites are prioritized on the National Priority List (NPL) using a hazard ranking system focused on human health effects. CERCLA authorizes two kinds of response actions:

1. Short-term removals that require a prompt response, and
2. Long-term remediation actions that reduce environmental and health threats from hazardous substance releases.

Short-term (i.e. time critical) removals are warranted where the contamination is judged to pose an immediate threat to human health or the environment. Long-term remediation actions apply to serious, but not immediately life threatening releases at NPL sites. Under CERCLA, those responsible for the release must pay for remediation. Where property owners or others responsible for releases cannot be identified, funding and responsibility for cleanup is delegated by EPA. Remediation funding is only available with EPA authorization. Cleanup actions under CERCLA must be based on professionally developed project plans. CERCLA authority is most commonly delegated to government agencies with project planning capacity.

Currently, there are no Superfund sites in the Douglas Creek watershed. The Philipsburg Mining Area site (CERCLIS ID MTD980666523) is a candidate for listing on the NPL. To date, federal investigations have included a preliminary assessment (URS Operating Services, Inc., 2010) and a site investigation (**Attachment A**). The EPA may continue to do additional characterization and remediation work in the watershed, in cooperation and consultation with the local watershed group (Granite Headwaters) and DEQ (Robert Parker, personal e-mail with Eric Sivers, 2015).

6.3.2 The Surface Mining Control and Reclamation Act (SMCRA)

DEQ’s Abandoned Mine Lands program (AML) is responsible for reclamation of abandoned mines in Montana. The AML reclamation program is funded through the Surface Mining Control and Reclamation Act of 1977 (SMCRA). SMCRA funding is collected as a per ton fee on coal production that is then distributed to states by the federal Office of Surface Mining Reclamation and Enforcement (OSM). Funding eligibility is based on land ownership and date of mining disturbance. Eligible abandoned coal mine sites have a priority for reclamation construction funding over eligible non-coal sites. Areas within federal Superfund sites or areas where there is a reclamation obligation under state or federal law are not eligible for expenditures from the abandoned mine reclamation program. **Table 6-1** lists the priority abandoned mines in the Douglas Creek watershed. These are a subset of the priority abandoned mines found within the Flint Creek TPA, summarized in Section 8.5.6 of the parent document (Montana Department of Environmental Quality, 2012a).

Table 6-1. Priority Abandoned Mine sites in the Douglas Creek watershed

Site Name	Receiving Stream	Disturbed Area (acres)	Ranking Score
Algonquin	Frost Creek	13.5	16.12
Bimetallic/Old Red	Douglas Creek	16.6	52.2
Douglas Creek Tailings*	Douglas Creek	12.9	347.98
Douglas Creek Tailings*	Douglas Creek	8.2	347.98
Douglas Creek Waste Rock	Douglas Creek	6.8	14.1
Granite Mountain	Douglas Creek	5.3	38.66
Little Gem	Frost Creek	11.9	5.15
Trout	Frost Creek	19.3	57.6
Wenger #2	Frost Creek	13.1	76.35

*Remediation action completed.

6.3.3. Other Historical Mine Remediation Programs

The State of Montana was awarded monies for the Upper Clark Fork River Basin Grant Program via a series of settlements against the Atlantic Richfield Company (ARCO) signed between 1999 and 2008. These settlements were a result the extensive mining-related damages to natural resources within the Upper Clark Fork watershed. The Natural Resource Damage Program (NRDP), which is part of the

Montana Department of Justice, filed the lawsuit and administers a grant process as a way to disperse the settlement funds. Government agencies and private entities/individuals are eligible for the grant funding, and Upper Clark Fork River Basin (UCFRB) is a unique opportunity for remediation in the Flint Creek TPA. Funding must be applied within the Upper Clark Fork watershed, and the Flint Creek watershed is included within its boundaries.

Several types of projects are eligible for funding but those most applicable to TMDL implementation are restoration projects and monitoring and research projects. UCFRB is an annual program and has a slightly different application process for grants under \$25,000 than for those over \$25,000. **Appendix B** provides a summary of additional mining remediation programs and approaches that may be applied within the Douglas Creek watershed. The extent that these programs may be necessary will depend in part on the decision whether or not to add the Philipsburg Mining Area to the NPL.

6.4 RESTORATION APPROACHES BY SOURCE CATEGORY

Refer to Section 8.5 of the parent document (Montana Department of Environmental Quality, 2012a) for an explanation of restoration approaches by source category, including metals.

6.5 POTENTIAL FUNDING SOURCES

Funding of water quality restoration or improvement project is essential for completing restoration activities and evaluating the resulting load reductions. Several government agencies fund watershed or water quality improvement projects. Below is a brief summary of potential funding sources for such projects. Other funding opportunities exist for addressing nonpoint source pollution. Additional information regarding funding opportunities from state agencies is contained in Montana's Nonpoint Source Management Plan (Montana Department of Environmental Quality, 2012b) and information regarding additional funding opportunities can be found at <http://www.epa.gov/nps/funding.html>.

6.5.1 Section 319 Nonpoint Source Grant Program

Section 319 grant funds are typically used to help identify, prioritize, and implement water quality protection projects with focus on TMDL development and implementation of nonpoint source projects. Individual contracts under the yearly grant typically range from \$20,000 to \$150,000, with a 25% or more match requirement. 319 projects typically need to be administered through a non-profit or local government such as a conservation district, a watershed planning group, or a county.

6.5.2 Future Fisheries Improvement Program

The Future Fisheries grant program is administered by Fish, Wildlife and Parks (FWP) and offers funding for on-the-ground projects that focus on habitat restoration to benefit wild and native fish. Anyone ranging from a landowner or community-based group to a state or local agency is eligible to apply. Applications are reviewed annually in December and June. Projects that may be applicable to the Douglas Creek watershed include restoring streambanks, improving fish passage, and restoring/protecting spawning habitats.

6.5.3 Watershed Planning and Assistance Grants

The Department of Natural Resources & Conservation (DNRC) administers Watershed Planning and Assistance Grants to watershed groups that are sponsored by a Conservation District. Funding is capped at \$10,000 per project and the application cycle is quarterly. The grant focuses on locally developed

watershed planning activities; eligible activities include developing a watershed plan, group coordination costs, data collection, and educational activities.

6.5.4 Resource Indemnity Trust/Reclamation and Development Grants Program

The Resource Indemnity Trust/Reclamation and Development Grants Program (RIT/RDG) is a biennial program administered by DNRC that can provide up to \$300,000 to address environmental issues. This money can be applied to low-priority sites included on the AML priority list for which cleanup under AML is uncertain. RIT/RDG funds can also be used for conducting site assessment and characterization activities such as identifying specific sources of water quality impairment. RIT/RDG projects typically need to be administered through a non-profit or local government such as a conservation district, watershed planning group, or county government office.

6.5.5 Other Funding Sources

Numerous other funding opportunities exist for addressing nonpoint source pollution. Additional information regarding funding opportunities from state agencies is contained in Montana's Nonpoint Source Management Plan (Montana Department of Environmental Quality, 2012) and information regarding additional funding opportunities can be found at <http://www.epa.gov/nps/funding.html>.

7.0 MONITORING FOR EFFECTIVENESS

Future monitoring of Douglas Creek will include efforts from EPA, DEQ and Granite Headwaters. Refer to the parent document (Montana Department of Environmental Quality, 2012a) for an explanation of monitoring for effectiveness in the Flint Creek TPA.

Antimony issues in Douglas Creek appear to be linked to remaining mine waste in the lower canyon, and occur primarily during high flow. Suggestions for further antimony sampling include the Douglas Creek tunnel, further bracketing of the identified Douglas Creek waste rock deposits, Contact Mill slurry, and groundwater between the Contact Mill and Douglas Creek. DEQ recommends that any future samples collected in the Douglas Creek watershed by EPA or other parties be analyzed for total recoverable metals to aid comparison to Montana's water quality standards.

8.0 STAKEHOLDER AND PUBLIC PARTICIPATION

Stakeholder and public involvement is a component of total maximum daily load (TMDL) planning supported by EPA's guidelines and required by Montana state law (Montana Code Annotated (MCA) 75-5-703, 75-5-704) which directs DEQ to consult with watershed advisory groups and local conservation districts during the TMDL development process. Technical advisors, stakeholders and interested parties, state and federal agencies, interest groups, and the public were solicited to participate in differing capacities throughout the TMDL development process in the Flint Creek TPA. Stakeholder and public involvement efforts for this addendum follow the general steps outlined in Section 10 of the parent document (Montana Department of Environmental Quality, 2012a) and include many of the same participants.

8.1 PARTICIPANTS AND ROLES

Throughout completion of the parent document, DEQ worked with stakeholders to keep them apprised of project status and solicited input from a TMDL technical advisory group. A description of the participants and their roles is provided in Section 10 of the parent document (Montana Department of Environmental Quality, 2012a). That advisory group also played a similar role with the current addendum document. Agencies and groups that participated in the development of this document are summarized below.

8.1.1 Montana Department of Environmental Quality

Montana state law (MCA 75-5-703) directs DEQ to develop all necessary TMDLs. DEQ has provided resources toward completion of these TMDLs in terms of staff, funding, internal planning, data collection, technical assessments, document development, and stakeholder communication and coordination. DEQ has worked with other state and federal agencies to gather data and conduct technical assessments. DEQ has also partnered with watershed organizations to collect data and coordinate local outreach activities for this project.

8.1.2 U.S. Environmental Protection Agency

EPA is the federal agency responsible for administering and coordinating requirements of the CWA. Section 303(d) of the CWA directs states to develop TMDLs (see **Section 1.1**), and EPA has developed guidance and programs to assist states in that regard. EPA has provided funding and technical assistance to Montana's overall TMDL program and is responsible for final TMDL approval. Project management was primarily provided by the EPA Regional Office in Helena, Montana.

The Douglas Creek Site (Philipsburg Mining Area) is being considered for addition to the National Priority List (aka Superfund). EPA Superfund Technical Assessment and Response Team 3 completed a preliminary assessment and a site investigation of the site, and the resulting reports were of great value to DEQ's source assessment efforts.

8.1.3 TMDL Advisory Group

The TMDL advisory group members and participation was summarized in Section 10 of the parent document (Montana Department of Environmental Quality, 2012a). For this addendum, DEQ provided an electronic draft of the document to members of the parent document TMDL advisory group for a three-week review period. DEQ corresponded with members of the TMDL advisory group via e-mail and telephone.

8.1.4 Area Landowners

Since much of the Douglas Creek watershed is in private ownership, local landowner cooperation in the TMDL process was critical. Their contribution included access for stream sampling and field assessments. The DEQ sincerely thanks the planning area landowners for their logistical support and informative participation in impromptu water resource and land management discussions with DEQ's and EPA's field staff and consultants.

8.2 RESPONSE TO PUBLIC COMMENTS

Upon completion of the draft TMDL document, and prior to submittal to EPA, DEQ issues a press release and enters into a public comment period. During this timeframe, the draft TMDL document is made available for general public comment, and DEQ addresses and responds to all formal public comments.

The public review period began on February 26, 2015, and ended on April 1, 2015. DEQ made the draft document available to the public, and solicited public input and comments. These outreach efforts were conducted via emails to watershed advisory group members and other interested parties, posts on the DEQ website, and announcements in the following newspapers: the Philipsburg Mail, the Montana Standard (Butte), the Anaconda Leader, and the Missoulian.

No comments were received during the public comment period.

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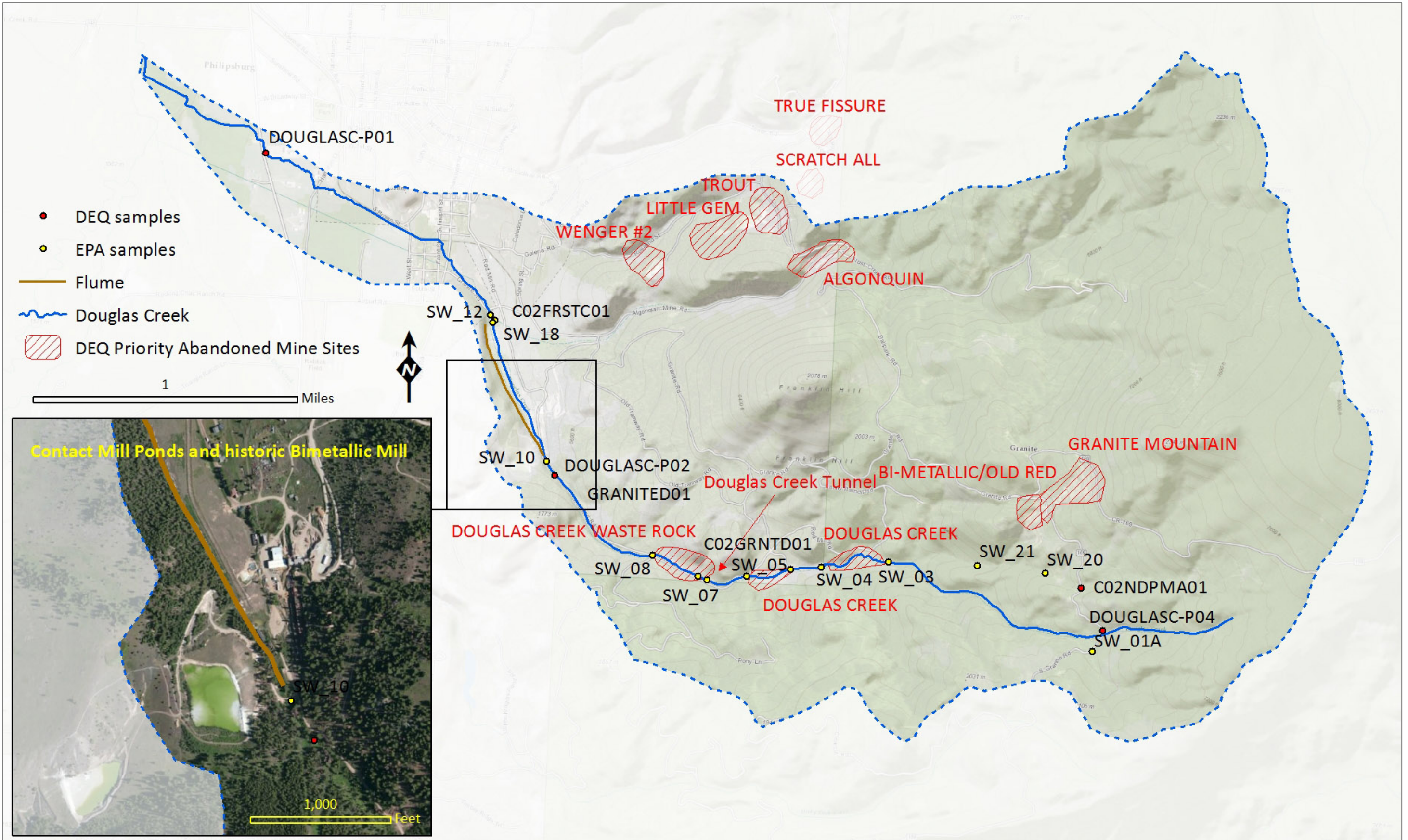
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APPENDIX A - LOCATION OF MINING-RELATED FEATURES AND WATER QUALITY SAMPLE SITES



APPENDIX B - CLEANUP/RESTORATION AND FUNDING OPTIONS FOR MINE OPERATIONS OR OTHER SOURCES OF METALS CONTAMINATION

There are several approaches for cleanup of mining operations or other sources of metals contamination in the State of Montana. Most of these are discussed below, with focus on abandoned or closed mining operations.

B1.0 THE COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (CERCLA)

CERCLA is a federal law that addresses cleanup on sites, such as historic mining areas, where there has been a hazardous substance release or threat of release. Sites are prioritized on the National Priority List (NPL) using a hazard ranking system with significant focus on human health. Petroleum related products and associated raw materials are not covered under CERCLA. Other federal regulations such as Resource Conservation and Recovery Act and associated Leaking Underground Storage Tank cleanup requirements tend to address petroleum.

Under CERCLA, the potentially responsible party or parties must pay for all remediation efforts based upon the application of a strict joint and several liability approach whereby any existing or historical land owner can be held liable for restoration costs. Where viable landowners are not available to fund cleanup, funding can be provided under Superfund authority. Federal agencies can be delegated Superfund authority, but cannot access funding from Superfund.

Cleanup actions under CERCLA must be based on professionally developed plans and can be categorized as either Removal or Remedial. Removal actions can be used to address the immediate need to stabilize or remove a threat where an emergency exists. Cleanup of metals-contaminated soils in the Town of Superior was performed as a removal action.

Once removal activities are completed, a site can then undergo Remedial Actions or may end up being scored low enough from a risk perspective that it no longer qualifies to be on the NPL for Remedial Action. Under these conditions the site is released back to the state for a "no further action" determination. At this point there may still be a need for additional cleanup since there may still be significant environmental threats or impacts, although the threats or impacts are not significant enough to justify Remedial Action under CERCLA. Any remaining threats or impacts would tend to be associated with wildlife, aquatic life, or aesthetic impacts to the environment or aesthetic impacts to drinking water supplies versus threats or impacts to human health. A site could, therefore, still be a concern from a water quality restoration perspective, even after CERCLA removal activities have been completed.

Remedial actions may or may not be associated with or subsequent to removal activities. A remedial action involves cleanup efforts whereby Applicable or Relevant and Appropriate Requirements and Standards (ARARS), which include state water quality standards, are satisfied. Once ARARS are satisfied, then a site can receive a "no further action" determination.

B2.0 THE MONTANA COMPREHENSIVE CLEANUP AND RESTORATION ACT (CECRA)

The 1985 Montana Legislature passed the Environmental Quality Protection Fund Act. This Act created a legal mechanism for the Department to investigate and clean up, or require liable persons to investigate and clean up, hazardous or deleterious substance facilities in Montana. The 1985 Act also established the Environmental Quality Protection Fund (EQPF). The EQPF is a revolving fund in which all penalties and costs recovered pursuant to the EQPF Act are deposited. The EQPF can be used only to fund activities relating to the release of a hazardous or deleterious substance. Although the 1985 Act established the EQPF, it did not provide a funding mechanism for the Department to administer the Act. Therefore, no activities were conducted under this Act until 1987.

The 1987 Montana Legislature passed a bill creating a delayed funding mechanism that appropriated 4 percent of the Resource Indemnity Trust (RIT) interest money for Department activities at non-National Priority List facilities beginning in July 1989 (§ 15-38-202 Montana Code Annotated (MCA)). In October 1987, the Department began addressing state Superfund facilities. Temporary grant funding was used between 1987 and 1989 to clean up two facilities and rank approximately 250 other facilities. Beginning in fiscal year 1995, the 4 percent allocation was changed to 6 percent to adjust for other legislative changes in RIT allocations. Effective July 1, 1999, the 6 percent allocation was increased to 9 percent.

The 1989 Montana Legislature significantly amended the Act, changing its name to the Montana Comprehensive Environmental Cleanup and Responsibility Act (CECRA) (§75-10-75 MCA) and providing the Department with similar authorities as provided under the federal Superfund Act (CERCLA) (U.S. Environmental Protection Agency, 2011). With the passage of CECRA, the state Superfund program became the CECRA Program. Major revisions to CECRA did not occur until the 1995 Legislature, when the Voluntary Cleanup and Redevelopment Act (VCRA) (§75-10-730 MCA), a mixed-funding pilot program, and a requirement to conduct a collaborative study on alternative liability schemes were added and provisions related to remedy selection were changed. Based on the results of the collaborative study, the 1997 Legislature adopted the Controlled Allocation of Liability Act, which provides a voluntary process for the apportionment of liability at CECRA facilities and establishes an orphan share fund. Minor revisions to CECRA were also made by the 1999 and 2001 Legislatures.

As of June 2013, there were 208 facilities on the CECRA Priority List (Montana Department of Environmental Quality, 2011a). CECRA facilities are ranked maximum, high, medium, low and operation and maintenance priority based on the severity of contamination at the facility and the actual and potential impacts of contamination to public health, safety, and welfare and the environment. The Department maintains database narratives that explain contamination problems and status of work at each state Superfund facility.

B2.1 THE CONTROLLED ALLOCATION OF LIABILITY ACT (CALA)

The Montana Legislature added the Controlled Allocation of Liability Act (Montana Department of Environmental Quality, 2011b) (§§ 75-10-742 through 752, MCA) to the Comprehensive Environmental Cleanup and Responsibility Act (Montana Department of Environmental Quality, 2011a) (§§ 75-10-701 through 752, MCA), the state Superfund law, in 1997. The department administers CALA including the orphan share fund it establishes.

CALA (Montana Department of Environmental Quality, 2011b) is a voluntary process that allows Potentially Responsible Parties (PRP) to petition for an allocation of liability as an alternative to the strict, joint and several liability scheme included in CECRA. CALA provides a streamlined alternative to litigation that involves negotiations designed to allocate liability among persons involved at facilities requiring cleanup, including bankrupt or defunct persons. Cleanup of these facilities must occur concurrently with the CALA process and CALA provides the funding for the orphan share of the cleanup. Since CECRA cleanups typically involve historical contamination, liable persons often include entities that are bankrupt or defunct and not affiliated with any viable person by stock ownership. The share of cleanup costs for which these bankrupt or defunct persons are responsible is the orphan share. Department represents the interests of the orphan share throughout the CALA process.

The funding source known as the orphan share fund is a state special revenue fund created from a variety of sources. These include an allocation of 8.5 percent of the metal mines license tax, certain penalties and additional funds from the resource indemnity trust fund and 25 percent of the resource indemnity and groundwater assessment taxes (which will increase to 50 percent when the RIT reaches \$100 million). The current balance of the Orphan Share Fund is around \$4 million and revenues projected for the rest of this biennium are about \$2 million.

In the absence of a demonstrated hardship, claims for orphan share reimbursement may not be submitted until the cleanup is complete. This ensures that facilities are fully remediated before reimbursement. The result is that a PRP could be expending costs it anticipates being reimbursed for some time before the PRP actually submits a claim.

CALA was designed to be a streamlined, voluntary allocation process. For facilities where a PRP does not initiate the CALA process, strict, joint and several liability remains. Any person who has been noticed as being potentially liable as well as any potentially liable person who has received approval of a voluntary cleanup plan can petition to initiate the CALA process. CALA includes fourteen factors to be considered in allocating liability. Based on these factors causation weighs heavily in allocation but is not the only factor considered.

B2.2 THE VOLUNTARY CLEANUP AND REDEVELOPMENT ACT (VCRA)

The 1995 Montana Legislature amended the Comprehensive Environmental Cleanup and Responsibility Act (CECRA) (Section 75-10-705 MCA), creating the Voluntary Cleanup and Redevelopment Act (VCRA) (Sections 75-10-730 through 738, MCA). VCRA formalizes the voluntary cleanup process in the state. It specifies application requirements, voluntary cleanup plan requirements, agency review criteria and time frames, and conditions for and contents of no further action letters.

The act was developed to permit and encourage voluntary cleanup of facilities where releases or threatened releases of hazardous or deleterious substances exist, by providing interested persons with a method of determining what the cleanup responsibilities will be for reuse or redevelopment of existing facilities. Any entity (such as facility owners, operators, or prospective purchasers) may submit an application for approval of a voluntary cleanup plan to the Department. Voluntary Cleanup Plans (VCPs) may be submitted for facilities whether or not they are on the CECRA Priority List (Montana Department of Environmental Quality, 2011a). The plan must include (1) an environmental assessment of the facility; (2) a remediation proposal; and (3) the written consent of current owners of the facility or property to both the implementation of the voluntary cleanup plan and access to the facility by the applicant and its

agents and Department. The applicant is also required to reimburse the Department for any costs that the state incurs during the review and oversight of a voluntary cleanup effort.

The act offers several incentives to parties voluntarily performing facility cleanup. Any entity can apply and liability protection is provided to entities that would otherwise not be responsible for site cleanup. Cleanup can occur on an entire facility or a portion of a facility. The Department cannot take enforcement action against any party conducting an approved voluntary cleanup. The Department review process is streamlined: the Department has 30 to 60 days to determine if a voluntary cleanup plan is complete, depending on how long the cleanup will take. When the Department determines an application is complete, it must decide within 60 days whether to approve or disapprove of the application; these 60 days also includes a 30-day public comment period. The Department's decision is based on the proposed uses of the facility identified by the applicant and the applicant conducts any necessary risk evaluation. Once a plan has been successfully implemented and Department costs have been paid, the applicant can petition the Department for closure. The Department must determine whether closure conditions are met within 60 days of this petition and, if so, the Department will issue a closure letter for the facility or the portion of the facility addressed by the voluntary cleanup.

The act is contained in §§ 75-10-730 through 738, MCA. Major sections include: § 75-10-732 - eligibility requirements; § 75-10-733 and § 75-10-734 - environmental property assessment and remediation proposal requirements; § 75-10-735 - public participation; § 75-10-736 - timeframes and procedures for Department approval/disapproval; § 75-10-737 - voluntary action to preclude remedial action by DEQ; and § 75-10-738 - closure process. Section 75-10-721, MCA of CECRA must also be met.

The Department does not currently have a memorandum of agreement (MOA) with the Environmental Protection Agency (EPA) for its Voluntary Cleanup Program. However, the Department and EPA are in the process of negotiating one. EPA has indicated that Montana's Voluntary Cleanup Program includes the necessary elements to establish the MOA. Currently, EPA is reviewing the latest draft of the MOA.

The Department has produced a VCRA Application Guide (Montana Department of Environmental Quality, 2012a) to assist applicants in preparing a new application; this guide is not a regulation and adherence to it is not mandatory.

As of 2012, the Department has approved 31 voluntary clean plans, including mining, manufactured gas, wood treating, dry cleaning, salvage, pesticide, fueling, refining, metal plating, defense, and automotive repair facilities (Montana Department of Environmental Quality, 2012b). Applicants have expressed interest and/or submitted applications for voluntary cleanup at fifteen other facilities. The Department maintains a registry of VCRA facilities.

B3.0 ABANDONED MINE LANDS CLEANUP

The purpose of the Abandoned Mine Lands Reclamation (AML) Program is to protect human health and the environment from the effects of past mining and mineral processing activities. Funding for cleanup is via the Federal Abandoned Mine Fund, which is distributed to the State of Montana via a grant program. The Abandoned Mine Fund is generated by a per ton fee levied on coal producers and the annual grant is based on coal production. There are no collections or contributions to the Abandoned Mine Fund from mineral production beyond coal production fees. Expenditures under the abandoned mine program can only be made on “eligible” abandoned mine sites. For a site to be eligible, mining must have ceased

prior to August 4, 1977 (private lands, other dates apply to federal lands). In addition, there must be no continuing reclamation responsibility under any state or federal law. No continuing reclamation responsibility can mean no mining bonds or permits have been issued for the site, however, it has also been interpreted to mean that there can be no viable responsible party under State or Federal laws such as CERCLA or CECRA. While lands eligible for the Abandoned Mine Funds include hard rock mines and gravel pits (collectively categorized as “non-coal”), abandoned coalmines have the highest priority for expenditures from the Fund. As part of the approved plan for Montana, abandoned coal mines are required to be prioritized and funded for reclamation ahead of eligible non-coal mine sites. . Cleanup of any eligible site is prioritized based primarily on human health, which can include health risks such as open shafts, versus risks only associated with hazardous substances, as is the case under CERCLA.

Montana's AML Program maintains an inventory of all potential cleanup sites, and also has a list of non-coal priority sites from which to work from. The DEQ conducts cleanups under the Abandoned Mine Funds as public works contracts utilizing professional engineers for design purposes and private construction contractors to perform the actual work.

Limited scoping and ranking of water pollution from discharging abandoned coal mines has been completed and Montana’s AML program is evaluating how to proceed with funding water treatment and stream quality restoration at the highest priority abandoned coal mine sites. In cases of non-coal cleanups, mitigating impacts associated with discharging adits can be included within the cleanup, although ongoing water treatment is not pursued as a reclamation option to avoid long-term operational commitments, which are outside the scope of the program and funding source. Therefore, even after cleanup, an abandoned non-coal mine site could still represent a source of contaminant loading to a stream, especially if there is a discharging adit associated with the site. Where discharging adits are not of concern, cleanup of either coal or non-coal mines may generally represent efforts to achieve all reasonable land, water, and soil conservation practices for that site.

A Guide to Abandoned Mine Reclamation (Noble and Koerth, 1996) provides further description of the Abandoned Mine Lands Program and how cleanup activities are pursued.

B4.0 CLEANUP ON FEDERAL AGENCY LANDS

A Federal land management agency may pursue cleanup actions outside of any requirements under CERCLA or CECRA where such activities are consistent with overall land management goals and funding availability.

B5.0 PERMITTED OR BONDED SITES

Newer mining sites that are or have been in recent operation are required to post bonds as part of their permit conditions. These bond and permit conditions help ensure cleanup to levels that will satisfy Montana Water Quality Standards during operation and after completion of a mining operation. Such sites also include larger placer mines greater than 5 acres in size. There are no permitted or bonded sites in the Flint Creek TMDL planning area.

B6.0 VOLUNTARY CLEANUP AGREEMENT

At least one location within Montana (the Upper Blackfoot Mining Complex) is being addressed via a voluntary cleanup approach based on an agreement between the responsible person and the State of Montana. Although similar in nature to the goals of CECRA, this cleanup effort is currently not considered a remedial action under CECRA. The responsible person is responsible for cleanup costs in this situation.

B7.0 LANDOWNER VOLUNTARY CLEANUP OUTSIDE OF A STATE DIRECTED OR STATE NEGOTIATED EFFORT

A landowner could pursue cleanup outside the context of CECRA or other state negotiated cleanup approaches. Under such conditions, liability would still exist since there is presumably a lack of professional oversight and assurance of meeting appropriate environmental and human health goals. Regulatory requirements such as where waste can be disposed, stormwater runoff protection, and multiple other environmental conditions would still need to be followed to help ensure that the cleanup activity does not create new problems. This approach can be risky since the potential for additional future work would likely make it more cost effective to pursue cleanup under CECRA or some other state negotiated approach where PRP liability can be resolved.

B8.0 STATE EMERGENCY ACTIONS

Where a major emergency exists, the State can undertake remedial actions and then pursue reimbursement from a responsible party. This situation does not exist within the Douglas Creek project area, nor the Flint Creek TMDL planning area.

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**ATTACHMENT A - ANALYTICAL RESULTS REPORT FOR A CERCLA SITE
INSPECTION PHILPSBURG MINING AREA (DOUGLAS CREEK) NEAR
PHILPSBURG, GRANITE COUNTY, MONTANA**

START 3

Superfund Technical Assessment and Response Team 3 –
Region 8



**United States
Environmental Protection Agency
Contract No. EP-W-05-050**

**ANALYTICAL RESULTS REPORT
for a
CERCLA SITE INSPECTION**

**PHILIPSBURG MINING AREA (Douglas Creek)
Near Philipsburg, Granite County, Montana**

TDD No. 1103-02

June 21, 2012



URS
OPERATING SERVICES, INC.

In association with:

**Garry Struthers Associates, Inc.
LT Environmental, Inc.
OTIE
TechLaw, Inc.
Tetra Tech EMI**

ANALYTICAL RESULTS REPORT
for a
CERCLA SITE INSPECTION
at the
PHILIPSBURG MINING AREA (Douglas Creek)
Near Philipsburg, Granite County, Montana

(CERCLIS ID # MTD980666523)

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**ANALYTICAL RESULTS REPORT
for a
CERCLA SITE INVESTIGATION
at the
PHILIPSBURG MINING AREA (Douglas Creek)
Near Philipsburg, Granite County, Montana**

CERCLIS ID# MTD980666523

TABLE OF CONTENTS

	<u>PAGE #</u>
SIGNATURE PAGE	i
DISTRIBUTION LIST	ii
TABLE OF CONTENTS	iii
1.0 INTRODUCTION	1
2.0 OBJECTIVES	2
3.0 SITE LOCATION AND DESCRIPTION	2
4.0 SITE BACKGROUND	4
4.1 Site History	
4.2 Site Characteristics	
4.2.1 Physical Geography	
4.2.2 Geology	
4.2.3 Hydrogeology	
4.2.4 Hydrology	
4.2.5 Meteorology	
4.3 Previous Investigations	
5.0 DATA QUALITY OBJECTIVES PROCESS	12
6.0 SAMPLE NOMENCLATURE, LOCATIONS AND METHODS	13
6.1 Sample Nomenclature	
6.2 Sample Locations	
6.2.1 Source Samples	
6.2.2 Surface Water Samples	
6.2.3 Sediment Samples	
6.3 Sample Methods	
6.3.1 Soil and Sediment Source Sampling	
6.3.2 Aqueous Source and Surface Water Sampling	
7.0 ANALYTICAL RESULTS	17
7.1 Analytical Parameters	
7.2 Analytical Data – Comparison of Results to Background and Screening Benchmarks	
7.3 Selection of Background Locations and Values	
7.4 Soil Source (Mining Waste) Sample Results	
7.5 Aqueous Source (Adits and Seeps) Sample Results (Total and Dissolved Metals)	

7.6	Sediment Source (Adit) Sample Results	
7.7	Surface Water Release Sample Results (Total Metals)	
7.8	Surface Water Release Sample Results (Dissolved Metals)	
7.9	Sediment Release Sample Results	
8.0	PATHWAY ANALYSIS	29
8.1	Sources and Waste Characterization	
8.1.1	Historical Bi-Metallic Mill Tailings	
8.1.2	Contact Mill East Tailings	
8.1.3	Douglas Creek Waste Rock	
8.1.4	Douglas Creek West Tailings	
8.1.5	Douglas Creek East Tailings	
8.1.6	Bi-Metallic/Old Red Waste Rock and Tailings	
8.1.7	Granite Mountain Waste Rock and Tailings	
8.1.8	Granite Mountain/Bi-Metallic Adit	
8.1.9	New Departure Adit	
8.1.10	Douglas Creek West Tailings Pile, Western Seep	
8.1.11	Douglas Creek West Tailings Pile, Eastern Seep	
8.2	Surface Water Pathway	
8.3	Groundwater Pathway	
8.4	Soil Exposure Pathway	
8.5	Air Pathway	
9.0	DATA QUALITY ANALYSIS	47
9.1	Data Quality Objectives	
9.2	Data Validation and Interpretation	
10.0	MEASUREMENT QUALITY OBJECTIVES	50
10.1	Field Quality Control Procedures	
10.2	Data Quality Assessment	
10.2.1	Bias	
10.2.2	Sensitivity	
10.2.3	Precision	
10.2.4	Representativeness	
10.2.5	Comparability	
10.2.6	Completeness	
11.0	DATA GAPS	55
12.0	SUMMARY	56
13.0	LIST OF REFERENCES	59

TABLE OF CONTENTS, cont.

FIGURES

Figure 1	Site Location, Area of Influence, and 15-Mile Downstream Target Distance Limit Map
Figure 2	Source Sample Locations and Selected Metals Results
Figure 3	Sediment Sample Locations and Selected Metals Results
Figure 4	Surface Water Sample Locations and Selected Total Metals Results
Figure 5	Surface Water Sample Locations and Selected Dissolved Metals Results

TABLES

Table 1	Background Concentrations of Elevated Metals
Table 2	Threatened and Endangered Species Occurring in Granite County, Montana
Table 3	Domestic Wells within a 4-Mile Radius of the Site
Table 4	Sample Locations and Rationale
Table 5	Soil Source (Mining Waste) Sample Results
Table 6	Aqueous Source (Adits and Seeps) Sample Results (Total and Dissolved Metals)
Table 7	Sediment Source (Adit) Sample Results
Table 8	Surface Water Release Sample Results (Total Metals)
Table 9	Surface Water Release Sample Results (Dissolved Metals)
Table 10	Sediment Release Sample Results
Table 11	Relative Percent Difference

APPENDICES

Appendix A	Data Quality Objectives Seven-Step Planning Approach
Appendix B	Project Photolog
Appendix C	Project Field Logbooks
Appendix D	Conceptual Site Model
Appendix E	Laboratory Data, Validation Reports and Chains-of-Custody (under separate cover)

ACRONYM LIST

AES	atomic emission spectroscopy
ARR	Analytical Results Report
CCC	criteria continuous concentration (chronic)
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratories Program
CMC	criteria maximum concentration (acute)
CMC	Contact Mining Company
CRSC	Cancer Risk Screening Concentration
CVAA	Cold-Vapor Atomic Absorption
DQIs	data quality indicators
DQOs	Data Quality Objectives
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FSP	Field Sampling Plan
FWS	U.S. Fish and Wildlife Service
GPS	Global Positioning System

TABLE OF CONTENTS, cont.

ACRONYM LIST, cont.

GSA	Geological Society of America
HRS	Hazard Ranking System
IDW	investigation-derived waste
MBMG	Montana Bureau of Mines and Geology
MDEQ	Montana Department of Environmental Quality
MDSL	Montana Department of State Lands
MFWP	Montana Fish, Wildlife, and Parks
MNHP	Montana Natural Heritage Program
MS	mass spectrometry
MS/MSD	matrix spike/matrix spike duplicate
NOAA	National Oceanic and Atmospheric Administration
PA	Preliminary Assessment
PPE	probable point of entry
PMA	Philipsburg Mining Area
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RAS	Routine Analytical Services
RDSC	Reference Dose Screening Concentration
RPD	relative percent difference
RSL	Regional Screening Level
SAR	Sampling Activities Report
SCDM	Superfund Chemical Data Matrix
SI	Site Inspection
START	Superfund Technical Assessment and Response Team
TAL	Target Analyte List
TDD	Technical Direction Document
TDL	Target Distance Limit
TMDL	Total Maximum Daily Load
TSOPs	Technical Standard Operating Procedures
UOS	URS Operating Services, Inc.
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
XRF	X-ray fluorescence

1.0 INTRODUCTION

This Analytical Results Report (ARR) for the Philipsburg Mining Area (PMA), Douglas Creek site (CERCLIS ID# MTD980666523) near Philipsburg, Granite County, Montana has been prepared to satisfy the requirements of Technical Direction Document (TDD) No. 1103-02 issued to URS Operating Services, Inc. (UOS) under the U.S. Environmental Protection Agency (EPA) Region 8 Superfund Technical Assessment and Response Team 3 (START 3) Contract No. EP-W-05-050. This report has been prepared in accordance with the EPA “Guidance for Performing Site Inspections under CERCLA,” Interim Final, September 1992 (EPA 1992), and the “Region 8 Supplement to Guidance for Performing Site Inspections under CERCLA” (EPA 1993). This ARR is intended to be used in conjunction with the Philipsburg Mining Area (Douglas Creek) Field Sampling Plan (FSP) (UOS 2011a) and the Philipsburg Mining Area (Douglas Creek) Sampling Activities Report (SAR) (UOS 2011b).

Field work at the Philipsburg Mining Area, Douglas Creek site was conducted by UOS during the week of June 27, 2011 and followed the focused Site Inspection (SI) format and the applicable UOS Technical Standard Operating Procedures (TSOPs) (UOS 2005b) and the Generic Quality Assurance Project Plan (UOS 2005a).

Field activities specifically included collecting 58 environmental samples comprised of 21 surface water samples (includes 2 background and 4 source samples), 19 sediment samples (includes 2 background and 1 source sample), and 16 soil/source samples (includes 3 background samples), plus 2 field Quality Assurance/Quality Control (QA/QC) samples (in addition to the laboratory matrix spike/matrix spike duplicates [MS/MSD]) (Table 4).

All samples were analyzed for Target Analyte List (TAL) total or dissolved metals and were shipped via FedEx to the Contract Laboratory Program (CLP), Routine Analytical Services (RAS) laboratory ALS Laboratory Group in Salt Lake City, Utah. Water samples that were analyzed for low level total mercury (at the request of the Montana Department of Environmental Quality [MDEQ]) were sent to Energy Laboratories, Inc. in Billings, Montana. All samples were received by the laboratories in good condition, within holding times, and with custody seals intact.

All CLP laboratory data were validated by a third party subcontracted chemist at TechLaw, Inc. Energy Laboratory data for mercury were not validated as there were no detections of mercury (at the reporting limit of 0.01 microgram per liter [$\mu\text{g/L}$]) in any of the samples. No significant data quality issues were

identified, and the CLP Form 1 documents and the validation reports are presented under separate cover in Appendix E.

This report presents the analytical results for characterization of the onsite sources and targets impacted in the surface water pathway. Other pathways are also discussed (Section 8.0). Field observations are presented in the SAR and project photos are presented in Appendix B.

2.0 OBJECTIVES

The purpose of this SI was to gather information for the evaluation of this site with regard to the EPA's Hazard Ranking System (HRS) criteria. The specific objectives of this SI were to:

- Confirm potential sources (including both remediated and unremediated mining waste piles, and unremediated adit and seep discharges) and evaluate each by HRS criteria, including volumes, containment, and contaminant characteristics;
- Determine if source areas are used recreationally or are adjacent to residences;
- Further define the surface water pathway, including defining the extent of wetlands along Douglas Creek and the flow rate of the creek during field activities;
- Evaluate contaminant migration through the surface water pathway;
- Determine potential groundwater and air pathway targets;
- Evaluate the impact on surface water receptor targets, including wetlands and human food chain threat targets;
- If possible, document source areas being used recreationally (particularly for fishing) and the presence of residents near mining sites; and
- Determine the potential impacts to public health and the environment from source contaminants.

3.0 SITE LOCATION AND DESCRIPTION

The Philipsburg Mining Area is located in west-central Montana, to the east of the town of Philipsburg, Montana, in Granite County (Figure 1). It is the second largest historical mining area in Montana and covers an irregular and poorly defined area of about 8 square miles on the west flank of the Flint Creek Range (U.S. Geological Survey [USGS] 1967). None of the mines in the area are currently active, although one mill (Contact Mill) is currently in production. The dominant land use of the area is multiple use national forest.

Douglas Creek¹ forms one of four drainage basins within the PMA. The Douglas Creek drainage basin contains two creeks, Douglas Creek and Frost Creek (Figure 1). Only Douglas Creek was the focus of this investigation.

The headwaters of Douglas Creek are located approximately 3.5 linear miles southeast of the town of Philipsburg (Figure 1). The creek flows generally to the west and northwest for a total distance of 5 miles to Flint Creek, passing through the southern part of Philipsburg about 4 miles from its head waters and 1 mile upstream of Flint Creek. The headwater elevation is approximately 7,200 feet above mean sea level (amsl) while the elevation at the confluence with Flint Creek is approximately 5,125 feet amsl (USGS 1996a, b). The mid-point of Douglas Creek lies at approximately 46.31° latitude and -113.268° longitude.

The Douglas Creek drainage basin collects water from an area of approximately 3 square miles. In the headwaters to the southeast of Philipsburg, the creek bifurcates, with a northern branch originating from overland flows draining from the south side of Granite Mountain and discharge coming from the New Departure adit, and a southern branch originating in, and flowing through, largely undisturbed and unleased forested land to the east (Figures 2-5).

From the south side of Granite Mountain, the northern branch continues downstream past the Granite Mountain and Bi-Metallic/Old Red waste rock piles before joining the southern branch of Douglas Creek just above the Douglas Creek east tailings pile. After the two branches join, Douglas Creek then flows generally west past the Douglas Creek east and west tailings piles to the Granite Mountain/Bi-Metallic adit, a distance of approximately 1 mile. From the Granite Mountain/Bi-Metallic adit, the creek continues generally west, flowing past the Douglas Creek waste rock pile, and then northwest to a point due east of the Contact Mill east tailings impoundment where it is diverted into a wooden flume (Photo 43), a total distance of about 0.75 mile. The creek then flows through the flume for approximately 0.6 mile past the historical Bi-Metallic Mill tailings. At a point just west of the northern end of the historical Bi-Metallic Mill tailings, the flume discharges back into the creek bed and Douglas Creek continues to the northwest for a distance of approximately 1.8 miles where it drains into Flint Creek at a point located approximately 1 mile to the west of Philipsburg (USGS 1996a) (Figures 2-5).

Previously identified potential sources along Douglas Creek include seven mining waste piles, two flowing adits, and two seeps. These potential sources, along with their estimated quantities or volumes,

¹ There is another Douglas Creek in Granite County, Montana, which drains into Flint Creek approximately 20 miles downstream (northeast) of Philipsburg. (Also see footnote 14).

are summarized as follows (listed from downstream to upstream) (Montana Department of State Lands [MDSL] 1994, MDEQ 1996) (Figure 2):

Mining Waste Piles:

- Historical Bi-Metallic Mill tailings (reclaimed): 909,000 ft² (MDEQ 2011h);
- Contact Mill east tailings: 301,500 ft² (MDEQ 2011b);
- Douglas Creek waste rock: 76,000 cubic yards (yd³) (MDEQ 1996);
- Douglas Creek west tailings (reclaimed): 107,000 yd³ (MDEQ 1994, 2011f);
- Douglas Creek east tailings: 61,000 yd³ (MDEQ 1994, MDEQ 2011f);
- Bi-Metallic/Old Red waste rock and tailings: 13,000 yd³ waste rock and >280 yd³ tailings (MDEQ 1994); and
- Granite Mountain waste rock and tailings: 53,000 yd³ waste rock and 8,000 yd³ tailings (MDEQ 1994).

Adit Discharges:

- Granite Mountain/Bi-Metallic adit: approximately 50 gallons per minute (gpm) (MDEQ 1994); and
- New Departure adit: approximately 60 gpm (MDEQ 1994).

Seeps Associated with a Tailings Pile:

- Douglas Creek west tailings pile, eastern seep: approximately 10 gpm (Pioneer 2004); and
- Douglas Creek west tailings pile, western seep: < 2 gpm (Pioneer 2004).

4.0 SITE BACKGROUND

4.1 SITE HISTORY

The PMA was a major silver-producing area as well as nearly the only domestic source of natural battery-grade manganese dioxide. The area produced 24,000,000 ounces of silver, 83,000 ounces of gold, 80,000,000 pounds of zinc, 23,000,000 pounds of lead, and 4,000,000 pounds of copper from 1904 to 1962. At least 70,000 short tons of manganese came from within 1.5 miles of Philipsburg where replacement deposits were located in the central part of the mining area (USGS 1967).

The quartz veins of the PMA were discovered in 1865 by Hector Horton. He had been prospecting Flint Creek when he became interested in the area's quartz outcrops and as a result staked the Cordova lode. The following spring he reported his discovery at the town of Silver Bow, Montana starting a stampede to the area. By June 1866, claims had been staked on many of the important lodes in the area (MDEQ 2011a).

Located within the Douglas Creek drainage basin, the Granite Mountain lode was first located in 1872, but the claim was allowed to lapse and it was relocated in 1875. The lode was a silver-bearing vein located in granite. Development of the mine was slow until 1880 when a specimen from the mine was assayed at 2,000 ounces of silver per ton. In 1884 a town developed around the Granite mine as miners built cabins on lots rented to them by the Granite Mountain Mining Company. By 1890, over 500 men were employed in the Granite Mountain Mine and associated mills. Ore was originally sent to the Algonquin mill, located approximately 3 miles to the north on Frost Creek, then to a mill adjacent to the mine, and finally to a third mill built at Rumsey, located about 2 miles south of the mine. From 1885 to 1892 the mine and mill were extremely prosperous, with \$20 million of ore removed (over 53,000,000 tons) and \$11 million paid in dividends. The silver crash of 1893 brought the mine to a halt for 3 years. When it reopened in 1896, the mines operations were merged with those of the Bi-Metallic mine (MDEQ 2011a).

The Bi-Metallic mine worked the James G. Blaine lode, which had been located in 1881. The mine worked the same vein as the Granite Mountain Mine, although the ore was not as rich. Nevertheless, the mine still managed to produce \$6 million in bullion from 1883 to 1893, when due to the silver crash, the mine became idle. The consolidated mines worked out of the Bi-Metallic shaft. In 1896, the 8,850 foot long Douglas Creek tunnel² was completed, which drained the Bi-Metallic mine at 1,000 feet and the Granite Mountain shaft at 1,460 feet. In 1888, the 50-stamp Bi-Metallic mill was built on Douglas Creek, about 1 mile south of Philipsburg³. The capacity of this mill was increased to 200 tons in 1891. Also during this time period, a 150-ton concentrator was erected near the mine to treat the tailings and waste dumps of the previous operations. This concentrator also enabled the company to process lower grade ore that remained in the mine (MDEQ 2011a).

² This is the "Granite Mountain/Bi-Metallic adit" source discussed in this report.

³ The town that grew around the mill was called Kirkville. In the Preliminary Assessment [PA] this area was referred to as the Kirkville/Contact site.

By 1900, 425 men were employed underground and 185 men worked the hoists, mills, and offices. The 150-ton concentrator was later expanded to 300-ton capacity. The combined operation managed to produce \$1 million of silver bullion a year from 1898 to 1904 and for a time was considered the largest silver mine in the world. Periods of inactivity followed, including a mine closure in 1905 due to low silver prices. Work continued intermittently until 1958 when the Granite Mountain surface structures were destroyed by a fire.

Total production for the two mines through 1913 is estimated to be more than \$32 million in silver and gold. The vein had been stoped to 2,600 feet below the surface, with total drifts and stopes measuring an aggregate 20 miles (MDEQ 2011a).

In the late 1970s, a new mill (the Contact Mill) was constructed on the site of the historical Bi-Metallic mill, located approximately 1 mile south of Philipsburg on the Contact Mill Road. This area was historically known as Kirkville. The Contact Mill is a contract mill for ore mined from small mines in the area and, therefore, does not have a site-specific mine associated with its milling services. The mill, owned by the Contact Mining Company (CMC), uses flotation to separate the ore concentrate from the waste rock and has a capacity of 500 to 600 tons per day. As of November 2011, the mill was reported to be operating five days a week, 24 hours a day, and was processing approximately 170 tons of ore per week (Philipsburg Mail 2011).

The mill has recently been leased by RX Exploration to mill feedstock from the Drumlummon Mine located in Marysville (near Helena), Montana. Depending upon production from the Drumlummon Mine, mill production may increase to approximately 400 tons per day, with operations expanding to seven days a week (Philipsburg Mail 2011).

Based on self-monitoring effluent data supplied by the mill to the MDEQ, the mill operated from July through October 2005, April through July 2006, October 2007, and June 2008 (MDEQ 2011b). The mill was also active during the field sampling activities conducted in June 2011. Since February 2004, CMC has received at least four letters from the MDEQ citing permit violations for exceeding effluent limits and failure to submit required monitoring data (MDEQ 2011b).

Current ownership of the parcels of interest in the study area (i.e., mining properties containing waste and land parcels adjacent to Douglas Creek) is largely split between CMC (Helena,

Montana) and Cottage Inc. (Philipsburg, Montana), although various other entities own smaller portions of the area (Montana State Library 2012).

4.2 SITE CHARACTERISTICS

4.2.1 Physical Geography

The headwaters of Douglas Creek are located approximately 3.5 linear miles southeast of the town of Philipsburg (Figure 1). The creek flows generally to the west and northwest for a total distance of 5 miles to Flint Creek, passing through the southern part of Philipsburg about 4 miles from its head waters and 1 mile upstream of Flint Creek.

The headwater elevation is approximately 7,200 feet amsl while the elevation at the confluence with Flint Creek is approximately 5,125 feet amsl (USGS 1996a, b). The terrain is mountainous with incised stream valleys, some with relatively steep slopes. Vegetation varies from grassland shrubs in lower elevations to montane forests in the higher elevations.

4.2.2 Geology

The PMA is located on the eastern edge of the Philipsburg batholith and the western edge of the Philipsburg Thrust Fault, at the base of the Flint Creek Range. The Philipsburg batholith is located in the far west-central portion of Montana and extends approximately 10 miles from east to west and 7 miles from north to south (Montana Bureau of Mines and Geology [MBMG] 2003).

The PMA is located in an area of folded and faulted Precambrian, Paleozoic and Mesozoic sedimentary rocks that have been intruded by Tertiary batholiths. Most of the batholiths consist of medium-grained granodiorite. The eastern and southern parts of the PMA are underlain by the west end of one of these batholiths, and the northwestern part is underlain by Precambrian and Paleozoic sedimentary rocks that form a broad north-dipping anticline (MBMG 1982). The sedimentary rocks in the area consist mainly of limestone, dolomite, shale, and quartzite, which near the margin have been metamorphosed to marble, tactite, and hornfels (USGS 1967).

The intrusion of the Philipsburg batholith combined with the previous folding and faulting in the area resulted in fracturing. This allowed for manganese-rich ore deposition to take place in the newly formed fissure veins (USGS 1967). Contact mineralization developed Paleozoic carbonate rocks during the time of intrusion, leading to the deposition of the silver- and manganese-bearing deposits (Geological Society of America [GSA] 1980; MBMG 2003).

The ore deposits in the Philipsburg area can be divided into four groups: steeply dipping quartz veins, quartz veins along bedding, manganese-rich replacement deposits, and contact metasomatic magnetite deposits. The metals mined from the quartz deposits were silver, zinc, and lead, and the metals mined from the manganese and magnetite deposits were manganese and iron, respectively. Total minerals present in the four groups of deposits described above include rhodochrosite, barite, mica, sphalerite, galena, pyrite, tennantite, chalcopyrite, lead, silver, enargite, copper, gold, zinc, and manganese (USGS 1967).

A more extensive discussion of the geology and mineral deposit in the Philipsburg area can be found in “Geology and Ore Deposits of the Philipsburg District, Granite County, Montana” U.S. Geological Survey Bulletin 1237 (USGS 1967).

CMC installed three groundwater monitoring wells in the Contact mill area in June 2011. Well logs indicate that limestone bedrock was encountered between 8.5 and 14 feet below ground surface (bgs) at the three locations (Contact Mining 2012).

4.2.3 Hydrogeology

Information regarding the hydrogeology of the Philipsburg area is scarce. The town of Philipsburg gathers its drinking water from surface water (a mixture of water taken from Fred Burr Creek and Silver Spring); therefore, very few well records exist to provide consistent subsurface lithologic information. The three main aquifers in the Philipsburg area are:

- Undifferentiated Quaternary deposits of sand and gravel,
- Pleistocene deposits of sand and gravel, and
- Madison Group limestone.

The majority of wells in the area are completed in the Pleistocene deposits. The sand and gravel aquifers range in thickness from 0 to 100 feet below ground surface (bgs) with yields ranging from 20 to 40 gpm. A limestone aquifer (within the Madison Group) is found at a depth of up to 400 feet bgs with yields ranging from 10 to 20 gpm (MBMG 2012).

CMC installed three groundwater monitoring wells in the mill area in June and September 2011 (Contact Mining 2011). Wells were installed just below the east tailing impoundment dam (downgradient well MW1), just below the decant pond serving the west tailings impoundment (downgradient well MW3), and approximately 600 feet southeast of the west tailings impoundment (upgradient well MW2). Limestone bedrock was encountered at 8.5 feet bgs in MW1, 14 feet bgs at MW2 and 13 feet bgs at MW3. Static water level was reported to be 5 feet bgs in MW3. Water levels from the other wells were not recorded.

4.2.4 Hydrology

The Douglas Creek drainage basin collects water from an area of about 3 square miles. Douglas Creek drains into Flint Creek at a point located approximately 1 mile to the west of Philipsburg (USGS 1996a).

Much of the flow in Douglas Creek is derived from snow melt. During the sampling event, a significant amount of surface runoff was noted due to above average winter snowfall and a wet spring. While UOS planned to collect flow measurements from the creek and adits using a Marsh-McBirney Model 2000 flow meter, the meter was not available from the EPA during the time of the sampling event. The flow rate of Douglas Creek was estimated to be 30 cfs, and approximately 50 gpm (approximately 0.1 cfs) from each adit. During this time a flow of 328 to 371 cfs was recorded for Flint Creek at the Maxville gauge station located 11 miles upstream from Philipsburg. Average annual flow at this gauge station between 1941 and 2011 is 97.4 cfs (USGS 2012).

For comparison, during the June 9, 2009 site reconnaissance for the PA, UOS observed Douglas Creek to be flowing at approximately 10 to 20 cfs. During this time a flow of 174 cfs was recorded for Flint Creek at the Maxville gauge station.

Douglas Creek is diverted into an elevated wooden flume for a distance of approximately 0.6 mile, from a point just east of the Contact Mill east tailings impoundment, to just west of the north end of the historical Bi-Metallic mill tailings (Photo 43, MDEQ 2011b).

The Montana Natural Heritage Program (MNHP) has completed provisional wetland mapping in the area. This mapping indicates that wetlands located along Douglas Creek, from the highest probable point of entry (PPE) below the Bi-Metallic/Old Red waste rock pile to Douglas Creek's confluence with Flint Creek, include: three freshwater emergent wetlands (Palustrine Emergent, temporarily flooded), approximately 1.14 miles total length), two riparian shrub wetlands (0.375 mile total length), and one each of riparian emergent (0.25 mile in length), riparian forested (0.25 mile in length), and palustrine scrub/shrub wetlands (0.15 mile in length) (MNHP 2010). All of these wetlands exist in lengths extending at least 0.1 mile⁴.

Flint Creek, below its confluence with Douglas Creek, is continuously bounded on both sides by freshwater emergent wetlands, with smaller lengths of freshwater scrub-shrub wetlands for the entire remaining 13.5 miles of the Target Distance Limit (TDL) (MNHP 2010).

4.2.5 Meteorology

Douglas Creek is located in a semiarid climate zone. Most of the annual precipitation falls as snow. The mean annual precipitation, as totaled from the U.S. Department of Agriculture (USDA), is 15.00 inches. The net annual precipitation, as calculated from precipitation and evapotranspiration data, is 5.2 inches (USDA 2009). The 2-year, 24-hour rainfall for the area is 1.52 inches (National Oceanic and Atmospheric Administration [NOAA] 2012).

⁴ The zone of observed contamination, as documented by chemical analysis of surface water and sediment samples collected during this investigation, stretches from the New Departure adit to just below the historic Bi-Metallic tailings pile, a distance of approximately 3.4 miles. Wetlands that appear to be HRS-eligible within this zone total approximately 1 mile, yielding 2 miles of wetlands frontage. Additional sampling downstream of the historical Bi-Metallic tailings could greatly increase the length of the zone of observed contamination, greatly increasing the amount of wetlands frontage.

4.3 PREVIOUS INVESTIGATIONS

The EPA conducted a Potential Hazardous Waste Site Identification and Preliminary Assessment of the Philipsburg Mining Area in 1980 (EPA 1980).

In the early 1990s, the MDSL Abandoned Mine Reclamation Bureau coordinated the “Abandoned Mine Reclamation Bureau Hazardous Materials Inventory,” an extensive, state-wide program to identify, document, and prioritize suspected problem mining sites in Montana (MDSL 1994, MDEQ 1996). Since the early 1990s, the original Hazardous Materials Inventory has been updated on a continual basis. Currently, the MDEQ compiles priority sites into the “Prioritized Short List of Abandoned Mine Land Sites,” which presently contains 133 former mining sites across the State (MDEQ 2011c). Of these 133, three sites occur along Douglas Creek: “Granite Mountain 20-110” (tailings and waste rock), “Bi-Metallic/Old Red 20-002” (tailings), and “Douglas Creek Waste Rock 20-503” (waste rock) (MDEQ 2011c). All three sites⁵ are listed in the top 20 priority sites for the program.

An additional site along the creek, “Douglas Creek 20-003” (tailings), is included on the MDEQs “DEQ-MWCB Priority Sites List” (MDEQ 2011c). These tailings were reclaimed as part of a project conducted by the MDEQ Mine Waste Cleanup Bureau in 2000. The reclamation project involved the excavation, relocation, and consolidation of two separate tailings piles into two separate lined repositories. Each repository was graded and then covered with a geomembrane, a drainage layer, and 2 feet of cover soil. The repositories were constructed on both the north and south slopes above Douglas Creek, and the stream channel was routed around the repositories via lined channels. Groundwater intercept drains and an impermeable cap were added to the consolidated waste areas. Pre- and post-reclamation surface water and sediment samples were collected in 1993, 1996, 2002, and 2003 (MDEQ 2011d).

In 1997, MDEQ published the report “Watershed Analysis of the Abandoned Hardrock Priority Mine Sites” of the area, which included surface water loading and sediment data collected from Douglas Creek (adjacent to the Douglas Creek tailings as well as the Douglas Creek waste rock piles) in 1996 (MDEQ 1997).

⁵ Within the program, the discharge from the Granite Mountain/Bi-Metallic adit is considered part of the Douglas Creek waste rock priority site (20-503). For the purposes of the HRS, the discharge will be treated as a different source.

The MDEQ also conducted the Flint Creek Mine Adit Discharge Reconnaissance in 2007 and 2008. As part of this study, MDEQ collected sediment and surface water samples from various locations within the PMA, including from Douglas Creek. In 2007, MDEQ collected a single sediment sample from Douglas Creek. MDEQ also collected surface water samples in both 2007 and 2008 from Douglas Creek (MDEQ 2007).

The MDEQ Total Maximum Daily Load (TMDL) Program has also conducted sampling along Douglas Creek from 2007 through 2009 (MDEQ 2011d).

UOS prepared a PA for the PMA for the EPA in 2010. The PA was based on observations during a site reconnaissance conducted in June 2009 and on information obtained from historical records; federal, state, and local agencies; and personal interviews. Data collected during these investigations were summarized in the report entitled “Preliminary Assessment, Philipsburg Mining Area, Philipsburg, Granite County, Montana, TDD No. 0904-01” dated January 19, 2010 (UOS 2010).

The PA report focused on information regarding all priority sites listed for the PMA, including three of the four sites on the list that exist along Douglas Creek: “Granite Mountain 20-110,” “Bi-Metallic/Old Red 20-002,” and “Douglas Creek 20-003.”⁶ The PA report summarized the milling and mining activities of the PMA and the source potential of those activities, described the source area contaminant characteristics, determined possible exposure pathways and targets of contamination, and discussed the potential impacts to public health and the environment from the sources identified. The site reconnaissance confirmed the presence of vast quantities of tailings in and around the Douglas Creek streambed and that the adit (located approximately 200 feet upstream from the Douglas Creek waste rock pile) continues to discharge acid mine drainage into the creek. The PA report concluded that, within the Douglas Creek Sub-basin, a particular threat potential exists via the surface water human food chain exposure pathway, with lesser potential threat posed via the soil exposure and air pathways (UOS 2010).

5.0 DATA QUALITY OBJECTIVES PROCESS

The EPA Data Quality Objectives (DQO) Process is a seven-step systematic planning approach to develop acceptance or performance criteria for EPA-funded projects (EPA 2000). The seven steps of the DQO process are:

⁶ The site “Douglas Creek Waste Rock 20-503” was not included in the PA.

- Step 1 The Problem Statement;
- Step 2 Identifying the Decision;
- Step 3 Identifying the Decision Inputs;
- Step 4 Defining the Study Boundaries;
- Step 5 Developing a Decision Rule;
- Step 6 Defining Tolerance Limits on Decision Errors; and
- Step 7 Optimizing the Sample Design.

Based on information provided by the EPA and MDEQ, an understanding of the nature of the site (i.e., historical mining activities), the potential sources present (tailings and waste rock piles located adjacent to Douglas Creek, and seeps and adits that drain into Douglas Creek), and the potential risks associated with the hazardous substances likely present in the sources, the project team identified the surface water pathway and possibly the soil exposure pathway as pathways of potential concern. These risks and pathways of concern are presented in the Conceptual Site Model in Appendix D, and described in more detail in the Data Quality Objectives Seven-Step Planning Approach, presented in Appendix A.

The MDEQ-7 water quality standard for total mercury in surface water is 0.05 µg/L, lower than the Contract Required Quantitation Limit (CRQL) for the CLP Program (0.2 µg/L). In order to compare potential impacts from the mining area to the Montana water quality standard, MDEQ requested that samples be collected and analyzed using a method with a lower detection limit for total mercury (MDEQ 2011g). At the EPA's request, UOS procured a private laboratory, Energy Laboratories, Inc. in Billings, Montana, to perform the low-level total mercury analysis. The reporting limit for all samples was 0.01 µg/L.

6.0 SAMPLE NOMENCLATURE, LOCATIONS AND METHODS

6.1 SAMPLE NOMENCLATURE

Sample identification followed the following format:

- PMA_DC_(Matrix ID)_(Sample Number)_0611

PMA stands for Philipsburg Mining Area and DC stands for Douglas Creek. The 0611 signifies the month and year the sample was collected. Matrices were identified as follows:

- SE = sediment, including sediment from adits

- SW = surface water, including surface water from adit discharges and seeps
- SO = soil (waste pile/ source samples)

Sample locations were then numbered sequentially.

6.2 SAMPLE LOCATIONS

A total of 58 environmental samples were collected from 36 different locations within the Douglas Creek drainage. These samples were comprised of 21 surface water samples, 19 sediment samples, 16 soil/source samples, and 2 field QA/QC samples (Table 4, Figures 2-5).

Sampling locations generally followed those pre-determined in the FSP with some exceptions, which are outlined in Section 3.0 of the SAR (UOS 2011b). Discrete sample locations were determined in the field based upon safe access, orientation to waste sources (for surface water and sediment locations), and levels of contamination determined through field screening with a field-portable Innov-X *Omega*TM X-Ray Fluorescence Spectrometer (XRF) (for soil/source samples) (Photo 28). Discrete sample locations were biased towards the highest concentration detected with the XRF. Each sample location was photographed and recorded with a Trimble Recon[®] Global Positioning System (GPS) instrument.

Access to the land parcel where Douglas Creek enters Flint Creek was not granted by the land owners, so sampling locations on Flint Creek upstream and downstream from its confluence with Douglas Creek had to be collected from locations some distance away (i.e., downstream location was approximately 0.5 miles below the confluence, upstream location was approximately 5.5 miles above the confluence). No sediment sample could be collected from Flint Creek downstream of Douglas Creek due to safety concerns with high and fast water (Photos 38, 39).

Given the distance from the confluence, and the presence of at least one other large creek (Fred Burr Creek) between the sampling locations, it cannot be said with certainty that Douglas Creek is the sole source of the metals concentrations noted in the downstream surface water sample. Access will have to be gained to the land at the confluence of the creeks in any future investigation (see Section 11 for data gaps identified for this site).

6.2.1 Source Samples

Soil Source (Mining Waste) Samples

Thirteen soil/source samples (plus three background soil samples) were collected from seven different mining waste piles (Tables 4, 5; Figure 2). Sampling locations generally followed those pre-determined in the FSP with some exceptions, which are outlined in Section 3.0 of the SAR (UOS 2011b).

An unplanned additional soil/source sample (PMA_DC_SO_07A_0611, Photo 31) was collected from the Bi-Metallic/Old Red waste rock source from a lobe of material that appeared possibly to have a different origin from the other material due to its location. However, the analytical results show that a sample of this material has very similar metals concentrations to the other Bi-Metallic/Old Red waste rock sample (PMA_DC_SO_07_0611, Photo 30).

Only one source sample was collected from each Douglas Creek tailing pile (two each were planned), as only one location where tailings appeared to be exposed was identified at each pile (Photos 7, 8).

Aqueous Source (Adits and Seeps) Samples

Five aqueous source samples (includes one duplicate sample collected for mercury only) were collected from two flowing adits (Photos 26, 36, 45) and two seeps (Photos 17, 18) (Tables 4, 6; Figure 2). The third seep historically identified on the east side of the Douglas Creek east tailings pile could not be found.

Sediment Source (Adit) Samples

Two sediment source samples (includes one replicate) were collected from the New Departure adit (Photos 36, 37) (Tables 4, 7; Figure 2).

6.2.2 Surface Water Samples

Seventeen surface water samples (includes 2 background and 1 duplicate sample) were collected from Douglas (14 samples), Frost (1 sample), and Flint creeks (2 samples) (Tables 4, 8, 9; Figures 4, 5). Sampling locations generally followed those pre-

determined in the FSP with some exceptions, which are outlined in Section 3.0 of the SAR (UOS 2011b). The background surface water sampling locations (Photos 40 and 41) and a selection of photos of other surface water sampling locations (Photos 42, 43, 44, 45, and 46) are shown in Appendix B.

6.2.3 Sediment Samples

Seventeen sediment samples (includes 2 background samples) were collected from Douglas (14 samples), Frost (1 sample), and Flint creeks (1 sample), and the drainage below the Contact Mill east tailings (1 sample), which was not flowing at the time of the assessment (Tables 4, 10; Figure 3). Two adit sediment samples are discussed separately in Section 6.2.1 above. Sampling locations generally followed those pre-determined in the FSP with some exceptions, which are outlined in Section 3.0 of the SAR (UOS 2011b).

The background sediment sampling locations (Photos 40 and 41) and a selection of photos of other sediment sampling locations (Photos 42, 43, 44, 45, 46) are shown in Appendix B. No sediment could be collected from the downstream Flint Creek location due to safety concerns related to high and fast flowing water (Photos 38, 39).

6.3 SAMPLE METHODS

6.3.1 Soil and Sediment Source Sampling

Soil and sediment source samples were collected in accordance with procedures described in UOS TSOP 4.16, “Surface and Shallow Depth Soil Sampling” and UOS TSOP 4.17, “Sediment Sampling” (UOS 2005b), respectively. Disposable, dedicated plastic scoops were used for soil and sediment collection (Photo 47). All soil and sediment samples were collected as biased grab samples from the 0- to 2-foot depth interval. Discrete sample locations for soils were determined in the field based upon field screening with a field-portable Innov-X *Omega*TM XRF (Photo 28). Using the XRF, metals concentrations at a number of locations in an area of interest (e.g. the ‘east end’ of a tailings pile) were compared to known approximate background concentrations, and then a sample for laboratory analysis was collected from the location showing the highest average concentration of metals of interest (e.g. arsenic and lead).

At sediment sampling locations, co-located surface water samples were collected prior to the collection of sediment so as to minimize the entrainment of sediment into the water. Soil and sediment samples for total metals were placed in appropriate sample containers and were stored on ice to $< 4^{\circ}\text{C}$. All sampling locations were photographed and their locations recorded with the GPS (Photo 23).

6.3.2 Aqueous Source and Surface Water Sampling

Surface water sampling was conducted according to UOS TSOP 4.18, “Surface Water Sampling” (UOS 2005b). START personnel measured general water quality parameters, including pH, temperature, and electrical conductivity of each sample using a Eutech Instruments PCSTestr 35 Model multi-parameter instrument (Photo 48), as described in TSOP 4.14 “Water Sample Field Measurements” (UOS 2005b). All field data was recorded in the field logbooks (Appendix C). Field instrumentation was calibrated daily and all calibration and field data were recorded in a field logbook. All aqueous source and surface water samples designated as dissolved metals were filtered by using a peristaltic pump to draw the water directly through a 0.45 micrometer (μm) filter with disposable dedicated Tygon[®] tubing into the sample bottle. Water samples were collected directly from the source into the sample bottle. All samples were preserved with nitric acid to a pH < 2 and stored on ice immediately after collection. Sampling was generally conducted from the farthest downstream location to the farthest upstream location to minimize the potential for cross-contamination. The sample locations were photographed and recorded with a GPS (Appendix B) (UOS 2011b).

7.0 ANALYTICAL RESULTS

7.1 ANALYTICAL PARAMETERS

The surface soil/source, surface water, and sediment samples collected during this site assessment were analyzed by the following methods:

- Total TAL metals in soil and sediment samples by method CLP-SOW ISMO1.2 – ICP-AES CRQL;
- Dissolved and total TAL metals in surface water samples by CLP-SOW ISMO1.2 ICP-MS CRQL; and

- Low-level total mercury in surface water samples by method E245.1 (Cold-Vapor Atomic Absorption [CVAA]).

7.2 ANALYTICAL DATA – COMPARISON OF RESULTS TO BACKGROUND AND SCREENING BENCHMARKS

The sample data collected during this SI were reviewed using the HRS guidelines for analytical interpretation (Office of the Federal Register 1990). The analytical data is listed in Tables 5 through 10. Elevated concentrations of contaminants reported as 3 times or more above background contaminant values are noted in the analytical results tables and are determined by sample concentrations based on the following:

- If the background analyte concentration is greater than its Sample Quantitation Limit (SQL), and if the release sample analyte concentration is greater than its SQL, 3 times greater than the background, and 5 times greater than the blank concentration; and
- If the background analyte concentration is not greater than its SQL and if the release sample analyte concentration is greater than its SQL, greater than the background Contract Required Detection Limit (CRDL), and 5 times greater than the blank analyte concentration.

Analytical results are also compared to environmental benchmark values. Soil source samples were compared to Superfund Chemical Data Matrix (SCDM) Reference Dose Screening Concentration (RDSC) and Cancer Risk Screening Concentration (CRSC) benchmark values. Analytical results for dissolved metals in surface water and aqueous source samples were compared to SCDMs environmental benchmarks for freshwater for the surface water pathway (i.e., acute criteria maximum concentrations [CMCs] and chronic criteria continuous concentrations [CCCs]) (Tables 6, 9) (EPA 2004). Analytical results for total metals in surface water and aqueous source samples were compared to MDEQ acute and chronic aquatic life standards for freshwater (Tables 6, 8) (MDEQ 2010).

SCDMs benchmarks for dissolved cadmium, copper, lead, nickel, silver, and zinc have been adjusted for an average hardness value (equivalent CaCO_3) of 65.4898, as computed from calcium and magnesium concentrations from all surface water and aqueous source samples analyzed for dissolved metals as part of this assessment. Calculations were performed as outlined in footnote E of the SCDM (EPA 2004). MDEQ standards for total cadmium, copper, lead,

nickel, silver, and zinc have been adjusted for an average hardness value (equivalent CaCO_3) of 75.147 as computed from calcium and magnesium concentrations from all surface water and aqueous source samples analyzed for total metals as part of this assessment. Calculations were performed as outlined in footnote 12 of the MDEQ Circular DEQ-7 Montana Numeric Water Quality Standards (MDEQ 2010).

While no benchmarks have been established for sediment within the SCDM, analytical results for sediment were compared to EPA Region 3 Freshwater Sediment Screening Benchmarks for screening purposes (Tables 7, 10). As these benchmarks are not part of the HRS guidelines, these screening results cannot be used to assess the site under the HRS, but rather to assist in the evaluation of potential impacts to sensitive species and environments.

For soil source samples (Table 5), analytical results that are greater than 3 times the background soil value are highlighted (showing observed contamination for the soil exposure pathway). For all source samples (Tables 5, 6, 7), analytical results which exceed a benchmark are indicated by an open star (☆). For release samples (Tables 8, 9, 10) results which exceed the background concentration by 3 times and are in excess of a benchmark (i.e. ‘Level 1 concentrations’) are indicated by a closed star (★). Release sample results that exceed the background concentration by 3 times but are not in excess of a benchmark (i.e. ‘Level 2 concentrations’), or there is no benchmark available, are indicated by an open star (☆). Sample quantitation limits are included in the validation reports in Appendix E.

All CLP laboratory data were validated by a third party subcontracted chemist at TechLaw, Inc. Data for total mercury in water were not validated as there were no detections of mercury in any of the samples at the reporting limit of 0.01 $\mu\text{g/L}$. No significant data quality issues were identified and the CLP Form 1 documents, data reports from Energy Laboratory, data validation reports, and chains-of-custody are presented under separate cover in Appendix E.

“J” qualified data used to document background conditions (Table 1), as well as an observed release (Tables 8, 9, 10) and observed contamination for the soil exposure pathway (Table 5), was adjusted for low, high, or unknown bias as per the EPA guidance document: EPA 540-F-94-028 “Using Qualified Data to Document an Observed Release and Observed Contamination” (EPA 1996).

Data gathered as part of this SI indicates that the surface water pathway is affected by metals in mining sources in the Douglas Creek sub-basin of the PMA.

7.3 SELECTION OF BACKGROUND LOCATIONS AND VALUES

In order to determine representative background conditions, a total of three background soil and two co-located background surface water and sediment locations were chosen in areas within the Douglas Creek sub-basin believed to be located outside the area of influence of mining activities, but still within an area of similar geology and affecting the same target population (Figures 2-5). The three background soil/source sample locations (PMA_DC_SO_01_0611, PMA_DC_SO_02_0611, and PMA_DC_SO_03_0611) (Photos 49, 50, 51) were located on a parcel of unleased National Forest land to the north of the Granite Mountain area (Figure 2). While a historical adit was identified in the field near (within a few hundred feet) the suggested PMA_DC_SO_02_0611 sampling location, that specific location was moved above the adit to an area that appeared to be undisturbed by mining activities (Photo 50).

Regardless of the presence of the adit, the concentrations of metals in all three samples were comparable (Table 5). The highest concentrations of metals of interest were split between samples PMA_DC_SO_02_0611 (e.g., highest concentrations of antimony, arsenic, copper, lead, mercury, silver) and PMA_DC_SO_03_0611 (e.g., highest concentrations of aluminum, cadmium, manganese, nickel, zinc). The highest background value of each of the three selected locations was taken as the investigation background value for evaluation of the site (Table 1).

The two background surface water/sediment sample locations were both collected from the south branch of Douglas Creek, as flow in the north branch largely originated from the New Departure adit (Photos 40, 41) (Figures 3-5). The most upstream background sample (PMA_DC_SW/SE_01A_0611) was collected at a point approximately 3,000 feet due south of the Granite Mountain waste rock pile on the south side of a ridge separating the south branch from the north branch. The most downstream background sample (PMA_DC_SW/SE_01B_0611) was also located on the southern branch of Douglas Creek, immediately upstream of its confluence with the northern branch and about 4,000 feet southeast of the Granite Mountain waste rock pile. The highest background value from either of the two locations was taken as the investigation background value for evaluation of the surface water pathway (Tables 1, 6, 7, 8, 9, 10).

The chosen background concentrations for the most commonly elevated metals from the study area are shown in Table 1 below. Background values utilized by the MDSL and MDEQ for the Abandoned Hard Rock Mine Priority Sites program are shown for soil source values, while values from 2009 sampling event conducted by the MDEQ TMDL programs are also shown for sediment and surface water:

**Table 1
 Background Concentrations of Elevated Metals**

	Sb	As [§]	Cd	Cu	Pb	Mg	Mn	Hg	Ag	Zn
Soil Source (mg/kg)										
UOS (this study)	5.8 UJ	60.7	0.60 UJ	11.9	76.4	5,800	538 J (667)	0.49	6.4	81.5
MDSL/MDEQ* (1994, 1996)	4 UJ	25 J	0.5 U	9.8	9	NR	1,230	0.161J	NR	41
Sediment (mg/kg)										
UOS (this study)	0.92 J	11.4	0.4 J	5.8	6.0	3,520	329 J (408)	0.028 J (0.051)	0.91 U	21.5 (32.3)
MDEQ (2011e)**	NR	< 1	< 0.2	< 5	< 5	NR	NR	NR	NR	< 5
Surface Water (µg/L)										
UOS (this study) total metals	0.54 J	1.8	1.0 U	2.0 U	1.0 U	1,030	8.1	0.01 U	1.0 U	0.61 J (0.79)
UOS (this study) dissolved metals	0.52 J	1.6	1.0 U	2.0 U	1.0 U	1,020	7.3	NA	1.1 J (1.6)	1.8 J
MDEQ (2011e)**	NR	< 3	NR	< 1	< 0.5	< 1,000	8	< 10	NR	< 10

§ The Montana DEQ Remediation Division uses a generic action level of 40 mg/kg for arsenic in residential surface soil. Note that this action level is below the chosen background value for arsenic for this study.

* Precise sample location unknown, but listed as “20-110-SS-1 from the Granite Mountain Mine.”

** Samples collected by MDEQ TDML program from Station ID: DOUGLASC-P04, at essentially the same location as the UOS “upper” background co-located surface water/sediment sample. Sediment results are from 8/12/2008 and surface water results are from 6/2/2009.

(X.X) Corrected Value as per EPA 540-F-94-028 “Using Qualified Data to Document an Observed Release and Observed Contamination” (EPA 1996).

NE Metal not elevated in media.

NR Not reported.

NA Not analyzed.

mg/kg milligrams per kilogram

7.4 SOIL SOURCE (MINING WASTE) SAMPLE RESULTS

Sixteen soil source samples were collected from seven different mining waste piles and three background locations (Tables 1, 4, 5; Figure 2). The background samples as discussed in detail in Section 7.3 above.

When compared to the investigation background values, numerous metals are elevated above 3 times above background concentrations in all source samples collected (Table 5). The most common elevated metals were antimony, copper, and silver (exceedances in 11 of 13 samples), followed by arsenic (10 of 13), lead (8 of 13), and zinc (7 of 13). Other metals that were elevated above 3 times background in at least four source samples included cadmium, mercury, and selenium.

Concentrations of arsenic exceeded both the SCDMs RDSC and CRSC benchmarks in 12 of 13 soil/source samples, and concentrations of antimony exceeded the SCDM RDSC in 10 of 13 samples. There were no other SCDM benchmark exceedances for those metals that have a benchmark available. While there are no SCDM benchmarks for copper, iron, lead, manganese or thallium, the analytical results of one source sample exceeded the RSL for copper in residential soil of 3,100 milligrams per kilogram (mg/kg), one source sample result for iron exceeded the RSL for iron in residential soils of 55,000 mg/kg, six source samples exceeded the EPA RSL for lead in residential soil of 400 mg/kg, three results exceeded the RSL for manganese in residential soil of 1,800 mg/kg, and six source samples exceeded the RSL for thallium in residential soil of 0.78 mg/kg (Table 5).

The Montana DEQ Remediation Division uses a generic action level of 40 mg/kg for arsenic in residential soil. It is noted that this concentration is lower than the background arsenic concentration of 60.7 mg/kg chosen for this study (Table 1). Concentrations of arsenic exceeded this generic action level in 11 of 13 soil/source samples.

An analysis of the analytical data from soil/source samples reveals the following:

- Concentrations of arsenic in all three background samples exceeded the SCDM CRSC benchmark, and two of the three samples exceeded the SDCM RDSC benchmark;
- The Bi-Metallic/Old Red tailings sample PMA_DC_SO_06_0611 (Photo 29) contained the highest concentrations of arsenic (35,400 mg/kg), cadmium (38.6 mg/kg), and zinc (5,270 mg/kg) than any other source sample;
- The samples from the Contact Mill east tailings contained the highest concentrations of copper (up to 13,400 mg/kg) and magnesium (up to 17,800 mg/kg) of any source samples;

- The highest concentrations of lead (up to 7,240 mg/kg) from source samples were associated with the historical Bi-Metallic mill tailings (samples PMA_DC_SO_16_0611 and PMA_DC_SO_17_0611) (Photos 22, 23).
- Concentrations of metals, in particular cadmium, copper, mercury, and zinc, varied greatly between the two source samples collected from the Contact Mill East tailings (PMA_DC_SO_14_0611 and PMA_DC_SO_15_0611), likely reflecting the varied sources of ore processed in the mill; and
- Concentrations of antimony, arsenic, lead, and silver were much lower in both source samples collected from the Contact Mill East tailings (PMA_DC_SO_14_0611 and PMA_DC_SO_15_0611) than those in other source samples.

7.5 AQUEOUS SOURCE (ADITS AND SEEPS) SAMPLE RESULTS (TOTAL AND DISSOLVED METALS)

Five aqueous source samples were collected from two adits and two seeps (Tables 4, 6; Figure 2):

- PMA_DC_SW_17_0611 and its duplicate PMA_DC_SW_89_0611 (analyzed for mercury only), collected from the New Departure adit (Photos 36, 37);
- PMA_DC_SW_13_0611, collected from the Granite Mountain/Bi-Metallic adit (Photo 26)];
- PMA_DC_SW_15_0611, collected from the seep at the east end of the Douglas Creek west tailings pile (Photo 18); and
- PMA_DC_SW_16_0611, collected from the seep at the west end of the Douglas Creek west tailings pile (Photo 17).

Aqueous source samples were not compared to surface water background results.

Analytical results from the aqueous source sample collected from the New Departure adit did not exceed any of the environmental benchmarks.

Analytical results for dissolved metals from the aqueous source sample collected from the Granite Mountain/Bi-Metallic adit exceeded the SCDM acute CMC and chronic CCC benchmarks for cadmium and zinc; as well as the chronic CCC for iron. The results for total metals exceeded both the MDEQ chronic and acute benchmarks for arsenic, cadmium, copper, and zinc; and the chronic benchmark for aluminum and iron (Table 6).

For the seep at the east end of the Douglas Creek west tailings, only dissolved silver exceeded the SCDMs acute CMC benchmark.

Analytical results for total metals from the aqueous source sample collected from the seep at the west end of the Douglas Creek west tailings pile exceeded both the MDEQ acute and chronic benchmarks for aluminum, arsenic, cadmium, copper, lead, and zinc; the acute benchmark for silver; and the chronic benchmark for iron. The analytical results for dissolved metals from this location exceeded the SCDMs chronic CCC benchmark for arsenic, copper, and lead (Table 6).

An analysis of the analytical data from aqueous source samples reveals the following:

- Discharge from the New Departure adit generally appears to be much less contaminated than the other three aqueous sources, with arsenic being the only metal elevated greater than 3 times the background surface water values;
- Discharge from the seep at the west end of the Douglas Creek west tailings pile contained the highest concentrations of aluminum (4,550 µg/L), antimony (116 µg/L), arsenic (2,100 µg/L), chromium (4.4 µg/L), copper (129 µg/L), lead (825 µg/L), and silver (55.0 µg/L) of any water sample collected during this investigation;
- Discharge from the seep at the east end of the Douglas Creek west tailings pile contained fewer elevated metals than the western seep (5 elevated metals versus 12 for the western seep), as well as fewer metals occurring at much lower concentrations, than those in the seep at the west end of the pile;
- Discharge from the Granite Mountain/Bi-Metallic adit contained the highest concentrations of cadmium (6.1 µg/L), cobalt (13.4 µg/L), magnesium (25,100 µg/L), manganese (28,900 µg/L), and zinc (4,790 µg/L) of any water sample collected during this investigation; and
- There appears to be an unidentified source of arsenic, lead, and zinc contamination to surface water below the New Departure adit, but above the Granite Mountain and Bi-Metallic/Old Red sources.

7.6 SEDIMENT SOURCE (ADIT) SAMPLE RESULTS

Two sediment source samples (PMA_DC_SE_17_0611 and its replicate PMA_DC_SE_89_0611) were collected from the New Departure adit (Tables 4, 7; Figure 2). Sediment was not collected from the Granite Mountain/Bi-Metallic adit.

There are no SCDMs benchmarks for sediment. However, when compared to the EPA Region III Freshwater Sediment Screening Benchmarks, concentrations of arsenic and manganese in both samples exceeded sediment benchmarks.

7.7 SURFACE WATER RELEASE SAMPLE RESULTS (TOTAL METALS)

Fifteen surface water release samples for total metals were collected as part of the assessment, including 12 samples from Douglas Creek, 1 sample from Frost Creek, and 2 samples from Flint Creek (Tables 4, 8; Figure 4). The background surface water samples for total metals are discussed in detail in Section 7.3 above.

When compared to the investigation background values for total metals in surface water, the most common elevated metals were arsenic (exceedances in 14 of 15 samples), followed by lead and zinc (13 of 15), and manganese (12 of 15). Other results for total metals that were elevated above 3 times background in at least four surface water release samples included antimony, cadmium, iron, magnesium, and nickel (Table 8).

Concentrations of total lead exceeded the MDEQ aquatic life standards in 13 of 15 surface water release samples, and total copper exceeded these standards in 12 of 15 samples. The only other metals to exceed MDEQ standards were zinc (7 of 15) and cadmium (4 of 15). Both acute and chronic aquatic life standards for were exceeded for zinc in every surface release sample collected below the Granite Mountain/Bi-Metallic adit discharge. The acute standard for copper was exceeded in one sample (PMA_DC_SW_21_0611) collected below the Granite Mountain and Bi-Metallic/Old Red PPE. Chronic standards were also exceeded in nearly all surface water release samples for copper and lead. The chronic standard for cadmium was exceeded in four release samples.

A background surface water sample was not collected from Frost Creek as it was outside the scope of this investigation. Nevertheless, for comparative purposes, total arsenic, lead, magnesium, and zinc were all elevated in the surface water sample PMA_DC_SW_18_0611 collected within Frost Creek (just above its confluence with Douglas Creek) when compared to the Douglas Creek background surface water values. In addition, the concentration of zinc in the sample exceeded the MDEQ acute and chronic aquatic life standards, and lead in the sample exceeded the MDEQ chronic aquatic life standards (Table 8).

As discussed above in Section 6.2, access to the land parcel where Douglas Creek enters Flint Creek was not granted by the land owners, so attribution sampling locations on Flint Creek upstream (PMA_DC_SW_23_0611) and downstream (PMA_DC_SW_22_0611) of its confluence with Douglas Creek had to be located a significant distance away from the confluence (Figures 4, 5). While the sample collected from Flint Creek below Douglas Creek showed concentrations of total arsenic and manganese elevated over the upstream Flint Creek sample, given the lack of attribution sampling closer to the confluence of the two creeks it cannot be said with certainty that Douglas Creek is the sole source of the elevated concentrations⁷.

Nevertheless, for comparative purposes, and assuming that the elevated concentrations originate in Douglas Creek, concentrations of total arsenic in the downstream Flint Creek sample are also elevated greater than 3 times the chosen background concentration in Douglas Creek.

No detections of total mercury were noted in any of the water samples sent to the private laboratory for analysis. The reporting limit for the method used was 0.01 µg/L (Appendix E).

Finally, the analytical data from surface water samples analyzed for total metals appears to show that there is an unknown source of antimony, arsenic, copper, lead, and zinc contamination to surface water below the New Departure adit, but above the Granite Mountain and Bi-Metallic/Old Red sources.

7.8 SURFACE WATER RELEASE SAMPLE RESULTS (DISSOLVED METALS)

Fifteen surface water release samples for dissolved metals were collected as part of the assessment, including 12 samples from Douglas Creek, 1 sample from Frost Creek, and 2 samples from Flint Creek (Tables 4, 9; Figure 5). The background surface water samples for dissolved metals are discussed in detail in Section 7.3 above.

When compared to the investigation background values for dissolved metals in surface water, the most common elevated metals were arsenic (exceedances in 14 of 15 samples), followed by zinc (13 of 15) and manganese (10 of 15). The only other results for dissolved metals that were elevated above 3 times background in at least four surface water release samples were those for copper (Table 9).

⁷ For example, Fred Burr Creek enters Flint Creek below the upstream sampling location and the confluence with Douglas Creek.

Concentrations of dissolved zinc exceeded the SCDMs acute CMC and chronic CCC environmental benchmarks in 7 of 15 surface water release samples. Concentrations of dissolved copper exceeded the acute CMC standard in one sample and the chronic CCC standard in four samples. The only other metal result to exceed a SCDMs benchmark was cadmium, which exceeded the SCDM chronic CCC benchmark in one sample.

A background surface water sample was not collected from Frost Creek as it was outside the scope of this investigation. Nevertheless, for comparative purposes, no dissolved metals were elevated in the surface water sample PMA_DC_SW_18_0611 collected within Frost Creek (just above its confluence with Douglas Creek) when compared to the Douglas Creek background surface water values for dissolved metals (Table 9). The concentration of dissolved zinc in this sample exceeded both the acute and chronic SCDMs benchmarks.

As discussed above in Section 6.2, access to the land parcel where Douglas Creek enters Flint Creek was not granted by the land owners, so attribution sampling locations on Flint Creek upstream (PMA_DC_SW_23_0611) and downstream (PMA_DC_SW_22_0611) of its confluence with Douglas Creek had to be located a significant distance away from the confluence (Figures 4, 5). While the sample collected from Flint Creek below Douglas Creek showed concentrations of dissolved arsenic elevated over the upstream Flint Creek sample, given the lack of attribution sampling closer to the confluence of the two creeks it cannot be said with certainty that Douglas Creek is the sole source of the elevated concentrations⁸.

Nevertheless, for comparative purposes, and assuming that the elevated concentrations originate in Douglas Creek, concentrations of dissolved arsenic in the downstream Flint Creek sample are also elevated greater than 3 times the chosen background concentration in Douglas Creek.

As with total metals, the analytical data from surface water samples analyzed for dissolved metals appears to show that there is an unknown source of antimony, arsenic, copper, and zinc contamination to surface water below the New Departure adit, but above the Granite Mountain and Bi-Metallic/Old Red sources.

⁸ For example, Fred Burr Creek enters Flint Creek below the upstream sampling location and the confluence with Douglas Creek.

7.9 SEDIMENT RELEASE SAMPLE RESULTS

Fifteen sediment release samples were collected as part of the assessment, including 12 samples from Douglas Creek, 1 sample from Frost Creek, 1 sample from below the Contact Mill east tailings pile, and 1 sample from Flint Creek collected above its confluence with Douglas Creek (Tables 4, 10; Figure 3). The background samples are discussed in detail in Section 7.3 above.

When compared to the investigation background values for metals in sediment, the most common elevated metals were arsenic, copper, lead, mercury, silver, and zinc (exceedances in 12 of 15 samples), followed by manganese (11 of 15), and cadmium (10 of 15). The only other results for metals in sediment release samples that were elevated above 3 times background in at least four release samples were those for antimony (Table 10).

There are no SCDMs benchmarks for sediment. However, when compared to the EPA Region III Freshwater Sediment Screening Benchmarks, concentrations of numerous metals, including antimony, arsenic, cadmium, copper, lead, manganese, mercury, silver and zinc, in most sediment release samples exceeded sediment benchmarks (Table 10, Figure 3).

A background sediment sample was not collected from Frost Creek as it was outside the scope of this investigation. Nevertheless, when compared to the Douglas Creek background sediment samples, concentration of antimony, arsenic, cadmium, copper, lead, magnesium, manganese, mercury, silver, thallium, and zinc were elevated in the sediment sample PMA_DC_SE_18_0611 collected within Frost Creek just above its confluence with Douglas Creek.

As discussed above in Section 6.2, access to the land parcel where Douglas Creek enters Flint Creek was not granted by the land owners, so sampling locations on Flint Creek upstream and downstream from its confluence with Douglas Creek had to be collected from locations some distance away. In addition, as no sediment sample could be collected from Flint Creek downstream of Douglas Creek due to safety concerns related to high and fast water, no comparison can be made for the upstream sediment sample collected from Flint Creek above its confluence with Douglas Creek. Nevertheless, when compared to the Douglas Creek background sediment samples; this upstream sediment sample did not have any elevated concentrations of metals.

The analytical data from sediment samples also reveals the following:

- There appears to be an unidentified source of antimony, arsenic, cadmium, copper, lead, manganese, mercury, silver, and zinc contamination to sediments in Douglas Creek below the New Departure adit, but above the Granite Mountain and Bi-Metallic/Old Red sources.
- Significantly higher concentrations of mercury in sediments were identified at and upstream of the Granite Mountain/ Bi-Metallic/ Old Red source area.
- The sediment sample from Frost Creek contained the highest concentrations of cadmium, magnesium, and zinc of any sediment sample collected.
- The highest concentrations of antimony and lead in sediments were found within the sediment sample below the Contact Mill east tailings, although both samples collected from this potential source had concentrations of these metals below background concentrations.

8.0 PATHWAY ANALYSIS

8.1 SOURCES AND WASTE CHARACTERIZATION

Previously identified potential sources along Douglas Creek include seven mining waste piles, two flowing adits, and two seeps (Figure 2). These potential sources, along with their estimated quantities or volumes, are summarized (from downstream to upstream) as follows:

Mining Waste Piles:

- Historical Bi-Metallic Mill tailings (reclaimed): 909,000 ft² (MDEQ 2011h);
- Contact Mill east tailings: 301,500 ft² (MDEQ 2011b);
- Douglas Creek waste rock: 76,000 cubic yards (yd³) (MDEQ 1996);
- Douglas Creek west tailings (reclaimed): 107,000 yd³ (MDEQ 1994, 2011f);
- Douglas Creek east tailings: 61,000 yd³ (MDEQ 1994, MDEQ 2011f);
- Bi-Metallic/Old Red waste rock and tailings: 13,000 yd³ waste rock and >280 yd³ tailings (MDEQ 1994); and
- Granite Mountain waste rock and tailings: 53,000 yd³ waste rock and 8,000 yd³ tailings (MDEQ 1994).

Adit Discharges:

- Granite Mountain/Bi-Metallic adit: approximately 50 gallons per minute (gpm) (MDEQ 1994); and
- New Departure adit: approximately 60 gpm (MDEQ 1994).

Seeps Associated with a Tailings Pile:

- Douglas Creek west tailings pile, eastern seep: approximately 10 gpm (Pioneer 2004); and
- Douglas Creek west tailings pile, western seep: < 2 gpm (Pioneer 2004).

Source sample locations are displayed in Figure 2 and discussed in Table 4 and Section 7 above. All source sample results are displayed in Tables 5, 6, and 7. Photographs of the sample locations are presented in Appendix B.

8.1.1 Historical Bi-Metallic Mill Tailings

The historical Bi-Metallic Mill tailings pile is the most downstream source investigated (Photos 1, 21, 22, 23). The pile is located approximately 1 mile south-southeast of the town of Philipsburg (Figure 2) and sits at an elevation of approximately 5,400 feet amsl. According the MDEQ, these tailings were reclaimed in the 1980s as a condition of the original Contact Mill discharge permit (MDEQ 2011b). While the volume of the tailings pile could not be determined in the field as representative depth measurements could not be gathered, from aerial photographs the surface area of the pile is estimated to be approximately 101,000 yd².

The pile appeared to be unlined and had a grass cover that was in generally good condition, but appeared to be unmaintained. In some areas the cover vegetation appeared to be stressed, and no vegetative cover was present in an area that also appears to be occasionally inundated (Photo 1). Covering material consisted of topsoil 2 to 12 inches thick. No geotextile cover was noted beneath the topsoil, and no functioning leachate collection and removal system associated with the pile was observed (Appendix C).

Although there is a channel constructed through the middle of the pile for run-on control, Douglas Creek has been diverted around the pile through a flume (Photo 43). The channel through the pile was dry at the time of the site inspection. Water that falls on the tailings pile would most likely percolate downward through the pile.

Metals observed in both of the tailings samples (PMA_DC_SO_16_0611 and PMA_DC_SO_17_0611) at concentrations greater than 3 times the background values include antimony, cadmium, copper, lead, selenium, and silver. Arsenic concentrations in both samples exceeded SCDM RDSC and CRSC benchmarks. Antimony concentrations in both samples exceeded the SCDM RDSC benchmark, and concentrations of lead exceeded the EPA residential RSL (Table 5). No historical analytical data regarding the waste characteristics of the historical Bi-Metallic tailings could be found for comparison to these results.

8.1.2 Contact Mill East Tailings

The Contact Mill east⁹ tailings pile¹⁰ is located within a surface impoundment about 500 feet due south of the historical Bi-Metallic Mill tailings pile (Figure 2) and sits at an elevation of approximately 5,540 feet amsl (Photos 2, 3, 4, 24). The volume of tailings within the Contact Mill east tailings pile is unknown, but the total surface area of the impoundment is approximately 33,500 yd² (MDEQ 2011b). At its closest point, the toe of the impoundment dam is approximately 150 feet from Douglas Creek. At the time of the sampling activities, tailings slurry was being actively pumped into the Contact Mill east tailings impoundment berm (Photo 3) and the tailings within the impoundment were largely covered with water (Photo 2).

According to the MDEQ, the east tailings pile of the Contact Mill is unlined and the leakage/infiltration is the mode of waste water discharge from the pile. A portion of the waste water is apparently recirculated back to the mill. CMC contends that the “slime fraction” (fine particles) of the discharge has effectively sealed the impoundment within

⁹ A second tailings impoundment [west] exists for this facility, but as it is sited within a different drainage from Douglas Creek, it has not been included as a potential source in this investigation.

¹⁰ This source was referred to as a “surface impoundment” in the FSP and SAR, but more closely matches the HRS definition of a “pile” (pile = slurries deposited with the intention of dewatering the waste and accumulating a large pile of wastes in one area). As such, this source will be considered a pile from henceforth (see Highlight 4-1, page 44 of the HRS Guidance Manual (EPA 540-R-92-026)).

which the tailings lie. However, the MDEQ contends that the impoundment ultimately discharges to groundwater through infiltration (MDEQ 2011b).

During the time of the investigation, tailings were being pumped from the mill up onto the eastern berm of the pond, being released from a pipe that was mounted on the back of a small bulldozer (Photo 3). As the tailings were being pumped onto the crest of the berm, a portion of the tailings slurry was being transported down the berm wall and towards Douglas Creek (Photo 4). This is direct evidence of hazardous substance migration of the tailings from the impoundment. A sediment sample (PMA_DC_SE_11_0611) was collected within the PPE, adjacent to the Creek, but no liquid was reaching the Creek at the time of the site inspection.

Concentrations of metals, in particular cadmium, copper, mercury, and zinc, varied greatly between the two source samples (PMA_DC_SO_14_0611 and PMA_DC_SO_15_0611) collected from the Contact Mill East tailings, likely reflecting the varied sources of ore processed in the mill. The only metal observed in both of the samples at concentrations greater than 3 times the background values was copper, although concentrations of beryllium, cadmium, selenium, and zinc were elevated in at least one of the two samples. Arsenic concentrations in both of the samples exceeded the SCDM CRSC benchmark, and the RDSC benchmark for arsenic was also exceeded in one of the samples (Table 5). While historical analytical data from the tailings within the Contact Mill east tailings impoundment were not available, wastewater discharge quality results have documented elevated concentrations of arsenic, copper, lead, and zinc (MDEQ 2011b).

8.1.3 Douglas Creek Waste Rock

The Douglas Creek Waste Rock pile is located approximately 0.6 mile southeast and upstream of the Contact Mill east tailings pile and sits at an elevation of approximately 5,720 feet amsl (Figure 2; Photos 5, 25). The volume of waste rock was estimated by the MDSL to be 76,000 yd³ (MDSL 1994), and the pile has a total surface area of approximately 11,400 yd².

The Douglas Creek Waste Rock pile did not have a cover and was sparsely vegetated with pine trees (Photo 5). No evidence of an engineered liner was observed and no

functioning leachate collection and removal system associated with the pile was noted. The southern edge of the waste rock pile is, in places, less than 20 feet distant from Douglas Creek; however, whether or not an observed release (i.e., erosion of the pile into the creek) was occurring or had previously occurred was not documented by the field team during the site inspection.

Metals observed in both of the waste rock samples (PMA_DC_SO_12_0611 and PMA_DC_SO_13_0611) at concentrations greater than 3 times the background values include antimony, arsenic, and silver. Copper and lead were both elevated in only one of the samples. Arsenic concentrations in both samples exceeded both SCDM RDSC and CRSC benchmarks. Antimony in one of the samples exceeded the SCDM RDSC benchmark (Table 5).

One source (soil) sample was collected from the Douglas Creek waste rock site by the MDEQ in 1995. Levels of arsenic, lead, and mercury were elevated above 3 times background in the sample (MDEQ 1996).

8.1.4 Douglas Creek West Tailings

The Douglas Creek west tailings pile is located about 1,200 feet east and upstream of the Douglas Creek waste rock pile (Figure 2) and sits at an elevation of approximately 5,855 feet amsl (Photos 7, 27). It is one of two reclaimed tailings piles that together were referred to historically as the “Douglas Creek tailings.”¹¹ The volume of the west tailings pile has been estimated to be approximately 107,000 yd³ (MDEQ 2011f), and the reclaimed tailings cover an estimated area of 16,940 yd². The exact volume of the pile could not be determined during this assessment as the boundaries of the piles were not well-defined and representative depth measurements could not be gathered. Although the precise edge of the reclaimed tailings could not be determined, Douglas Creek flows immediately at the base of the pile.

The tailings were reclaimed as part of a project conducted by the MDEQ Mine Waste Cleanup Bureau in 2000. The reclamation project involved the excavation, relocation,

¹¹ As they exist as two distinct and separate piles, they will be treated as separate sources under the HRS and for the purposes of this investigation. MDSL (1994) named the downstream pile “Tailings Pile 1” or TP1, and the upstream pile “Tailings pile 2” or TP2. For clarity, the downstream (western) pile has been named the ‘Douglas Creek west tailings pile’ and the upstream (eastern) pile has been named the Douglas Creek east tailings pile for this report.

and consolidation of the west and east tailings piles into two separate lined repositories. Each repository was graded and then covered with a geomembrane, a drainage layer, and 2 feet of cover soil. The repository for the Douglas Creek west tailings was constructed largely on the south slope of Douglas Creek, and the stream channel was routed around the repository via a lined channel. Groundwater intercept drains and an impermeable cap were added to the consolidated waste area.

The Douglas Creek west tailings pile was confirmed to have generally sound grass cover overlying 6 inches of topsoil with an underlying geotextile cover, although some areas of pile showed evidence of erosion of the surficial materials. What appeared to be tailings were observed uncovered near the eastern end of the Douglas Creek west tailings pile, possibly due to erosion of covering material (Photo 7). The sample collected from this material (PMA_DC_SO_11_0611) contained concentrations of antimony, arsenic, cadmium, copper, lead, manganese, silver, and zinc greater than 3 times the background values. The arsenic concentration in this sample exceeded both the SCDM RDSC and CRSC benchmarks and the antimony concentration in this sample exceeded the SCDM RDSC benchmark. Concentrations of manganese and thallium exceeded the EPA residential RSL (Table 5).

In 1993, the MDSL collected two composite samples from the Douglas Creek west tailings pile. Antimony, arsenic, cadmium, copper, lead, manganese, mercury, nickel, and zinc were all elevated at least 3 times the background soil concentration (MDSL 1994).

8.1.5 Douglas Creek East Tailings

The Douglas Creek east tailings pile is located about 1,200 feet east-northeast and upstream of the Douglas Creek west tailings (Figure 2) and sits at an elevation of approximately 6,000 feet amsl (Photos 6, 8, 19). It is one of two reclaimed tailings piles that together were referred to historically as the “Douglas Creek tailings.” The volume of the west tailings pile has been estimated to be approximately 61,000 yd³ (MDEQ 2011f) and the reclaimed tailings cover an estimated area of 14,520 yd². The exact volume of the pile could not be determined during this assessment as the boundaries of the piles were not well-defined and representative depth measurements could not be gathered. Although the precise edge of the reclaimed tailings could not be determined, Douglas Creek flows immediately at the base of the pile.

The tailings were reclaimed as part of a project conducted by the MDEQ Mine Waste Cleanup Bureau in 2000. The reclamation project involved the excavation, relocation, and consolidation of the west and east tailings piles into two separate lined repositories. Each repository was graded and then covered with a geomembrane, a drainage layer, and 2 feet of cover soil. The repository for the Douglas Creek east tailings was constructed largely on the north slope of Douglas Creek, and the stream channel was routed around the repository via a lined channel. Groundwater intercept drains and an impermeable cap were added to the consolidated waste area.

The Douglas Creek east tailings pile was confirmed to have generally sound grass cover overlying 6 inches of topsoil with an underlying geotextile cover, although some areas of pile showed evidence of erosion of the surficial materials (Photo 6). Logging operations appear to have possibly uncovered tailings (Photo 8) at the Douglas Creek east tailings. A sample collected from this material (PMA_DC_SO_09_0611) contained concentrations of antimony, arsenic, manganese, silver, and zinc greater than 3 times the background values. The arsenic concentration in this sample exceeded both the SCDM RDSC and CRSC benchmarks and the antimony concentration in this sample exceeded the SCDM RDSC benchmark. Concentrations of manganese and thallium exceeded the EPA residential RSL (Table 5).

In 1993, the MDSL collected three composite samples from the Douglas Creek east tailings pile. Antimony, arsenic, cadmium, copper, lead, manganese, mercury, and zinc were all elevated at least 3 times the background soil concentration (MDSL 1994).

8.1.6 Bi-Metallic/Old Red Waste Rock and Tailings

The Bi-Metallic/Old Red waste rock and tailings pile is located 0.6 mile east-northeast and upstream of the Douglas Creek east tailings (Figure 2) (Photos 9, 10, 11, 28, 29, 30, 31, 47). The Bi-Metallic/Old Red area is intimately associated with the Granite Mountain site to the northeast (both spatially and historically), and may possibly be considered a single source area. The majority of the mining waste is waste rock that occurs in various sparsely vegetated, convoluted lobes and mounds (Photo 28) covering approximately 62,000 yd². The toe of the lowest lobe of material sits at approximately 6,650 feet amsl while the top of the waste occurs at a flattened area at about 6,780 feet amsl.

The volume of the waste rock has been estimated previously to be approximately 13,000 yd³ (MDSL 1994). Exact volumes of the Bi-Metallic/Old Red waste piles could not be determined during this assessment as the horizontal and vertical boundaries of the piles were complex and convoluted (Photo 9), and discrete depths at various points across the piles could not be determined.

There are at least two milling areas associated with the Bi-Metallic/Old Red area, and there is an unknown quantity of tailings present at the site. The milling areas are both located on the western side of the area. A shallow depression, possibly a former tailings pond, was noted in the northeastern corner of the Bi-Metallic/Old Red area¹² (Photo 29). The tailings appeared to be comingled with the surrounding waste rock, and determining an exact volume of material was not possible, although the MDSL has previously estimated that there are approximately 280 yd³ covering 140 yd². Tailings from the mills were slurried down a dry tributary to Douglas Creek and were probably the source of the Douglas Creek east and west tailings piles (MDSL 1994). During field activities, a decomposed wooden flume was noted extending from the southwest corner of the Bi-Metallic/Old Red mining waste piles west to Douglas Creek (Photo 13), a distance of approximately 1,000 feet. Tailings that had spilled from the flume were documented throughout its length with the field-portable XRF, including immediately adjacent to Douglas Creek (Photo 53). The sample PMA_DC_SE_21_0611, collected from Douglas Creek at a point the flume intersects Douglas Creek, contained elevated concentrations of antimony, arsenic, cadmium, copper, lead, manganese, mercury, silver, and zinc, documenting an observed release.

The Bi-Metallic waste had no cover, and no evidence of a liner or associated leachate collection and removal system was noted. Active erosion gulleys were present on all piles (Photo 10), and the toe of the Bi-Metallic/Old Red waste rock pile had lobes of material stretching up to 100 feet downslope from the base of the pile towards Douglas Creek (Photo 11).

Two samples of waste rock (PMA_DC_SO_07_0611 and PMA_DC_SO_07A_0611) were collected in the source area. Both of these samples contained concentrations of antimony, arsenic, copper, and silver greater than 3 times the background values. One of

¹² This area was included as part of the Granite Mountain site in the MDSL priorities sites inventory, but as it is more closely associated spatially to the Bi-Metallic/Old Red source area, it was included there in this investigation.

the samples was also elevated greater than 3 times the background value for lead and mercury. Arsenic concentrations in both samples exceeded both the SCDM RDSC and CRSC benchmarks and the antimony concentration in both samples exceeded the SCDM RDSC benchmark. Concentrations of thallium in both samples exceeded the EPA residential RSL (Table 5).

One sample collected from the tailings located in the northeast corner of the source area (PMA_DC_SO_06_0611) contained concentrations of antimony, arsenic, beryllium, cadmium, copper, iron, lead, manganese, mercury, selenium, silver, and zinc elevated at least 3 times background soil values. The arsenic concentration in the tailings sample exceeded both SCDM RDSC and CRSC benchmarks, and antimony exceeded the SCDM RDSC benchmark. Iron, lead and manganese concentrations exceeded their respective EPA residential RSL (Table 5).

In 1993, the MDSL collected two samples of waste rock and two samples of tailings from the Bi-Metallic/Old Red site. Antimony, arsenic, cadmium, copper, mercury, lead, and zinc were all elevated at least 3 times background soil concentrations. For the tailings samples, the same metals, plus manganese, were elevated at least 3 times the background soil concentrations (MDSL 1994).

8.1.7 Granite Mountain Waste Rock and Tailings

The Granite Mountain waste rock and tailings area is located directly east-northeast of the Bi-Metallic/Old Red area, and the two are intimately related both spatially and historically (Figure 2; Photos 9, 12, 14, 15, 16, 32, 33, 34, 35). The majority of the mining waste is present in a continuous but convoluted pile of unvegetated waste rock containing approximately 53,000 yd³ and covering over 26,500 yd² (MSDL 1994). Farther downslope to the east is a distinct pile that the MSDL listed as a tailings pile, containing approximately 8,000 yd³ and covering an estimated 2,000 yd² (MSDL 1994). The toe of the tailings pile is located at approximately 6,820 feet amsl, while the top of the waste rock occurs approximately 250 feet higher, at about 7,070 feet amsl.

The Granite Mountain piles had no cover and no evidence of a liner or associated leachate collection and removal system. A recently formed sinkhole measuring

approximately 10 feet deep by 12 feet in diameter was noted in the southeast corner of the Granite Mountain tailings (Photo 12). The sinkhole contained water in the bottom.

Two source samples were collected from this area, one sample from near the top of the main waste rock pile (PMA_DC_SO_04_0611) and one on the west side of the lower tailing pile (PMA_DC_SO_05_0611). The concentrations of metals in both samples were very similar, with antimony, arsenic, copper, lead, mercury, silver, and zinc being elevated greater than 3 times the background values in both samples. Cadmium was elevated above background in one of the samples. Arsenic concentrations in both samples exceeded both SCDM RDSC and CRSC benchmarks, and antimony concentrations in both samples exceeded the SCDM RDSC benchmark. Lead and thallium concentrations in both samples exceeded their respective EPA residential RSLs (Table 5).

In 1993, the MDSL collected one sample from the waste rock. Antimony, arsenic, copper, lead, mercury, and zinc were all elevated at least 3 times the background soil concentrations (MDSL 1994).

8.1.8 Granite Mountain/Bi-Metallic Adit

In 1896, the 8,850 foot long Douglas Creek tunnel was completed, which drained the Bi-Metallic mine at 1,000 feet and the Granite Mountain shaft at 1,460 feet. This tunnel is now referred to as the Granite Mountain/Bi-metallic adit (or the “Granite drain” by the MDEQ TDML program) (Photos 26, 45). The collapsed adit is located approximately 200 feet upstream of the Douglas Creek waste rock pile. This adit was noted to be flowing during the abandoned mine sites inventory conducted by MDSL in 1994 and 1995 and continues to discharge acid mine drainage into the creek to the present day (UOS 2011b). Flow from the adit was estimated to be approximately 50 gpm in October 1995 (MDEQ 1996), and again in 2011 (UOS 2011b). In June 2009, the MDEQ TDML program measured the flow from the adit to be approximately 170 gpm (MDEQ 2011e).

Sediment was not collected from the Granite Mountain/Bi-Metallic adit. UOS collected one sample of the aqueous discharge from the adit (PMA_DC_SW_13_0611). This sample contained the highest concentrations of total and dissolved cadmium (6.1 and 6.0 µg/L), total and dissolved magnesium (25,100 and 25,500 µg/L), total and dissolved manganese (28,900 and 29,200 µg/L), and total and dissolved zinc (4,790 and 4,880

µg/L) of any water sample collected during this investigation (Table 6). Concentrations of total arsenic, cadmium, copper, and zinc in this sample exceeded both MDEQ acute and chronic freshwater aquatic life standards, while concentrations of total aluminum and iron exceeded chronic aquatic life standards. Concentrations of dissolved cadmium and zinc exceeded both the SCDMs acute CMC and chronic CCC environmental benchmarks for fresh water, while the concentration of iron exceeded the SCDM chronic CCC benchmark.

When compared to a sample of the discharge collected by the MDEQ in 1995, the UOS sample concentrations are significantly higher for arsenic, cadmium, copper, magnesium, manganese, and zinc. When compared to two samples collected from the adit discharge in 2009 by the MDEQ TDML program, concentrations of metals in the UOS sample are generally similar or higher (MDEQ 2011e).

8.1.9 New Departure Adit

The New Departure adit is located approximately 2/3 mile southeast from the Granite Mountain Mine area (Photos 36, 37). Flow from this adit was measured at 63 gpm in June 2009 and 112 gpm in August 2009 (MDEQ 2011e). During the field assessment activities for this SI, discharge from the adit formed a significant portion of the flow of the northern branch of Douglas Creek and was estimated to be approximately 60 gpm.

UOS collected two aqueous samples of the discharge from the New Departure adit, PMA_DC_SW_17_0611 and its duplicate PMA_DC_SW_89_0611 (analyzed for mercury only), as well as two sediment samples, PMA_DC_SE_17_0611 and its replicate PMA_DC_SE_89_0611 (analyzed for the full suite of TAL total metals) (Tables 6, 7).

For the New Departure aqueous source sample, only arsenic was elevated greater than 3 times the background surface water value for Douglas Creek for both total and dissolved concentrations. There were no exceedances of any chosen environmental benchmarks for the sample. The sample concentration was non-detect at a reporting limit of 0.01 µg/L for mercury.

When compared to the investigation background values for sediment from Douglas Creek, only arsenic (in PMA_DC_SE_17_0611) and mercury (in the replicate PMA_DC_SE_89_0611) are elevated 3 times above background sediment concentrations

(Table 7). When compared to background soil concentrations (assuming that the sediment could become exposed during low discharge periods), there are no exceedances.

Discharge from the New Departure adit generally appears to be much less contaminated than the other three aqueous sources, with arsenic being the only metal elevated greater than 3 times the background surface water values. Historical analytical data from the MDEQ or MDSL were not available for comparison.

8.1.10 Douglas Creek West Tailings Pile, Western Seep

The seep located at the west end (near the terminus of the erosion control bales) (Photo 17) of the Douglas Creek West tailings pile was estimated to be flowing at approximately 10 gpm (UOS 2011b). UOS collected one sample (PMA_DC_SW_16_0611) of the discharge from the seep. Sediment was not collected.

The sample from the seep discharge contained concentrations of total aluminum, antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, magnesium, manganese, and zinc elevated greater than 3 times the background surface water values. Dissolved concentrations of antimony, arsenic, copper, magnesium, and zinc were also elevated. The sample contained the highest concentrations of total aluminum (4,550 µg/L), total antimony (116 µg/L), total arsenic (2,100 µg/L), total chromium (4.4 µg/L), total copper (129 µg/L), total iron (11,900 µg/L), total lead (825 µg/L), and total silver (55.0 µg/L) of any water sample collected during this investigation (Table 6). Concentrations of total aluminum, arsenic, cadmium, copper, lead, and zinc exceeded both MDEQ acute and chronic aquatic life standards, while concentrations of total silver exceeded the acute standard and concentrations of total iron exceeded the chronic standard. Concentrations of dissolved copper exceeded both SCDM acute CMC and chronic CCC benchmarks, while dissolved arsenic and lead concentrations exceeded the SCDM chronic CCC benchmark.

Historical analytical data from the MDEQ or MDSL was not available for comparison.

8.1.11 Douglas Creek West Tailings Pile, Eastern Seep

The seep located near the east end of the Douglas Creek west tailings pile (Photo 18) was estimated to be flowing at less than 2 gpm. UOS collected one sample (PMA_DC_SW_15_0611) of the discharge from the seep. Sediment was not collected.

The sample collected from the seep contained total arsenic, magnesium, manganese, and zinc, and concentrations of dissolved arsenic, magnesium, silver, and zinc all elevated at least 3 times the respective background surface water value for metals. The concentrations of metals in this sample were much lower than those within the sample collected from the seep at the west end of the tailings pile. The concentration of dissolved silver exceeded the SCDM acute CMC benchmark.

Historical analytical data from the MDEQ or MDSL were not available for comparison.

8.2 SURFACE WATER PATHWAY

The surface water pathway is the pathway most impacted by mining and milling activities in the Douglas Creek sub-basin. According to the current MDEQ “Prioritized Short List of Abandoned Mine Land Sites,” 3 of the top 20 problem mining sites in Montana, involving 4 of the potential sources investigated in this assessment, occur along Douglas Creek (MDEQ 2011c). Three tailings piles containing over 225,000 yd³ have been reclaimed within the sub-basin, but more than 140,000 yd³ of mining waste remains exposed, in some areas directly adjacent to the creek (MDEQ 2011c, f).

The sources of impact to surface water in the Douglas Creek sub-basin are adit and seep discharges, the migration of mining waste into the creek, and water flow over waste piles. The main inflows contributing to surface water contamination are the Granite Mountain/Bi-Metallic adit, two seeps associated with the reclaimed Douglas Creek west tailings pile, and to a lesser degree, the New Departure adit. There also appears to be an unknown source of surface water contamination located above the Granite Mountain area, but below the New Departure adit. The PPE that extends furthest downstream in Flint Creek from the various sources located in the Douglas Creek sub-basin is the PPE from the historical Bi-Metallic tailings pile (Figure 1).

Douglas Creek collects water from an area of about 3 square miles. Douglas Creek drains into Flint Creek at a point located approximately 1 mile to the west of Philipsburg (USGS 1996a).

Most of the flow in Douglas Creek is derived from snow melt. During the June 2009 site reconnaissance for the PA, UOS observed Douglas Creek to be running at approximately 10 to 20 cfs. During this time a flow of 109 cfs was given for Flint Creek at the Maxville gauge station located 11 miles upstream from Philipsburg. The average annual discharge of Flint Creek for the years 1942 through 2011, measured at the USGS station at Maxville (12329500) (at the end of the TDL) is 97.4 cfs (USGS 2012). The banks of Douglas Creek and Flint Creek are both within the 100-year floodplain (FEMA 2012).

There is no documentation of surface water intakes for drinking water use along Douglas Creek or Flint Creek within the aggregate 15-mile downstream limit. The closest town of any size on Flint Creek downstream of Philipsburg is Hall, population 152, located about 10 miles downstream of the terminus of the TDL. Regardless, according to records from Montana's GWIC, residents of Hall all appear to use groundwater as their potable water source.

No data regarding angling days per year within Douglas Creek was available from the Montana Department of Fish and Wildlife MFISH database¹³, although brown and westslope cutthroat trout have been historically reported within the first 1 mile of Douglas Creek upstream of its confluence with Flint Creek (MFWP 2012a). Flint Creek is a widely used fishery, however, with almost 4,200 angling days in 2009 along its 42.9 mile length. Specific angling data for the stretch of Flint Creek within the 15-Mile TDL was not available, although fishing was confirmed to occur just outside of the town of Philipsburg by a local fly fishing expert (UOS 2011c). A 2007 2-day fish population survey conducted from river mile 23.4 to 23.5 on Flint Creek (approximately 8 miles along the TDL), counted over 260 brown trout each survey, as well as rainbow and westslope cutthroat trout, and a single bull trout (MFWP 2012a). The bull trout is federally-listed as a threatened species. The westslope cutthroat trout is listed as a state species of special concern.

The MFISH database also shows that, beginning with its confluence with Douglas Creek and continuing downstream for a distance of 3.7 miles, habitat is degraded and overall fisheries resource value is reduced (MFWP 2012a). MFWP has conducted fish tissue sampling on Flint

¹³ It was mistakenly reported in the PA report for the PMA that Douglas Creek was fished an average of 45 days per year and the miles 0 to 1.5 are a Montana Fisheries Protected Area due to the presence of the westslope trout species. This data actually referred to another Douglas Creek, which is located approximately 20 miles downstream (northeast) of Philipsburg, which drains into Flint Creek in Granite County.

Creek and, based on elevated concentrations of mercury, has recommended that anglers limit the amount of brown trout, rainbow trout, and mountain whitefish consumed (MFWP 2012b).

The MNHP has completed provisional wetland mapping in the area. This mapping indicates that wetlands located along Douglas Creek, from the highest PPE below the Bi-Metallic/Old Red waste rock to Douglas Creek's confluence with Flint Creek, include: three freshwater emergent wetlands (wetlands code: PEMA, approximately 1.14 miles total length), two riparian shrub wetlands (code: Rp1SS, 0.375 mile total length), and one each of riparian emergent (code: Rp1EM, 0.25 mile in length), riparian forested (code: Rp1FO, 0.25 mile in length), and palustrine scrub/shrub wetlands (code: PSSA, 0.15 mile in length) (MNHP 2010) (Figures 3-5).

All of these wetlands exist in length of at least 0.1 mile¹⁴. The zone of observed contamination, as documented by chemical analysis of surface water and sediment samples collected during this investigation, stretches from the New Departure adit to just below the historical Bi-Metallic tailings pile, a distance of approximately 3.4 miles (Figures 3-5). Wetlands that appear to be HRS-eligible within this zone total approximately 1 mile, yielding 2 miles of wetlands frontage.

Flint Creek, below its confluence with Douglas Creek, is continuously bounded on both sides by freshwater emergent wetlands (PEMA and PEMC), with smaller lengths of freshwater scrub-shrub (PSSA) wetlands for the entire remaining 13.5 miles of the TDL (MNHP 2010). As such, if additional sampling conducted downstream of the historical Bi-Metallic tailings showed that the zone of observed contamination extended downstream into Flint Creek, the amount of wetlands frontage within the TDL would be greatly increased.

Sensitive or threatened environments or species were not observed during this site inspection.

Federally listed threatened, endangered, and candidate species known to or believed to occur in Granite County are presented below in Table 2. The threatened bull trout has been documented by the U.S. Fish and Wildlife Service (USFWS) to occur within the TDL. The wolverine and whitebark pine are both candidate species. The gray wolf and the bald eagle have both recently been delisted as endangered and are now considered a "recovered" species (USFWS 2012).

¹⁴ The zone of observed contamination, as documented by chemical analysis of surface water and sediment samples collected during this investigation, stretches from the New Departure adit to just below the historic Bi-Metallic tailings pile, a distance of approximately 3.4 miles. Wetlands that appear to be HRS-eligible within this zone total approximately 1 mile, yielding 2 miles of wetlands frontage. Additional sampling downstream of the historic Bi-Metallic tailings could greatly increase the length of the zone of observed contamination, greatly increasing the amount of wetlands frontage.

There are 14 Montana state-listed species of concern that have been verified to occur in Granite County and are at risk or at high risk (i.e., have been given a state rank of “S1” or “S2”) (MNHP 2012). These include the westslope cutthroat trout and the bull trout, which have both been documented to occur within the TDL for the site (MFWP 2012a). Seventeen plant species found in Granite County are also state-listed as at risk or at high risk (MNHP 2012).

TABLE 2
Threatened and Endangered Species Occurring in Granite County, Montana

Common Name	Scientific Name	Rank	Habitat
Mammals			
Canada Lynx	<i>Lynx canadensis</i>	T	Subalpine conifer forests
Grizzly Bear	<i>Ursus arctos</i>	T	Generalist
North American wolverine	<i>Gulo gulo luscus</i>	C	High-elevation areas with deep, persistent and reliable spring snow cover (to mid-May)
Fish			
Bull Trout	<i>Salvelinus confluentus</i>	T	Mountain streams, rivers, lakes
Plants			
Whitebark pine	<i>Pinus albicaulis</i>	C	Conifer forests

T = Threatened
 E = Endangered
 C = Candidate

UOS collected surface water release samples from Douglas Creek, adit and seep discharges, and Flint Creek in late June 2011. Two background surface water samples were collected from separate locations on the southern branch of Douglas Creek, upstream of any known historical mining activities. Analysis of the surface water release samples for total and dissolved metals indicates that concentrations of antimony, arsenic, copper, lead, manganese, and zinc were found at levels greater than 3 times background levels at the majority of locations sampled along Douglas Creek. The water sample collected from Flint Creek downstream of its confluence with Douglas Creek also showed concentrations of arsenic, lead, and manganese elevated greater than the upstream Flint Creek water sample. Surface water sampling locations are shown in Figures 4 and 5 and analytical results from release samples are shown in Tables 8 and 9.

UOS also collected sediment release samples from Douglas Creek, one adit, and from Flint Creek (upstream of Douglas Creek only). Two background sediment samples were co-located with the background surface water samples, on Douglas Creek upstream of any known historical mining

activities. Analysis of the sediment release samples for total metals indicates that concentrations of antimony, arsenic, cadmium, copper, lead, manganese, mercury, silver, and zinc were found at levels greater than 3 times background sediment levels at the majority of locations sampled along Douglas Creek. Sediment sampling locations are shown in Figure 3 and analytical results from release samples are shown in Table 10.

8.3 GROUNDWATER PATHWAY

The groundwater pathway was not evaluated as part of this investigation.

The city of Philipsburg does not obtain its water supply from groundwater. The current water supply is obtained from surface water. According to Dick Hoehne, Director of Public Utilities for the city of Philipsburg, the town has no municipal wells, and very few domestic wells, as the town has instituted a ban on them (UOS 2010). However, a few homeowners outside the city limits of Philipsburg do have domestic wells, as well as the few who had domestic wells within the city limits before the enactment of the well ban. Montana's GWIC has records of approximately 49 private domestic well permits within a 4-mile radius of the site (MBMG 2012).

It should be noted that while the Philipsburg Public Schools has a well on its property, according to Dick Hoehne, it is used solely for irrigation purposes.

UOS personnel observed the following residences in the Douglas Creek sub-basin area:

- One small cabin approximately 400 feet north of the Douglas Creek east tailings pile,
- one small cabin approximately 0.5 mile north of the Granite Mountain waste rock pile (Photo 20), and
- four houses located north of and adjacent to (within 200 feet of) the historical Bi-Metallic tailings pile (Photo 21).

The two small cabins did not appear to be continually occupied, and the owners were not present during the field activities. The houses located adjacent to the historical Bi-Metallic tailings pile appeared to be full-time residences. The drinking water source for these residences was not ascertained.

The average number of persons per household in Granite County, Montana is 2.08 (U.S. Department of the Interior, Bureau of the Census [U.S. Census Bureau] 2012). Assuming that

each domestic well serves one household, the total number of residents using groundwater within the 4-mile radius of the site can be calculated to be approximately 102 people (Table 3, below). The data from the Montana Department of Mines and Geology website does not provide information on the current status of each well within the 4-mile radius (MBMG 2012).

TABLE 3
Domestic Wells within a 4-Mile Radius of the Site

Radius (miles)	Number of Persons served by Domestic wells
0 – 0.25	0
0.25 – 0.50	2
0.50 – 1.0	4
1.0 – 2.0	29
2.0 – 3.0	23
3.0 – 4.0	44
Total	102

There are no records available of any water quality testing for any of these private domestic wells.

CMC installed three groundwater monitoring wells in the mill area in June and September 2011 (Contact Mining 2011). Wells were installed just below the east tailing impoundment dam (downgradient well MW1), just below the decant pond serving the west tailings impoundment (downgradient well MW3), and approximately 600 feet southeast of the west tailings impoundment (upgradient well MW2). Static water level was reported to be 5 feet bgs in MW3. Water levels from the other wells were not recorded. Results from a single monitoring event conducted in October 2011 appear to show that concentrations of cadmium and zinc in MW1 are elevated 3 times above background concentrations (from MW2), and exceed the MDEQ Human Health Standards for ground water.

A more in-depth investigation, including well sampling and testing, would need to be performed in order to confirm a release to the groundwater pathway.

8.4 SOIL EXPOSURE PATHWAY

The Douglas Creek sub-basin within the Philipsburg Mining Area has numerous sources of exposed mine waste. In June 2011, UOS collected soil samples from the surface of waste rock and tailings piles located within the sub-basin. The sources examined as a part of this investigation include the historical Bi-Metallic tailings, the East Contact Mill tailings, the Douglas Creek waste rock, exposed tailings at the east and west Douglas Creek reclaimed tailings piles, the Bi-Metallic/Old Red tailings and waste rock, and the Granite Mountain waste rock.

Most of the above sources lack covering material and are sparsely vegetated. Only the Douglas Creek east and west tailings piles are known to have liners beneath the waste. Access to the mining waste is not restricted in any way and is, in fact, encouraged by a tourist driving trail denoted the “Granite Mountain Way,” and the placement of picnic tables, benches, and interpretive signs. UOS witnessed numerous recreationists during the two weekdays it spent in the field, including vehicles driving over waste piles. Additional anecdotal evidence of recreational use of the mining area and specifically of the waste piles themselves included dirt bike tracks on the surface of the Granite Mountain waste rock, historical Bi-Metallic Mill tailings, and Bi-Metallic/Old Red piles, and discarded beer cans on the Granite Mountain waste rock. A hiker was observed near the Douglas Creek waste rock pile. There are a couple of cabins in the eastern part of the Douglas Creek sub-basin that do not appear to be continually occupied and a limited number of houses located adjacent to the historical Bi-Metallic tailings pile. About half of Philipsburg’s 930 residents reside within 1 mile of the historical Bi-Metallic tailings pile, but only three or four houses exist within 200 feet of the pile.

8.5 AIR PATHWAY

The air pathway was not evaluated as a part of this site reassessment because of the very low population density in the Douglas Creek sub-basin and the fact that the ground surface is snow-covered for approximately 4 months out of the year.

9.0 DATA QUALITY ANALYSIS

9.1 DATA QUALITY OBJECTIVES

The EPA DQO Process is a seven-step systematic planning approach to develop acceptance or performance criteria for EPA-funded projects. Based on information provided by the EPA and

MDEQ, an understanding of the nature of the site (i.e., historical mining activities) and the potential sources present (tailings and waste rock piles located adjacent to Douglas Creek, and seeps and adits that drain into Douglas Creek), and the potential risks associated with the hazardous substances likely present in the sources, the project team identified the surface water pathway and possibly the soil exposure and groundwater pathways as pathways of potential concern. These risks and pathways of concern are presented in the Conceptual Site Model in Appendix D, and described in more detail in the Data Quality Objectives Seven-Step Planning Approach, presented in Appendix A.

Surface water and sediment samples were used to determine if there was a significant release of contaminants in the surface water pathway. Soil samples were collected from waste sources to identify the hazardous substances present in the mining waste and to determine the potential for contamination in Douglas Creek by flow over this waste.

This SI was prompted by the ongoing concern of degraded water quality in Douglas Creek and Flint Creek due to the unremediated mining waste and discharges. Previous sampling events have documented an observed release of metals from these sources. The principal goal of this study was to confirm that contamination from the sources along Douglas Creek has migrated into the environment where it is impacting potential environmental and/or human health targets in the surface water pathway.

The primary study questions that were answered by the results of this investigation were:

1. Determining if waste piles and draining adits contained elevated concentrations of metals;
2. Determining if surface waters and sediments in Douglas Creek and Flint Creek were impacted by sources at former mine and milling sites;
3. Determining if environmental sample concentrations of metals exceed applicable benchmarks; and
4. Determining if elevated concentrations of metals identified in the surface water and sediments are attributable to the sources at the former mine and milling sites.

Eighteen surface water samples (includes 2 background and 1 duplicate) and 17 sediment samples (includes 2 background samples) were collected in late June 2011 from Douglas Creek, Frost

Creek, and Flint Creek in an effort to attribute contamination in Douglas Creek and Flint Creek to various mining waste sources.

Sixteen soil/source samples (includes 3 background samples), 2 sediment source samples (includes 1 replicate), and five aqueous source samples (includes 1 duplicate) were collected in June 2011 from the potential sources along Douglas Creek.

All analytical data have been reviewed and verified to ensure that data is acceptable for the intended use (Appendix E). The Data Quality Objectives for this project have been met and the data collected are of sufficient quality to answer the study questions.

9.2 DATA VALIDATION AND INTERPRETATION

All data analyzed by the CLP RAS laboratory (ALS Laboratory Group) were validated by a third party subcontracted chemist from TechLaw, Inc. according to the document “EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,” dated January 2010 (EPA 2010). Raw data were reviewed for completeness and transcription accuracy on to the summary forms. Approximately 10 to 20 percent of the results reported in each of the samples, calibrations, and quality control analyses were recalculated and verified. If problems were identified during the recalculation of results, a more thorough calculation check was performed.

There were six sample data groups: MH30A0, MH30A9, MH30B0, MH30C9, MH30D0, MH30E2. Each data group has a corresponding data validation package. There were some qualifications applied to each data package associated with this sampling event. Descriptions of each qualification are summarized in the Review Narrative Summary at the front of each package and detailed in various subsequent review sections. In brief, the reasons given for data qualification were blank contamination, negative blank contamination, ICP interference, matrix spike recovery issues, and that serial dilution criteria were not met.

All data are deemed acceptable for use as qualified in the data validation reports. The data validation reports, laboratory form “1s,” chains-of-custody, and SQL calculations are presented in Appendix E.

10.0 MEASUREMENT QUALITY OBJECTIVES

10.1 FIELD QUALITY CONTROL PROCEDURES

All samples were handled and preserved as described in UOS TSOP 4.2, “Sample Containers, Preservation, and Maximum Holding Times.” Calibration of the pH, temperature, and conductivity meters followed instrument manufacturers’ instruction manuals and UOS TSOP 4.14, “Water Sample Field Measurements.” Sample collection generally progressed from downstream to upstream to prevent cross-contamination (UOS 2005b).

The following samples were collected to evaluate quality assurance at the site in accordance with the “Guidance for Performing Site Inspections under CERCLA,” Interim Final September 1992, the “Region 8 Supplement to Guidance for Performing Site Inspections under CERCLA,” and the UOS Generic QAPP (EPA 1992, 1993; UOS 2005a):

- One double-volume sediment sample and one triple volume surface water sample were collected at the PMA_DC_SW/SE_01A_0611 location and used for a MS/MSD. (The extra volume samples were not labeled as separate samples.)
- One field surface water duplicate was collected at the PMA_DC_SW_09_0611 location. The duplicate sample, labeled PMA_DC_SW_99_0611, was blind to the lab. Samples were collected for both total and dissolved metals. The percent difference between both the total metals water samples and the dissolved metals water samples was 2 percent.
- One field sediment replicate was collected at the PMA-DC-SE-17_0611. The replicate sample, labeled PMA_DC_SE_89_0611, was blind to the lab. The percent difference between the sediment samples was 9 percent.

The UOS Generic QAPP serves as the primary guide for the integration of QA/QC procedures for the START contract (UOS 2005a).

10.2 DATA QUALITY ASSESSMENT

Quality attributes are qualitative and quantitative characteristics of the collected data. The principle quality attributes to environmental studies are bias, sensitivity, precision, representativeness, comparability, and completeness. Data quality indicators (DQIs) are specific

indicators of quality attributes. The following DQIs were considered during the review of field collection techniques and field QA/QC results, as well as laboratory QA/QC:

10.2.1 Bias

Bias is systematic or persistent distortion of a measurement process that causes errors in one direction. The extent of bias can be determined by an evaluation of laboratory initial calibration/continuing calibration verification, laboratory control samples, interference checks, spike duplicates, blank spike, MS/MSD, method blank, and trip blank.

A review of the validation forms for soil, sediment, and water samples analyzed for metals detected a high bias in the data set MH30A0 for antimony, beryllium, cadmium, sodium, and thallium; in the data set MH30C9 for beryllium; in the data set MH30D0 for beryllium and silver; and in the data set MH30E2 for beryllium, cadmium, sodium, and thallium. There was a positive interference for these metals in the ICP interference check samples. However, these results, with the exception of silver, were not qualified as “J+” if the results were also qualified as not detected due to blank contamination. For silver, bias was not assigned because the result was also qualified with both a positive and a negative bias.

Due to negative blank contamination, a negative bias was assigned for mercury in data set MH30A0; for vanadium in data set MH30A9; for potassium and vanadium in data set MH30B0; for cadmium, lead, nickel, silver, and vanadium in data set MH30C9; for cadmium, cobalt, iron, lead, manganese, nickel, and silver in data set MH30D0; and for mercury in data set MH30E2.

10.2.2 Sensitivity

Sensitivity generally refers to the capability of a method or instrument to discriminate between small differences in analyte concentration and is generally discussed as detection limits. Before sampling begins, it is important to compare detection limits and project requirements in order to select a method with the necessary detection limits to meet the project goals. The detection limits are described in the analytical methods.

All detection limits met the CLP requirements; therefore, all sensitivity requirements for the project were met.

The MDEQ-7 water quality standard for total mercury in surface water is 0.05 µg/L, lower than the CRQL for the CLP Program (0.2 µg/L). In order to compare potential impacts from the mining area to the Montana water quality standard, MDEQ requested that samples be collected and analyzed using a method with a lower detection limit (reporting limit for all samples was 0.01 µg/L) for total mercury MDEQ 2011g). At the EPA's request, UOS procured a private laboratory, Energy Laboratories, Inc. in Billings, Montana, to perform the low-level total mercury analysis.

There were no detections of mercury at the reporting limit of 0.01 µg/L in any of the samples.

10.2.3 Precision

Precision is the measure of agreement among repeated measurements of the same property under identical, or substantially similar, conditions and is expressed as the relative percent difference (RPD) between the sample pairs. The field duplicate and MS/MSD were used to evaluate precision.

The average RPD was 2 percent for the surface water samples and 9 percent for sediment samples. Results are generally deemed acceptable if the RPD between the sample pairs is < 35% for soils and sediments, and < 20% for waters. The only result outside of the acceptable range was an RPD of 63% for silver between the water sample PMA_DC_SW_09_0611 and its duplicate PMA_DC_SW_99_0611. The concentrations of silver were at or near the detection limit for these two samples. RPD results are presented in Table 11.

10.2.4 Representativeness

Representativeness is the measure of the degree to which data accurately and precisely represent a characteristic of a population parameter, variations at a sampling point, a process condition, or an environmental condition. Representativeness was achieved by adherence to TSOPs for sampling procedures, field and laboratory QA/QC procedures, appropriateness of sample material collected, analytical method and sample preparation, and achievement of acceptance criteria documented in the FSP for the project. Various deviations from the FSP were documented within Section 3.0 of the SAR (UOS 2011b) and are listed again below:

- The background surface water/sediment sample location was moved from the north branch of Douglas Creek, to the south branch, as flow in the north branch largely originated from the New Departure adit.
- The background soil/source sample locations were moved farther north to unleased National Forest land in an effort to reduce the possibility of surface contamination from the mining and milling areas.
- Two surface water/sediment sample locations were added at the confluence of Douglas Creek and Frost Creek in order to determine the contaminant contribution of Frost Creek.
- Two surface water/sediment sampling locations were added along Flint Creek to assess an observed release from Douglas Creek. Due to the landowner refusing access, Flint Creek could not be sampled immediately adjacent to its confluence with Douglas Creek. As such, the upstream Flint Creek location was located approximately 3.5 miles upstream of the confluence, and the downstream location was located approximately 0.5 mile downstream. No sediment could be collected from the downstream Flint Creek location due to safety concerns related to high and fast water.
- Only one source sample was collected from each Douglas Creek tailing pile (two each were planned), as only one location where tailings appeared to be exposed was identified at each pile.
- An additional soil/source sample was collected from the Bi-Metallic/Old Red waste rock source from a lobe of material that appeared possibly to have a different origin from the other material.

10.2.5 Comparability

Comparability is the qualitative term that expresses the confidence that two data sets can contribute to common interpretation and analysis and is used to describe how well samples within a data set, as well as two independent data sets, are interchangeable.

This is the first data set gathered from the Douglas Creek area for the EPA. While it was expected that comparability would be controlled by collecting all samples in one sampling event for this site, lack of access to the area where Douglas Creek meets Flint

Creek precluded this. Data from previous sampling events by the MDEQ is not expected to be used except for comparative purposes.

All samples were sent to a CLP laboratory or a private laboratory (total mercury in water only), and all CLP data were validated (Appendix E). All samples were collected using the same FSP, TSOPs, and sampling equipment; therefore, all sample data from this event are internally comparable. These same methods and procedures will be used during any future sampling events to ensure comparability.

10.2.6 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system and is measured using the formula: *Percent Completeness = (Number of Valid Measurements / Number of Planned Measurements) x 100*. Excluding the opportunity samples that were added in the field, the percent completeness for this project was 82 percent. When adding the five opportunity samples collected in the field, the percent completeness increases to 92 percent. Samples were generally collected in accordance with the FSP, except for instances where access could not be gained, or where conditions in the field were different than expected or unsafe (e.g., the third reported seep not being located, high water was creating unsafe sampling conditions for the collection of sediment at the PMA_DC_SE_22_0611 location).

The following is a list of locations that were not sampled:

- Flint Creek immediately upgradient of its confluence with Douglas Creek (access not granted);
- Flint Creek immediately downgradient of its confluence with Douglas Creek (access not granted);
- Douglas Creek immediately upgradient of its confluence with Flint Creek (access not granted);
- A second source sample location on the Douglas Creek east tailings pile (only one location where tailings appeared to be exposed was identified on the pile); and,

- A second source sample location on the Douglas Creek east tailings pile (only one location where tailings appeared to be exposed was identified on the pile).

11.0 DATA GAPS

Upon completion of field work for this project and the receipt of analytical data, several key data gaps concerning the surface water pathway have emerged. These include the need for:

- Further sampling of surface water and sediment within Douglas Creek to identify the source of metals contamination located between the New Departure adit and the PPE for the Granite Mountain and Bi-Metallic/Old Red mining waste piles;
- Collection of attribution surface water and sediment samples directly at the confluence of Douglas Creek and Flint Creek;
- Collection of additional surface water and sediment samples from Flint Creek below its confluence with Douglas Creek to document the downstream extent of the observed release from Douglas Creek;
- Field delineation and expert determination of HRS-eligible wetlands (i.e., meeting the definition of a wetlands as outlined in 40 CFR 230.0) along Douglas Creek and Flint Creek within the 15-mile TDL;
- Collection of precise volume estimates of mining waste piles; and
- Documentation of human fish consumption along the 15-mile TDL.

Additional data gaps for the groundwater and soil exposure pathways include the need to:

- Document potable water source for residences near the historical Bi-Metallic tailings pile and collect samples to evaluate ground water exposure pathway and potential targets; and
- Collect surface soil samples from residential properties located within 200 feet of the historical Bi-Metallic Mill tailings pile.

12.0 SUMMARY

The Philipsburg Mining Area is located in west-central Montana, to the east of the town of Philipsburg, Montana, in Granite County. None of the mines in the area is currently active, although one mill (Contact Mill) is sporadically in production. Douglas Creek is one of four drainage basins within the mining area.

Previously identified potential sources within the Douglas Creek sub-basin include seven mining waste piles, and discharges from two adits and two seeps. Three of the mining waste piles have undergone reclamation in the past. These potential sources, listed from downstream to upstream, are the historical Bi-Metallic Mill tailings (reclaimed), the Contact Mill east tailings (active tailings pile), the Douglas Creek waste rock, the discharging Granite Mountain/Bi-Metallic adit, the “western” Douglas Creek west tailings pile seep, the Douglas Creek west tailings (reclaimed), the “eastern” Douglas Creek west tailings pile seep, the Douglas Creek east tailings (reclaimed), the Bi-Metallic/Old Red waste rock and tailings, the Granite Mountain waste rock and tailings, and the discharging New Departure adit. The MDEQ compiles problem former mining sites across the state into the “Prioritized Short List of Abandoned Mine Land Sites.” The Granite Mountain waste rock and tailings, the Bi-Metallic/Old Red waste rock and tailings, and the Douglas Creek waste rock the (this site includes both the waste rock and the Granite Mountain/Old Red adit discharge) are all listed in the top 20 priority sites for the program. Three tailings piles containing over 225,000 yd³ have been reclaimed within the sub-basin, but more than 140,000 yd³ of mining waste remains exposed, in some areas directly adjacent to the creek.

Appropriate background values for determining if metals concentrations in mining waste sources were determined by the collection of three background soil locations and using the highest background value from the three locations for each analyte as the investigation background. When compared to the investigation background values, the most common metals that were elevated greater than 3 times above background concentrations were antimony, arsenic, cadmium, copper, lead, manganese, mercury, silver, and zinc.

Aqueous source samples showed that the Granite Mountain/Bi-Metallic adit and a seep located near the west end of the Douglas Creek west tailings are both contributing concentrations of aluminum, arsenic, cadmium, copper, magnesium, manganese, and zinc to Douglas Creek at levels greater than 3 times the background surface water concentrations.

The surface water pathway is the pathway most impacted by mining and milling activities in the Douglas Creek sub-basin. Appropriate background values for surface water and sediment were determined by

selecting two background locations on the south branch of Douglas Creek above known mining sites (the north branch of Douglas Creek largely originated from discharge from the New Departure adit) and using the highest background value from the two locations for each analyte as the investigation background. An observed release of antimony, arsenic, cadmium, copper, lead, magnesium, manganese, mercury, silver, and zinc to the surface water pathway is documented from the surface water and sediment results of samples collected from Douglas Creek in late June 2011.

Concentrations of total copper and lead exceeded the MDEQ aquatic life standards in the majority of surface water release samples collected. The only other metals to exceed MDEQ standards were zinc (7 of 15) and cadmium (4 of 15). Concentrations of dissolved zinc exceeded the SCDMs environmental benchmarks in 7 of 15 surface water release samples, and dissolved copper exceeded these standards 4 of 15 samples. The only other metal result to exceed a SCDMs benchmark was cadmium (1 of 15).

Concentrations of total and dissolved arsenic in a sample collected from Flint Creek downstream of its confluence with Douglas Creek also exceeded the SCDMs benchmark for arsenic, although an attribution surface water sample could not be collected from Flint Creek directly above the confluence due to lack of access.

Concentrations of arsenic, copper, lead, manganese, mercury, silver, and zinc, were all elevated greater than 3 times the background values in all 12 sediment release samples collected within Douglas Creek. Antimony and cadmium were both elevated greater than 3 times the background values in 11 of 12 sediment release samples. While there are no applicable SCDM benchmarks for metals in sediments, the concentrations of numerous metals, including antimony, arsenic, cadmium, copper, lead, manganese, mercury, silver and zinc in most sediment release samples exceed EPA Region 3 Freshwater Sediment Screening Benchmarks.

An attribution sediment sample could not be collected from Flint Creek directly above the confluence due to lack of access, and a sediment sample co-located with the downstream Flint Creek surface water sample could not be collected from Flint Creek downstream of Douglas Creek due to safety concerns related to high and fast water.

Environmental targets have been identified within the reach of Douglas Creek that is documented to have releases from the identified sources (from New Departure adit downstream to just below the historical Bi-Metallic tailings). These targets include an estimated 2 miles of potentially HRS-eligible wetland frontage. While only the last mile of Douglas Creek (i.e., below the historical Bi-Metallic tailings pile and

between Philipsburg and Flint Creek) appears to be a fishery, Flint Creek below the confluence with Douglas Creek is an active fishery where fish are caught and probably consumed by sports fishermen. MFWP has conducted fish tissue sampling on Flint Creek and, based on elevated concentrations of mercury, has recommended that anglers limit the amount of brown trout, rainbow trout, and mountain whitefish consumed. Flint Creek downstream of Douglas Creek is continuously bounded on both sides by freshwater emergent wetlands, with smaller patches of freshwater scrub-shrub, for the remaining 13.5 miles of the TDL. The federally listed threatened bull trout has been documented to occur within the TDL. Additional sampling is needed to confirm that identified environmental and human health targets within Flint Creek exist within an area documented to have been affected by releases from the Douglas Creek sources.

There is no documentation that surface water from Douglas Creek and Flint Creek within the 15-mile downstream limit is used as a source of drinking water.

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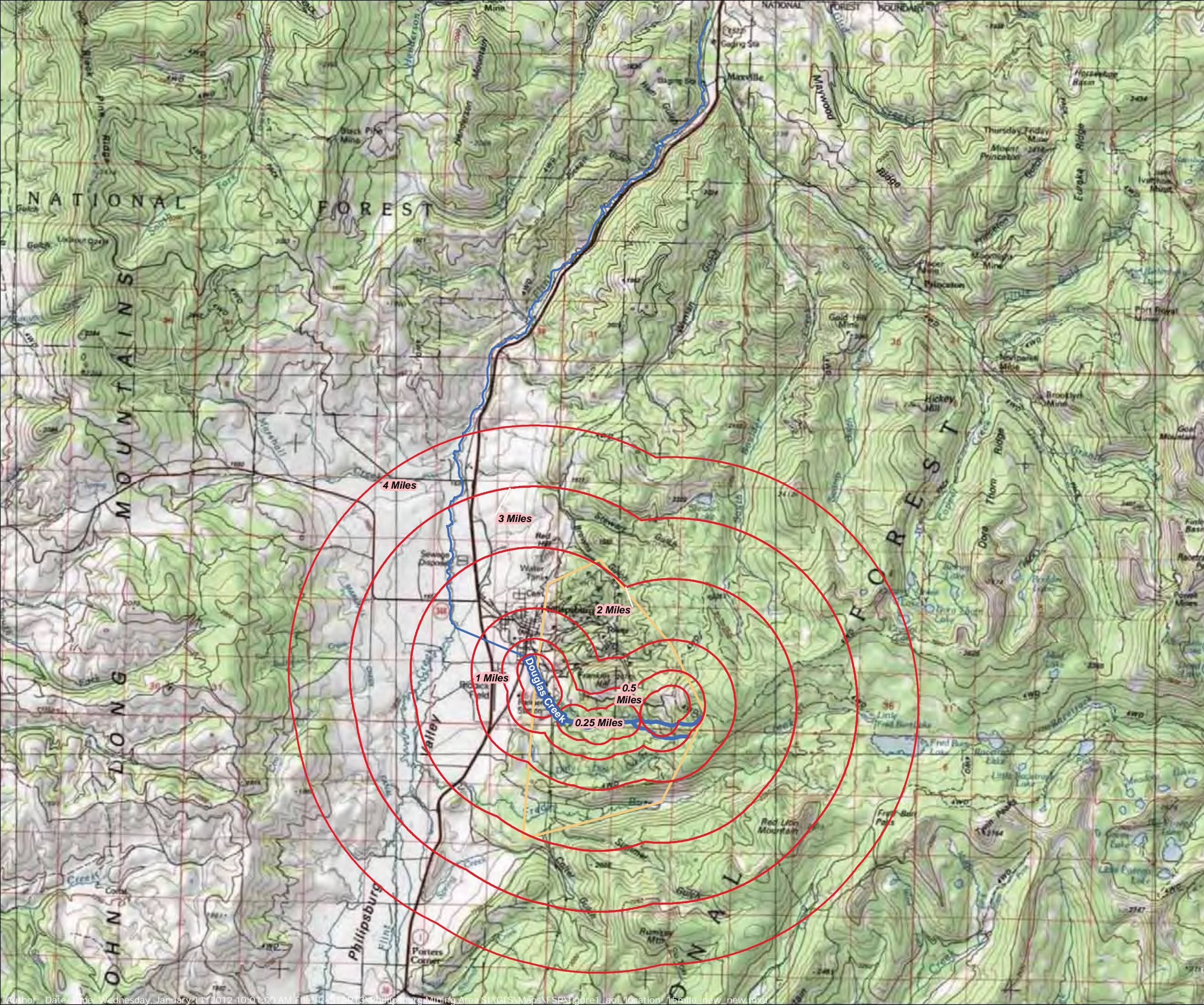
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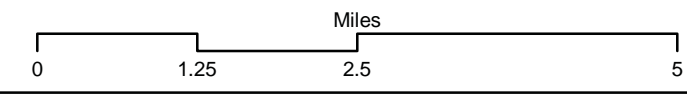
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- Legend**
- Douglas Creek 15 - Mile Target Distance Limit
 - 4 - Mile Area of Influence
 - Phillipsburg Mining Area

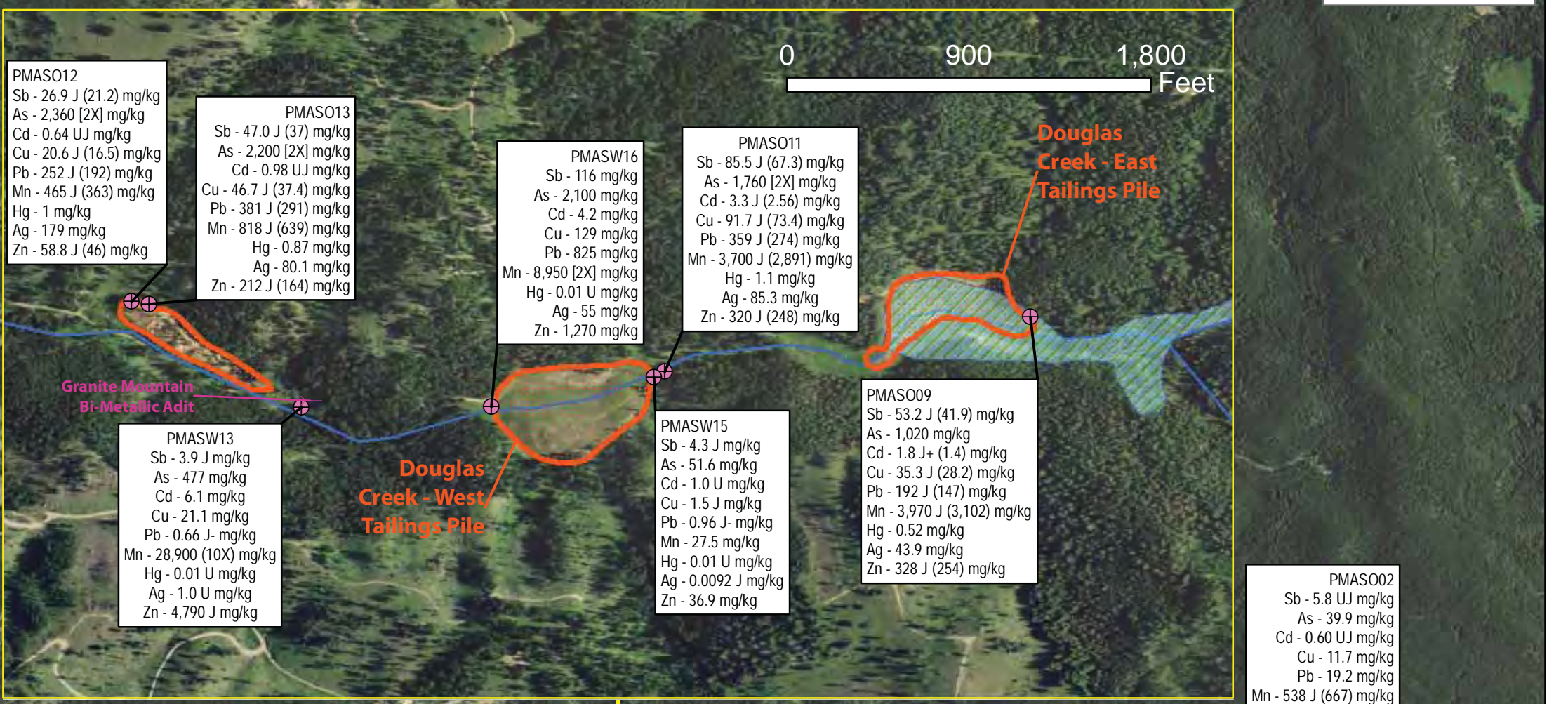
Philipsburg Mining Area (Douglas Creek)
 TDD Title: Site Location, Area of Influence, and 15 - Mile Downstream Target Distance Limit Map
 Figure Title:
 Figure No. 1
 TDD State: MT
 TDD County: Granite
 TDD: 1103-02
 Date: 06/2012

Base Data Source: NAIP 2006, UOS GPS acquisition 2009
 Datum/Projection: NAD 1983 Zone 13N UTM





*Aqueous samples are total metals results



PMASO12
Sb - 26.9 J (21.2) mg/kg
As - 2,360 [2X] mg/kg
Cd - 0.64 UJ mg/kg
Cu - 20.6 J (16.5) mg/kg
Pb - 252 J (192) mg/kg
Mn - 465 J (363) mg/kg
Hg - 1 mg/kg
Ag - 179 mg/kg
Zn - 58.8 J (46) mg/kg

PMASO13
Sb - 47.0 J (37) mg/kg
As - 2,200 [2X] mg/kg
Cd - 0.98 UJ mg/kg
Cu - 46.7 J (37.4) mg/kg
Pb - 381 J (291) mg/kg
Mn - 818 J (639) mg/kg
Hg - 0.87 mg/kg
Ag - 80.1 mg/kg
Zn - 212 J (164) mg/kg

PMASW16
Sb - 116 mg/kg
As - 2,100 mg/kg
Cd - 4.2 mg/kg
Cu - 129 mg/kg
Pb - 825 mg/kg
Mn - 8,950 [2X] mg/kg
Hg - 0.01 U mg/kg
Ag - 55 mg/kg
Zn - 1,270 mg/kg

PMASO11
Sb - 85.5 J (67.3) mg/kg
As - 1,760 [2X] mg/kg
Cd - 3.3 J (2.56) mg/kg
Cu - 91.7 J (73.4) mg/kg
Pb - 359 J (274) mg/kg
Mn - 3,700 J (2,891) mg/kg
Hg - 1.1 mg/kg
Ag - 85.3 mg/kg
Zn - 320 J (248) mg/kg

PMASO09
Sb - 53.2 J (41.9) mg/kg
As - 1,020 mg/kg
Cd - 1.8 J+ (1.4) mg/kg
Cu - 35.3 J (28.2) mg/kg
Pb - 192 J (147) mg/kg
Mn - 3,970 J (3,102) mg/kg
Hg - 0.52 mg/kg
Ag - 43.9 mg/kg
Zn - 328 J (254) mg/kg

PMASO02
Sb - 5.8 UJ mg/kg
As - 39.9 mg/kg
Cd - 0.60 UJ mg/kg
Cu - 11.7 mg/kg
Pb - 19.2 mg/kg
Mn - 538 J (667) mg/kg
Hg - 0.21 mg/kg
Ag - 2.3 mg/kg
Zn - 81.5 mg/kg

PMASO03
Sb - 5.0 UJ mg/kg
As - 60.7 mg/kg
Cd - 0.42 UJ mg/kg
Cu - 11.9 mg/kg
Pb - 76.4 mg/kg
Mn - 245 J mg/kg
Hg - 0.49 mg/kg
Ag - 6.4 mg/kg
Zn - 48.2 mg/kg

PMASO01
Sb - 5.2 UJ mg/kg
As - 8 mg/kg
Cd - 0.43 UJ mg/kg
Cu - 2.2 U mg/kg
Pb - 6.4 mg/kg
Mn - 85.3 J mg/kg
Hg - 0.046 J- mg/kg
Ag - 0.37 J mg/kg
Zn - 16.1 mg/kg

PMASO05
Sb - 70.3 J (55.4) mg/kg
As - 2,520 [2X] mg/kg
Cd - 1.0 J+ (0.78) mg/kg
Cu - 100 J (80) mg/kg
Pb - 788 mg/kg
Mn - 1,760 J (1,375) mg/kg
Hg - 7.4 [5X] mg/kg
Ag - 63.7 mg/kg
Zn - 450 mg/kg

PMASO04
Sb - 52.0 J (40.9) mg/kg
As - 3,900 [3X] mg/kg
Cd - 2.4 mg/kg
Cu - 91.8 mg/kg
Pb - 709 mg/kg
Mn - 1,230 J (961) mg/kg
Hg - 3.6 [5X] mg/kg
Ag - 59.3 mg/kg
Zn - 435 mg/kg

PMASO07
Sb - 44.6 J (35.1) mg/kg
As - 4,760 [4X] mg/kg
Cd - 1.3 UJ mg/kg
Cu - 46.9 J (37.5) mg/kg
Pb - 294 J (225) mg/kg
Mn - 876 J (684) mg/kg
Hg - 1.1 mg/kg
Ag - 41 mg/kg
Zn - 201 J (156) mg/kg

PMASO06
Sb - 127 J (100) mg/kg
As - 35,400 (20X) mg/kg
Cd - 38.6 J (29.9) mg/kg
Cu - 1,340 J (1,072) mg/kg
Pb - 1,110 J (847) mg/kg
Mn - 2,860 J (2,234) mg/kg
Hg - 7.2 [5X] mg/kg
Ag - 72.6 mg/kg
Zn - 5,270 J (4,085) mg/kg

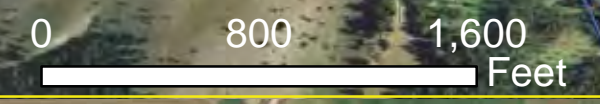
PMASO07a
Sb - 58.9 J (46.4) mg/kg
As - 3,860 [3X] mg/kg
Cd - 1.4 UJ mg/kg
Cu - 70.1 J (56.1) mg/kg
Pb - 512 J (390) mg/kg
Mn - 913 J (713) mg/kg
Hg - 5.7 [5X] mg/kg
Ag - 91.4 mg/kg
Zn - 260 J (202) mg/kg

PMASO17
Sb - 365 J (287) mg/kg
As - 420 mg/kg
Cd - 7.1 mg/kg
Cu - 372 mg/kg
Pb - 4,460 mg/kg
Mn - 122 J (95) mg/kg
Hg - 0.84 mg/kg
Ag - 26.1 mg/kg
Zn - 218 mg/kg

PMASO16
Sb - 370 J (291) mg/kg
As - 173 mg/kg
Cd - 25.6 mg/kg
Cu - 253 mg/kg
Pb - 7,240 [2X] mg/kg
Mn - 88.7 J (69.0) mg/kg
Hg - 1 mg/kg
Ag - 32 mg/kg
Zn - 2,420 mg/kg

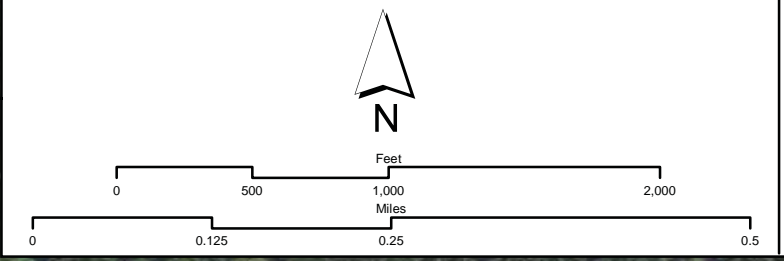
PMASO15
Sb - 6.0 UJ mg/kg
As - 9.9 mg/kg
Cd - 0.50 UJ mg/kg
Cu - 38.1 mg/kg
Pb - 19.2 mg/kg
Mn - 847 J (662) mg/kg
Hg - 0.0028 J- mg/kg
Ag - 8.5 mg/kg
Zn - 45.4 mg/kg

PMASO14
Sb - 6.6 UJ mg/kg
As - 25.9 mg/kg
Cd - 4.5 mg/kg
Cu - 13,400 [3X] mg/kg
Pb - 65.9 mg/kg
Mn - 1,430 J (1,117) mg/kg
Hg - 0.24 mg/kg
Ag - 10.4 mg/kg
Zn - 494 mg/kg



Page Size: Arch C

Projection System:
NAD 1983 UTM Zone 12N



TDD Title: **Phillipsburg Mining Area (Douglas Creek)**
Figure: 2
Figure Title: Source Sample Results
TDD County: GRANITE
TDD State: MT
TDD: 1103-02
Date: 06/2012

Sources
Lab Results
Field Observations
Esri World Imagery
National Hydrography Dataset



SE18
 Sb - 19.2 J mg/kg
 As - 276 mg/kg
 Cd - 16.3 mg/kg
 Cu - 68.7 mg/kg
 Pb - 194 mg/kg
 Mn - 9,500 J (2X) mg/kg
 Hg - 1 mg/kg
 Ag - 4.9 mg/kg
 Zn - 3,700 mg/kg

SE19
 Sb - (13.0) 25.7 J mg/kg
 As - 381 mg/kg
 Cd - 3.6 mg/kg
 Cu - 71.3 mg/kg
 Pb - 289 mg/kg
 Mn - (11,694) 14,500 J (3X) mg/kg
 Hg - 2.8 (2X) mg/kg
 Ag - 13.7 mg/kg
 Zn - 1,880 mg/kg

SE12
 Sb - (18.8) 37.3 J mg/kg
 As - 929 mg/kg
 Cd - 2.5 mg/kg
 Cu - 50.5 mg/kg
 Pb - 191 mg/kg
 Mn - (8,306) 10,300 J (2X) mg/kg
 Hg - 1.8 (2X) mg/kg
 Ag - 20 mg/kg
 Zn - 1,130 mg/kg

SE10
 Sb - (16.8) 33.2 J mg/kg
 As - 811 mg/kg
 Cd - 2.3 mg/kg
 Cu - 44.5 mg/kg
 Pb - 217 mg/kg
 Mn - (4,750) 5,890 J mg/kg
 Hg - 2.4 (2X) mg/kg
 Ag - 49.6 mg/kg
 Zn - 730 mg/kg

SE11
 Sb - 150 J mg/kg
 As - 281 mg/kg
 Cd - 5.1 mg/kg
 Cu - 178 mg/kg
 Pb - 1,320 mg/kg
 Mn - 92.4 J mg/kg
 Hg - 1.8 mg/kg
 Ag - 15.8 mg/kg
 Zn - 434 mg/kg

SE23
 Sb - 8.3 UJ mg/kg
 As - 8.3 mg/kg
 Cd - 0.69 UJ mg/kg
 Cu - 8.4 J mg/kg
 Pb - 9.4 J mg/kg
 Mn - 214 J mg/kg
 Hg - 0.039 J mg/kg
 Ag - 0.051 J mg/kg
 Zn - 44.4 J mg/kg

SE08
 Sb - (32.1) 63.5 J mg/kg
 As - 1,720 mg/kg
 Cd - (2.6) 3.7 J mg/kg
 Cu - (89.3) 109 J mg/kg
 Pb - 368 J mg/kg
 Mn - (4,750) 5,890 J (2X) mg/kg
 Hg - 11.7 (10X) mg/kg
 Ag - 53.8 mg/kg
 Zn - (573) 860 J mg/kg

SE09
 Sb - (30.3) 59.9 J mg/kg
 As - 1,540 mg/kg
 Cd - 2.8 mg/kg
 Cu - 73.6 mg/kg
 Pb - 378 mg/kg
 Mn - (4,250) 5,270 J mg/kg
 Hg - 4.1 (3X) mg/kg
 Ag - 46.1 mg/kg
 Zn - 739 mg/kg

SE07
 Sb - (26.2) 51.8 J mg/kg
 As - 1,390 mg/kg
 Cd - (2.3) 3.2 J mg/kg
 Cu - (54.3) 66.3 J mg/kg
 Pb - (231) 332 J mg/kg
 Mn - (3,629) 4,500 J mg/kg
 Hg - 7.9 (5X) mg/kg
 Ag - 91.7 mg/kg
 Zn - (499) 749 J mg/kg

SE06
 Sb - (13.7) 27.2 J mg/kg
 As - 632 mg/kg
 Cd - (1.7) 2.4 J mg/kg
 Cu - (34.7) 42.3 J mg/kg
 Pb - (149) 214 J mg/kg
 Mn - (2,242) 2,780 J mg/kg
 Hg - 6.3 (5X) mg/kg
 Ag - 37.6 mg/kg
 Zn - (310) 465 J mg/kg

SE05
 Sb - (4.6) 9.2 J mg/kg
 As - 286 mg/kg
 Cd - 1.5 UJ mg/kg
 Cu - (26.1) 31.8 J mg/kg
 Pb - (107) 154 J mg/kg
 Mn - (1,210) 1,500 J mg/kg
 Hg - 4.1 (3X) mg/kg
 Ag - 6.3 mg/kg
 Zn - (169) 253 J mg/kg

SE04
 Sb - (11.6) 23.0 J mg/kg
 As - 708 mg/kg
 Cd - (1.3) 1.9 J mg/kg
 Cu - (46.0) 56.1 J mg/kg
 Pb - (206) 267 J mg/kg
 Mn - (2,306) 2,860 J mg/kg
 Hg - 7.0 (5X) mg/kg
 Ag - 26.8 mg/kg
 Zn - (254) 381 J mg/kg

SE03
 Sb - (23.0) 45.6 J mg/kg
 As - 1,090 mg/kg
 Cd - 3.8 mg/kg
 Cu - (102) 124 J mg/kg
 Pb - (343) 494 J mg/kg
 Mn - (2,282) 2,830 J mg/kg
 Hg - 31.7 (25X) mg/kg
 Ag - 69.4 mg/kg
 Zn - (491) 737 J mg/kg

SE01B
 Sb - 5.4 UJ mg/kg
 As - 4.3 mg/kg
 Cd - 0.45 UJ mg/kg
 Cu - 5.8 UJ mg/kg
 Pb - 6.0 mg/kg
 Mn - 271 J mg/kg
 Hg - 0.017 J mg/kg
 Ag - 0.91 mg/kg
 Zn - 16.0 mg/kg

SE21
 Sb - (47.6) 94.3 J mg/kg
 As - 2,270 (2X) mg/kg
 Cd - (2.6) 3.6 J mg/kg
 Cu - (167) 204 J mg/kg
 Pb - (606) 872 J mg/kg
 Mn - (2,960) 3,670 J mg/kg
 Hg - 81.8 (50X) mg/kg
 Ag - 115 mg/kg
 Zn - (847) 1,270 J mg/kg

SE20
 Sb - (19.5) 38.7 J mg/kg
 As - 955 mg/kg
 Cd - (3.4) 4.8 J mg/kg
 Cu - (132) 161 J mg/kg
 Pb - (792) 1,140 J mg/kg
 Mn - (1823) 2,260 J mg/kg
 Hg - 39.6 (25X) mg/kg
 Ag - 57.5 mg/kg
 Zn - (487) 730 J mg/kg

SE01A
 Sb - 5.4 UJ mg/kg
 As - 4.3 mg/kg
 Cd - 0.45 UJ mg/kg
 Cu - 5.8 UJ mg/kg
 Pb - 6 mg/kg
 Mn - 271 J mg/kg
 Hg - 0.017 J mg/kg
 Ag - 0.91 mg/kg
 Zn - 16 mg/kg

Mine Adit
 Sediment Sample Location
 Flowline
 Wetlands
 Waste Piles

Projection System:
 NAD 1983 UTM Zone 12N
 Page Size: 11x17

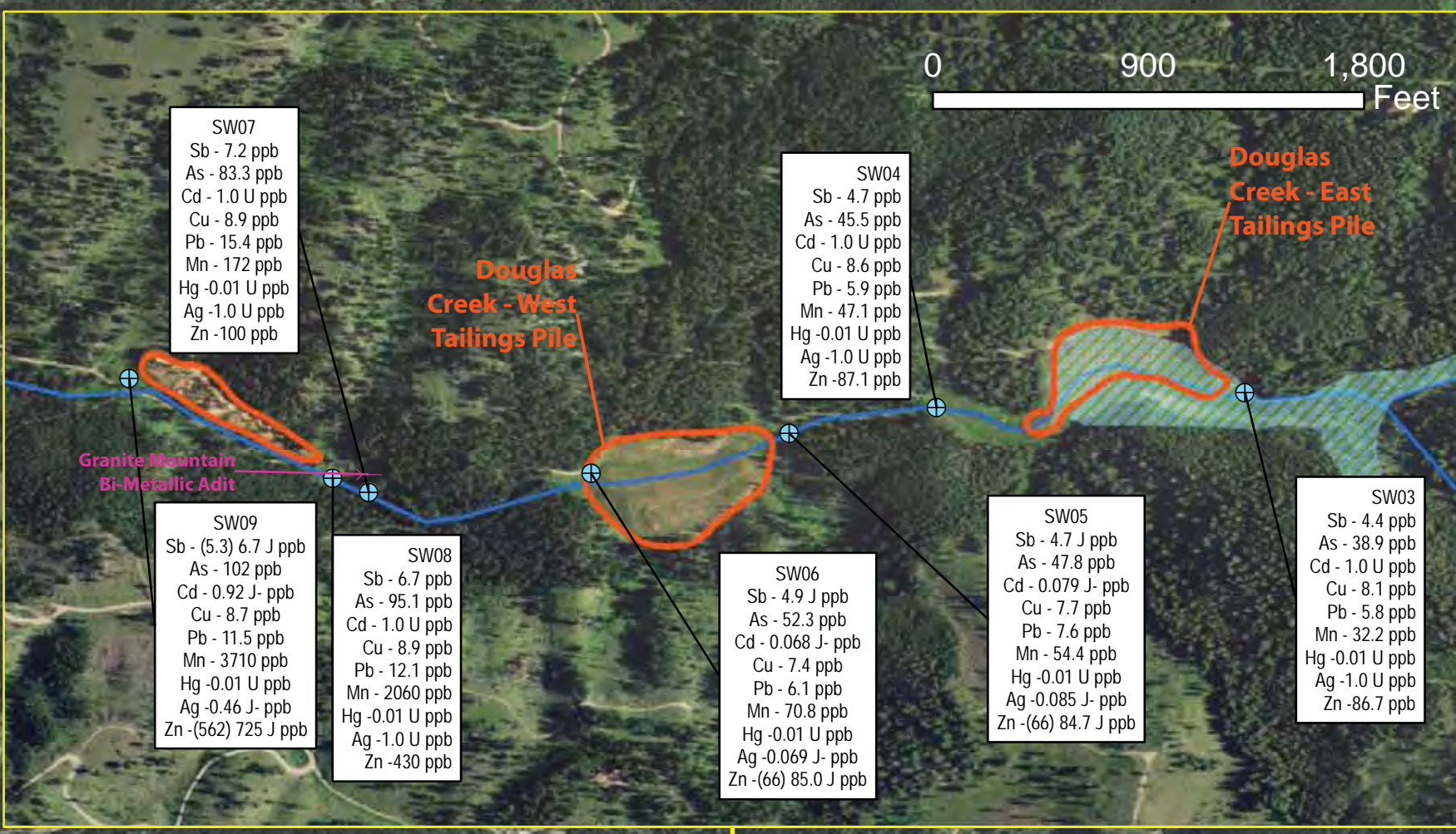
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 TDD State: MT
 TDD: 1103-02
 Date: 06/2012

Sources:
 Esri World Imagery
 National Hydrography Dataset



SW22

Sb	- 2.0 U ppb
As	- 16.4 ppb
Cd	- 1.0 U ppb
Cu	- 1.0 J ppb
Pb	- 1.0 U ppb
Mn	- 19.8 ppb
Hg	- 0.01 U ppb
Ag	- 1.0 U ppb
Zn	- 2.6 ppb



SW18

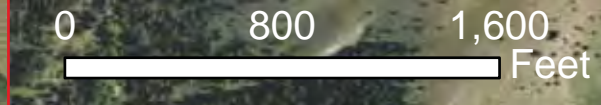
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As	- 55.8 ppb
Cd	- 1.0 U ppb
Cu	- 5.1 ppb
Pb	- 12.4 ppb
Mn	- 1020 ppb
Hg	- 0.01 U ppb
Ag	- 1.0 U ppb
Zn	- 252 ppb

SW12

Sb	- 6.9 ppb
As	- 106 ppb
Cd	- 1.0 U ppb
Cu	- 8 ppb
Pb	- 11 ppb
Mn	- 2840 ppb
Hg	- 0.01 U ppb
Ag	- 1.0 U ppb
Zn	- 554 ppb

SW10

Sb	- 7.3 ppb
As	- 115 ppb
Cd	- 1.2 ppb
Cu	- 8.4 ppb
Pb	- 12.7 ppb
Mn	- 2930 ppb
Hg	- 0.01 U ppb
Ag	- 1.0 U ppb
Zn	- 602 ppb



SW09

Sb	- (5.3) 6.7 J ppb
As	- 102 ppb
Cd	- 0.92 J - ppb
Cu	- 8.7 ppb
Pb	- 11.5 ppb
Mn	- 3710 ppb
Hg	- 0.01 U ppb
Ag	- 0.46 J - ppb
Zn	- (562) 725 J ppb

SW08

Sb	- 6.7 ppb
As	- 95.1 ppb
Cd	- 1.0 U ppb
Cu	- 8.9 ppb
Pb	- 12.1 ppb
Mn	- 2060 ppb
Hg	- 0.01 U ppb
Ag	- 1.0 U ppb
Zn	- 430 ppb

SW06

Sb	- 4.9 J ppb
As	- 52.3 ppb
Cd	- 0.068 J - ppb
Cu	- 7.4 ppb
Pb	- 6.1 ppb
Mn	- 70.8 ppb
Hg	- 0.01 U ppb
Ag	- 0.069 J - ppb
Zn	- (66) 85.0 J ppb

SW05

Sb	- 4.7 J ppb
As	- 47.8 ppb
Cd	- 0.079 J - ppb
Cu	- 7.7 ppb
Pb	- 7.6 ppb
Mn	- 54.4 ppb
Hg	- 0.01 U ppb
Ag	- 0.085 J - ppb
Zn	- (66) 84.7 J ppb

SW03

Sb	- 4.4 ppb
As	- 38.9 ppb
Cd	- 1.0 U ppb
Cu	- 8.1 ppb
Pb	- 5.8 ppb
Mn	- 32.2 ppb
Hg	- 0.01 U ppb
Ag	- 1.0 U ppb
Zn	- 86.7 ppb

SW21

Sb	- 5.1 J ppb
As	- 40.8 ppb
Cd	- 0.40 J - ppb
Cu	- 11.3 ppb
Pb	- 6.4 ppb
Mn	- 43.1 ppb
Hg	- 0.01 U ppb
Ag	- 0.063 J - ppb
Zn	- (93) 120 J ppb

SW20

Sb	- 4.3 ppb
As	- 26.6 ppb
Cd	- 1.0 U ppb
Cu	- 8.1 ppb
Pb	- 5.6 ppb
Mn	- 4.2 ppb
Hg	- 0.01 U ppb
Ag	- 1.0 U ppb
Zn	- 48.4 ppb

SW01A

Sb	- 2.0 U ppb
As	- 1.4 ppb
Cd	- 1.0 U ppb
Cu	- 2.0 U ppb
Pb	- 1.0 U ppb
Mn	- 8.1 ppb
Hg	- 0.01 U ppb
Ag	- 1.0 U ppb
Zn	- 0.46 J ppb

SW23

Sb	- 2.0 U ppb
As	- 1.7 ppb
Cd	- 1.0 U ppb
Cu	- 1.8 J ppb
Pb	- 1.0 U ppb
Mn	- 6 ppb
Hg	- 0.01 U ppb
Ag	- 1.0 U ppb
Zn	- (1.1) 1.4 J ppb

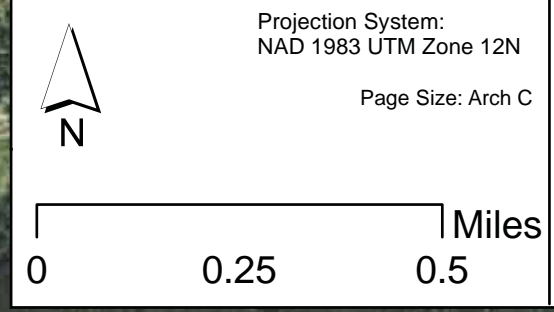
Flume

Granite Mountain Bi-Metallic Mill Tailings Pile

Contact Mill East Tailings Impoundment Pile

Granite Mountain Tailings/Waste Rock Pile

Bi-Metallic/Old Red Tailings Pile



Projection System: NAD 1983 UTM Zone 12N
Page Size: Arch C

TDD Title: **Phillipsburg Mining Area (Douglas Creek)**

Figure: 4
Figure Title: Surface Water Locations and Selected Total Metals Results

TDD County: GRANITE
TDD State: MT

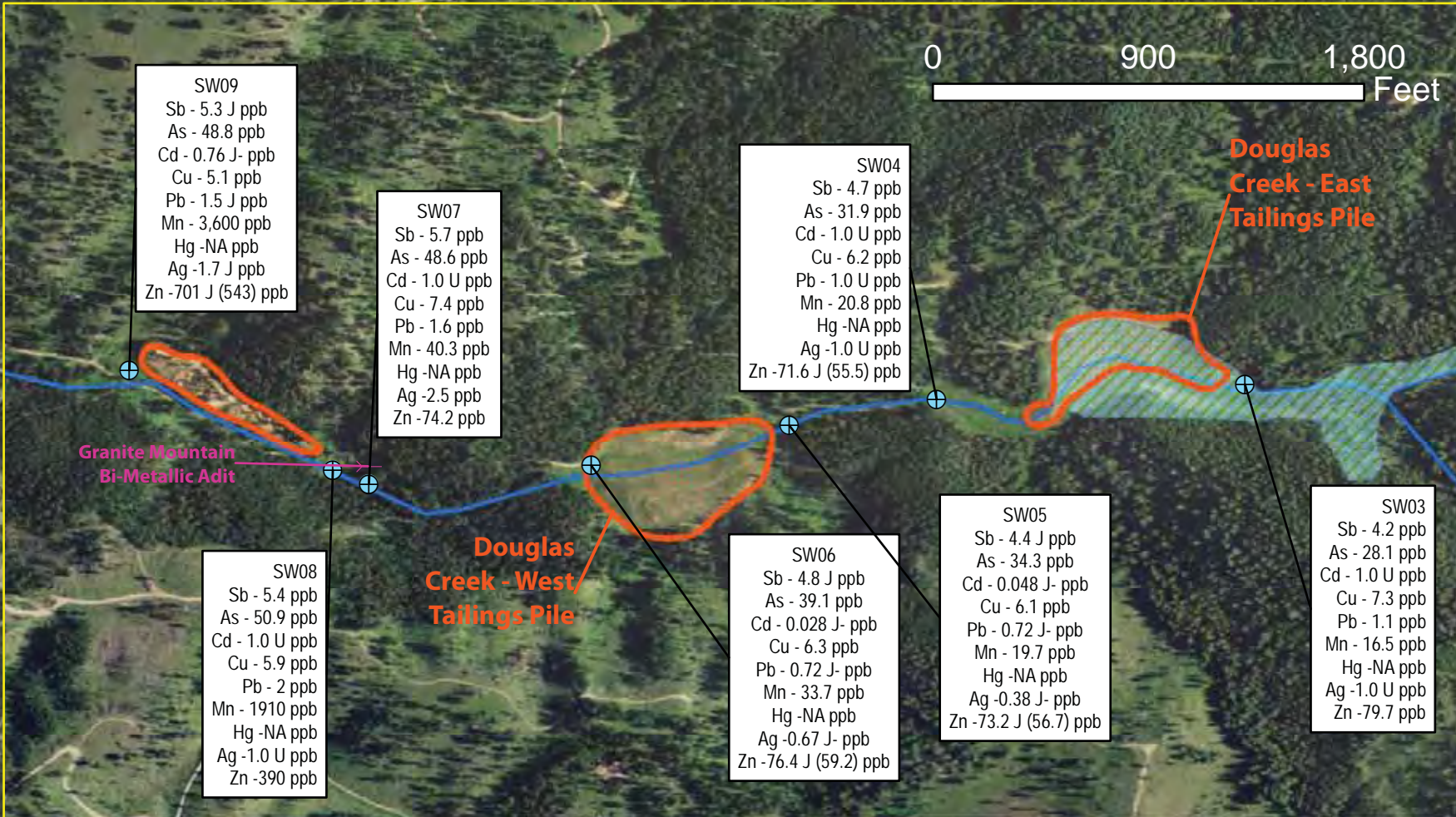
TDD: 1103-02
Date: 06/2012

Sources:
Esri World Imagery
National Hydrography Dataset

URS
OPERATING SERVICES



SW22
Sb - 2.0 U ppb
As - 14.3 ppb
Cd - 1.0 U ppb
Cu - 0.76 J ppb
Pb - 1.0 U ppb
Mn - 5.9 ppb
Hg - NA ppb
Ag - 1.0 U ppb
Zn - 1.8 J ppb



SW08
Sb - 5.4 ppb
As - 50.9 ppb
Cd - 1.0 U ppb
Cu - 5.9 ppb
Pb - 2 ppb
Mn - 1910 ppb
Hg - NA ppb
Ag - 1.0 U ppb
Zn - 390 ppb

SW06
Sb - 4.8 J ppb
As - 39.1 ppb
Cd - 0.028 J ppb
Cu - 6.3 ppb
Pb - 0.72 J ppb
Mn - 33.7 ppb
Hg - NA ppb
Ag - 0.67 J ppb
Zn - 76.4 J (59.2) ppb

SW05
Sb - 4.4 J ppb
As - 34.3 ppb
Cd - 0.048 J ppb
Cu - 6.1 ppb
Pb - 0.72 J ppb
Mn - 19.7 ppb
Hg - NA ppb
Ag - 0.38 J ppb
Zn - 73.2 J (56.7) ppb

SW03
Sb - 4.2 ppb
As - 28.1 ppb
Cd - 1.0 U ppb
Cu - 7.3 ppb
Pb - 1.1 ppb
Mn - 16.5 ppb
Hg - NA ppb
Ag - 1.0 U ppb
Zn - 79.7 ppb

SW18
Sb - 4.2 ppb
As - 55.8 ppb
Cd - 1.0 U ppb
Cu - 5.1 ppb
Pb - 12.4 ppb
Mn - 1020 ppb
Hg - 0.01 U ppb
Ag - 1.0 U ppb
Zn - 252 ppb

SW19
Sb - 4.3 ppb
As - 55.3 ppb
Cd - 1.0 U ppb
Cu - 5.1 ppb
Pb - 9.7 ppb
Mn - 1420 ppb
Hg - 0.01 U ppb
Ag - 1.0 U ppb
Zn - 314 ppb

SW12
Sb - 6.9 ppb
As - 106 ppb
Cd - 1.0 U ppb
Cu - 8 ppb
Pb - 11 ppb
Mn - 2840 ppb
Hg - 0.01 U ppb
Ag - 1.0 U ppb
Zn - 554 ppb

SW10
Sb - 7.3 ppb
As - 115 ppb
Cd - 1.2 ppb
Cu - 8.4 ppb
Pb - 12.7 ppb
Mn - 2930 ppb
Hg - 0.01 U ppb
Ag - 1.0 U ppb
Zn - 602 ppb

SW21
Sb - 5.1 J ppb
As - 30.8 ppb
Cd - 0.35 J (0.27) ppb
Cu - 10.5 ppb
Pb - 2.0 J ppb
Mn - 33.9 ppb
Hg - NA ppb
Ag - 0.84 J ppb
Zn - 117 J (91) ppb

SW20
Sb - 4.1 ppb
As - 21.6 ppb
Cd - 1.0 U ppb
Cu - 7.3 ppb
Pb - 2 ppb
Mn - 1.0 U ppb
Hg - NA ppb
Ag - 1.0 U ppb
Zn - 46.9 ppb

SW01A
Sb - 2.0 U ppb
As - 1.2 ppb
Cd - 1.0 U ppb
Cu - 2.0 U ppb
Pb - 1.0 U ppb
Mn - 7.3 ppb
Hg - NA ppb
Ag - 1.0 U ppb
Zn - 1.8 J (2.3) ppb

Flume

Granite Mountain Bi-Metallic Mill Tailings Pile

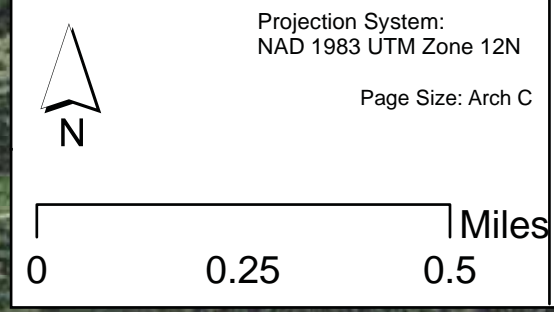
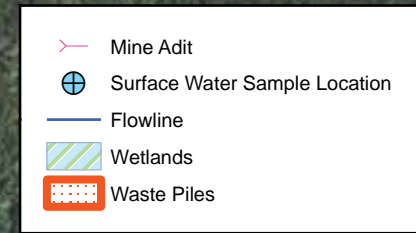
Contact Mill East Tailings Impoundment Pile

Granite Mountain Tailings/Waste Rock Pile

Bi-Metallic/Old Red Tailings Pile

0 800 1,600 Feet

SW23
Sb - 2.0 U ppb
As - 1.7 ppb
Cd - 1.0 U ppb
Cu - 2.0 U ppb
Pb - 1.0 U ppb
Mn - 3.9 ppb
Hg - NA ppb
Ag - 1.0 U ppb
Zn - 1.5 J ppb



Projection System:
NAD 1983 UTM Zone 12N
Page Size: Arch C

TDD Title: **Phillipsburg Mining Area (Douglas Creek)**

Figure: 5
Figure Title: Surface Water Locations and Selected Dissolved Metals Results

TDD County: GRANITE
TDD State: MT
TDD: 1103-02
Date: 06/2012

Sources:
Esri World Imagery
National Hydrography Dataset

TABLE 4
Sample Locations and Rationale (changes from FSP noted in bold and shading)

Matrix	Sample #	Location	Rationale
Soil	PMA_DC_SO_01_0611	Unleased Forest Service land north of Granite	Determine background conditions on site and characterize onsite sources and contamination.
	PMA_DC_SO_02_0611	Unleased Forest Service land north of Granite	Determine background conditions on site and characterize onsite sources and contamination.
	PMA_DC_SO_03_0611	Unleased Forest Service land north of Granite	Determine background conditions on site and characterize onsite sources and contamination.
	PMA_DC_SO_04_0611	Grab sample from Granite Mountain waste rock	Characterize onsite sources and contamination.
	PMA_DC_SO_05_0611	Grab sample from Granite Mountain tailings	Characterize onsite sources and contamination.
	PMA_DC_SO_06_0611	Grab sample from Bi-Metallic/Old Red tailings	Characterize onsite sources and contamination.
	PMA_DC_SO_07_0611	Grab sample from Bi-Metallic/Old Red waste rock	Characterize onsite sources and contamination.
	PMA_DC_SO_07A_0611	Grab sample from Bi-Metallic/Old Red waste rock (OPPORTUNITY SAMPLE ADDED IN FIELD.)	Characterize onsite sources and contamination. (Sample added as origin of source appeared to be different than remaining material.)
	PMA_DC_SO_08_0611	Grab sample from Douglas Creek east tailings (if exposed) (SAMPLE NOT COLLECTED.)	Characterize onsite sources and contamination. (Sample not collected as tailings were found to be exposed at only one location [PMA_DC_SO_09_0611] on this tailings pile.)
	PMA_DC_SO_09_0611	Grab sample from Douglas Creek east tailings	Characterize onsite sources and contamination.
	PMA_DC_SO_10_0611	Grab sample from Douglas Creek west tailings (if exposed)) (SAMPLE NOT COLLECTED.)	Characterize onsite sources and contamination. (Sample not collected as tailings were found to be exposed at only one location [PMA_DC_SO_11_0611] on this tailings pile.)
	PMA_DC_SO_11_0611	Grab sample from Douglas Creek west tailings	Characterize onsite sources and contamination.
PMA_DC_SO_12_0611	Grab sample from Douglas Creek waste rock	Characterize onsite sources and contamination.	

TABLE 4, cont.
Sample Locations and Rationale (changes from FSP noted in bold and shading)

Matrix	Sample #	Location	Rationale
Soil (cont.)	PMA_DC_SO_13_0611	Grab sample from Douglas Creek waste rock	Characterize onsite sources and contamination.
	PMA_DC_SO_14_0611	Grab sample from Contact Mill east tailings	Characterize onsite sources and contamination.
	PMA_DC_SO_15_0611	Grab sample from Contact Mill east tailings	Characterize onsite sources and contamination.
	PMA_DC_SO_16_0611	Grab sample from historical bi-Metallic Mill tailings	Characterize onsite sources and contamination.
	PMA_DC_SO_17_0611	Grab sample from historical bi-Metallic Mill tailings	Characterize onsite sources and contamination.
Surface Water and Sediment	PMA_DC_SW_01_0611 and PMA_DC_SE_01_0611	Grab sample collected from “north branch” of Douglas Creek immediately upstream of the PPE from the Granite Mountain/Bi-Metallic/Old Red tailings pile. (SAMPLES RENAMED TO PMA_DC_SW_01A_0611 and PMA_DC_SE_01A_0611 and MOVED TO SOUTH BRANCH OF DOUGLAS CREEK.)	Document background conditions along Douglas Creek. (Note: This was to be the sample location if the New Departure adit is not flowing. As the New Departure adit was found to be flowing, the “north branch” was considered to be potentially contaminated and the background location was moved to the “southern” branch of Douglas Creek.) See Figure 3.
	PMA_DC_SW_01A_0611 and PMA_DC_SE_01A_0611	Grab sample collected from “upper” location on “south branch” of Douglas Creek. (SAMPLES RENAMED FROM PMA_DC_SW_01_0611 and PMA_DC_SE_01_0611 to PMA_DC_SW_01A_0611 and PMA_DC_SE_01A_0611.)	Document background conditions along Douglas Creek. (Sample location moved from “north” branch of Douglas Creek to this location because New Departure adit was flowing.)
	PMA_DC_SW_01B_0611 and PMA_DC_SE_01B_0611	Grab sample collected from “lower” location on “south branch” of Douglas Creek. (OPPORTUNITY SAMPLE ADDED IN FIELD.)	Document background conditions along Douglas Creek. (Sample added to provide additional background characterization.)

TABLE 4, cont.
Sample Locations and Rationale (changes from FSP noted in bold and shading)

Matrix	Sample #	Location	Rationale
Surface Water and Sediment, cont.	PMA_DC_SW_02_0611 and PMA_DC_SE_02_0611	Grab sample collected from Douglas Creek immediately downstream of the PPE from the Granite Mountain/Bi-Metallic/Old Red tailings and waste rock. (SAMPLES RENAMED PMA_DC_SW_21_0611 and PMA_DC_SE_21_0611.)	Document potential site impacts to fisheries, wetlands, and recreational users along Douglas Creek downstream of the Granite Mountain/Bi-Metallic/Old Red tailings and waste rock. (Sample renamed due to “north” branch being potentially contaminated from New Departure adit.)
	PMA_DC_SW_03_0611 and PMA_DC_SE_03_0611	Grab sample collected from Douglas Creek immediately upstream of the Douglas Creek east tailings.	Document potential site impacts to fisheries, wetlands, and recreational users along Douglas Creek upstream of the Douglas Creek east tailings.
	PMA_DC_SW_04_0611 and PMA_DC_SE_04_0611	Grab sample collected from Douglas Creek immediately downstream of the Douglas Creek east tailings.	Document potential site impacts to fisheries, wetlands, and recreational users along Douglas Creek downstream of the Douglas Creek east tailings.
	PMA_DC_SW_05_0611 and PMA_DC_SE_05_0611	Grab sample collected from Douglas Creek immediately upstream of the Douglas Creek west tailings.	Document potential site impacts to fisheries, wetlands, and recreational users along Douglas Creek upstream of the Douglas Creek west tailings.
	PMA_DC_SW_06_0611 and PMA_DC_SE_06_0611	Grab sample collected from Douglas Creek immediately downstream of the Douglas Creek west tailings.	Document potential site impacts to fisheries, wetlands, and recreational users along Douglas Creek downstream of the Douglas Creek west tailings.
	PMA_DC_SW_07_0611 and PMA_DC_SE_07_0611	Grab sample collected from Douglas Creek immediately upstream of the discharge from the Granite Mountain/Bi-Metallic/Old Red adit.	Document potential site impacts to fisheries, wetlands, and recreational users along Douglas Creek upstream of the Granite Mountain/Bi-Metallic/Old Red adit.
	PMA_DC_SW_08_0611 and PMA_DC_SE_08_0611	Grab sample collected from Douglas Creek immediately downstream of the discharge from the Granite Mountain/Bi-Metallic/Old Red adit, and upstream of the Douglas Creek waste rock pile.	Document potential site impacts to fisheries, wetlands, and recreational users along Douglas Creek downstream of the Granite Mountain/Bi-Metallic/Old Red adit, and upstream of the Douglas Creek waste rock pile.

TABLE 4, cont.
Sample Locations and Rationale (changes from FSP noted in bold and shading)

Matrix	Sample #	Location	Rationale
Surface Water and Sediment, cont.	PMA_DC_SW_09_0611 and PMA_DC_SE_09_0611	Grab sample collected from Douglas Creek immediately downstream of the Douglas Creek waste rock.	Document potential site impacts to fisheries, wetlands, and recreational users along Douglas Creek downstream of the Douglas Creek waste rock.
	PMA_DC_SW_10_0611 and PMA_DC_SE_10_0611	Grab sample collected from Douglas Creek immediately upstream of the Contact Mill east tailings impoundment.	Document potential site impacts to fisheries, wetlands and recreational users upstream of the Contact Mill east tailings impoundment.
	PMA_DC_SW_11_0611 and PMA_DC_SE_11_0611	Grab sample collected from Douglas Creek immediately downstream of the Contact Mill east tailings impoundment and upstream of the historical Bi-Metallic Mill tailings. (SAMPLE PMA_DC_SW_11_0611 NOT COLLECTED. SAMPLE PMA_DC_SE_11_0611 WAS MOVED.)	Document potential site impacts to fisheries, wetlands, and recreational users along Douglas Creek downstream of the Contact mill east tailings impoundment and upstream of the historical Bi-Metallic Mill tailings. (Not collected because Douglas Creek is diverted into a flume upstream of this location. As such, PMA_DC_SE_11_0611 was moved from Douglas Creek to within drainage from Contact Mill east tailings impoundment [i.e., changed from a release sample to an attribution sample].)
	PMA_DC_SW_12_0611 and PMA_DC_SE_12_0611	Grab sample collected from Douglas Creek downstream of the historical Bi-Metallic Mill tailings.	Document potential site impacts to fisheries, wetlands, and recreational users along Douglas Creek downstream of the historical Bi-Metallic mill tailings.
	PMA_DC_SW_13_0611	Grab sample from Granite Mountain/Bi-Metallic/Old Red adit discharge	Characterize onsite sources and contamination.
	PMA_DC_SW_14_0611	Opportunity grab sample from potential spring/seep at east end of Douglas Creek east tailings pile (if flowing) (SAMPLE NOT COLELCTED.)	Characterize onsite sources and contamination. (Sample not collected as this seep could not be located in the field.)

TABLE 4, cont.
Sample Locations and Rationale (changes from FSP noted in bold and shading)

Matrix	Sample #	Location	Rationale
Surface Water and Sediment, cont.	PMA_DC_SW_15_0611	Opportunity grab sample from potential spring/seep at east end of Douglas Creek west tailings pile (if flowing)	Characterize onsite sources and contamination.
	PMA_DC_SW_16_0611	Opportunity grab sample from potential spring/seep at west end of Douglas Creek west tailings pile (if flowing)	Characterize onsite sources and contamination.
	PMA_DC_SW_17_0611	Opportunity grab sample from New Departure adit (if flowing)	Characterize onsite sources and contamination.
	PMA_DC_SW_20_0611 and PMA_DC_SE_20_0611	Douglas Creek above Granite Mountain and Bi-Metallic/Old Red PPE. (LOCATION ADDED IN FIELD.)	Document potential site impacts to fisheries, wetlands, and recreational users along Douglas Creek downstream of the New Departure adit. (Sample added due to “north” branch being potentially contaminated from New Departure adit and need to collect sample upstream of Granite Mountain and Bi-Metallic/Old Red PPE.)
	PMA_DC_SW_21_0611 and PMA_DC_SE_21_0611	Douglas Creek below Granite Mountain and Bi-Metallic/Old Red PPE. (SAMPLES RENAMED FROM PMA_DC_SW_02_0611 and PMA_DC_SE_02_0611.)	Document potential site impacts to fisheries, wetlands, and recreational users along Douglas Creek downstream of the Granite Mountain/Bi-Metallic/Old Red tailings and waste rock. (Sample renamed due to “north” branch being potentially contaminated from New Departure adit and background being moved.)
	PMA_DC_SW_22_0611 and PMA_DC_SE_22_0611	Flint Creek below confluence with Douglas Creek (SAMPLE LOCATION ADDED IN FIELD. SAMPLE, PMA_DC_SE_22_0611 NOT COLLECTED.)	Document potential site impacts to fisheries, wetlands, and recreational users along Flint Creek downstream of its confluence with Douglas Creek. (Sample PMA_DC_SE_22_0611 not collected due to safety concerns from high water. Sample location not ideally located immediately at confluence due to lack of access.)

TABLE 4, cont.
Sample Locations and Rationale (changes from FSP noted in bold and shading)

Matrix	Sample #	Location	Rationale
Surface Water and Sediment, cont.	PMA_DC_SW_23_0611 and PMA_DC_SE_23_0611	Flint Creek above confluence with Douglas Creek (SAMPLE LOCATION ADDED IN FIELD.)	Document background conditions on Flint Creek immediately above its confluence with Douglas Creek. (Sample location not ideally located immediately at confluence due to lack of access.)
QA/QC	PMA_DC_SW_99_0611	Duplicate of sample PMA_DC_SW-09.	Document the precision of sample collection procedures and laboratory analysis.
	PMA_DC_SE_89_0611	Duplicate of sample PMA_DC_SE_17.	Document the precision of sample collection procedures and laboratory analysis.
	PMA_DC_SW_79_0611	Rinsate Blank. (NOT COLLECTED AS ONLY DISPOSABLE SAMPLING EQUIPMENT WAS USED.)	Document thoroughness of decontamination process in the field.

Table 5
Soil Source (Mining Waste) Sample Results
Units of milligrams per kilogram (mg/kg) parts per million (ppm)

Field Sample ID: Laboratory Sample ID: Location:	Superfund Chemical Data Matrix (SCDM) RDSC (mg/Kg)	Superfund Chemical Data Matrix (SCDM) CRSC (mg/Kg)	EPA Residential Screening Levels (RSLs) (mg/Kg)	PMA_DC_SO_01_0611 MH30C2 Background Soil in unleased FS land north of Granite	PMA_DC_SO_02_0611 MH30C3 Background Soil in unleased FS land north of Granite	PMA_DC_SO_03_0611 MH30C4 Background Soil in unleased FS land north of Granite	PMA_DC_SO_04_0611 MH30C0 Granite Mountain waste rock	PMA_DC_SO_05_0611 MH30C1 Granite Mountain tailings	PMA_DC_SO_06_0611 MH30F8 Bi-Metallic/Old Red tailings
Aluminum	-	-	77,000	12,300	24,600	11,000	4,610	6,690	27,200
Antimony	31	-	31	5.2 UJ	5.8 UJ	5.0 UJ	52.0 J (40.9) ☆	70.3 J (55.4) ☆	127 J (100) ☆
Arsenic	23	0.43	0.39	8.0 ☆	39.9 ☆	60.7 ☆	3,900 [3X] ☆	2,520 [2X] ☆	35,400 [20X] ☆
Barium	5,500	-	15,000	181	186	107	327	423	175 J
Beryllium	160	-	160	0.43 UJ	0.63 UJ	0.42 UJ	0.45 UJ	0.45 UJ	11.0
Cadmium	39	-	70	0.43 UJ	0.60 UJ	0.42 UJ	2.4	1.0 J+ (0.78)	38.6 J (29.9)
Calcium	-	-	-	1,410	1,020	1,320	1,120	1,690	905
Chromium	230	-	-	5.1	7.7	5.6	2.2	3.3	7.5
Cobalt	-	-	23	5.0 J	5.9 J (7.4)	4.6 J	4.5 UJ	4.5	7.7
Copper	-	-	3,100	2.2 U	11.7	11.9	91.8	100 J (80)	1,340 J (1,072)
Iron	-	-	55,000	17,300	19,500	15,700	30,700	29,800	212,000 [3X] ☆
Lead	-	-	400	6.4	19.2	76.4	709 ☆	788 ☆	1,110 J (847) ☆
Magnesium	-	-	-	5,800	3,730	3,140	1,190	3,230	961
Manganese	11,000	-	1,800	85.3 J	538 J (667)	245 J	1,230 J (961)	1,760 J (1,375)	2,860 J (2,234) ☆
Mercury	23	-	10	0.046 J-	0.21	0.49	3.6 [5X]	7.4 [5X]	7.2 [5X]
Nickel	1,600	-	-	3.5 U	6.5	3.4 U	3.6 U	3.6 U	5.9 U
Potassium	-	-	-	2,520	1,850	968	2,170	3,330	1,730
Selenium	390	-	390	3.0 U	3.4 U	0.26 J	0.27 J	3.1 U	2.6 J (1.84)
Silver	390	-	390	0.37 J	2.3	6.4	59.3	63.7	72.6
Sodium	-	-	-	434 UJ	486 UJ	421 UJ	446 UJ	448 UJ	737 UJ
Thallium	-	-	0.78	2.2 U	2.4 UJ	2.1 UJ	3.9 ☆	3.5 J+ (2.55) ☆	3.7 UJ
Vanadium	550	-	390	40.3	40.6	36.6	34.9	38.0	63.1
Zinc	23,000	-	23,000	16.1	81.5	48.2	435	450	5,270 J (4,085)

J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the analyte is reliable.
 U The analyte was not detected above the CRQL.
 UJ The analyte was not detected at a level greater than or equal to the adjusted CRQL. However, the reported adjusted CRQL is approximate and may be inaccurate or imprecise.
 J- The associated numerical value is an estimated quantity but the result may be biased low.
 J+ The associated numerical value is an estimated quantity but the result may be biased high.
 RDSC Superfund Chemical Data Matrix (SCDM) Reference Dose Screening Concentration
 CRSC Superfund Chemical Data Matrix (SCDM) Cancer Risk Screening Concentration
 mg/kg milligrams per kilogram
 ppm parts per million
 (#X) Dilution factor. If not listed dilution factor is 1
 (X.X) Corrected Value as per EPA 540-F-94-028 "Using Qualified Data to Document an Observed Release and Observed Contamination."
 XX.X Highest background value
 [XX] Analytical result > 3 x highest background value = observed contamination
 ☆ Concentration is > benchmark
 [3X] Sample was diluted 3 times for analysis
 Sources: EPA 2011 (CLP limits and Low Concentration Detection Limits, Regional Screening Levels); EPA 2004 (SCDM)

Table 5, cont.
Soil Source (Mining Waste) Sample Results
Units of milligrams per kilogram (mg/kg) parts per million (ppm)

Field Sample ID: Laboratory Sample ID: Location: Analytes	Highest background value	Superfund Chemical Data Matrix (SCDM) RDSC (mg/Kg)	Superfund Chemical Data Matrix (SCDM) CRSC (mg/Kg)	EPA Residential Regional Screening Levels (RSLs) (mg/Kg)	PMA_DC_SO_07_0611 MH30F9 Bi-Metallic/Old Red waste rock	PMA_DC_SO_07A_0611 MH30G0 Bi-Metallic/Old Red waste rock	PMA_DC_SO_09_0611 MH30H6 Douglas Creek east tailings, from riprap area	PMA_DC_SO_11_0611 MH30E9 Douglas Creek west tailings, near toe on eastern side	PMA_DC_SO_12_0611 MH30E7 Douglas Creek waste rock pile	PMA_DC_SO_13_0611 MH30E8 Douglas Creek waste rock pile
Aluminum	24,600	-	-	77,000	3,320	3,830	3,120	1,930	4,640	5,700
Antimony	5.8 UJ	31	-	31	44.6 J (35.1) ☆	58.9 J (46.4) ☆	53.2 J (41.9) ☆	85.5 J (67.3) ☆	26.9 J (21.2)	47.0 J (37) ☆
Arsenic	60.7 ☆	23	0.43	0.39	4,760 [4X] ☆	3,860 [3X] ☆	1,020 ☆	1,760 [2X] ☆	2,360 [2X] ☆	2,200 [2X] ☆
Barium	186	5,500	-	15,000	134	137 J	179 J	187 J	138 J	120 J
Beryllium	0.63 UJ	160	-	160	0.39 UJ	0.46 UJ	0.46 U	0.43 UJ	0.48 UJ	0.51 U
Cadmium	0.60 UJ	39	-	70	1.3 UJ	1.4 UJ	1.8 J+ (1.4)	3.3 J (2.56)	0.64 UJ	0.98 UJ
Calcium	1,410			-	1,400	2,340	1,210	724	1,580	1,540
Chromium	7.7	230	-	-	3.0 U	2.4 U	2.3 U	2.1 J	2.3 U	4.1
Cobalt	5.9 J (7.4)	-	-	23	4.4	4.6 U	4.6 U	4.3 U	4.8 U	5.2
Copper	11.9	-	-	3,100	46.9 J (37.5)	70.1 J (56.1)	35.3 J (28.2)	91.7 J (73.4)	20.6 J (16.5)	46.7 J (37.4)
Iron	19,500	-	-	55,000	29,200	27,600	12,800	15,100	25,100	30,900
Lead	76.4	-	-	400	294 J (225)	512 J (390)	192 J (147)	359 J (274)	252 J (192)	381 J (291)
Magnesium	5,800	-	-	-	673	1,350	1,890	825	1,400	2,120
Manganese	538 J (667)	11,000	-	1,800	876 J (684)	913 J (713)	3,970 J (3,102) ☆	3,700 J (2,891) ☆	465 J (363)	818 J (639)
Mercury	0.49	23	-	10	1.1	5.7 [5X]	0.52	1.1	1.0	0.87
Nickel	6.5	1,600	-	-	3.1 U	3.7 U	3.7 U	3.4 U	3.8 U	4.1 U
Potassium	2,520	-	-	-	1,760	2,490	1,550	986	2,110	2,020
Selenium	0.26 J	390	-	390	0.37 J (0.26)	3.2 U	3.2 U	3.0 U	3.4 U	3.5 U
Silver	6.4	390	-	390	41.0	91.4	43.9	85.3	179	80.1
Sodium	486 UJ			-	392 UJ	462 UJ	459 UJ	430 UJ	479 UJ	507 U
Thallium	2.4 UJ	-	-	0.78	3.0 J+ (2.19) ☆	3.6 J+ (2.6) ☆	8.8 J (6.42) ☆	8.5 J (6.2) ☆	2.4 UJ	2.5 U
Vanadium	40.6	550	-	390	26.8	27.0	20.0	20.7	26.7	41.2
Zinc	81.5	23,000	-	23,000	201 J (156)	260 J (202)	328 J (254)	320 J (248)	58.8 J (46)	212 J (164)

J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the analyte is reliable.
 U The analyte was not detected above the CRQL.
 UJ The analyte was not detected at a level greater than or equal to the adjusted CRQL. However, the reported adjusted CRQL is approximate and may be inaccurate or imprecise.
 J- The associated numerical value is an estimated quantity but the result may be biased low.
 J+ The associated numerical value is an estimated quantity but the result may be biased high.
 RDSC Superfund Chemical Data Matrix (SCDM) Reference Dose Screening Concentration
 CRSC Superfund Chemical Data Matrix (SCDM) Cancer Risk Screening Concentration
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 XX.X Highest background value
 (#X) Dilution factor. If not listed dilution factor is 1
 (X.X) Corrected Value as per EPA 540-F-94-028 "Using Qualified Data to Document an Observed Release and Observed Contamination."
 [XX] Analytical result > 3 x highest background value = observed contamination
 ☆ Concentration is > benchmark
 [3X] Sample was diluted 3 times for analysis
 Sources: EPA 2011 (CLP limits and Low Concentration Detection Limits, Regional Screening Levels); EPA 2004 (SCDM)

Table 5, cont.
Soil Source (Mining Waste) Sample Results
Units of milligrams per kilogram (mg/kg) parts per million (ppm)

Field Sample ID: Laboratory Sample ID: Location:	Highest background value	Superfund Chemical Data Matrix (SCDM) RDSC (mg/Kg)	Superfund Chemical Data Matrix (SCDM) CRSC (mg/Kg)	EPA Residential Regional Screening Levels (RSLs) (mg/Kg)	PMA_DC_SO_14_0611 MH30A7 Contact Mill east tailings	PMA_DC_SO_15_0611 MH30A8 Contact Mill east tailings	PMA_DC_SO_16_0611 MH30A6 Historical Bi-Metallic mill tailings	PMA_DC_SO_17_0611 MH30A5 Historical Bi-Metallic mill tailings
Aluminum	24,600	-	-	77,000	12,400	9,160	422	850
Antimony	5.8 UJ	31	-	31	6.6 UJ	6.0 UJ	370 J (291) ☆	365 J (287) ☆
Arsenic	60.7 ☆	23	0.43	0.39	25.9 ☆	9.9 ☆	173 ☆	420 ☆
Barium	186	5,500	-	15,000	274	63.0	88.7	202
Beryllium	0.63 UJ	160	-	160	1.8	2.4	0.46 U	0.49 UJ
Cadmium	0.60 UJ	39	-	70	4.5	0.50 UJ	25.6	7.1
Calcium	1,410	-	-	-	31,600	48,000	457 U	492 U
Chromium	7.7	230	-	-	10.2	12.0	0.91 U	3.2
Cobalt	5.9 J (7.4)	-	-	23	15.8 J	5.0 UJ	4.6 UJ	4.9 UJ
Copper	11.9	-	-	3,100	13,400 [3X] ☆	38.1	253	372
Iron	19,500	-	-	55,000	54,700	8,530	9,060	10,700
Lead	76.4	-	-	400	65.9	19.2	7,240 [2X] ☆	4,460 ☆
Magnesium	5,800	-	-	-	8,030	17,800	457 U	492 U
Manganese	538 J (667)	11,000	-	1,800	1,430 J (1,117)	847 J (662)	88.7 J (69.0)	122 J (95)
Mercury	0.49	23	-	10	0.24	0.0028 J-	1.0	0.84
Nickel	6.5	1,600	-	-	11.6	6.3	3.7 U	3.9 U
Potassium	2,520	-	-	-	2,140	3,030	461	478 J
Selenium	0.26 J	390	-	390	10	3.5 U	3.5	2.8 J (2)
Silver	6.4	390	-	390	10.4	8.5	32.0	26.1
Sodium	486 UJ	-	-	-	554 UJ	496 UJ	457 U	492 UJ
Thallium	2.4 UJ	-	-	0.78	2.8 UJ	2.5 UJ	2.3 U	2.5 U
Vanadium	40.6	550	-	390	33.1	15.5	4.6 U	4.9 U
Zinc	81.5	23,000	-	23,000	494	45.4	2,420	218

J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the analyte is reliable.
 U The analyte was not detected above the CRQL.
 UJ The analyte was not detected at a level greater than or equal to the adjusted CRQL. However, the reported adjusted CRQL is approximate and may be inaccurate or imprecise.
 J- The associated numerical value is an estimated quantity but the result may be biased low.
 J+ The associated numerical value is an estimated quantity but the result may be biased high.
 RDSC Superfund Chemical Data Matrix (SCDM) Reference Dose Screening Concentration
 CRSC Superfund Chemical Data Matrix (SCDM) Cancer Risk Screening Concentration
 mg/Kg milligrams per kilogram
 ppm parts per million
 XX.X Highest background value
 (#X) Dilution factor. If not listed dilution factor is 1
 (X.X) Corrected Value as per EPA 540-F-94-028 "Using Qualified Data to Document an Observed Release and Observed Contamination."
 [XX] Analytical result > 3 x highest background value = observed contamination
 ☆ Concentration is > benchmark
 [3X] Sample was diluted 3 times for analysis
 Sources: EPA 2011 (CLP limits and Low Concentration Detection Limits, Regional Screening Levels); EPA 2004 (SCDM)

Table 6
Aqueous Source (Adits and Seeps) Sample Results (Total and Dissolved Metals)
Units of micrograms per liter (µg/L) parts per billion (ppb)

Field Sample ID: Laboratory Sample ID: Location: Analysis: Analytes	Highest background value (dissolved metals)	Superfund Chemical Data Matrix (SCDM) Environmental Freshwater (compare to dissolved results)		Highest background value (total metals)	MT Circular DEQ-7 Aquatic Life Standards (compare to total results)		PMA_DC_SW_17_0611 MH30C6	PMA_DC_SW_17_0611 MH3AB8	PMA_DC_SW_89_0611	PMA_DC_SW_15_0611 MH30D5	PMA_DC_SW_15_0611 MH30D6
		Acute CMC (µg/L)	Chronic CCC (µg/L)		Acute (µg/L)	Chronic (µg/L)	New Departure adit Total metals	New Departure adit Dissolved metals	Duplicate of PMA_DC_SW_17_0611 Total mercury only	Seep at east end of Douglas Creek west tailings Total metals	Seep at east end of Douglas Creek west tailings Dissolved metals
Aluminum	46.6	750	87	73.9	750	87	42.8	28.6	-	57.3	20.0 U
Antimony	2.0 UJ	-	-	2.0 UJ	-	-	2.0 U	2.0 U	-	4.3 J	4.6
Arsenic	1.6	340	150	1.8	340	150	10.8	10.6	-	51.6	47.9
Barium	25.9	-	-	27.1	-	-	16.9	15.9	-	29.6	28.3
Beryllium	1.0 U	-	-	1.0 U	-	-	1.0 U	1.0 U	-	1.0 U	1.0 U
Cadmium	1.0 U	1.39**	0.20**	1.0 U	1.60*	0.22*	1.0 U	1.0 U	-	1.0 U	1.0 U
Calcium	5,220	-	-	5,210	-	-	5,760	5,790	-	17,900	17,800
Chromium	0.27 J	-	-	2.0 U	-	-	2.0 U	2.0 U	-	2.0 U	2.0 U
Cobalt	1.0 U	-	-	1.0 U	-	-	1.0 U	1.0 U	-	1.0 U	1.0 U
Copper	2.0 U	9.40**	6.50**	2.0 U	10.70*	7.31*	2.0 U	2.0 U	-	1.5 J	1.4 J
Iron	64.3 J-	-	1,000	105 J	-	1,000	200 U	200 U	-	113 J	200 U
Lead	1.0 UJ	47.63**	1.86**	1.0 U	56.75*	2.21*	1.0 U	1.0 U	-	0.96 J-	1.0 U
Magnesium	1,020	-	-	1,030	-	-	1,150	1,120	-	4,100	4,330
Manganese	7.3	-	-	8.1	-	-	17.6	5.5	-	27.5	4.6
Mercury	NA	1.4	0.77	0.01 U	1.7	0.91	0.01 U	-	0.01 U	0.01 U	-
Nickel	1.0 U	327.96**	36.46**	1.0U	368.43*	40.96*	1.0 U	1.0 U	-	0.28 J	1.0 U
Potassium	898	-	-	892	-	-	500 U	411 J-	-	1,880	1,760
Selenium	5.0 U	-	5.0	5.0 U	20	5.0	5.0 U	5.0 U	-	5.0 U	5.0 U
Silver	1.1 J	1.83**	-	1.0 U	2.48	-	1.0 U	1.0 U	-	0.0092 J	3.2 ☆
Sodium	2,710	-	-	2,720	-	-	2,420	2,420	-	6,450	6,620
Thallium	1.0 U	-	-	1.0 U	-	-	1.0 U	1.0 U	-	1.0 U	1.0 U
Vanadium	5.0 U	260	-	0.34 J-	-	-	5.0 U	5.0 U	-	0.70 J	0.62 J
Zinc	1.8 J	83.71**	83.71**	0.61 J	94.05*	94.05*	0.62 J	1.2 J	-	36.9	30.6

* Value has been adjusted for an average hardness value of 75.147 (equivalent CaCO₃) as calculated from all surface water total metals results from this assessment. Calculations performed as per footnote 12 of the MDEQ Circular DEQ-7 Montana Numeric Water Quality Standards (August 2010).

** Value has been adjusted for an average hardness value of 65.4898 (equivalent CaCO₃) as calculated from all surface water dissolved metals results from this assessment. Calculations performed as per footnote E of the SCDMs Hazardous Substance Benchmarks (Jan 2004).

CCC criteria continuous concentration

CMC criteria maximum concentration

J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the analyte is reliable.

U The analyte was not detected above the CRQL.

UJ The analyte was not detected at a level greater than or equal to the adjusted CRQL. However, the reported adjusted CRQL is approximate and may be inaccurate or imprecise.

J- The associated numerical value is an estimated quantity but the result may be biased low.

J+ The associated numerical value is an estimated quantity but the result may be biased high.

ICP-MS Inductively coupled plasma-mass spectrometry

µg/L microgram per liter

ppb parts per billion

☆ Concentration is > benchmark

Sources: EPA 2011 (CLP limits and Low Concentration Detection Limits); EPA 2004 (SCDM); MDEQ 2010 (Circular DEQ-7, Montana Numeric Water Quality Standards)

Table 6
Aqueous Source (Adits and Seeps) Sample Results (Total and Dissolved Metals)
Units of micrograms per liter (µg/L) parts per billion (ppb)

Field Sample ID: Laboratory Sample ID: Location: Analysis: Analytes	Highest background value (dissolved metals)	Superfund Chemical Data Matrix (SCDM) Environmental Freshwater (compare to dissolved results)		Highest background value (total metals)	MT Circular DEQ-7 Aquatic Life Standards (compare to total results)		PMA_DC_SW_16_0611 MH30D3	PMA_DC_SW_16_0611 MH30D4	PMA_DC_SW_13_0611 MH30C9	PMA_DC_SW_13_0611 MH30D0
		Acute CMC (µg/L)	Chronic CCC (µg/L)		Acute (µg/L)	Chronic (µg/L)	Seep at west end of Douglas Creek west tailings	Seep at west end of Douglas Creek west tailings	Granite Mountain/Bi-Metallic adit	Granite Mountain/Bi-Metallic adit
							Total metals	Dissolved metals	Total metals	Dissolved metals
Aluminum	46.6	750	87	73.9	750	87	4,550 ☆	43.3	706 ☆	37.9
Antimony	2.0 UJ	-	-	2.0 UJ	-	-	116	21.8	3.9 J	2.3 J
Arsenic	1.6	340	150	1.8	340	150	2,100 ☆	235 ☆	477 ☆	11.1
Barium	25.9	-	-	27.1	-	-	284	24.3	18.9	18.9
Beryllium	1.0 U	-	-	1.0 U	-	-	0.46 J	1.0 U	1.0 UJ	1.0 UJ
Cadmium	1.0 U	1.39**	0.20**	1.0 U	1.60*	0.22*	4.2 ☆	1.0 U	6.1 ☆	6.0 ☆
Calcium	5,220	-	-	5,210	-	-	99,700	26,400	135,000 [2X]	133,000 [2X]
Chromium	0.27 J	-	-	2.0 U	-	-	4.4	2.0 U	2.0 U	2.0 U
Cobalt	1.0 U	-	-	1.0 U	-	-	2.3	1.0 U	13.4	13.5
Copper	2.0 U	9.40**	6.50**	2.0 U	10.70*	7.31*	129 ☆	6.7 ☆	21.1 ☆	0.85 J
Iron	64.3 J-	-	1,000	105 J	-	1,000	11,900 ☆	200 U	5,970 ☆	1,900 ☆
Lead	1.0 UJ	47.63**	1.86**	1.0 U	56.75*	2.21*	825 ☆	2.2 ☆	0.66 J-	1.0 UJ
Magnesium	1,020	-	-	1,030	-	-	7,030	4,070	25,100	25,500
Manganese	7.3	-	-	8.1	-	-	8,950 [2X]	84.8	28,900 [10X]	29,200 [10X]
Mercury	NA	1.4	0.77	0.01 U	1.7	0.91	0.01 U	-	0.01 U	-
Nickel	1.0 U	327.96**	36.46**	1.0U	368.43*	40.96*	2.9	1.0 U	7.3	7.3
Potassium	898	-	-	892	-	-	3,900	2,020	2,250	2,290
Selenium	5.0 U	-	5.0	5.0 U	20	5.0	5.0 U	5.0 U	0.34 J	5.0 U
Silver	1.1 J	1.83**	-	1.0 U	2.48	-	55.0 ☆	1.0 U	1.0 U	0.025 J
Sodium	2,710	-	-	2,720	-	-	6,450	6,140	11,600	11,800
Thallium	1.0 U	-	-	1.0 U	-	-	1.0 U	1.0 U	1.0 U	1.0 U
Vanadium	5.0 U	260	-	0.34 J-	-	-	13.1	1.0 J	5.0 U	5.0 U
Zinc	1.8 J	83.71**	83.71**	0.61 J	94.05*	94.05*	1,270 ☆	10.5	4,790 J ☆	4,880 J ☆

* Value has been adjusted for an average hardness value of 75.147 (equivalent CaCO₃) as calculated from all surface water total metals results from this assessment. Calculations performed as per footnote 12 of the MDEQ Circular DEQ-7 Montana Numeric Water Quality Standards (August 2010).

** Value has been adjusted for an average hardness value of 65.4898 (equivalent CaCO₃) as calculated from all surface water dissolved metals results from this assessment. Calculations performed as per footnote E of the SCDMs Hazardous Substance Benchmarks (Jan 2004).

CCC criteria continuous concentration

CMC criteria maximum concentration

J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the analyte is reliable.

U The analyte was not detected above the CRQL.

UJ The analyte was not detected at a level greater than or equal to the adjusted CRQL. However, the reported adjusted CRQL is approximate and may be inaccurate or imprecise.

J- The associated numerical value is an estimated quantity but the result may be biased low.

J+ The associated numerical value is an estimated quantity but the result may be biased high.

ICP-MS Inductively coupled plasma-mass spectrometry

µg/L microgram per liter

ppb parts per billion

☆ Concentration is > benchmark

[3X] Sample was diluted 3 times for analysis

Sources: EPA 2011 (CLP limits and Low Concentration Detection Limits); EPA 2004 (SCDM); MDEQ 2010 (Circular DEQ-7, Montana Numeric Water Quality Standards)

Table 7
Sediment Source (Adit) Sample Results
Concentration in Units of milligrams per kilogram (mg/kg) or parts per million (ppm)

Field Sample ID: Laboratory Sample ID: Location: Analytes	EPA Region 3 Freshwater Sediment Screening Benchmark (mg/kg)	PMA_DC_SE_17_0611 MH30B8 New Departure adit	PMA_DC_SE_89_0611 MH30B9 Duplicate of PMA_DC_SE_17_0611
Aluminum	-	12,600	7,600
Antimony	2	7.9 UJ	6.1 UJ
Arsenic	9.8	57.2 ☆	33.7 ☆
Barium	-	110	81.3
Beryllium	-	0.66 U	0.51 U
Cadmium	0.99	0.66 U	0.51 U
Calcium	-	1,390	1,440
Chromium	43.4	3.9	2.9
Cobalt	50	6.6 UJ	5.1 UJ
Copper	31.6	9.1	3.5 U
Iron	20,000	11,600	8,630
Lead	35.8	10.7	5.6
Magnesium	-	1,280	943
Manganese	460	720 J ☆	474 J ☆
Mercury	0.18	0.075 J-	0.11
Nickel	22.7	5.2 U	4.1 U
Potassium	-	495 J	413 J
Selenium	2	4.6 U	3.6 U
Silver	1.0	0.21 J	1.0 U
Sodium	-	656 U	509 U
Thallium	-	3.3 U	2.5 U
Vanadium	-	25.8	22.0
Zinc	121	25.3	15.7

J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the analyte is reliable.
 U The analyte was not detected above the CRQL.
 UJ The analyte was not detected at a level greater than or equal to the adjusted CRQL. However, the reported adjusted CRQL is approximate and may be inaccurate or imprecise.
 J- The associated numerical value is an estimated quantity but the result may be biased low.
 J+ The associated numerical value is an estimated quantity but the result may be biased high.
 mg/Kg milligrams per kilogram ppm parts per million
 X.X highest background soil value XX Analytical result > 3 x highest background value
 ☆ Concentration is > benchmark
 Sources: EPA 2006 (Region 3 Freshwater Sediment Screening Benchmarks)

Table 8
Surface Water Release Sample Results (Total Metals)
Units of µg/L (ppb)

Field Sample ID: Laboratory Sample ID: Location: Analytes	MT Circular DEQ-7 Aquatic Life Standards		PMA_DC_SW_01A_0611 MH3AB7	PMA_DC_SW_01B_0611 MH30G7	PMA_DC_SW_20_0611 MH30G1	PMA_DC_SW_21_0611 MH30G4	PMA_DC_SW_03_0611 MH30D9	PMA_DC_SW_04_0611 MH30D7	PMA_DC_SW_05_0611 MH30H3
	Acute (µg/L)	Chronic (µg/L)	<u>Background</u> Douglas Creek “upper” background	<u>Background</u> Douglas Creek “lower” background	Douglas Creek above Granite Mountain and Bi-Metallic/Old Red PPE	Douglas Creek below Granite Mountain and Bi-Metallic/Old Red PPE	Douglas Creek above Douglas Creek east tailings pile	Douglas Creek below Douglas Creek east tailings pile	Douglas Creek above Douglas Creek west tailings pile
Aluminum (dissolved**)	750	87	46.6	28.2	52.7	69.7	53.5	57.2	47.2
Aluminum (total)	-	-	73.9	72.2	83.3	86.2	80.7	93.4	78.4
Antimony	-	-	2.0 U	2.0 UJ	4.3	5.1 J	4.4	4.7	4.7 J
Arsenic	340	150	1.4	1.8	26.6 ☆	40.8 ☆	38.9 ☆	45.5 ☆	47.8 ☆
Barium	-	-	27.1	25.3	18.9	21.0	23.3	24.9	24.6
Beryllium	-	-	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Cadmium	1.60*	0.22*	1.0 U	1.0 U	1.0 U	0.40 J- ★	1.0 U	1.0 U	0.079 J-
Calcium	-	-	4,350	5,210	3,480	5,550	5,780	6,780	6,850
Chromium	-	-	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Cobalt	-	-	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Copper	10.70*	7.31*	2.0 U	2.0 U	8.1 ★	11.3 ★	8.1 ★	8.6 ★	7.7 ★
Iron	-	1,000	200 U	105 J (133)	200 U	73.5 J	200 U	200 U	124 J
Lead	56.75*	2.21*	1.0 U	1.0 U	5.6 ★	6.4 ★	5.8 ★	5.9 ★	7.6 ★
Magnesium	-	-	816	1,030	693	1,160	1,210	1,430	1,400
Manganese	-	-	8.1	3.3	4.2	43.1 ☆	32.2 ☆	47.1 ☆	54.4 ☆
Mercury	1.7	0.91	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Nickel	368.43*	40.96*	1.0 U	1.0U	1.0U	1.0 U	1.0U	1.0U	0.090 J-
Potassium	-	-	838	892	500 U	498 J	666	775	763
Selenium	20	5.0	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Silver	2.48	-	1.0 U	1.0 U	1.0 U	0.063 J-	1.0 U	1.0 U	0.085 J-
Sodium	-	-	2,560	2,720	2,410	2,540	2,780	2,970	2,850
Thallium	-	-	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vanadium	-	-	5.0 U	0.34 J- (0.43)	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Zinc	94.05*	94.05*	0.46 J	0.61 J (0.79)	48.4 ☆	120 J ☆ (93)	86.7 ☆	87.1 ☆	84.7 J (66) ☆

* Value has been adjusted for an average hardness value of 75.147 (equivalent CaCO3) as calculated from all surface water total metals results from this assessment. Calculations performed as per footnote 12 of the MDEQ Circular DEQ-7 Montana Numeric Water Quality Standards (August 2010).

** Dissolved results are shown for aluminum, as the MDEQ Aquatic Life Standards for aluminum apply only to the dissolved, not the total fraction.

J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the analyte is reliable.

U The analyte was not detected above the CRQL.

UJ The analyte was not detected at a level greater than or equal to the adjusted CRQL. However, the reported adjusted CRQL is approximate and may be inaccurate or imprecise.

J- The associated numerical value is an estimated quantity but the result may be biased low.

J+ The associated numerical value is an estimated quantity but the result may be biased high.

ICP-MS Inductively coupled plasma-mass spectrometry

µg/L microgram per liter

ppb parts per billion

XX.X Background value

☆ Elevated Concentration (concentration is > 3X background, but not > than a benchmark or no benchmark available)

★ Elevated Concentration (concentration is > 3X background and > than a benchmark)

Sources: EPA 2011 (CLP limits and Low Concentration Detection Limits); EPA 2004 (SCDM); MDEQ 2010 (Circular DEQ-7, Montana Numeric Water Quality Standards)

Table 8,cont.
Surface Water Release Sample Results (Total Metals)
Units of µg/L (ppb)

Field Sample ID: Laboratory Sample ID: Location: Analytes	Highest background value	MT Circular DEQ-7 Aquatic Life Standards		PMA_DC_SW_06_0611 MH30H0	PMA_DC_SW_07_0611 MH30D1	PMA_DC_SW_08_0611 MH30C7	PMA_DC_SW_09_0611 MH3AC2	PMA_DC_SW_99_0611 MH30F0	PMA_DC_SW_10_0611 MH30B5	PMA_DC_SW_12_0611 MH30B3
		Acute (µg/L)	Chronic (µg/L)	Douglas Creek below Douglas Creek west tailings pile	Douglas Creek above Granite Mountain/Bi-Metallic adit discharge	Douglas Creek below Granite Mountain/Bi-Metallic adit discharge and above Douglas Creek waste rock	Douglas Creek below Douglas Creek waste rock	Douglas Creek below Douglas Creek waste rock (duplicate of PMA_DC_SW_09_0611)	Douglas Creek above Contact Mill east tailings	Douglas Creek below Historical Bi-Metallic mill tailings and above Frost Creek
Aluminum (dissolved**)	46.6	750	87	51.9	52.7	42.8	36.4	40.6	38.7	36.3
Aluminum (total)	73.9	-	-	70.6	107	128	181	128	136	135
Antimony	2.0 UJ	-	-	4.9 J	7.2 ☆	6.7 ☆	(5.3) 6.7 J	(5.0) 6.3 J	7.3 ☆	6.9 ☆
Arsenic	1.8	340	150	52.3 ☆	83.3 ☆	95.1 ☆	102 ☆	101 ☆	115 ☆	106 ☆
Barium	27.1	-	-	24.2	28.3	26.4	26.1	25.3	29.3	28.7
Beryllium	1.0 U	-	-	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Cadmium	1.0 U	1.60*	0.22*	0.068 J-	1.0 U	1.0 U	0.92 J- ★	0.86 J- ★	1.2 ★	1.0 U
Calcium	5,210	-	-	7,320	8,670	16,300	24,700	24,700	25,000	24,600
Chromium	2.0 U	-	-	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Cobalt	1.0 U	-	-	1.0 U	1.0 U	1.0 U	1.5	1.5	1.2	1.2
Copper	2.0 U	10.70*	7.31*	7.4 ★	8.9 ★	8.9 ★	8.7 ★	8.0 ★	8.4 ★	8.0 ★
Iron	105 J (133)	-	1,000	132 J	218	501 ☆	697 ☆	638 ☆	559 ☆	539 ☆
Lead	1.0 U	56.75*	2.21*	6.1 ★	15.4 ★	12.1 ★	11.5 ★	9.6 ★	12.7 ★	11.0 ★
Magnesium	1,030	-	-	1,530	1,740	3,550 ☆	5,030 ☆	5,080 ☆	5,270 ☆	5,230 ☆
Manganese	8.1	-	-	70.8☆	172 ☆	2,060 ☆	3,710 ☆	3,700 ☆	2,930 ☆	2,840 ☆
Mercury	0.01 U	1.7	0.91	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Nickel	1.0U	368.43*	40.96*	0.061 J-	1.0 U	1.0 U	1.1 ☆	1.1 ☆	1.1 ☆	1.1 ☆
Potassium	892	-	-	785	857	952	1,060	1,030	1,200	1,180
Selenium	5.0 U	20	5	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Silver	1.0 U	2.48	-	0.069 J-	1.0 U	1.0 U	0.46 J-	0.23 J-	1.0 U	1.0 U
Sodium	2,720	-	-	2,940	3,200	3,860	4,250	4,280	4,930	4,880
Thallium	1.0 U	-	-	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vanadium	0.34 J- (0.43)	-	-	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	0.45 J-	5.0 U
Zinc	0.61 J (0.79)	94.05*	94.05*	(66) 85.0 J ☆	100 ★	430 ★	725 J (562) ★	728 J (564) ★	602 ★	554 ★

* Value has been adjusted for an average hardness value of 75.147 (equivalent CaCO₃) as calculated from all surface water total metals results from this assessment. Calculations performed as per footnote 12 of the MDEQ Circular DEQ-7 Montana Numeric Water Quality Standards (August 2010).

** Dissolved results are shown for aluminum, as the MDEQ Aquatic Life Standards for aluminum apply only to the dissolved, not the total fraction.

J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the analyte is reliable.

U The analyte was not detected above the CRQL.

UJ The analyte was not detected at a level greater than or equal to the adjusted CRQL. However, the reported adjusted CRQL is approximate and may be inaccurate or imprecise.

J- The associated numerical value is an estimated quantity but the result may be biased low.

J+ The associated numerical value is an estimated quantity but the result may be biased high.

ICP-MS Inductively coupled plasma-mass spectrometry

µg/L microgram per liter

ppb parts per billion

XX.X Background value

☆ Elevated Concentration (concentration is > 3X background, but not > than a benchmark or no benchmark available)

★ Elevated Concentration (concentration is > 3X background and > than a benchmark)

Sources: EPA 2011 (CLP limits and Low Concentration Detection Limits); EPA 2004 (SCDM); MDEQ 2010 (Circular DEQ-7, Montana Numeric Water Quality Standards)

Table 8,cont.
Surface Water Release Sample Results (Total Metals)
Units of µg/L (ppb)

Field Sample ID: Laboratory Sample ID: Location: Analytes	Highest background value	MT Circular DEQ-7 Aquatic Life Standards		PMA_DC_SW_18_0611 MH30A9	PMA_DC_SW_19_0611 MH30B1	PMA_DC_SW_23_0611 MH30F4	PMA_DC_SW_22_0611 MH30F2
		Acute (µg/L)	Chronic (µg/L)	Frost Creek, above confluence with Douglas Creek (different drainage, not within TDL)	Douglas Creek below confluence with Frost Creek	Flint Creek above Douglas Creek (different drainage, not within TDL)	Flint Creek below Douglas Creek
Aluminum (dissolved**)	46.6	750	87	39.0	38.0	10.9 J	10.0 J
Aluminum (total)	73.9	-	-	123	121	80.0	44.5
Antimony	2.0 UJ	-	-	4.2	4.3	2.0 U	2.0 U
Arsenic	1.8	340	150	55.8	55.3 ☆	1.7	16.4 ☆
Barium	27.1	-	-	25.6	25.9	70.5	66.6
Beryllium	1.0 U	-	-	1.0 U	1.0 U	1.0 U	1.0 U
Cadmium	1.0 U	1.60*	0.22*	1.0 U	1.0 U	1.0 U	1.0 U
Calcium	5,210	-	-	15,700	17,300	23,400	22,200
Chromium	2.0 U	-	-	2.0 U	2.0 U	2.0 U	2.0 U
Cobalt	1.0 U	-	-	1.0 U	1.0 U	1.0 U	1.0 U
Copper	2.0 U	10.70*	7.31*	5.1	5.1	1.8 J	1.0 J
Iron	105 J (133)	-	1,000	292	316	200 U	200 U
Lead	1.0 U	56.75*	2.21*	12.4	9.7 ★	1.0 U	1.0 U
Magnesium	1,030	-	-	3,870	4,150 ☆	6,750	7,180 ☆
Manganese	8.1	-	-	1,020	1,420 ☆	6.0	19.8
Mercury	0.01 U	1.7	0.91	0.01 U	0.01 U	0.01 U	0.01 U
Nickel	1.0U	368.43*	40.96*	0.56 J	0.68 J	1.0 U	1.0 U
Potassium	892	-	-	1,040	1,070	1,640	1,310
Selenium	5.0 U	20	5	5.0 U	5.0 U	5.0 U	5.0 U
Silver	1.0 U	2.48	-	1.0 U	1.0 U	1.0 U	1.0 U
Sodium	2,720	-	-	5,150	5,160	2,880	3,480
Thallium	1.0 U	-	-	1.0 U	1.0 U	1.0 U	1.0 U
Vanadium	0.34 J- (0.43)	-	-	0.34 J-	0.28 J-	0.96 J (0.77)	5.0 U
Zinc	0.61 J (0.79)	94.05*	94.05*	252	314 ★	1.4 J (1.1)	2.6

* Value has been adjusted for an average hardness value of 75.147 (equivalent CaCO₃) as calculated from all surface water total metals results from this assessment. Calculations performed as per footnote 12 of the MDEQ Circular DEQ-7 Montana Numeric Water Quality Standards (August 2010).

** Dissolved results are shown for aluminum, as the MDEQ Aquatic Life Standards for aluminum apply only to the dissolved, not the total fraction.

J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the analyte is reliable.

U The analyte was not detected above the CRQL.

UJ The analyte was not detected at a level greater than or equal to the adjusted CRQL. However, the reported adjusted CRQL is approximate and may be inaccurate or imprecise.

J- The associated numerical value is an estimated quantity but the result may be biased low.

J+ The associated numerical value is an estimated quantity but the result may be biased high.

ICP-MS Inductively coupled plasma-mass spectrometry

µg/L microgram per liter

ppb parts per billion

XX.X Background value

☆ Elevated Concentration (concentration is > 3X background, but not > than a benchmark or no benchmark available)

★ Elevated Concentration (concentration is > 3X background and > than a benchmark)

Sources: EPA 2011 (CLP limits and Low Concentration Detection Limits); EPA 2004 (SCDM); MDEQ 2010 (Circular DEQ-7, Montana Numeric Water Quality Standards)

Table 9
Surface Water Release Sample Results (Dissolved Metals)
Units of µg/L (ppb)

Field Sample ID: Laboratory Sample ID: Location: Analytes	Superfund Chemical Data Matrix (SCDM) Environmental Freshwater		PMA_DC_SW_01A_061 1 MH30C5	PMA_DC_SW_01B_061 1 MH30G8	PMA_DC_SW_20_0611 MH30G2	PMA_DC_SW_21_061 1 MH30G5	PMA_DC_SW_03_0611 MH30E0	PMA_DC_SW_04_061 1 MH30D8	PMA_DC_SW_05_06 11 MH30H4
	Acute CMC (µg/L)	Chronic CCC (µg/L)	Background Douglas Creek “upper” background	Background Douglas Creek “lower” background	Douglas Creek above Granite Mountain and Bi-Metallic/Old Red PPE	Douglas Creek below Granite Mountain and Bi-Metallic/Old Red PPE	Douglas Creek above Douglas Creek east tailings pile	Douglas Creek below Douglas Creek east tailings pile	Douglas Creek above Douglas Creek west tailings pile
Aluminum	750	87	46.6	28.2	52.7	69.7	53.5	57.2	47.2
Antimony	-	-	2.0 U	2.0 UJ	4.1	5.1 J	4.2	4.7	4.4 J
Arsenic	340	150	1.2	1.6	21.6 ☆	30.8 ☆	28.1 ☆	31.9 ☆	34.3 ☆
Barium	-	-	25.9	24.4	17.7	20.3	21.3	22.3	22.2
Beryllium	-	-	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Cadmium	1.39*	0.20*	1.0 U	1.0 U	1.0 U	0.35 J (0.27) ★	1.0 U	1.0 U	0.048 J-
Calcium	-	-	4,310	5,220	3,470	5,560	5,650	6,690	6,830
Chromium	-	-	0.27 J (0.35)	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Cobalt	-	-	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Copper	9.40*	6.50*	2.0 U	2.0 U	7.3 ★	10.5 ★	7.3 ★	6.2 ☆	6.1 ☆
Iron	-	1,000	200 U	64.3 J- (82)	200 U	60.5 J-	200 U	200 U	60.8 J-
Lead	47.63*	1.86*	1.0 U	1.0 UJ	2.0	2.0 J	1.1	1.0 U	0.72 J-
Magnesium	-	-	779	1,020	680	1,170	1,140	1,470	1,420
Manganese	-	-	7.3	0.81 J-	1.0 U	33.9 ☆	16.5	20.8	19.7
Mercury	1.4	0.77	NA	NA	NA	NA	NA	NA	NA
Nickel	327.96*	36.46*	1.0 U	1.0 U	1.0 U	0.12 J-	1.0 U	1.0 U	0.075 J-
Potassium	-	-	825	898	429 J-	499 J	661	771	761
Selenium	-	5.0	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Silver	1.83*	-	1.0 U	1.1 J (1.6)	1.0 U	0.84 J	1.0 U	1.0 U	0.38 J-
Sodium	-	-	2,490	2,710	2,380	2,560	2,720	3,050	2,900
Thallium	-	-	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vanadium	260	-	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	0.51 J-	5.0 U
Zinc	83.71*	83.71*	1.8 J (2.3)	1.1 J	46.9 ☆	117 J (91)★	79.7 ☆	71.6 J (55.5)★	73.2 J (56.7)★

* Value has been adjusted for an average hardness value of 65.4898 (equivalent CaCO₃) as calculated from all surface water dissolved metals results from this assessment. Calculations performed as per footnote E of the SCDMs Hazardous Substance Benchmarks (Jan 2004).

- CCC criteria continuous concentration
- CMC criteria maximum concentration
- J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the analyte is reliable.
- U The analyte was not detected above the CRQL.
- UJ The analyte was not detected at a level greater than or equal to the adjusted CRQL. However, the reported adjusted CRQL is approximate and may be inaccurate or imprecise.
- J- The associated numerical value is an estimated quantity but the result may be biased low.
- J+ The associated numerical value is an estimated quantity but the result may be biased high.
- NA Not analyzed
- ICP-MS Inductively coupled plasma-mass spectrometry
- µg/L microgram per liter ppb parts per billion
- X.X Background value XX.X Highest background value
- ☆ Elevated Concentration (concentration is > 3X background, but not > than a benchmark or no benchmark available)
- ★ Elevated Concentration (concentration is > 3X background and > than a benchmark)

Sources: EPA 2011 (CLP limits and Low Concentration Detection Limits); EPA 2004 (SCDM)

Table 9, cont.
Surface Water Release Sample Results (Dissolved Metals)
Units of µg/L (ppb)

Field Sample ID: Laboratory Sample ID: Location:	Highest background value	Superfund Chemical Data Matrix (SCDM) Environmental Freshwater		PMA_DC_SW_06_0611 MH30H1	PMA_DC_SW_07_0611 MH30D2	PMA_DC_SW_08_0611 MH30C8	PMA_DC_SW_09_0611 1 MH3AC3	PMA_DC_SW_99_0611 MH30F1	PMA_DC_SW_10_0611 1 MH30B6	PMA_DC_SW_12_0611 1 MH30B4
		Acute CMC (µg/L)	Chronic CCC (µg/L)	Douglas Creek below Douglas Creek west tailings pile	Douglas Creek above Granite Mountain/Bi-Metallic adit discharge	Douglas Creek below Granite Mountain/Bi-Metallic adit discharge and above Douglas Creek waste rock	Douglas Creek below Douglas Creek waste rock	Douglas Creek below Douglas Creek waste rock duplicate of PMA_DC_SW_09_0611	Douglas Creek above Contact Mill east tailings	Douglas Creek below Historical Bi-Metallic mill tailings and above Frost Creek
Aluminum	46.6	750	87	51.9	52.7	42.8	36.4	40.6	38.7	36.3
Antimony	2.0 UJ	-	-	4.8 J	5.7	5.4	5.3 J	5.2	5.9	5.8
Arsenic	1.6	340	150	39.1 ☆	48.6 ☆	50.9 ☆	48.8 ☆	49.2 ☆	50.9 ☆	49.8 ☆
Barium	25.9	-	-	22.4	22.5	22.1	22.7	22.2	21.6	22.5
Beryllium	1.0 U	-	-	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Cadmium	1.0 U	1.39*	0.20*	0.028 J-	1.0 U	1.0 U	0.76 J-	1.0 U	1.0 U	1.0 U
Calcium	5,220	-	-	7,300	8,470	15,700	24,900	24,300	24,500	24,600
Chromium	0.27 J (0.35)	-	-	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	0.19 J
Cobalt	1.0 U	-	-	0.035 J-	1.0 U	1.1 U	1.6	1.8	1.2	1.3
Copper	2.0 U	9.40*	6.50*	6.3 ☆	7.4 ★	5.9	5.1	5.0	4.5	4.7
Iron	64.3 J- (82)	-	1,000	75.5 J-	200 U	285	353	348	217	203
Lead	1.0 UJ	47.63*	1.86*	0.72 J-	1.6	2.0	1.5 J	1.6	1.7	1.6
Magnesium	1,020	-	-	1,550	1,650	3,370	5,090	5,060	5,110	5,160
Manganese	7.3	-	-	33.7 ☆	40.3 ☆	1910 ☆	3,600 ☆	3,610 ☆	2,660 ☆	2,640 ☆
Mercury	NA	1.4	0.77	NA	NA	NA	NA	NA	NA	NA
Nickel	1.0 U	327.96*	36.46*	0.13 J-	1.0 U	1.0 U	1.1	1.2 U	1.0 U	1.1
Potassium	898	-	-	792	838	914	1,030	1,020	1,170	1,160
Selenium	5.0 U	-	5.0	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Silver	1.1 J (1.6)	1.83*	-	0.67 J-	2.5	1.0 U	1.7 J	1.0 U	1.0 U	3.0
Sodium	2,710	-	-	2,960	3,150	3,710	4,300	4,370	4,780	4,860
Thallium	1.0 U	-	-	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vanadium	5.0 U	260	-	5.0 U	0.30 J-	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Zinc	1.8 J (2.3)	83.71*	83.71*	76.4 J (59.2)☆	74.2 ☆	390 ★	701 J (543)★	702 ★	484 ★	485 ★

* Value has been adjusted for an average hardness value of 65.4898 (equivalent CaCO₃) as calculated from all surface water dissolved metals results from this assessment. Calculations performed as per footnote E of the SCDMs Hazardous Substance Benchmarks (Jan 2004).

CCC criteria continuous concentration

CMC criteria maximum concentration

J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the analyte is reliable.

U The analyte was not detected above the CRQL.

UJ The analyte was not detected at a level greater than or equal to the adjusted CRQL. However, the reported adjusted CRQL is approximate and may be inaccurate or imprecise.

J- The associated numerical value is an estimated quantity but the result may be biased low.

J+ The associated numerical value is an estimated quantity but the result may be biased high.

NA Not analyzed

ICP-MS Inductively coupled plasma-mass spectrometry

µg/L microgram per liter

ppb parts per billion

XX.X Background value

☆ Elevated Concentration (concentration is > 3X background, but not > than a benchmark or no benchmark available)

★ Elevated Concentration (concentration is > 3X background and > than a benchmark)

Sources: EPA 2011 (CLP limits and Low Concentration Detection Limits); EPA 2004 (SCDM)

Table 9, cont.
Surface Water Release Sample Results (Dissolved Metals)
Units of µg/L (ppb)

Field Sample ID: Laboratory Sample ID: Location:	Highest background value	Superfund Chemical Data Matrix (SCDM) Environmental Freshwater		PMA_DC_SW_18_0611 MH30B0	PMA_DC_SW_19_0611 MH30B2	PMA_DC_SW_23_0611 MH30F5	PMA_DC_SW_22_0611 MH30F3
		Acute CMC (µg/L)	Chronic CCC (µg/L)	Frost Creek, above confluence with Douglas Creek (different drainage, not within TDL)	Douglas Creek below confluence with Frost Creek	Flint Creek above Douglas Creek (different drainage, within TDL)	Flint Creek below Douglas Creek
Aluminum	46.6	750	87	39.0 U	38.0	20.0 U	20.0 U
Antimony	2.0 UJ	-	-	3.4 U	3.7	2.0 U	2.0 U
Arsenic	1.6	340	150	30.3	31.3 ☆	1.7	14.3 ☆
Barium	25.9	-	-	18.3	19.4	68.4	63.3
Beryllium	1.0 U	-	-	1.0 U	1.0 U	1.0 U	1.0 U
Cadmium	1.0 U	1.39*	0.20*	1.0 U	1.0 U	1.0 U	1.0 U
Calcium	5,220	-	-	15,300	16,700	23,300	21,700
Chromium	0.27 J (0.35)	-	-	0.22 J	0.21 J	2.0 U	2.0 U
Cobalt	1.0 U	-	-	1.0 U	1.0 U	1.0 U	1.0 U
Copper	2.0 U	9.40*	6.50*	3.0	3.2	2.0 U	0.76 J
Iron	64.3 J- (82)	-	1,000	200 U	200 U	200 U	200 U
Lead	1.0 UJ	47.63*	1.86*	1.0 U	1.1	1.0 U	1.0 U
Magnesium	1,020	-	-	3,560	3,840 ☆	6,660	6,910 J (5,573)☆
Manganese	7.3	-	-	793	1,220 ☆	3.9	5.9
Mercury	NA	1.4	0.77	NA	NA	NA	NA
Nickel	1.0 U	327.96*	36.46*	1.0 U	1.0 U	1.0 U	1.0 U
Potassium	898	-	-	1,000	1,020	1,580	1,260
Selenium	5.0 U	-	5.0	5.0 U	5.0 U	5.0 U	5.0 U
Silver	1.1 J (1.6)	1.83*	-	1.0 U	2.8	1.0 U	1.0 U
Sodium	2,710	-	-	4,950	4,920	2,860	3,390
Thallium	1.0 U	-	-	1.0 U	1.0 U	1.0 U	1.0 U
Vanadium	5.0 U	260	-	5.0 U	5.0 U	0.57 J-	5.0 U
Zinc	1.8 J (2.3)	83.71*	83.71*	192	253 ★	1.5 J	1.8 J

* Value has been adjusted for an average hardness value of 65.4898 (equivalent CaCO₃) as calculated from all surface water dissolved metals results from this assessment. Calculations performed as per footnote E of the SCDMs Hazardous Substance Benchmarks (Jan 2004).

- CCC criteria continuous concentration
- CMC criteria maximum concentration
- J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the analyte is reliable.
- U The analyte was not detected above the CRQL.
- UJ The analyte was not detected at a level greater than or equal to the adjusted CRQL. However, the reported adjusted CRQL is approximate and may be inaccurate or imprecise.
- NA Not analyzed
- ICP-MS Inductively coupled plasma-mass spectrometry
- µg/L microgram per liter
- ppb parts per billion
- XX.X Background value
- ☆ Elevated Concentration (concentration is > 3X background, but not > than a benchmark or no benchmark available)
- ★ Elevated Concentration (concentration is > 3X background and > than a benchmark)

Sources: EPA 2011 (CLP limits and Low Concentration Detection Limits); EPA 2004 (SCDM)

Table 10
Sediment Release Sample Results
 Units of milligrams per kilogram (mg/kg) parts per million (ppm)

Field Sample ID:		PMA_DC_SE_01A_0611	PMA_DC_SE_01B_0611	PMA_DC_SE_20_0611	PMA_DC_SE_21_0611	PMA_DC_SE_03_0611	PMA_DC_SE_04_0611	PMA_DC_SE_05_0611	PMA_DC_SE_06_0611	PMA_DC_SE_07_0611
Laboratory Sample ID:	EPA Region 3 Freshwater Sediment Screening Benchmark (mg/kg)	MH30B7	MH30G9	MH30G3	MH30G6	MH30E6	MH30E5	MH30H5	MH30H2	MH30F7
Location:		Background Douglas Creek "upper" background	Background Douglas Creek "lower" background	Douglas Creek above Granite Mountain and Bi-Metallic/Old Red PPE	Douglas Creek below Granite Mountain and Bi-Metallic/Old Red PPE	Douglas Creek above Douglas Creek east tailings pile	Douglas Creek below Douglas Creek east tailings pile	Douglas Creek above Douglas Creek west tailings pile	Douglas Creek below Douglas Creek west tailings pile	Douglas Creek above Granite Mountain/Bi-Metallic adit discharge
Analytes										
Aluminum	-	7,860	6,500	5,220	3,430	4,260	3,530	3,170	3,450	4,550
Antimony	2*	5.4 UJ	5.6 UJ	38.7 J (19.5) ★	94.3 J (47.6) ★	45.6 J (23.0) ★	23.0 J (11.6)	9.2 J (4.6)	27.2 J (13.7)	51.8 J (26.2) ★
Arsenic	9.8*	4.3	11.4	955 ★	2,270 [2X] ★	1,090 ★	708 ★	286 ★	632 ★	1,390 ★
Barium	-	124	106 J (423)	171 J	153 J	148 J	118 J	82.1 J	213 J	161 J
Beryllium	-	0.45 UJ	0.47 UJ	0.65 UJ	0.47 UJ	0.56 UJ	0.64 UJ	0.42 UJ	0.44 UJ	0.50 UJ
Cadmium	0.99	0.45 UJ	0.47 UJ	4.8 J (3.4) ★	3.6 J (2.6) ★	3.8 ★	1.9 J+ (1.3)	1.5 UJ	2.4 J+ (1.7) ★	3.2 J (2.3) ★
Calcium	-	2,100	2,350	1,720	909	1,340	1,590	1,550	2,070	2,150
Chromium	43.4	4.9	4.1 U	2.2 U	1.9 U	3.3 U	3.4 U	1.9 U	11.8	3.0 U
Cobalt	50	5.6 J (7.0)	4.7 U	6.5 U	4.7 U	5.6 U	6.4 U	4.2 U	5.0	5.0 U
Copper	31.6	5.8 U	2.3 UJ	161 J (132) ★	204 J (167) ★	124 J (102) ★	56.1 J (46.0) ★	31.8 J (26.1) ☆	42.3 J (34.7) ★	66.3 J (54.3) ★
Iron	20,000	17,100	17,400	15,000	16,500	16,300	12,400	9,370	37,000	14,300
Lead	35.8	6.0	4.1 J (5.9)	1,140 J (792) ★	872 J (606) ★	494 J (343) ★	267 J (206) ★	154 J (107) ☆	214 J (149) ☆	332 J (231) ☆
Magnesium	-	3,520	3,260	1,590	913	1,690	1,300	1,190	1,710	2,410
Manganese	460	271 J	329 J (408)	2,260 J (1,823) ★	3,670 J (2,960) ★	2,830 J (2,282) ★	2,860 J (2,306) ★	1,500 J (1,210)	2,780 J (2,242) ★	4,500 J (3,629) ★
Mercury	0.18	0.017 J-	0.028 J- (0.051)	39.6 [25X] ★	81.8 [50X] ★	31.7 [25X] ★	7.0 [5X] ★	4.1 [3X] ★	6.3 [5X] ★	7.9 [5X] ★
Nickel	22.7	3.6 U	3.7 U	5.2 U	3.8 U	4.5 U	5.1 U	3.3 U	3.5 U	4.0 U
Potassium	-	1,710	1,190	855	794	1,020	616 J	462	799	1,740
Selenium	2	0.56 J	3.3 U	4.6 U	0.32 J	3.9 U	4.4 U	2.9 U	3.1 U	3.5 U
Silver	1.0	0.91	0.10 J (0.174)	57.5 ★	115 ★	69.4 ★	26.8 ★	6.3 ★	37.6 ★	91.7 ★
Sodium	-	453 UJ	468 UJ	652 U	469 UJ	559 UJ	635 UJ	418 UJ	438 UJ	504 UJ
Thallium	-	2.3 U	2.3 UJ	5.5 J+ (3.0)	7.5 J (4.0)	5.8 J (3.1)	6.1 J (3.3)	3.5 J+ (1.9)	5.7 J (3.1)	8.3 J (4.5)
Vanadium	-	47.5	42.6	26.2	18.0	30.7	29.3	19.7	103	24.6
Zinc	121	16.0	21.5 J (32.3)	730 J (487) ★	1,270 J (847) ★	737 J (491) ★	381 J (254) ★	253 J (169) ★	465 J (310) ★	749 J (499) ★

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 J- The associated numerical value is an estimated quantity but the result may be biased low.
 J+ The associated numerical value is an estimated quantity but the result may be biased high.
 mg/Kg milligrams per kilogram ppm parts per million
 X.X Background value X.X Highest background value
 * chosen background values for antimony and arsenic (*) are greater than their respective benchmarks
 ☆ Elevated Concentration (concentration is > 3X background), but not greater than a benchmark.
 ★ Elevated Concentration (concentration is > 3X background), and is greater than a benchmark.
 [3X] Sample was diluted 3 times for analysis

Table 10, cont.
Sediment Release Sample Results
Units of milligrams per kilogram (mg/kg) parts per million (ppm)

Field Sample ID:			PMA_DC_SE_08_0611	PMA_DC_SE_09_0611	PMA_DC_SE_10_0611	PMA_DC_SE_11_0611	PMA_DC_SE_12_0611	PMA_DC_SE_18_0611	PMA_DC_SE_19_0611	PMA_DC_SE_23_0611
Laboratory Sample ID:	EPA Region 3 Freshwater Sediment Screening Benchmark (mg/kg)	Highest background value	MH30E2	MH30E1	MH30A3	MH30A4	MH30A2	MH30A0	MH30A1	MH30F6
Location:			Douglas Creek below Granite Mountain/Bi-Metallic adit discharge and above Douglas Creek waste rock	Douglas Creek below Douglas Creek waste rock	Douglas Creek above Contact Mill east tailings	Within drainage from Contact Mill east tailings (different drainage)	Douglas Creek below Historical Bi-Metallic mill tailings and above Frost Creek	Frost Creek, above confluence with Douglas Creek (different drainage, not within TDL)	Douglas Creek below confluence with Frost Creek	Flint Creek above Douglas Creek (different drainage, not within TDL)
Analytes										
Aluminum	-	7,860	4,480	4,200	3,870	1,620	3,910	14,000	3,950	8,210
Antimony	2*	5.6 UJ	63.5 J (32.1) ★	59.9 J (30.3) ★	33.2 J (16.8)	150 J	37.3 J (18.8) ★	19.2 J	25.7 J (13.0)	8.3 UJ
Arsenic	9.8*	11.4	1,720 ★	1,540 ★	811 ★	281	929 ★	276	381 ★	8.3
Barium	-	106J (423)	343	223	190	143	240	319	242	285 J
Beryllium	-	0.47 UJ	0.57 UJ	0.68 UJ	0.60 UJ	0.52 UJ	0.63 UJ	0.72 UJ	0.49 UJ	0.79 U
Cadmium	0.99	0.47 UJ	3.7 J (2.6) ★	2.8 ★	2.3 ★	5.1	2.5 ★	16.3	3.6 ★	0.69 UJ
Calcium	-	2,350	2,090	2,560	1,560	1,000	2,500	43,800	7,120	3,030
Chromium	43.4	4.9	12.8	3.0	3.1	2.8	2.3 U	8.5	4.9	8.1
Cobalt	50	5.6 J (7.0)	5.9	6.8 UJ	6.0 UJ	5.2 UJ	10.2 J	7.2 UJ	7.6 J	6.9 U
Copper	31.6	5.8 U	109 J (89.3) ★	73.6 ★	44.5 ★	178	50.5 ★	68.7	71.3 ★	8.4 J
Iron	20,000	17,400	37,100	13,600	12,400	15,500	12,000	21,500	17,200	13,400
Lead	35.8	6.0	368 J ★	378 ★	217 ★	1,320	191 ★	194	289 ★	9.4 J
Magnesium	-	3,520	1,730	1,850	1,710	944	1,750	28,800	4,220	3,080
Manganese	460	329 J (408)	5,890 J [2X] (4,750) ★	5,270 J (4,250) ★	5,890 J (4,750) ★	92.4 J	10,300 J [2X] (8,306) ★	9,500 J [2X]	14,500 J [3X] (11,694) ★	214 J
Mercury	0.18	0.028 J- (0.051)	11.7 [10X] ★	4.1 [5X] ★	2.4 [2X] ★	1.8	1.8 [2X] ★	1.0	2.8 [2X] ★	0.039 J-
Nickel	22.7	3.7 U	4.5 U	5.4 U	4.8 U	4.2 U	5.0 U	7.2	4.8	11.4
Potassium	-	1,710	1,270	1,480	1,400	817	1,390	2,440	1,150	1,340
Selenium	2	3.3 U	4.0 U	4.7 U	4.2 U	1.2 J	4.4 U	5.0 U	3.4 U	4.8 U
Silver	1.0	0.91	53.8 ★	46.1 ★	49.6 ★	15.8	20.0 ★	4.9	13.7 ★	0.051 J
Sodium	-	468 UJ	568 UJ	675 UJ	604 UJ	524 UJ	626 U	721 UJ	491 UJ	691 UJ
Thallium	-	2.3 UJ	11.4 J (6.1)	6.1	10.3 ★	2.6 UJ	16.4 ★	14.5	18.2 ★	3.5 UJ
Vanadium	-	47.5	93.8	20.4	23.2	8.4	20.8	35.9	35.8	14.0
Zinc	121	21.5 J (32.3)	860 J (573) ★	739 ★	730 ★	434	1,130 ★	3,700	1,880 ★	44.4 J

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 mg/Kg milligrams per kilogram ppm parts per million
 X.X Background value X.X Highest background value
 * chosen background values for antimony and arsenic (*) are greater than their respective benchmarks
 ☆ Elevated Concentration (concentration is > 3X background), but not greater than a benchmark.
 ★ Elevated Concentration (concentration is > 3X background), and is greater than a benchmark.
 [3X] Sample was diluted 3 times for analysis

Table 11
Relative Percent Difference (RPD)

Field Sample ID: Laboratory Sample ID: Location:	PMA_DC_SE_17_0611 MH30B8 New Departure adit sediment (mg/kg)	PMA_DC_SE_89_0611 MH30B9 Duplicate of PMA_DC_SE_17_0611 (mg/kg)	RPD (%)	PMA_DC_SW_09_0611 MH3AC2 Douglas Creek below Douglas Creek waste rock (µg/L) Total Metals	PMA_DC_SW_99_0611 MH30F0 duplicate of PMA_DC_SW_09_0611 (µg/L) Total Metals	RPD (%)	PMA_DC_SW_09_0611 MH3AC3 Douglas Creek below Douglas Creek waste rock (µg/L) Dissolved Metals	PMA_DC_SW_99_0611 MH30F1 (duplicate of PMA_DC_SW_09_0611) (µg/L) Dissolved Metals	RPD (%)
Aluminum	12,600	7,600	12	181	128	9	36.4	40.6	0
Antimony	7.9 UJ	6.1 UJ	-	6.7 J	6.3	2	5.3 J	5.2	1
Arsenic	57.2	33.7	13	102	101	0	48.8	49.2	0
Barium	110	81.3	8	26.1	25.3	1	22.7	22.2	2
Beryllium	0.66 U	0.51 U	-	1.0 U	1.0 U	-	1.0 U	1.0 U	-
Cadmium	0.66 U	0.51 U	-	0.92 J-	0.86 J-	2	0.76 J-	1.0 U	11
Calcium	1,390	1,440	1	24,700	24,700	0	24,900	24,300	2
Chromium	3.9	2.9	7	2.0 U	2.0 U	-	2.0 U	2.0 U	-
Cobalt	6.6 UJ	5.1 UJ	-	1.5	1.5	0	1.6	1.8	7
Copper	9.1	3.5 U	-	8.7	8.0	2	5.1	5.0	0
Iron	11,600	8,630	7	697	638	2	353	348	1
Lead	10.7	5.6	16	11.5	9.6	5	1.5 J	1.6	4
Magnesium	1,280	943	8	5,030	5,080	0	5,090	5,060	0
Manganese	720 J	474 J	10	3,710	3,700	0	3,600	3,610	0
Mercury	0.075 J-	0.11	9	0.01 U	0.01 U	-	NA	NA	-
Nickel	5.2 U	4.1 U	-	1.1	1.1	0	1.1	1.2 U	12
Potassium	495 J	413 J	5	1,060	1,030	1	1,030	1,020	1
Selenium	4.6 U	3.6 U	-	5.0 U	5.0 U	-	5.0 U	5.0 U	-
Silver	0.21 J	1.0 U	-	0.46 J-	0.23 J-	17	1.7 J	1.0 U	63
Sodium	656 U	509 U	-	4,250	4,280	0	4,300	4,370	1
Thallium	3.3 U	2.5 U	-	1.0 U	1.0 U	-	1.0 U	1.0 U	-
Vanadium	25.8	22.0	4	5.0 U	5.0 U	-	5.0 U	5.0 U	-
Zinc	25.3	15.7	12	725 J	728	0	701 J	702	0
AVERAGE			9			2			2

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 J+ The associated numerical value is an estimated quantity but the result may be biased high.
 mg/Kg milligrams per kilogram
 µg/L micrograms per liter

APPENDIX A

Data Quality Objectives Seven-Step Planning Approach

Data Quality Objectives Seven-Step Planning Approach

Step 1 Problem Statement	Step 2 Identifying the Decisions	Step 3 Decision Inputs	Step 4 Study Boundaries	Step 5 Decisions Rules	Step 6 Tolerance Limits on Errors	Step 7 Optimization of Sample Design
<p>At least seven separate piles of mining waste, two discharging adits, and two seeps associated with tailings piles are located along Douglas Creek.</p> <p>Previous sampling events have documented an observed release of metals from these potential sources (Douglas Creek tailings piles, Douglas Creek waste rock pile, and the Granite Mountain/Bi-Metallic/Old Red adit) to the creek.</p> <p>The last mile of Douglas Creek is a fishery, and wetlands have been identified along the banks of the creek. Douglas Creek drains into Flint Creek, which is a fishery and is located within the Target Distance Limit (TDL).</p>	<p>The principal decision that was to be determined by this CERCLA Site Investigation was whether or not wastes identified with sources along Douglas Creek have migrated to the surface water pathway.</p> <p>A secondary decision that was to be determined by this investigation was whether or not there are sufficient targets present in the study area (along Douglas Creek) to warrant further investigation of the soil exposure and groundwater pathways.</p>	<p>The information that was required to arrive at a decision for this site included:</p> <ul style="list-style-type: none"> Analytical data from surface water, soil, and sediment samples to determine if contaminants from the waste sources have migrated into Douglas Creek; Comparison of analytical results to background concentrations and HRS benchmarks; and Identification of environmental (e.g., wetlands and aquatic organisms) and human health targets (e.g., residents living near sources) directly or potentially impacted by migration of contaminants from the sources. 	<p>The site is defined by the boundaries of the waste sources identified along Douglas Creek. The TDL extends from the highest Probable Point of Entry (PPE) (located at the New Departure adit) to a point within Flint Creek 15 miles downstream of the lowest PPE (located just below the historic Bi-Metallic tailings pile).</p> <p>There are 900 people living in the community of Philipsburg. Very few (three or four) residences exist along Douglas Creek within 200 feet of source areas.</p> <p>The pathway of primary concern at the Philipsburg Mining Area (Douglas Creek) site is the Surface Water Pathway. The Soil Exposure and Groundwater Pathways are of secondary concern due to the paucity of targets.</p> <p>Potential human health and environmental targets include the population of Philipsburg (residents, workers at the Contact Mill, students), aquatic and wetland environments downstream of waste sources, and recreational users of the mining area.</p> <p>Samples collected for analysis included surface soils (from sources), aqueous discharges from two adits and two seeps, and surface water and stream sediments downstream from the multiple PPE and below wetlands along Douglas Creek. Domestic groundwater and surface soils from residential land parcels were not sampled.</p>	<p>Analytical results have been used to determine a preliminary HRS score for the surface water pathway.</p> <p>Results for each sample have been compared to site-specific background samples, and surface water or soil benchmarks, as appropriate.</p> <p>The EPA and other appropriate agencies (including the MDEQ) and their representatives will work together to evaluate the site data obtained during field activities and presented in this ARR to determine if additional information is required to characterize the site or migration of the waste from the site.</p>	<p>Samples have been collected to identify potential human health and environmental targets for the Surface Water Pathway and to determine background concentrations for soils, surface water, and sediments.</p> <p>Few targets have been identified for the groundwater and soil exposure pathways. Collection of groundwater and soil samples has, therefore, not occurred.</p> <p>Sampling, measurement, and decision errors have been minimized by using standard field and laboratory operating procedures, collecting an appropriate number of quality control samples, meeting standard holding times, and ensuring that samples are representative of site conditions. Sample locations have been biased to collect information from areas with the greatest potential for contamination. Field screening tools (i.e., field-portable x-ray fluorescence [XRF] spectrometers) were also used to achieve this.</p> <p>Sampling activities adhered to the START TSOPs and the UOS Generic QAPP to ensure data reproducibility. All data, with the exception of the low-level mercury water samples, have been validated in accordance with Contract Laboratory Program (CLP) National Functional Guidelines to document data quality. The low-level mercury water samples were all non-detect at a reporting limit of 0.01 micrograms per liter (µg/L).</p>	<p>Sample locations were field-modified by the project manager or leader of the field sampling crew based upon an understanding of environmental conditions and additional information obtained during field activities.</p> <p>Opportunity samples were collected in instances where it appeared that unidentified contamination was encountered in the field, as per the Field Sampling Plan (FSP).</p>

APPENDIX B

Project Photolog



PHOTO 1

Area of historical Bi-Metallic Mill tailings pile with no vegetation, looking northwest. Note dirt bike track.



PHOTO 2

Chuck Baker (START) collecting source sample PMA_DC_SO_15_0611 from Contact Mill east tailings. Photo shows water on surface and active pumping of tailings onto crest of tailings dam in distance (white material). Looking southeast.



PHOTO 3

Pumping of tailings onto crest of Contact Mill east tailings dam. Looking south.



PHOTO 4

Crest of Contact Mill east tailings dam, showing overflow of tailings to the east down dam face. Source sample PMA_DC_SO_14_0611 was collected at this location. Looking south.



PHOTO 5

Chuck Baker (START) collecting source sample PMA_DC_SO_13_0611 at toe of Douglas Creek Waste Rock pile, showing lack of vegetative cover. Looking north.



PHOTO 6

Erosion of cover material over Douglas Creek East tailings pile.



PHOTO 7

Chuck Baker (START) collecting source sample PMA_DC_SO_11_0611 from apparent exposed tailings at Douglas Creek West tailings pile. Looking west.



PHOTO 8

Chuck Baker (START) at apparent exposed tailings due to logging operations, Douglas Creek East tailings pile. Looking east.



PHOTO 9

Granite Mountain (far background, upper right) and Bi-Metallic/Old Red (middle ground) mining waste rock piles. Looking north.



PHOTO 10

Erosion channels on surface of Bi-Metallic waste rock pile, looking south.



PHOTO 11

Lobe of eroded waste rock at toe of Bi-Metallic waste rock pile. Looking east.



PHOTO 12

Jeff Miller (START) at sinkhole at base of Granite Mountain waste rock pile. Looking west.



PHOTO 13

Decomposed flume near base of Bi-Metallic waste rock pile. Looking east.



PHOTO 14

Recreational vehicle touring Granite Mountain and Bi-Metallic/Old Red areas. Looking west.



PHOTO 15

Jeff Miller (START) collecting source sample PMA_DC_SO_05_0611 from the Granite Mountain waste rock pile. Note dirt bike tracks through pile. Looking north.



PHOTO 16

Discarded beer cans on the Granite Mountain waste rock pile. Looking southwest.



PHOTO 17

Chuck Baker (START) collecting source sample PMA_DC_SW_16_0611 from seep near west end of Douglas Creek West tailings pile. Looking east.



PHOTO 18

Chuck Baker (START) collecting source sample PMA_DC_SW_15_0611 from seep near east end of Douglas Creek West tailings pile. Looking north.



PHOTO 19

View of Douglas Creek East tailings pile, showing “wetlands.” Looking east.



PHOTO 20

Jenifer Patureau (START) near a small cabin approximately ½ mile north of Granite Mountain source area. Looking southeast.



PHOTO 21

Houses located adjacent to historical Bi-Metallic tailings pile (in fore- and mid-ground). Looking southeast.

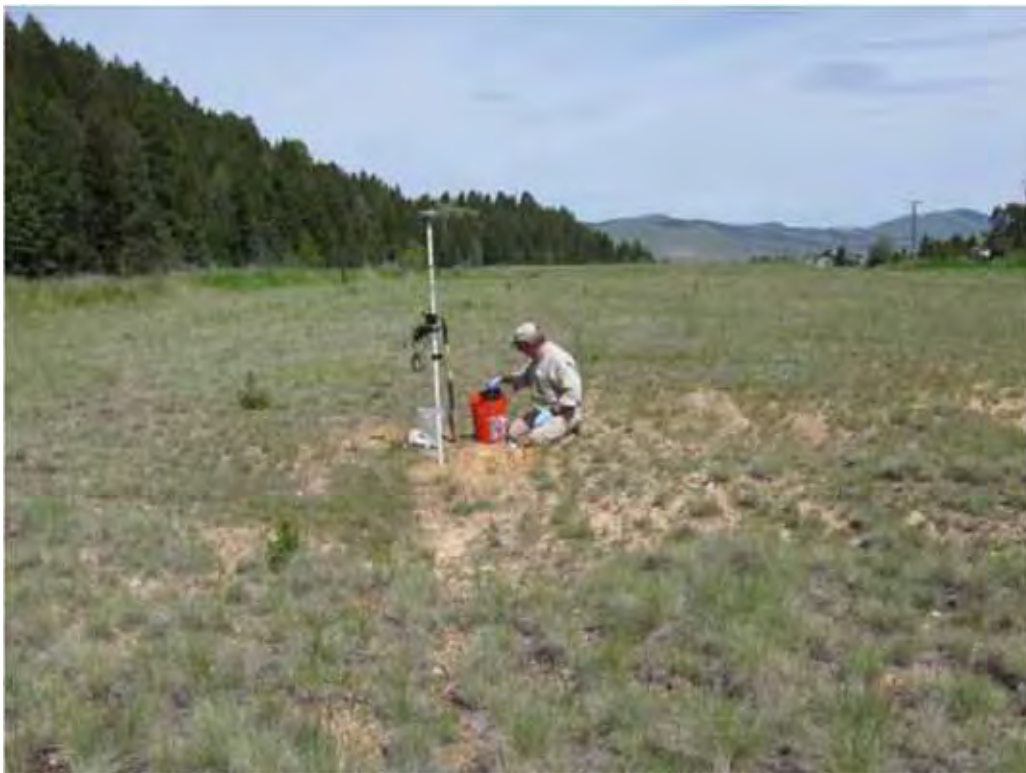


PHOTO 22

Chuck Baker (START) collecting source sample PMA_DC_SO_17_0611 from the historical Bi-Metallic Mill tailings. Looking northwest.



PHOTO 23

Chuck Baker (START) collecting GPS data at source sample location PMA_DC_SO_16_0611 on the historical Bi-Metallic tailings pile. Looking northwest.



PHOTO 24

Contact Mill east tailings impoundment. Looking east-southeast.



PHOTO 25

Chuck Baker (START) at PMA_DC_SO_12 source sample location at the Douglas Creek waste rock pile. Note sparse vegetation. Looking northeast.



PHOTO 26

Chuck Baker (START) collecting aqueous source sample PMA_DC_SW_13_0611 from the Granite Mountain/Bi-Metallic adit (Granite Drain). Facing northeast.



PHOTO 27

Logging road through reclaimed Douglas Creek west tailings. Looking northeast.



PHOTO 28

Megan Adamczyk (START) conducting XRF screening at northwest corner of Bi-Metallic/Old Red waste piles. Looking south.



PHOTO 29

Megan Adamczyk (START) collecting GPS data at PMA_DC_SO_06_0611 source sample location. Looking north.



PHOTO 30

Jeff Miller (START) collecting source sample PMA_DC_SO_07_0611 from Bi-Metallic/Old Red waste rock pile. Looking southeast.



PHOTO 31

Jeff Miller (START) collecting source sample PMA_DC_SO_07A_0611 from Bi-Metallic/Old Red waste rock pile. Looking southwest.



PHOTO 32

Granite Mountain area from top of Granite Mountain waste rock pile. Top of Bi-Metallic waste pile is to the left of the headframe. Looking west.



PHOTO 33

Top of Granite Mountain waste pile, looking northwest towards Mill A and Mill B (just off photo to the left).



PHOTO 34

Jeff Miller (START) collecting source sample PMA_DC_SO_04_0611 from Granite Mountain waste rock pile. Looking southwest.



PHOTO 35

Jeff Miller (START) conducting reconnaissance at Granite Mountain tailings. Sinkhole in foreground. Looking northeast.



PHOTO 36

Jeff Miller (START) collecting aqueous source sample PMA_DC_SW_17_0611 from New Departure adit.



PHOTO 37

Jeff Miller (START) collecting aqueous source sample PMA_DC_SW_17_0611 from New Departure adit.



PHOTO 38

Chuck Baker (START) collecting surface water sample PMA_DC_SW_22_0611 from Flint Creek, approximately ½ mile downstream of confluence with Douglas Creek. Note high and fast water. Looking south.



PHOTO 39

Chuck Baker (START) collecting surface water sample PMA_DC_SW_22_0611 from Flint Creek, approximately ½ mile downstream of confluence with Douglas Creek. Note high and fast water. Looking east.



PHOTO 40

Jeff Miller (START) collecting “upper” background surface water sample PMA_DC_SW_01A_0611 from southern branch of Douglas Creek. Robert Parker (USEPA) on left. Looking northwest.



PHOTO 41

Jeff Miller (START) collecting “lower” background surface water sample PMA_DC_SW_01B_0611 from southern branch of Douglas Creek, just upstream of its confluence with the northern branch. Looking northeast.



PHOTO 42

Chuck Baker (START) collecting sediment sample PMA_DC_SE_12_0611 from Douglas Creek tailings. Looking northeast.



PHOTO 43

Chuck Baker (START) collecting surface water sample PMA_DC_SW_10_0611 from Douglas Creek, above the Contact Mill east tailings. Looking northeast.



PHOTO 44

Chuck Baker (START) collecting surface water sample PMA_DC_SW_04_0611 from Douglas Creek, below the Douglas Creek east tailings pile. Looking east.



PHOTO 45

Chuck Baker (START) collecting surface water sample PMA_DC_SW_08_0611 from Douglas Creek, below the Granite Mountain/Bi-Metallic adit discharge. Looking east.



PHOTO 46

Chuck Baker (START) collecting surface water sample PMA_DC_SW_09_0611 from Douglas Creek, below the Douglas Creek waste rock pile. Note pile in background. Looking east.



PHOTO 47

Jeff Miller (START) collecting source sample PMA_DC_SO_07_0611 from the Bi-Metallic/Old Red waste rock pile. Looking northeast.



PHOTO 48

Megan Adamczyk (START) collecting surface water quality parameters at PMA_DC_SW_20_0611 location, above the Granite Mountain and Bi-Metallic/Old Red waste piles. Looking south.



PHOTO 49

Jeff Miller (START) collecting background soil sample PMA_DC_SO_01_0611 from location on unleased Forest Service land, approximately ½ mile north of the Granite Mountain area. Looking north.



PHOTO 50

Jeff Miller (START) collecting background soil sample PMA_DC_SO_02_0611 from location on unleased Forest Service land, approximately ½ mile north of the Granite Mountain area. Looking north.



PHOTO 51

Jeff Miller (START) collecting background soil sample PMA_DC_SO_03_0611 from location on unleased Forest Service land, approximately ½ mile northeast of the Granite Mountain area. Looking north.



PHOTO 52

Jeff Miller (START) collecting surface water sample PMA_DC_SW_23_0611 from Flint Creek, approximately 5 ½ miles above its confluence with Douglas Creek. Looking southeast.



PHOTO 53

Photo of surface water and sediment sample location PMA_DC_SW/SE_21_0611, below the PPE for the Bi-Metallic/Old Red waste piles. Douglas Creek on the right and the wooden tailings flume is on the left.

APPENDIX C

Project Field Logbooks

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...for outdoor writing people."



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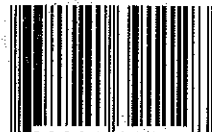
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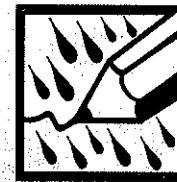
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Philipsburg Mining Area
(Douglas Creek)
Site Investigation
Philipsburg, Montana

TDD: 1103-02
36549080

Book 1

2

26 June 11

SUNDAY

Notes by Jeff Miller,

START = JKm

JKm

0700 Left Denver (Jen Paturreau, Jeff Miller, Megan Adamczyk) for Greeley to pick up Chuck Baker. Mobilization day.
0800 Leave Greeley bound for Fairmont, MT.

1235 Lunch in Casper, WY.

1945 Dinner in Butte, MT.

2055 Arrive Fairmont, check in, unload equipment + begin charging.

2110 End of day

[Signature]
26 June 11

WEATHER: MOSTLY SUNNY, HIGH NEAR 75°F

27 June 11

MONDAY

0700 START members meet in lobby of hotel then leave ^{for site}.
0810 START meets Rob Pankaj in P-bury + discussed plan. HRS tailgate meeting. Discussed lightning, access agreements. Grabbed breakfast.
0915 At SE/SW-12 location of Frosb Cr./Douglas Cr. confluence. Split supplies and into two groups: Megan/Chuck and Jen/Jeff/Rob.
1020 A Chris ^{Jr} ~~Forster~~ (Bowers?) stopped. Discussed what we were doing and access. ^{JKm} I → He stated he had recently purchased ~600+ acres in the area, including the land we were stopped at. I requested permission to collect a water sample and he replied yes, no problem.
1035 Collected PML-DC-SW OIA: ₅₆
'High' background SE/SW location on Douglas Creek, just off of Route 169.
1100 Drove up to Granite Mtn area. Lots of run off. Took photos.
[Signature] 27 June 11

27 June 11 (cont.) *JKM* MONDAY

of a couple of drainages (N. branch of Douglas Cr.), one of which is from the New Departure adit. Parked vehicles at Granite Mtn mine and walked down Forest Service / ~~County~~ ^{RA 169th} Road to access New Departure adit.

1225 Collected PMA DC SE/SW-017, plus ^{dup} ~~93~~ sediments. PMA-DC-SE-89-0611 and dup low level Hg surface water samples. PMA-DC-SW-89

1330 Back to vehicles. Quick lunch, then begin searching for SPT + SPS locations.

1410 Collected PMA-DC-SO-04
(XRF screening: # 774, As 3345, Pb 627, Mn 600.)

1440 Collected PMA-DC-SO-05
XRF: # 775, As 2773, Pb 807, Mn 1493

1500 Drove North past Granite Mtn Mine to Forest Service land to collect background.

~~JKM 27 June 11~~

27 June 11 (cont.)

Samples, on ~~unleased~~ land.

1525 Collected PMA-DC-SO-01

Walked furthest East up slope onto unleased land further.

1600 Collected PMA-DC-SO-02

Hiked ~ 300 m (?) further East and up slope onto unleased forest service land.

1625 Collected PMA-DC-SO-03

1700 Have driven back to Granite Mtn Mine. Will not investigate Bi-metal/Old Red Pile or area below to branch of Douglas Cr. today.

1800 To hotel, began sample prep.

2030. Sample prep. (bagging, labeling, preserving, filtering) all done. START activities done for day.

OBSERVATIONS:

- There is an abundance of surface

~~JKM 27 June 11~~

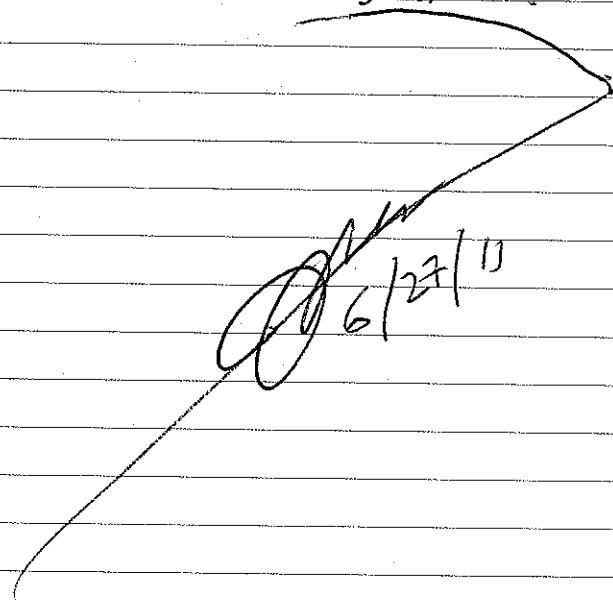
⁶
27 June 11 (cont) Jkm MONDAY

water runoff this season, including a very vigorous outfall from New Departure ~10 gal/sec, and a ~5 gal/sec flow from a tributary of Doug Cr. north of the New Departure flow.

- There is wide use of the Granite mtn mine area for recreational purposes, including (witnessed just today): Dirt biking directly over/on the Granite mtn tailings/waste rock pile, parking of vehicles and walking around on top of Granite mtn tailings; evidence of beer drinking on GM tailings, use of ~~picnic~~ picnic tables around Granite area. The dirt road leading to the New Departure adit was marked with orange plastic diamonds and promoted as the 'Granite Mountain Way'.
- START spoke with a mining buddy named John Hawthorn who was parked on top of the GM tailings.
- Witnessed a family w/ two small children Granite area.
- witnessed at least 2 ATVs at Granite.

27 June 11 (cont) Jkm MONDAY ⁷

- would estimate that the START team of Jen P. + Jeff M. witnessed a total of approximately 20 people recreating at or adjacent to immediate Granite Mountain mine area.
- witnessed a ~12' diameter by 10' deep sink hole at SE corner of GM tailings.
- Witnessed Chris Bowers having a small cabin being transported up CR 169 on a flat bed trailer to be placed on his land purchased from Granite Resources.



8

WEATHER: MOSTLY SUNNY AND V. WARM
(high near 88), TURNING
PARTLY CLOUDY w/ T-STREAMS

28 June 11 JKM
0700 Left hotel for P-burg. Crossed
vehicles on way.

0810 At P-burg. Got food + discussed
plan for day. 2 teams today:
JKM + Chuck, me + Megan. Jen +
Chuck will continue moving upstream
collecting samples. Megan and I
will collect source samples starting
at Old Red/Bi-metallic pile.

0900 At Old Red/BM. XRF screening
indicates tailings at NE corner of
area = ~745 Pb, 720,000 As.
Tailings connect to waste rock
beneath road. UR: ~300 Pb, 5,000
As

0930 Collected PMA-DC-50-06-0611
Tailings

working around "horseshoe" shaped
main pile of tailing:

XRF ~ Pb 500, As 4,000

1010 Collected PMA-DC-50-07-0611
from main lobe of waste rock pile

working around lower 'c' shaped
lobe: XRF: Pb 400, As 2600.

11035 Collected PMA-DC-50-07A-0611

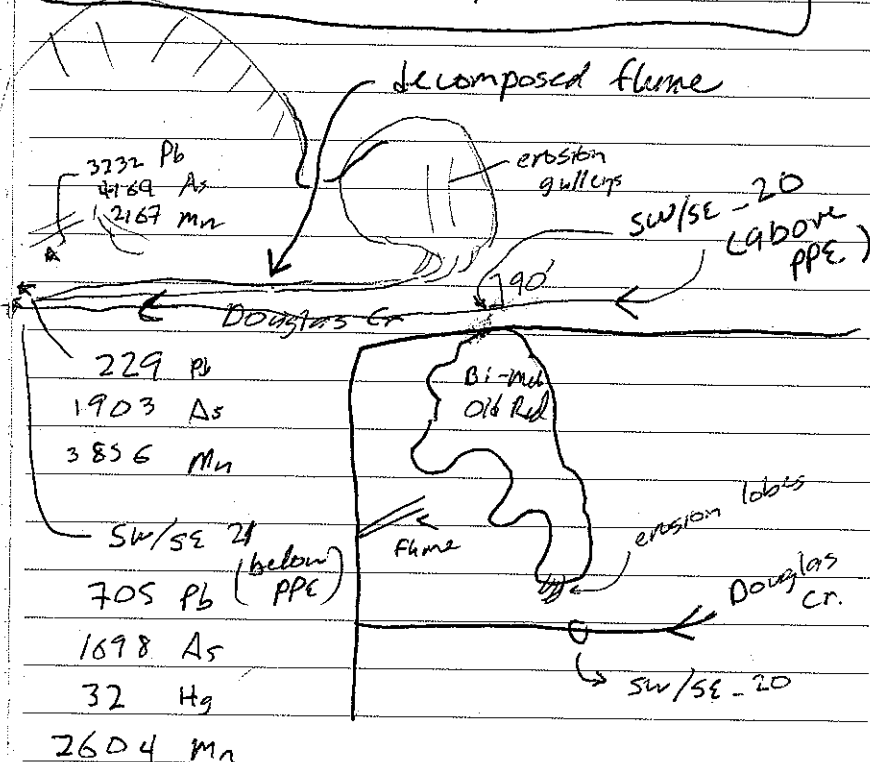
(cont.)

28 June 11 TUESDAY

JKM⁹

Dropped below s-most Bi-met lobe, to find PPE.

1120 PMA-DC-SW/SE-20-0611



COLLECTED

1215 PMA-DC-SW/SE-21-0611

below PPE from all of Granite
Mtn mine and Bi-Met/Old Red.
Permeability: T=6.8, PH=8.69

C=59 ms

1225 Began hike back to vehicle.

28 JUNE 11

28 JUNE 11 (cont.) TUESDAY Jkn


1300 Back to vehicle. Quick lunch.

Drive down to look for access to

Douglas Cr. east tailings, but other team has gathered the needed samples there. Meet other team back in town. I talked to Chuck Haroutunian and Matthew Churchman, both in the fly fishing industry in P-burg. Both indicated that they personally did not know of people fishing

Douglas Creek, Matthew said it was possible people, particularly locals, would though Flint Crisfished.1415 Chuck informed ~~me~~ me that PMA-DC-SW/SE-ΦIB had not been collected so Megan and I left to do so while Chuck and Jen left to collect Flint Creek samples.

1620 Collected PMA-DC-SW/SE-ΦIB-0611 ('South fork' of Douglas Cr., just above confluence with 'North fork' of Douglas Cr.)

1750 Back to hotel. Done for day after icing/preserving samples. 

29 June 11

0800 Meet rest of team to finish sample prep, packaging, etc.

1100 Leave hotel.

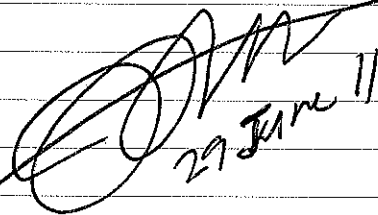
1150 Drop off 5 coolers of samples to be shipped via Fed ex (tracking #'s next page) in Butte.

Drive to Bozeman. Drop off sample for another project.

Drive onto Billings and drop off last cooler of water samples to be analyzed for low-level Hg at Energy Labs.

1500 Drive on through to Denver.

1745 Arrive in Denver.



29 June 11

FedExMPS
29JUN 11:06

Pcs: 5 1 of 1

Emp#: 137929 Rt#: STA

873170758023

MASTER TRK#:

Pkg Trk#*a: 795539114458

795539114469

795539114470

795539114480

Part # 166297-435 R1T2 01/11

Recipient Copy



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Manager

116 West Broadway
P.O. Box 1063
Philipsburg, MT 59858
406-859-9500
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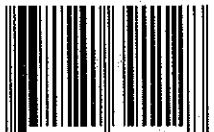
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"Rite in the Rain"
ALL-WEATHER
JOURNAL
No. 391

Philipsburg Mining Area
(Douglas Creek)
Site Investigation

Philipsburg, Montana
TDD: 1103-02
36549080

Book 2

6/27/11

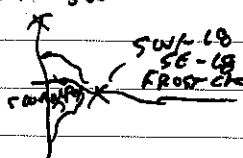
0800 ARRIVE ON SITE - MEET ROB
PARKER & DISCUSS PLAN
MEGAN / RUCK TO LOWER
SECTION, JEFF ROB, JEN TO
UPPER SECTION.

0920 - MA CALIBRATED PH METER

0950 - PMA_DC_SW_18_0611
- PMA_DC_SE_18_0611

UPGRADIENT OF CONFLUENCE - FROST
CK.

TN SW 50-19



TEMP - 8°C

COND - 145.5 μ S

PH - 8.35

1000 DOWN GRADIENT CONA. COLLECT
PMA_DC_SW_19_0611
SE_19_0611

PH

TEMP 9.4

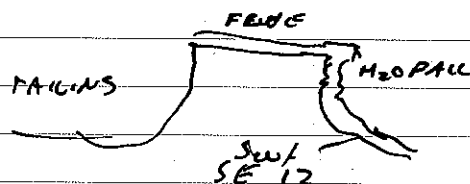
PH 8.29

COND 162.4 μ S

6/27/11

1030 - TO LOCATION. PMA_DC_SW_12_0611
PMA_DC_SE_12_0611

SAMPLE COLLECTED DOWNSTREAM OF
FLUE OUTPAUL / WATERPAUL BELOW
TAILINGS PILE.



TEMP 11.3°C

PH 8.2

COND 231 μ S

1115 - TO FIRST TAILINGS PILE -

UNLINED, GRASS COVERED (GOOD COVER)

SOMEWHAT DISTRESSED VEGETATION (PHOTO)

CONDUCT AREA RECON WITH

XRF, GPS FOR SOIL SAMPLING

VIC SAMPLE 17 MAP.

SOI-1 - HOLE 26" DEEP, 2" OF TOP SOIL

(BLACK AMENDED TAILINGS) ORANGE

TAILING BENEATH

Pb - 931, As 64, Zn 368

Cu - 65 PPM

LITTLE COVER AREA, NO VEG.

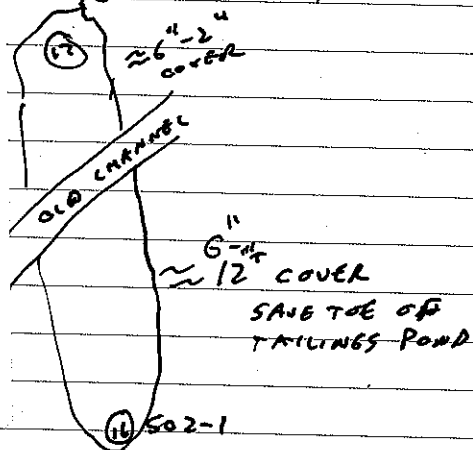
SOI-2 Pb - 1331, As 106, Zn 270

Cu - 332 PPM

612711

11:30 COLLECT ~~PMA~~ - PMA - DC - 50-17
~ 6" DEEP FROM LOCATION
WITHOUT COVER ~ 12' x 12'
CIRCLE (PROTO)

Historic Bi-
metallic
tailings



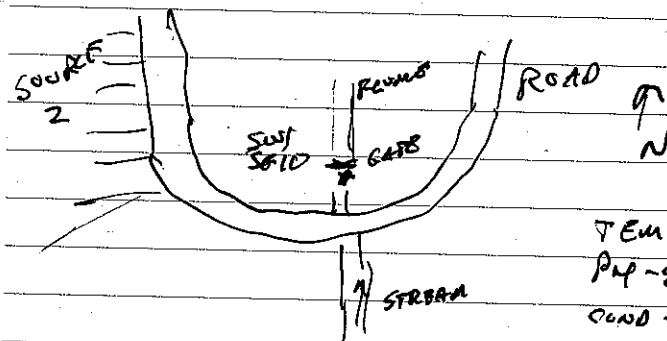
MYS X-502-1 Pb - 2069, AS 108,
WITH XRF Hg 33.3, Zn 545, Cu 158ppm

COLLECT PMA DC 50-16-0611

1200 - BREAK - LUNCH

1230 - SCOUT SWICE 10 - DETERMINE
10 WILL BE COLLECTED AT
GATE FOR FLUME UPGRADE BUT
OF SECOND SOURCE PILE.

612711

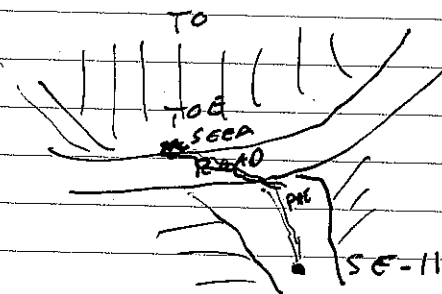


TEMP - 9.8°C
PH - 8.24
COND - 224 µS

1300 COLLECT PMA - DC - SW - 10 - 0611
SE - 10 - 0611

1315 TO SAMPLE PMA DC SE 11 0611
SAMPLE IS CURRENTLY NOT
FLOWING WATER. DOCUMENT
OVERLAND FLOW FROM
TOE, ACROSS ROAD TO CULVERT/
BCDB AT LOCATION II.
WILL COLLECT SEDIMENT SAMPLE

PB - 962
AS - 155
Zn - 279
Cu - 106

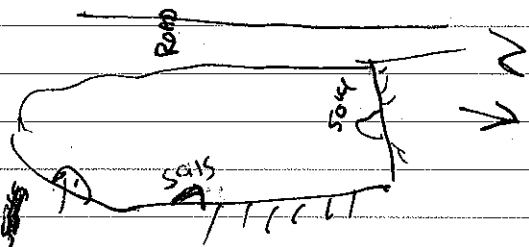


6127/11

1401 - TO UPPER TAILINGS POND.
POND IS ACTIVE, WITH H_2O
ON TOP. 2ND POND NOTED
ON OTHER SIDE OF RIDGE
(NOT SAMPLED).

ONE AREA OF RED COLORED TAILINGS
NOTED ON NORTH END OF POND.
2ND WHITE COLORED TAILINGS
NOTED ON NORTH END. DECIDE
TO COLLECT THEM AS

PMA-PC-SO-14-0611 (RED) NORTH W. END
PMA-PC-SO-15-0611 (WHITE) EAST.



1400
SO-14 XRP PB-61, AS-0, Zn 215, Cu 5169
11.8 mg

1415 PB-34-AS-0, Zn -51, Mn 665
Cu -0

6127/11

1500 - WORK COMPLETE AT LOWER
LEVEL. MOVE TO UPPER AREA
TO ASSIST IN SAMPLE COLLECTION,
RECON, SITE FAMILIARIZATION.

1600 AT GRANITE & PACK VEHICLE
UP, BREAKDOWN GPS & PATA
LOGGERS, XRF, & COMPLETE
SAMPLE LABELING.

1700 DEPART SITE FOR HOTEL

1810 ARRIVE HOTEL, UNPACK SAMPLES
DO SAMPLE PREP.

2030 COMPLETE SAMPLE FILTERING
LABELING & SHIPPING PREP.
WORK COMPLETE FOR DAY.

~~Chadwick
NFETP~~

6/28/11

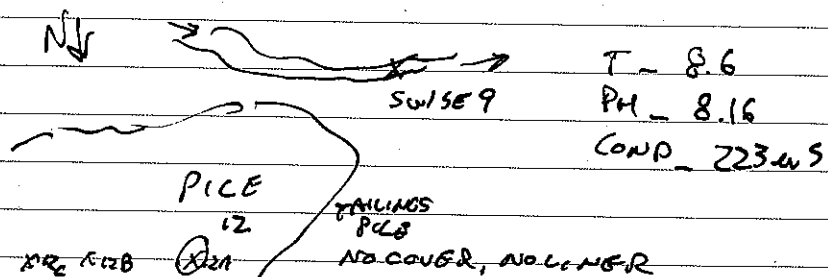
0700 - MEET FOR DEPARTURE TO SITE.

0800 - ARRIVE AT SITE.

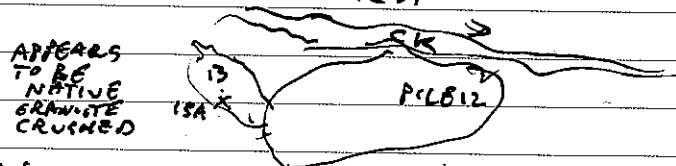
0900 - TO SAMPLE LOCATION 9.

COLLECT SAMPLES BELOW

TAILINGS PILE

0915 - COLLECT PMA_DC_SW_09_0611
- SE-09_0611

NO	AS	MN	ZN
12A #50	PB 162	AS 1543	MN 513, 1412m
12B #51	PB 205	AS 1933	MN 488, 2189
12C #52	PB 173	AS 1673	MN 345, 2195

0935 - COLLECT PMA_DC_SW_12_0611 FROM
LOCATION 12A

13 PD 1418, AS 1514, MN 22, MN 1197

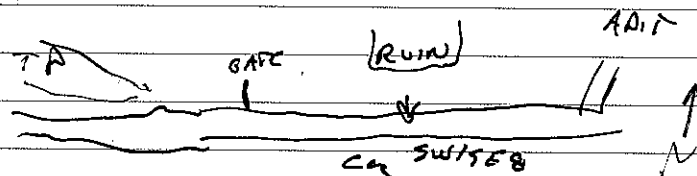
6/28/11

DECIDE TO COLLECT PMA_DC_SW_13_0611
AT PILE 13.1005 - TO PMA_DC_SW_08_0611
SE-08-0611

PH - 8.01

T - 8.2°C

COND - 147.5 uS



1015 - TO PMA_DC_SW_13_0611

ADIT SOURCE SAMPLE. WATER IS FLOWING
~~OVER GATE~~ ≈ 50 GPM

1020 - COLLECT SAMPLE

T - 13.5 13.2°C

PH - 7.95 7.95

COND - 852 uS 852 uS

1035 ENCOUNTER MAN HIKING WITH 2
GLYX DOGS AT SAMPLE LOCATION.1040 TO PMA_DC_SW_07_0611
SE-07-0611

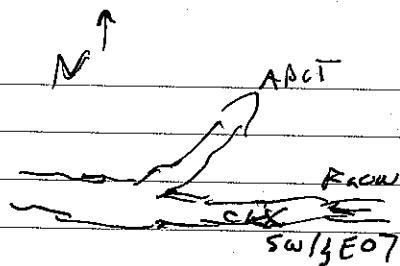
COLLECT SAMPLES.

6/28/11

PH 8.40

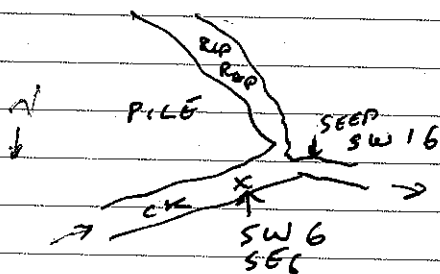
T 8.3

COND 54.245



LOSS TO LOCATION 6 - RECOVERED
PILE WITH GOOD GRASS COVERING
AND EROSION CONTROL - PHOTOS

(SEEP VISIBLE AT TOE OF PILE
NEAR TERMINUS OF EROSION
CONTROL. WILL COLLECT SEEP
SOURCE THERE.



NOTE:
DONG CR. WEST
TAILINGS PILE
(1 km)

1101 - COLLECT PMA_DC_SW_06_0611
SE-06-0611

T. 8.20

PH. 8.48

COND 54.245

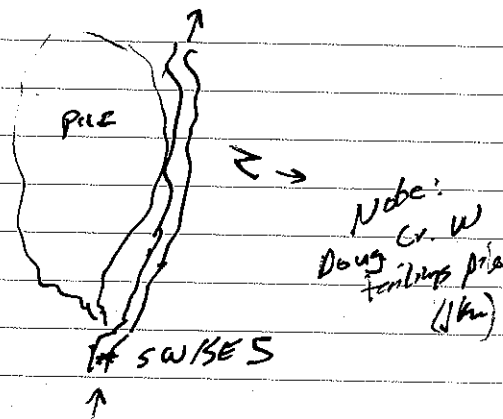
6/28/11

1115 TO SEEP - SW 16 COLLECT SAMPLE:
SW/16 phi: 8.26 temp: 9.6 cond: 173.7

1132 TO TOP OF TAILINGS PILE - COLLECT
XRF SO-10-A

P6 16, 2NS7, MN, 576, 450
P16, 2ND HOLE 2 6" - SIMILAR
MOVE FURTHER UP PILE - D16 2 6"
ENCOUNTER GEOTEXTILE. PILE
APPEARS TO BE ENGINEERED
COVERED.

1150 TO ~~SW~~ PMA_DC_SW_05_0611



T = 8.2

PH = 8.6

COND = 65.345

6/28/11

1156 - APPARENT TAILINGS NEAR PILE TOE
 56 PB 162, AS 240, MN 2313, Zn 254
 Cu 62

DICC \approx 8" & SHOOT READINGS.

57 PB 272, AS 1249, Zn 263 MN 891

DECIDE TO COLLECT,

PMA-DC-SO-11-0611 FROM
 THIS LOCATION AS REPRESENTATIVE
 OF TAILINGS IN NORTH PILE.

1207 TO UPPER RIPRAP DRAINAGE
 (UPGRADIENT EAST SIDE) & NOTE
 SEEP AT BASE OF RIPRAP. DECIDE
 TO COLLECT AS PMA-DC-SW-15-0611

1210 - COLLECT SAMPLES.

T - 13.2°C

PH - 7.95

COND - 150.3 μ S

ACTIV

1305 - TO PILE 100 SW-4
 PILE APPEARS SIMILAR TO PRIOR
 PILE, COVERED, GOOD VEGETATION
 COVER, ETC. TO DOWNSTREAM
 SEGMENT. SEGMENT HAS BEEN

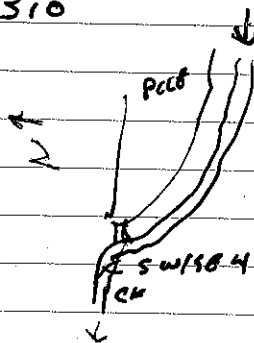
6/28/11

RECLAIMED WITH BORDER CHANNEL
 ING, ARTIFICIAL REINFORCED STREAM
 SIDES, & ENERGY DISSIPATION FEATURES.

COLLECT PMA-DC-SW-4-0611
 SE-4

1310

AT BASE OF TOE PILE



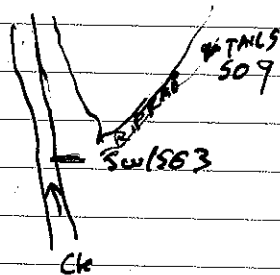
PH - ~~8.38~~ 8.38

T - 9.6

C - 64.8 μ S

1330 TO UPPER STREAM ABOVE PILE

PREPARE TO COLLECT
 PMA-DC-SW-3-0611
 SE-3-0611



PH - 8.30°

T - 8.6°C

C - 58.8 μ S

1345 TO TOP OF LOWER GRAIN RIPRAP
 LOGGING OPS HAVE UNCOVERED TAILINGS.

PB 167, AS 832, Zn 246, MN 2132

14 6/28/11

509

1350 - COLLECT ~~SOME~~ FROM R. PRAP AREA.

1420 - AFTER LEAVING PB MINE

AREA & CONSULTING WITH

PM - DECIDE TO COLLECT

FLINT CREEK SAMPLES

AT BRIDGE & UPGRADIENT

AT DOWNGRADIENT FLINT CR SAMPLE

AT CO RD 358. WILL COLLECT

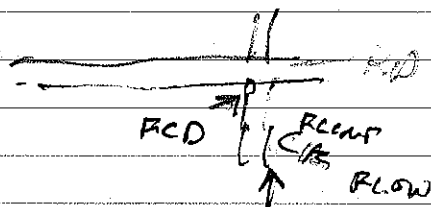
ON SOUTH SIDE FLINT CR.

1530 COLLECT FC DOWN SAMPLE

PM 8.15 (PMA-DC-SW-22-0611)

T 17.8°

COND 175.5



15:50 - TO RE ~~ROAD~~ UP - COLLECT
FROM WEST ACCESS

PMA-DC-SW-23-0011

PMA-DC-SW-23-0011

COND 178.2 MS

15

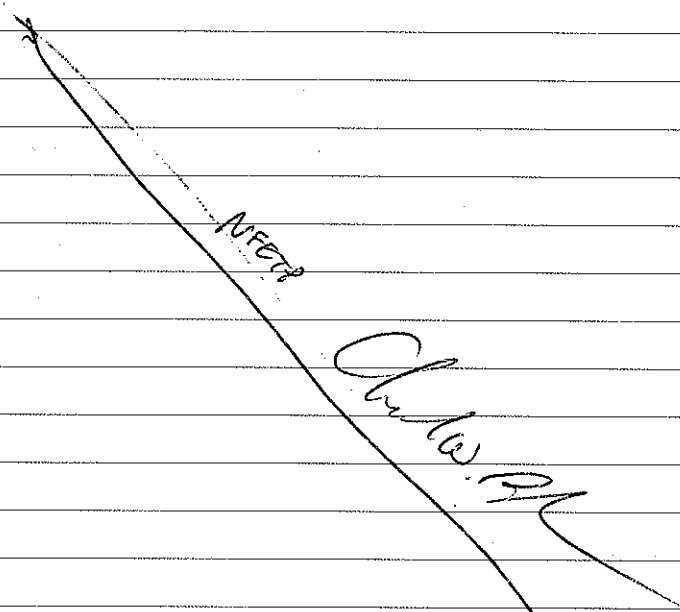
6/28/11

PM 8.35

T - 18.2

1600 - DEPART FOR HOTEL

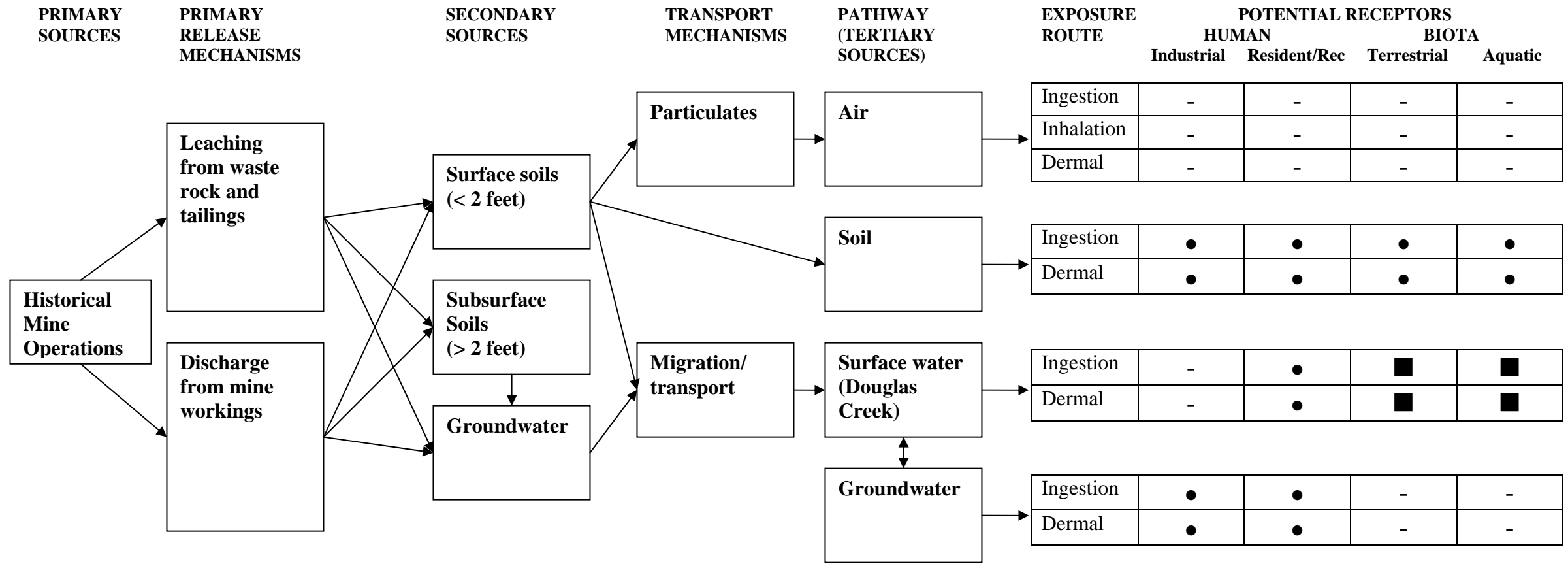
1705 - ARRIVE HOTEL.



APPENDIX D

Conceptual Site Model

APPENDIX D: Philipsburg Mining Area (Douglas Creek) Conceptual Site Model



- Complete Major Exposure Pathway
- Potentially Complete Exposure Pathway
- Likely Incomplete Exposure Pathway

APPENDIX E

**Laboratory Data, Validation Reports
and Chains-of-Custody**

(UNDER SEPARATE COVER)