Final
Remedial Investigation Report

Upper Blackfoot Mining Complex
Lewis and Clark County, Montana

Prepared for:

Montana Department of Environmental Quality
Remediation Division

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ACRONYMS AND ABBREVIATIONS

µm	micrometer
ABA	Acid-Base Accounting
AFDM	Ash Free Dry Mass
AMSL	above mean sea level
AOC	Administrative Order on Consent
AP	Acidification Potential
ARCO	Atlantic Richfield Company
ASARCO	American Smelting and Refining Company
BER	Board of Environmental Review (Montana)
bgs	below ground surface
BLM	U.S. Bureau of Land Management
BTV	Background Threshold Value
CALA	Controlled Allocation of Liability Act
CECRA	Comprehensive Environmental Cleanup and Responsibility Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
cfs	cubic feet per second
COC	contaminant of concern
COPC	contaminant of potential concern
CSEM	Conceptual site exposure model
DAF	Dilution Attenuation Factor
DEQ	Department of Environmental Quality (Montana)
DNRC	Department of Natural Resources and Conservation (Montana)
DSR	Comprehensive Data Summary Report (Tetra Tech 2007a)
ECO-SSL	Ecological soil screening level
EE/CA	Engineering Evaluation/Cost Analysis
EOT	Edge of Tailings
EPA	U.S. Environmental Protection Agency
EPT	Ephemeroptera/Plecoptera/Trichoptera
ERA	Ecological Risk Assessment
ERCLs	Environmental Requirements, Criteria, or Limitations
ERNS	Emergency Response Notification System

EU	Exposure Unit
FS	Feasibility Study
ft	feet
ft/d	Feet Per Day
ft^2/d	Square Feet Per Day
FWP	Fish, Wildlife and Parks
gpm	gallons per minute
g	Acceleration of gravity
GIS	Geographic Information System
GPS	Global Positioning Satellite
GWIC	Groundwater Information Center
ILS	In Line (Oxidation) System
IP	Implementation Plan (Temporary Water Quality Standards)
kg/day	Kilograms Per Day
LUST	Leaking Underground Storage Tank
m	meters
MBMG	Montana Bureau of Mines and Geology
MCA	Montana Code Annotated
MCL	Maximum Contaminant Level
MDHES	Montana Department of Health and Environmental Sciences
MDSL	Montana Department of State Lands
MFG	McCulley, Frick, and Gilman
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MGWPCS	Montana Groundwater Pollution Control System
MMI	Multimetric Macroinvertebrate Index
MPDES	Montana Pollutant Discharge Elimination System
MSD	minimum search distance
NCEA	National Center for Environmental Assessment
NOAA	National Oceanographic and Atmospheric Administration
NP	Neutralization Potential
NNP	Net Neutralization Potential
NPL	National Priorities List
NRCS	National Resource Conservation Service
NRIS	Natural Resource Inventory System

ORNL	Oak Ridge National Laboratory
PAET	Probable apparent effects threshold
PEL	Probable Effects Level
pH	a measure of acidity or alkalinity of a solution
PLPs	Potentially Liable Persons
PPRTV	Provisional Peer-Reviewed Toxicity Values
PQL	Practical Quantitation Limit
PRG	Preliminary Remediation Goal
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RIWP	Remedial Investigation Work Plan
RPD	Relative Percent Difference
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan
SEL	Screening Effects Level (Screening level concentration)
SLERA	Screening level ecological risk assessment
SOPs	Standard Operating Procedure
SPLP	Synthetic Precipitation Leaching Procedure
SSL	Soil Screening Level
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TEL	Threshold Effects Level
TMDL	Total Maximum Daily Load
UBMC	Upper Blackfoot Mining Complex
UPL	Upper Prediction Limit
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	Underground Storage Tank
UTL	Upper Tolerance limit
VCP	Voluntary Cleanup Plan
VCRA	Voluntary Cleanup and Redevelopment Act
WQA	Water Quality Act
XRF	x-ray fluorescence
yd	Yard

yd^3	Cubic yard

1.0 INTRODUCTION

The Upper Blackfoot Mining Complex (UBMC), also referred to as the UBMC Facility or Facility in this report, includes a mixture of National Forest and private lands that lie within a portion of the historic Heddleston Metal Mining District (Heddleston District) in the Rocky Mountains of Lewis and Clark County, Montana (**Figure 1**). The UBMC is located approximately 15 miles east of Lincoln, Montana, in the headwaters area of the upper Blackfoot River and covers an area of approximately 6 square miles including several sections within Township 15 North, Range 6 West. The Facility is comprised of a number of individual historic underground mines that developed deposits occurring principally as narrow, fault-controlled, base-metal (silver-lead-copper-zinc) veins. The Mike Horse Mine, the largest producing mine within the UBMC, occurs at latitude 47º01'31.87" North, and longitude 112º21'41.48" West.

Historic mining activity at the UBMC has resulted in hard-rock mining wastes and acidic discharges that impact the environment. Human health and environmental issues are related to elevated levels of heavy metals present in mine waste piles, tailings, acidic metal-bearing surface water, groundwater, sediments, water discharging from mine adits, and contaminated waste redeposited as stream sediments. Numerous investigations have been conducted over the last 20 years to characterize contamination in mine wastes. Contaminants at the Facility include, but are not limited to, arsenic, cadmium, copper, lead, iron, manganese, and zinc.

Mine wastes and associated contamination has prompted the Montana legislature to direct the Montana Department of Environmental Quality (DEQ) to complete a Remedial Investigation (RI) at the UBMC. In the fall of 2007, Tetra Tech Inc. (Tetra Tech) entered into a contract (Contract No. 407036, Task Order No. 9) with the DEQ to perform environmental consulting services for the RI. The RI was necessary to address data gaps presented in the Comprehensive Data Summary Report (DSR), issued by the DEQ in December 2007 (Tetra Tech 2007a). The DSR: 1) compiled all existing and available information relevant to the UBMC; 2) evaluated the data by comparing it to appropriate screening levels; and 3) identified additional data gaps.

Work that Tetra Tech has completed under Task Order No. 9 included review of past data collection activities to evaluate whether additional data gaps remained, the completion of work plans and sampling plans, field investigations, and reports associated with completion of this RI Report. Tetra Tech performed the RI sampling between the fall of 2007 and spring/summer 2008. This Remedial Investigation (RI) Report was prepared to provide a brief summary of historic data collection activities and present the data collected and generated during the fall 2007 and spring/summer 2008 field investigations.

1.1 Report Organization

This RI is organized in seven sections, followed by appendices that include figures, tables, field notes, and analytical reports.

Section 1.0, Introduction – describes the report organization; purpose, scope, and objectives of the report; site location and description; site historical overview; individual mine facility operational history, general site characteristics; site geology; and site hydrology and hydrogeology.

Section 2.0, Summary of Historical Reclamation Activities – presents a summary of previous interim actions, temporary water quality standards implementation plan, and future remedial actions.

Section 3.0, 2007 and 2008 Remedial Investigation Methods – presents a summary of the investigation methods used to address data gaps.

Section 4.0, Nature and Extent of Contamination – presents nature and extent of contamination for mine wastes, surface water, streambed and marsh sediment sampling, groundwater, revegetation, and ecological risk sampling.

Section 5.0, Conceptual Model of Contaminant Migration – describes the contaminants of potential concern, primary and secondary sources of contamination, release mechanisms, migration pathways for exposure, attenuation mechanisms, risk analysis approach, graphical site-specific conceptual site model, potential remedial action objectives, and data needed for remedial alternatives evaluation.

Section 6.0, Conclusions and Recommendations – presents conclusions and recommendations for the RI report.

Section 7.0, References – provides references cited in the text.

Figures and Tables (located at end of text)

Appendices

Appendix A – Historic aerial photographs and remedial investigation photographs

Appendix B – Field notes, survey data, and other field information

Appendix C – Monitoring wells and boring logs

Appendix D – Aquifer test results

Appendix E- Laboratory reports and data evaluation reports

1.2 Purpose, Scope, and Objectives

The most significant environmental issues within the UBMC are associated with impacts from historic mining activities that began with the prospecting of the area in about 1889, with significant mining activities occurring from the late 1930s through the late 1950s. Human health and environmental issues are primarily related to elevated levels of heavy metals present in mine waste piles, tailings, acidic metal-laden water discharging from mine openings, contaminated surface and groundwater, and the transport and redeposition of contaminated mine wastes as in-stream sediments.

The RI Work Plan (Tetra Tech 2007c) executed by Tetra Tech in 2007 and 2008 was formulated by careful and detailed review of the existing data and analysis presented in the DSR (Tetra Tech 2007a) and as such relies heavily on the data contained in that report. The scope of work defined in the RI Work Plan focused on filling data gaps identified in the DSR and included a review of additional historic information in DEQ files in Helena, Montana. The scope of work for this RI Report therefore, included investigation and sampling of soil, mine waste, streambed and marsh sediments, surface water, and groundwater. Additional sampling of invertebrates, soil, sediment, and vegetation was conducted to provide data for the support of future ecological risk assessment efforts. Also, vegetation was surveyed and soil was sampled to evaluate previous reclamation/removal actions and revegetation effectiveness for several mine waste areas and to plan for possible remedial reclamation work at these sites. The objectives of the RI are to:

- Determine the nature, full extent, and possible sources of soil, sediment, surface water, and groundwater contamination at and around the UBMC;
- Identify the geographical boundary for the Facility which is defined as any place that hazardous or deleterious substances have come to be located; and,

- Determine the success of all voluntary interim actions already completed at the UBMC, as well as analyze alternatives to remediate the rest of the UBMC.

The purpose of this RI report is to describe the processes and activities that:

- Summarize the available information that identifies, characterizes, and defines contaminant sources and historic releases at the Facility;
- Delineate the nature and extent of the contamination in mine wastes, soils, sediments, surface water, and groundwater;
- Develop a site-wide conceptual model for contaminant sources, release mechanisms, migration pathways, and attenuation mechanisms;
- Collect the data necessary to prepare baseline risks assessments for human health and the environment; and,
- Collect site-specific data that is both sufficient and necessary to develop and evaluate viable remedial alternatives.

This RI was prepared using guidance and methodology provided by DEQ's Remediation Division and EPA's Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA Interim Final (EPA 1988) for characterizing the nature and extent of risks posed by uncontrolled releases at hazardous waste sites and evaluating potential remedial options.

For purposes of this RI report the study area of the UBMC includes the area of historic mining in the Heddleston District and the immediately surrounding lands. This includes the drainage area from upgradient of the Mike Horse Mine and tailings impoundment, downstream to the natural marsh system where Swamp Gulch (site of the reclaimed Carbonate Mine) enters the Blackfoot River (**Figure 2**). This area generally coincides with lands that have been the focus of mine reclamation actions over the last 15 years, and includes the area covered by the United States Forest Service (USFS) USFS Engineering Evaluation/Cost Analysis (EE/CA; Hydrometrics 2007). Other historical studies, including surface water sampling and aquatic macroinvertebrate studies, have been carried out further downstream along the Blackfoot River to its junction with the Landers Fork about ten miles east of Lincoln, Montana. In 2011 studies, as part of this RI, were completed as far as Hogum Creek that included the collection of surface water and macroinvertebrate samples, as shown on **Figure 1**.

Based on the extensive historical environmental monitoring and data collection undertaken by various entities in the Blackfoot River drainage over the past 30 years or more, a systematic approach was used for review and discussion of past sampling results. In this RI report, the description of the nature and extent of contamination at the Facility (Section 4.0) is approached by presenting a summary statement or discussion where appropriate, regarding background samples and data, pre-reclamation sampling, and post-reclamation sampling that is relevant to characterizing existing facility conditions. Summaries are followed by: 1) a discussion of fall 2007 and spring/summer 2008 investigation work, which was designed to fill obvious data gaps and verify the results of some historical sampling; and 2) a brief discussion of combined historical and recent results.

1.3 Site Location and Description

The UBMC Facility contains both federally-owned lands (National Forest System) and private lands (historic ASARCO Patented Mining Claims, ASARCO Fee lands and other private property) located within the boundaries of the Lewis and Clark National Forest and within Lewis and Clark County, Montana (**Figure 1**). ASARCO transferred its patented mining claims and fee lands to the Montana Environmental Trust Group, LLC (METG), on December 9, 2009, as part

of the settlement of Montana's claims in the ASARCO bankruptcy. The Facility lies predominantly south of US Highway 200, about 15 miles east of the community of Lincoln, Montana (population 1,100) and about 5 miles west of Rogers Pass, at which US Highway 200 crosses the Continental Divide.

The Heddleston District portion of the Facility covers an area of about 6 square miles located in portions of Sections 16, 17, 19, 20, 21, 22, 27, 28, 29, 33, and 34 of Township 15 North, Range 6 West (**Figures 1 and 2**). This portion of the Facility is characterized by heavily forested, steep mountainous terrain, with elevations ranging from 5,200 feet above mean sea level (AMSL) at the confluence of Pass Creek and the Blackfoot River (near the head of a major marsh system, **Figures 1 and 2**), to as much as 7,200 feet AMSL on the ridge comprising Anaconda Hill along the northeast edge.

The Heddleston District portion of the Facility is situated near the headwaters of the Blackfoot River. Major tributary streams within the Facility include Mike Horse Creek, Beartrap Creek, Anaconda Creek, Stevens Gulch, Shave Creek, Paymaster Creek, Pass Creek, Swamp Gulch, and Meadow Creek (**Figures 1** and **2**). The Blackfoot River proper is formed at the confluence of Beartrap and Anaconda Creeks. This includes the drainage area upgradient of the Mike Horse Mine and tailings impoundment, downstream to the first marsh (herein after referred to as the "Upper Marsh") where Swamp Gulch (site of the reclaimed Carbonate Mine) enters the Blackfoot River (**Figures 1** and **2**). The Facility also includes the Blackfoot River channel and portions of the floodplain as it exits the upper marsh and flows down as far as the confluence of Hogum Creek. This river portion of the Facility is located in parts of Sections 19 and 20 of Township 15 North, Range 6 West; Sections 23, 24, 26, 33, 34 and 35 of Township 15 North, Range 7 West; and parts of Sections 4, 5, and 8 of Township 14 North, Range 7 West.

Under the Comprehensive Environmental Cleanup and Responsibility Act (CECRA), the "facility" includes "any site or area where a hazardous or deleterious substance has been deposited, stored, disposed of, placed, or otherwise come to be located." Under CECRA, the term "on-site" also includes all suitable areas in close proximity to the contamination necessary for implementation of the remedial action. Identification of these areas may change over time as new information becomes available.

1.4 Site Historical Overview

1.4.1 Mining History Overview

The Heddleston District was named for William Heddleston who, with his partner George Padbury, discovered the Calliope lode in 1889 (GCM 1993). A small mining operation was begun and an arrastra was built on Pass Creek to process the ore. Prior to 1915, prospectors discovered a number of lodes containing lead, zinc, and copper, including the Mike Horse, Carbonate, Paymaster, Midnight, and Anaconda mines. The district's early development was hampered by difficult access created by the lack of suitable roads. As a result, only minor shipments of ore were made to off-site smelters during this early period of mining (GCM 1993).

The district saw a revival of mining activity in 1915 when the Mike Horse Mine was taken over by the Sterling Mining and Milling Company of Ellensburg, Washington. A major lead deposit was developed at the Mike Horse Mine and in 1919 a (jig) concentrating mill was built to process the mine's ores, as well as the ore from the nearby Anaconda and Paymaster Mines. The Mike Horse Mine produced a modest amount of ore as concentrate by the end of the 1920s. The Mike Horse Mine was idle until 1938 when it was leased to the Mike Horse Mining and Milling Company. The following year, a 150 tons-per-day flotation mill was built, and, in 1940, a 15-mile electric power line was strung from Marysville to the mine. In 1941, the Mike Horse Dam was constructed across Beartrap Creek just upstream of the confluence with Mike

Horse Creek (**Figure 1**) to serve as an impoundment for the tailings from the newly constructed Mike Horse Mine flotation mill. The Mike Horse deposit continuously produced lead/zinc ore, containing some silver, for the next decade (GCM 1993).

In 1945, the assets of the Mike Horse Mining and Milling Company were purchased by ASARCO, and it kept the Mike Horse Mine operating until 1955, at which point the mine closed due to declining metals prices and near exhaustion of the ore body. The Rogers Mining Company of Helena leased and operated the mine sporadically from 1958 until early 1964 when the Anaconda Company of Butte acquired a lease to mine the Mike Horse deposit from ASARCO. The Anaconda Company conducted exploration activities from 1962 through 1973 in the Heddleston District (although not on the Mike Horse Mine claims), including detailed geologic mapping; geochemical sampling; drilling of 340 rotary, diamond, and reverse circulation drill holes; and the driving of 2 adits to collect bulk samples. This exploration work defined a substantial underground copper/molybdenum porphyry deposit. In 1979, following cessation of the Anaconda Company's exploration activities in the Heddleston District, the Anaconda Company was merged into ARCO (the Atlantic Richfield Company). ASARCO purchased all of ARCO's holdings in the Heddleston District in 1981. From 1981 until resolution of its bankruptcy filing, ASARCO performed limited exploration work on the property, as well as mine reclamation activities (with ARCO's participation) (GCM 1993).

Although the Mike Horse Mine was the mainstay of the district, other small mining operations were also active during the twentieth century. The Paymaster was in operation early in the 1900s but had closed by the mid-1920s. In the early 1960s, it was reopened with minor development work conducted by Paramount Estates of New York. The Anaconda Mine was developed early in the 1900s and produced minor amounts of ore containing gold, silver, copper, and lead intermittently through 1940. Both properties were purchased by the Anaconda Company in the mid-1960s and subsequently acquired by ASARCO (GCM 1993).

The preponderance of the district's mineral wealth came from the production of base metals such as lead and zinc. Total tonnage of ore produced from the Heddleston District is less than 450,000 tons, with 385,000 tons of that production coming from the Mike Horse Mine from 1945 to 1952. Although exact production figures for the district are not available, it appears that greater than 95 percent of the production from the district came from the Mike Horse Mine with only minor amounts of production coming from the Anaconda, Carbonate, and Paymaster mines (GCM 1993).

1.4.2 Land Ownership

The Lewis and Clark County records for land ownership were queried to identify all parcel owners within the UBMC and lands immediately west of the UBMC (Lewis and Clark County 2006). This land ownership is shown on **Figure 3**. A list of parcel owners from the UBMC, (approximately the east half of **Figure 3**) is provided in **Table 1**. Information about the patented mining claims owned by the METG is summarized by individual mine sites below (Section 1.5). METG also has title to fee land (formerly owned by ASARCO) immediately west of its patented claim holdings in the UBMC.

1.4.3 Regulatory and Permitting History

Regulatory clean-up activities at the UBMC commenced in 1987 when the Montana Legislature allocated funds to the Montana Department of State Lands (MDSL; now part of DEQ) for reclamation of the Mike Horse Mine under the State's abandoned mine reclamation program, with additional funding allocated in 1989. The MDSL performed site characterization activities and reclamation planning from 1987 through 1990, including plans for mine waste removal and water treatment designs (MDSL 1990). In 1990 however, the Montana Department of Health

and Environmental Sciences (MDHES, now DEQ), determined that potentially liable persons (PLPs) may exist for the Mike Horse site, and the state's reclamation plans were put on hold (MDHES 1990-91).

In June 1991, ASARCO and ARCO were identified by the MDHES as PLPs for hazardous or deleterious substance contamination at the UBMC, under CECRA. Required actions included development of a RI and feasibility study (FS), and implementation of a remedy to be determined by MDHES (MDHES 1991).

Between February 1992 and May 1993, ASARCO and ARCO met with MDHES regarding implementation of a voluntary remediation program at the UBMC in lieu of the formal RI and FS process. Terms and conditions of a voluntary program are outlined in a May 26, 1993 letter from MDHES, including preparation and submittal of annual work plans and other documents. MDHES reviewed plans and work, but did not approve any of the work (MDHES 1993a). Site reclamation activities proceeded under this agreement until 1998, when certain remedial actions, namely reclamation of the Paymaster Mine and No. 3 Tunnel area, proceeded under the newly established Montana Voluntary Cleanup and Redevelopment Act (VCRA) program (MFG 1996a).

In 1994, ASARCO applied for and, in 1995, received a Montana Pollutant Discharge Elimination System (MPDES) permit for discharge of treated water from the Mike Horse and Anaconda mine adit discharges (MDHES 1995). The MPDES permit (MTR-0030031) regulated the discharge of treated water to the Blackfoot River. However the form of treatment has changed from the old (constructed in 1995-96) wetlands-based water treatment system to the new (constructed in 2008) microfiltration water treatment plant (Sections 2.1.6 and 2.1.7).

ASARCO also applied for and received a Montana Groundwater Pollution Control System (MGWPCS) permit (permit MGWPCS-001001) in 1996 for treatment and subsurface discharge of a small (2 gallons per minute (gpm) or less) seasonal flow from the Paymaster adit (DEQ 1997). The Paymaster MGWPCS permit expired in September 2003 and was not renewed, since no discharge was ever recorded from the Paymaster Mine water treatment wetlands cell (DEQ 2006). ASARCO also held an authorization to discharge storm water from the UBMC Facility under Montana's general permit for storm water discharges (Authorization MTR300157). The storm water permit remained in effect until May 2011, when DEQ's Site Response Section assumed administrative duties to ensure water quality compliance under its CECRA authority (MDHES 1993b; DEQ 2011a.).

In 1999, ASARCO petitioned the Montana Board of Environmental Review (BER) for adoption of temporary water quality standards in portions of three streams at the UBMC (Hydrometrics 1999). Temporary standards were requested in portions of Mike Horse Creek, Beartrap Creek, and the upper Blackfoot River. The temporary standards were approved by the BER and were established in the Montana Surface Water Quality regulations (ARM 17.30.630) in June 2000. The temporary standards temporarily modify the water quality standards for a number of metals, including cadmium, copper, iron, lead, manganese, and zinc, as well as pH, until 2008. As part of the temporary standards petitioning process, ASARCO was to develop a conceptual plan for mitigation of all "water quality limiting factors" identified in the temporary standards support document, referred to as the Temporary Standards Implementation Plan (Hydrometrics 2000).

In November 2002, ASARCO entered into an Administrative Order on Consent (AOC) with the USFS for performance of an EE/CA for certain public lands within the UBMC. The AOC covers National Forest System lands along portions of Mike Horse Creek, Beartrap Creek (including the Mike Horse tailings impoundment) (Sections 20, 21, 27, and 28), and the Blackfoot River upstream of the confluence with Pass Creek (**Figure 1**), which may have been affected by operation of the Mike Horse Mine and tailings impoundment. The objective of the AOC was for

ASARCO to develop removal action alternatives through development of an EE/CA (Hydrometric 2007).

In 2003, DEQ brought legal action in State District Court against ASARCO and ARCO for recovery of DEQ's past and future remedial action costs associated with contamination and threats of contamination at the UBMC, and to require the companies to implement required remedial actions. As part of this action, DEQ also sought a declaratory judgment to establish liability for all future remedial action costs, including clean-up, which DEQ would incur in connection with the UBMC (First Judicial District Court 2003).

In 2005, ASARCO released a document entitled *Comprehensive Data Summary Report for the Upper Blackfoot Mining Complex, Lewis and Clark County, MT* (Hydrometrics 2005). The initial draft of the report was prepared as part of an interim settlement of the pending litigation. DEQ reviewed the draft report and provided comments to ASARCO and ARCO. DEQ's review of the resubmitted document (Hydrometrics 2005) indicated that the companies had not incorporated DEQ's comments adequately. Therefore, DEQ revoked the interim settlement agreement and completed the Comprehensive Data Summary Report itself with the assistance of its contractor, Tetra Tech (Tetra Tech 2007a).

In August of 2005, ASARCO filed for Chapter 11 bankruptcy. DEQ, the Montana Department of Justice, and the USFS filed claims in the bankruptcy that have since been settled (U.S. Bankruptcy Court 2008). This settlement also included settlement with ARCO. As part of the settlement, DEQ dismissed the state court action.

In December of 2006, the BER revoked the temporary water quality standards due to failures and delays on the part of ASARCO in implementing the Temporary Water Quality Standards Implementation Plan (BER 2006). ASARCO continued to treat water from the Mike Horse and Anaconda mine adit discharges using the wetlands-based water treatment system. In 2008, ASARCO constructed the ceramic microfiltration water treatment plant at the same location, effectively replacing the old treatment system in January 2009 (CDM 2008). These discharges were regulated under MPDES permit MT-0030031 until May 2011 when DEQ's Site Response Section assumed administrative duties to ensure water quality compliance under its CECRA authority (DEQ 2011a).

In July of 2007, the USFS - Region 1 and ASARCO released an EE/CA concerning the clean-up of contaminants on USFS land at the UBMC entitled *Engineering Evaluation Cost Analysis for the Mike Horse Dam and Impounded Tailings, Lower Mike Horse Creek, Beartrap Creek and the Upper Blackfoot River Floodplain Removal Areas Upper Blackfoot Mining Complex, Lewis and Clark County, MT* (Hydrometrics 2007). Also during July of 2007, the Helena National Forest, Lincoln Ranger District released an Action Memorandum based on the EE/CA (Helena National Forest 2007) selecting a preferred alternative for clean-up of the designated sub-areas. In brief, the Action Memorandum proposes: (1) total removal of the Mike Horse Dam and impounded tailings and placing the waste into the Paymaster Repository; (2) complete removal of mine waste from Lower Mike Horse Creek and placing the waste into the Paymaster Repository; (3) removal of all concentrated and intermixed tailings from the active floodplain of Beartrap Creek and placing the waste into the Paymaster Repository; and (4) complete mine waste removal (estimated at 45,000 cubic yards (yds^3)) from the Upper Blackfoot River Sub-area and placement of the waste into the Paymaster Repository (Helena National Forest 2007).

In 2007, DEQ contracted with Tetra Tech to complete a RI of the UBMC. The RI field work was performed during fall 2007 and summer of 2008. Pioneer Technical Services, Inc. (Pioneer) conducted a supplemental investigation in November 2011 to address specific data gaps identified by DEQ and Tetra Tech (Pioneer 2012). This RI Report discusses the results of the 2007, 2008, and 2011 work.

1.5 Individual Mine Facility Operational History

The following summary of the operational history of individual mine facilities within the UBMC is taken largely from the DSR (Tetra Tech 2007a), which in turn came largely from the cultural resource inventory and evaluation report by GCM Services, Inc. of Butte (1993). Other information comes from a geologic report by McClernan (1983).

1.5.1 Anaconda Mine

The Anaconda Mine (**Figure 4**) was discovered and developed during the early 1900s by Gottfried Krueger. The mine workings are located on the Little Joe, Copper Bell, Blue Cristle, and Anaconda patented mining claims. The mine had no significant production, however, in 1919, 116 tons of ore were mined yielding approximately 72 ounces of gold, along with 2,629 ounces of silver, 10,865 pounds of copper, and 12,973 pounds of lead. An average of about 25 tons of ore was taken from the Anaconda Mine during the following four years. The ore was processed in the mill at the Mike Horse Mine (GCM 1993).

By 1933 about 1,000 tons of ore had been produced from the Anaconda workings (Pardee and Schrader 1933). There are no records of production between 1933 and 1939. Records show that production in 1939 included the mining of 1,400 tons of ore that produced 12,394 ounces of silver, 280 ounces of gold, 14,600 pounds of lead, and 8,481 pounds of copper. In 1940, Giant Group Company of Helena processed 50 tons of mine tailings through the 50 ton mill they installed on the property. McClernan (1983) believed that total production from the Anaconda Mine was only about 1,660 tons of ore through the year 1948. This was apparently the last production year from the mine although GCM (1993) indicated some development work was conducted in 1961 by mine owner Paramount Estates of New York.

The Anaconda workings included two shafts and two adits, and were developed to mine a discontinuous, northeast-trending, brecciated, fracture-filled vein. The lower adit extended about 90 feet into the hillside while the upper adit was around 500 feet long. A shaft near the lower adit was approximately 325 feet deep (Pardee and Schrader 1933; McClernan 1983).The vein occurred over a vertical distance of approximately 300 feet and was 3 to 5 feet thick along a strike length of 75 feet. The deposit contained several minerals including: sphalerite, pyrite, galena, arsenopyrite, bournite, and rhodochrosite.

1.5.2 Carbonate Mine

The claims on the Carbonate Mine property (**Figure 4**) were staked in 1889 and were mined during the early 1900s. The property consists of four patented claims. Pardee and Schrader (1933) reported that the mine consisted of an adit which intersected the lode 106 feet from the portal, from which workings followed the vein about 750 feet to the northwest. Near the middle of the adit was a shaft. The shaft crossed the adit level about 100 feet below the surface and extended 200 feet below the adit level. Working levels were developed at about 100 feet and 200 feet, respectively, below the main adit level. The deposit consisted of veins and pods of quartz–rich material in a shear zone that contained pyrite, galena, and sphalerite.

Glacier Mining Trust of Wilborn, Montana controlled the mine in the 1930s; until 1939 when the mine was shut down. The mine was reported to have had 875 feet of tunnels and 425 feet of shafts (GCM 1993).

The mine was operated during the late 1940s until the mill burned down on August 8, 1949 and the mine was shut down (GCM 1993). New Silver Bell Mining Company operated the claims beginning in 1947. At that time, the property had 3,000 feet of drifts and 200 feet of shafts. The mill processed gold, silver, copper, and lead at a rate of 120-ton per day.

No production figures exist for the Carbonate Mine, but McClernan (1983) surmised that the amount of drifting in the mine and the nearby tailings pond indicate that although some production probably did occur that it does not seem that the mine was a major commercial operation (GCM 1993). The claims were purchased by the Anaconda Company in 1967 and acquired by ASARCO in 1981.

1.5.3 Mike Horse Mine & Tailings Impoundment

1.5.3.1 Mike Horse Mine

Joseph Heitmiller first located the Mike Horse claim (**Figure 4)** in 1898. Development work was undertaken for the following 15 years. However, little ore was shipped to smelters because of inadequate haul roads for large quantities of ore shipments. Production resumed in 1915 under the ownership of Sterling Mining and Milling Company of Ellensburg, Washington. Production continued until 1917 and in 1919 a new lode deposit was located.

A mill was constructed at the mine to process the lead-silver concentrate along with ore from the Anaconda and Paymaster mines. The mine continued to operate during the 1920s. The most productive years were 1923 and 1924 when 1,120 tons of ore were processed. Lead accounted for three-quarters of the ore's value while silver accounted for the remaining one-quarter (GCM 1993).

The mine had multiple adits spaced along 300 vertical feet. The mine workings intersect the Mike Horse, Little Nell, and Intermediate veins. The workings were connected via raises and stopes. The mine depth is approximately 450 feet (Pardee and Schrader 1933).

The Mike Horse Mining and Milling Company leased the property in 1938. The company subsequently constructed a 150 tons-per-day flotation mill in 1939, connected the site to electricity in 1940, and constructed the tailings impoundment in 1941 across Beartrap Creek to handle flotation mill tailings from the Mike Horse Mill (Section 1.4.1).

ASARCO purchased the mine in 1945 and operated it until closure in 1955 due to declining metal prices. In 1958, the Rogers Mining Company of Helena leased the mine and subsequently operated it until 1964 when the Anaconda Company of Butte acquired an assignment of the lease. The Anaconda Company then initiated a large-scale exploration project in the Heddleston District to evaluate a copper-molybdenum porphyry ore body (Stiller 2000). The mine continued to operate throughout World War II.

The bulk of production in the Heddleston Districts was through the Mike Horse mine. Peak production for the mine occurred between 1941 and 1952, averaging approximately 200 tons of ore per day. The ore was processed for a lead-zinc concentrate through the flotation mill. During that period the mine had 660 feet of winzes and 22,620 feet of drifts and crosscuts (GCM 1993).

1.5.3.2 Mike Horse Tailings Impoundment

The Mike Horse Tailings Impoundment was constructed on the Beartrap Creek drainage in 1941 for disposal of tailings from the Mike Horse Mine floatation mill. All tailings produced from the Mike Horse Mine after this time were placed in this impoundment. Jig tailings are present along the creeks and river within the UBMC. Therefore, it is reasonable to assume that jig tailings were deposited directly to the Mike Horse Creek and the ground surface prior to construction of the flotation mill and tailings impoundment. Mining activities ceased at the UBMC by the mid-1950s (Stiller 2000).

In June 1975, heavy precipitation and rapid snowmelt, along with blockage of a surface water diversion ditch by mudslide debris, caused the Mike Horse tailings impoundment to be breached. As a result, tailings were washed downstream and still persist along the Beartrap

Creek and the upper Blackfoot River floodplain. Several of the remedial investigation efforts discussed in this report (see Sections 3 and 4) focus on the effects of the tailings dam breach and the distribution of redeposited tailings in the valley bottom as sediment.

1.5.4 Paymaster Mine

The first work on the Paymaster Mine (**Figure 4**) property occurred in February of 1902 when a tunnel was reported to be under construction. Also in 1902, the Paymaster Gold Mining Company was incorporated and staked four claims (Black Diamond, Jumbo, Bonanza, and Cicero Lodes), which were patented in 1912. In 1912, improvements on the property included four discovery shafts, four tunnels, three drifts, and a winze (GCM 1993).

Surface development apparently never went much beyond these initial improvements. When Pardee and Schrader (1933) examined the site in August of 1927, they reported the workings were partly closed by caving and it appeared they had not been worked for several years. The underground workings of the mines included a 900-foot long crosscut at the lowest adit, several hundred feet of drifts and a 50-foot winze. About 100 tons of ore were reportedly shipped from the mine (GCM 1993).

The ore body for the Paymaster area was rich in molybdenum. The Midnight and Edith mines also accessed the same ore body. The Paymaster was re-opened in the 1960s via the mine's lower adit. However, no production was reported (McClernan 1983).

1.5.5 Edith Mine #2

The Edith Mine #2 (**Figure 4**) is a recent mining development within the Paymaster and Black Diamond ore veins. The ore body was rich in molybdenum which had been exploited earlier by the Paymaster Mine and also the Midnight Mine, located on the hill above the Edith (GCM 1993). The plat map for the original 1904 survey (Mineral Survey No. 7353 and 7356) of the mining claims showed two discovery shafts, and two tunnels within the general vicinity of the Edith Mine. There is no record of production and no mine features remain from the early operation at the Edith Mine #2.

The Anaconda Company re-opened the Edith Mine in 1967. The mining company drove a tunnel north into the ore body from the base of the south-facing hillside. While the ore body proved high in molybdenum, no known production was initiated by the Anaconda Company. The operation was shut down a few years later (GCM 1993).

1.5.6 Mary P Mine

The Mary P Mine (**Figure 4**) started operation in 1911. The mine was located a few hundred yards to the southeast of the Anaconda Mine on the opposite side (southwestern side) of the Blackfoot River. The mine operation included a discovery cut with a tunnel and a second tunnel with a short drift. There is no evidence of production from the Mary P and the mine was apparently closed down within a year or two (GCM 1993).

1.5.7 Midnight and Daylight Mines

The Midnight Mine (**Figure 4**) was listed as shipping ore in May of 1904, while the Daylight Mine showed production even earlier, in May of 1901. The two mines were part of the same operation of the Midnight Copper Mining Company, which had driven a connecting tunnel and drifts through the Midnight, Copper Gate, and Daylight claims (patented in 1911). The 1915 plat map of the claims shows four discovery cuts, two shafts, two tunnels, three extensive drifts, and a "branch of tunnel" (GCM 1993).

By 1929, the Midnight Mine was listed as having 3,000 feet of workings from several adits; however, during an idle period from 1926 to 1927, most of the old works had caved in. In 1929, work was underway on a new adit and 25 tons of copper and silver ore were shipped (Pardee and Schrader 1933; McClernan 1983).

1.5.8 Consolation Mines

Development on the Consolation Mine property (**Figure 4**) prior to 1933 consisted of several pits, three caved adits, and a shaft about 20 feet deep (Pardee and Schrader 1933). Mineralization occurs as a thin vein of quartz-galena-pyrite and sphalerite adjacent to a porphyry dike in contact with the Spokane Shale.

1.5.9 Flosse and Louise Mining Claims

The Flosse and Louise mining claims (Mineral Survey No. 10465) are approximately 41 acres in size and located along Beartrap Creek north of the Mike Horse Tailings Impoundment (**Figure 4**). The northern parts of the claims extend across Beartrap Creek. Lewis and Clark County records indicate the claims are owned by Mitchell and Joaquina Lovely of Helena, Montana.

The claims include small waste rock dumps located adjacent to Beartrap Creek. McClernan (1983) reported a mine named the Red Wing located on the same 40-acre parcel of ground, and it is probable that the Red Wing Mine operated on the Flosse and Louise mining claims. McClernan also reported that the Red Wing Mine has a 75 foot long adit that follows a near-vertical vein that trends southward. The vein is 2 inches to 4 feet thick and consists of crushed and sericitized diorite rock with sphalerite, galena, and pyrite. No productions statistics were available or reported (Tetra Tech EM Inc. 2007).

1.5.10 No. 3 Tunnel Area

The Anaconda Company drove a bulk sample adit (No. 3 Tunnel) for exploration of the south copper-molybdenum ore zone. Mine wastes were removed from the area in 1996. The wastes were amended with lime and placed in the Paymaster Repository along with mine wastes removed around the three lower Paymaster Mine adits.

1.5.11 Other Mines and Prospects

A number of smaller mines and prospects (some with adits that discharge water) have recently been identified in the perimeter areas of the UBMC. Some of the mine wastes and adit discharges were sampled during mine inventory activities as part of this RI in 2007 and 2008.

1.6 General Site Characteristics

1.6.1 Meteorology

Climatic conditions at the UBMC are typical of intermediate to high elevation regions of the Northern Rocky Mountains with long, cold winters and short, moderately hot summers. Based on climatic records from the National Oceanographic and Atmospheric Administration (WRCC 2011) weather station at Rogers Pass (approximately two miles north-northeast of the UBMC), average monthly minimum and maximum temperatures recorded at the Rogers Pass Station average 13.4 °F in January, and 81.5 °F in July, respectively (**Table 2**). A record cold temperature of –70 °F was recorded on January 20, 1954 (Envirocon 1993).

Average monthly precipitation for the period of record ranges from 0.65 inches in February to 3.10 inches in June. Annual precipitation for the period is 17.99 inches, with the highest annual precipitation (31.4 inches) occurring in 1975 and the lowest annual precipitation (13.9 inches) occurring in 1988. The greatest one-day storm event recorded since 1964 occurred on June 19,

1975, resulting in 2.98 inches of precipitation (Envirocon 1993) and a cross-valley embankment failure at the Mike Horse Tailing Impoundment.

Average climatic data from the Lincoln Ranger Station weather station located about 14 miles west of the UBMC are similar to that from the Rogers Pass Station. This indicates that weather patterns are relatively uniform throughout the UBMC and are reasonably well represented by the Rogers Pass data (Hydrometrics 2007).

1.6.2 Vegetation

As reported in Western Technology and Engineering, Inc., (WTE 1993a), vegetation of the UBMC is typical of the northern Rocky Mountains, although it has been modified by mining and timber harvesting. Coniferous forest, dominated primarily by lodgepole pine, spruce and Douglas fir, covers mesic slopes above drainage bottoms. Field observation noted many of the dense stands of conifers exhibit impacts due to defoliating insects and mistletoe. Standing dead timber is common on the drier south-facing slopes. Drier slopes are interspersed with communities dominated by mountain big sagebrush and fescue grassland. Several riparian/wetland vegetation communities are present along streams and the floodplain of the Blackfoot River, including plant communities dominated by coniferous or deciduous tree species (quaking aspen and cottonwood species), shrubs or herbaceous species. Additional detail on the UBMC vegetation is available in the report prepared by WTE (1993a).

1.6.3 Wildlife

The ecology of the UBMC is diverse in terms of biological species. Portions of the UBMC are located in federally-designated grizzly bear and gray wolf recovery areas and bald eagles, peregrine falcons, and whooping cranes may sometimes enter the UBMC (WTE 1993b). The Blackfoot River is considered to be a substantial fisheries resource below USFS's Aspen Grove Campground (approximately 12 miles downstream of the Blackfoot headwaters), and the Montana Department of Fish, Wildlife and Parks (FWP) considers the UBMC to include viable trout and big game habitats. Genetically pure westslope cutthroat trout were found in Anaconda Creek above the Anaconda mine site (MFG 1996a). Westslope cutthroat trout, a species of special concern in Montana, has declined over much of its historic range within the last century. Field personnel during the 2007 fall investigation for the RI also noted observing one fish in each Anaconda Creek and the upper Blackfoot River.

Bull trout is a Montana species of special concern and threatened under the Endangered Species Act. The recovery of bull trout is a fisheries priority under both State Fish Wildlife and Parks (FWP) and Federal United States Fish Wildlife Service (USFWS) programs in the Blackfoot Watershed. Bull trout inhabit approximately 125 miles of the Blackfoot River main stem. Densities of bull trout are very low in the upper Blackfoot River, but increase downstream of the North Fork at river mile 54 (Montana FWP 2005).

1.6.4 Soil

A National Resource Conservation Service (NRCS) soil survey has not been completed for the UBMC, although the USFS has completed soil surveys for portions of the Facility (MFG 1996a). Two major soil units were identified in the UBMC, including Typic Cryoboralfs and Typic Cryoboralfs-Typic Cryochrepts Complex. Both soil units consist of a mixed loamy skeletal soil with subsoil clay accumulations typically occurring 4 to 24 inches below the surface. Subsoils typically contain 40 to 60 percent angular rock fragments. The typical soil depth is approximately 40 to 60 inches over bedrock, although soil depths are variable over the UBMC. Typic Cryoboralfs are found on over 25 to 50 percent of slopes, primarily on lower and midslope

regions. The Typic Cryoboralfs-Typic Cryochrepts Complex are found on 40 to 60 percent of upper slope regions (MFG 1996a).

The Wetlands Inventory of the Upper Blackfoot Project Area, (WTE 1993a) describes the UBMC upland soils as being derived primarily from argillites, siltites and quartzites. Upland soils are medium-textured and consist of 40 to 80 percent angular rocks. Clay accumulations are common in subsoils. Drainage bottom soils are derived from stratified alluvial deposits. Soil textures are variable, and mostly range from silty loams to extremely gravelly, cobbly sandy loams.

In addition to the available UBMC soils information summarized above, ASARCO collected numerous soil samples from the UBMC as part of its reclamation planning and design activities. This sampling focused on characterization of native soils to assess their suitability for use as vegetation growth medium in mine waste covers and revegetation of mine waste removal areas. Most soils are characterized as silty to sandy loam, with abundant (up to 50 percent) coarse fragments and less than 10 percent organic matter. Extensive soil characterization work occurred in the Mike Horse, Paymaster, Anaconda, and Edith mine areas, as well as at the Meadow Creek and Bartlett Creek soil borrow areas (Hydrometrics 1995a, 1996a, 1997a, & 1998a). The annual native soil sampling programs are described in the UBMC annual data summary reports produced by ASARCO from 1993-98. Together with the general studies cited above, this data provides considerable information on UBMC area soils.

1.6.5 Demographics

The UBMC and surrounding area is sparsely populated and rural in character. According to the U.S. Census Bureau (http://factfinder.census.gov), the population density of the area is approximately one person per square mile. Based on an aerial photograph survey, one residence is located along Beartrap Creek approximately 0.6 miles upstream of the Mike Horse Tailings Impoundment, and four residences are located within two miles downstream (west) of the confluence of the Blackfoot River and Pass Creek. The closest of these residences is located along US Highway 200 approximately 0.75 miles from the Blackfoot River/Pass Creek confluence. Lincoln, Montana, located along the Blackfoot River approximately 15 miles west of the Pass Creek/Blackfoot River confluence, is the closest population center. As of the 2000 census, Lincoln had a population of 1,100 (http://factfinder.census.gov).

A search of the Montana Bureau of Mines and Geology (MBMG) Groundwater Information Center (GWIC) revealed six private drinking water wells within a one-mile radius of the approximate UBMC boundary (one-mile radius of the Mike Horse Tailings Impoundment, and one mile radius of the confluence of Blackfoot River and Pass Creek). All six wells are located west of the UBMC in Sections 18 and 19 of Township 5 North, Range 6 West, with the closest well approximately 0.75-miles from the Blackfoot River/Pass Creek confluence and north of US Highway 200.

1.6.6 Land Use

1.6.6.1 Current Land Use

Land use in the project area is National Forest, private industrial forest, mining claims, conservation land, ranching, and to a small extent, residential. Management of National Forest System lands is guided by the Helena National Forest Plan (USFS 1986). Lewis and Clark County has developed a growth plan, which includes the Lincoln Planning Area Growth Policy (Lewis and Clark County 2004). The Lincoln Planning Area Growth Policy sets guidelines for the protection of agricultural uses, rural lifestyle, and recreation. The growth policy addresses special zoning for establishment of construction practices within the special flood hazard area

and subdivision practices for Special Zoning District No. 42, both of which apply to areas within or adjoining the town of Lincoln, Montana. Neither of the special zoning items concerned the UBMC.

Lewis and Clark County Zoning Regulations were reviewed to evaluate what, if any, zoning regulations govern the Facility (Lewis and Clark County 2011). The zoning regulations did not specify any zoning requirements for the Facility or vicinity. Mr. Frank Reeves of the Lewis and Clark Planning Office was contacted on August 29, 2011 (Reeves 2011) to inquire whether there were other potential zoning requirements for the UBMC area. The project location local and general project activities for the UBMC were discussed. Mr. Reeves stated that there was no zoning for the UBMC area.

There are no developed recreational sites within the UBMC project area but dispersed recreation occurs throughout the area. Typical recreational uses may include hiking, camping, fishing, biking, motor biking, hunting, prospecting, and other similar uses. There is no known survey of actual use of the UBMC area, although long-time observations by USFS personnel indicate that facility use is largely recreational, with the highest facility use occurring in the fall during big game hunting season (Hydrometrics 2007).

US Highway 200 and the new Meadow Creek Road (constructed in 2010) provide general access to the area. The new Meadow Creek Road replaced the Mike Horse Creek Road to address safety concerns regarding poor visibility when entering on to Highway 200 from the old Mike Horse Road. Additional access is provided by local roads, USFS roads, and driveways.

The southwestern most portion of the UBMC project area contains both irrigated and non-irrigated prime farmland.

1.6.6.2 Future Land Use

Management of the National Forest will continue to be directed by the Helena National Forest Plan. Information on plans for the future in the area is contained in the Lincoln Planning Area Growth Policy (Lewis and Clark County 2004). For the UBMC, the growth plan sets forth policies to protect wildlife, recreation, and watershed values.

Land uses of private lands within the UBMC are not restricted by zoning or covenants at the present time. No significant development has occurred on private lands within the UBMC nor has any recent pattern of development evolved or become evident over time. There have been no recent building permits issued nor have any proposals for the subdivision of land been recently identified. Private lands have for the most part historically been used for mining activities, modest amounts of grazing, and recreation.

There are a large number of patented mining claims within the UBMC, most of which (41) were previously owned by ASARCO (see **Section 1.4.2**, and **Figure 3**) and are now held by the METG. Historically these patented mining claims were used exclusively for mining and mined land reclamation purposes.

In addition to patented mining claims, Asarco has historically held approximately 120 unpatented mining claims associated with a copper-molybdenum porphyry-type deposit within the UBMC. These claims are now held by the METG. It is possible that this deposit could be proposed for mining in the future, with facilities sited on either patented or unpatented ground within the UBMC.

1.6.7 Regulated Sites

Regulated facilities were reviewed (**Figure 5)** to identify existing regulatory and environmental conditions in connection with the UBMC, UBMC's individual mine sites, or other properties in the

area. Records were obtained from EPA and DEQ on-line databases. The approximate minimum search distance (MSD) for the UBMC vicinity review is noted in **Table 3**. **Table 3** also provides a summary of the records searched and facilities identified in the search.

1.6.7.1 Federal Database Information

Federal NPL and Active CERCLIS List

The Federal on-line databases searched included EPA superfund Information System, EPA EnviroFacts, EPA Institutional Controls and Federal Facilities Restoration and Reuse, and the National Response Center. Records searched for included EPA National Priorities List (NPL) sites, Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) sites, Resource Conservation and Recovery Act (RCRA) sites, EPA Toxic Release Inventory, Federal Institutional Control/Engineering Control Registry, and Emergency Response Notification System (ERNS). The databases were searched for regulated facilities within one-mile of the UBMC.

The record search indicated no Federal regulated facilities within the search distances (see **Table 3**) with the exception of one active CERCLIS site and one EPA Toxic Release facility. The active CERCLIS site identified in the search is the UBMC Facility. The Facility has EPA ID# MTD986069474 and is designated as a State-Lead Cleanup. The Toxic Release facility is the Bouma Post Yards, Inc. (EPA ID# MTD006473649) located 10 miles northeast of Lincoln, Montana and approximately 1.5 miles southwest of the intersection of Highway 200 and Highway 279.

1.6.7.2 State Database Information

State regulated facility information was obtained through the DEQ's Natural Resource Inventory System (NRIS). NRIS was used to search several DEQ database lists including (see **Table 3**): Remediation Response Sites, CECRA, Response Action, Controlled Allocation of Liability Act (CALA), Voluntary Cleanup and Redevelopment Act (VCRA), Brownfield, Water Quality Act (WQA), landfills, leaky underground storage tanks (LUST), underground storage tanks (USTs), and abandoned mine sites. The databases were searched for facilities within ½-mile of the UBMC.

The record search indicated regulatory facilities for three of the databases searched. The results are presented in the following sections.

Montana CECRA Listings

DEQ administers CECRA, which is the state equivalent to the EPA Superfund program. A review of state databases indicated that the UBMC Facility is an actively managed (high priority) CECRA facility.

Montana VCRA List (MSD = ½ mile)

DEQ administers the VCRA program for properties that are investigated and remediated under VCRA. The Paymaster Mine and No. 3 Tunnel of the UBMC are listed in the VCRA registry. However, the DEQ voided the Voluntary Cleanup Plan (VCP) in 2002 due to ASARCO's noncompliance with VCRA requirements.

Montana Abandoned Mines

The Montana Abandoned Mines database on NRIS listed the following mines within one-mile of the Facility. All of the mines were listed as being within the Heddleston Mining District and in the Blackfoot River Headwaters watershed. The names listed below are as depicted on the NRIS database search results. Most of these mines are within the UBMC.

- Blackfoot Belle
- Carbonate Heddleston District
- Carbonate Mine
- Daylight Lewis and Clark County
- Edith
- Mary P
- Mike Horse
- Paymaster Lewis and Clark County
- Upper Blackfoot Mines

1.6.7.3 Other Information

One site not listed in the State of Montana database information is the petroleum hydrocarbon release and activities at the Mike Horse Mine. The investigation and remediation of this release was performed by ASARCO in the 1990s. Remediation activities included the removal and off-site disposal of petroleum hydrocarbon-impacted soil and removal of a 1,000 gallon tank used for the storage of fuel (Hydrometrics 1997a).

Private and Commercial Water Supply Wells

Seventeen private or commercial water supply wells are listed on the MBMG, GWIC database in the vicinity of the Facility. These are located in Sections 18 and 19, Township 15 North, Range 6 West and Sections 23, 24, 26, 27, and 34, Township 15 North, Range 7 west. For these wells, the database indicated that static water levels ranged from 1.5 to 75 feet in depth and had a maximum yield of 6 to 150 gpm. The approximate location of these water supply wells is shown on **Figure 5.** A summary of the GWIC database information for each of the 17 wells appears in **Table 4**.

1.6.8 Current and Historical Aerial Photographs

Tetra Tech reviewed several current and historical aerial photographs showing the Facility. **Appendix A** provides copies of these aerial photographs showing principal mine sites and features. The following table provides a summary describing the aerial photographs.

REVIEW OF CURRENT AND HISTORICAL AERIAL PHOTOGRAPHS	
Photograph Year	**Description**
1938	Mike Horse Creek Road is present. Some of the hill sides are heavily vegetated with timber while others have more sparse timber, leaving large light-colored areas of the photograph. The photograph shows disturbance in the Mike Horse Mine, Anaconda Mine, and Shave Gulch and Midnight Hill areas. There appears to be two to three waste areas in the Anaconda Mine area, and a least one in the upper Mike Horse Mine area with additional disturbance in the area of the present-day repository and treatment cells. There are several waste areas obvious on Midnight Hill and at least one waste pile at the Consolation Mine. From the photograph, it is unclear whether mining had begun in the Capital Mine, Flossie-Louise, and Mary P Mine areas. Beartrap Creek appears to be free flowing to Mike Horse Creek. The tailings dam does not appear to have been constructed yet. It is unclear from the photograph whether the Mike Horse town site is in use.

REVIEW OF CURRENT AND HISTORICAL AERIAL PHOTOGRAPHS	
Photograph Year	**Description**
1961	Many roads have been cut on the hillsides surrounding Mike Horse Mine. Some of the areas with more sparse trees in the 1938 aerial photograph have now filled in and have moderate to dense cover. Several large waste areas appear in the Mike Horse Mine area and at least three waste areas are present at the Anaconda Mine area. The Flossie-Louise and Capital mines appear to have at least one waste pile. The photograph appears to also show disturbance at the Mary P and on the hillside north of Mary P there appears to be at least two small possible mine waste piles. The Mike Horse tailings impoundment is in place and has dammed water of Beartrap Creek. It is possible here may be some structures at the Mike Horse Mine town site.
1966	The 1966 aerial photograph shows an increase in road construction throughout the area west and northwest of Mike Horse Mine and also along and near Beartrap Creek above the tailings impoundment. Most of the roads appear to lead to drill or exploration pads. There are several mine waste areas in the Mike Horse Mine area and the Mike Horse tailings impoundment is in place. Structures are present at the Mike Horse Mine town site.
1975	The figure shows an oblique view of the 1975 breech of the Mike Horse Tailings Impoundment.
1979	The aerial photograph shows abundant disturbance on the hillsides west of Mike Horse Mine and in the Midnight Hill area. There are many roads that lead to likely drill pads or exploration areas. Three to five waste piles are present in the Anaconda Mine area and several in the Mike Horse Mine area. Several disturbed areas appear within Shave Gulch. Possible waste piles appear in the Edith Mine area. The Mary P Mine and Flossie-Louise Mine waste piles appear to be present. The Mike Horse tailings impoundment is still present. Heavy disturbance appears in the No. 3 Tunnel exploration area. Tailings from the 1975 tailings dam breech are present along the lower portion of Beartrap Creek and Blackfoot River. The Mike Horse town site does not appear to have any structures.
1995	Many of the roads and drill/exploration pads in the 1979 aerial photograph now have vegetation, likely trees and shrubs growing where the roads are/were. Five mine waste areas appear in the Anaconda Mine area and several in the Mike Horse Mine area. The tailings impoundment is still present and mine waste flood deposits are obvious along lower Beartrap Creek and the Blackfoot River. Three mine waste piles are present on Midnight Hill in Shave Gulch and the Consolation Mine appears to have two waste piles. The Mary P waste pile and two on the hillside north of the Blackfoot River are present and the waste areas at/near Edith Mine appear to also be present. No. 3 Tunnel area appears to still have disturbance near the tunnel. It appears that construction activities may possibly have commenced for the Anaconda Constructed Wetlands and the repository at the Mike Horse Mine.
2005	The aerial photograph shows several mine waste areas in the Mike Horse Mine area. The waste areas in the Anaconda Mine, Consolation Mine, and Edith Mine areas appear to have vegetation. The Carbonate Mine waste area and the Carbonate and Paymaster repositories have vegetation. The three Paymaster mine waste areas are visible in the aerial photograph. Most of the former exploration roads are now overgrown with vegetation, likely trees and brush. The Anaconda Constructed Wetlands are present as well as the treatment and sludge pond constructed on the Mike Horse repository. The Mike Horse tailings impoundment is still present and damming Beartrap Creek.
2007	The aerial shows the current conditions of the UBMC with the exception of recent changes to the wetlands-based water treatment system conversion to a ceramic microfiltration water treatment system.

1.7 Regional and Site Geology

1.7.1 Regional Geology

In the area between Rogers Pass on the continental divide and the town of Lincoln, the Blackfoot River flows westward in a narrow valley parallel to US Highway 200. Along this stretch, the river has down-cut through a series of resistant bedrock ridges consisting of folded and thrust-faulted red, green and gray sedimentary mudstone units of the Precambrian Belt Formation. These units crop out in a geologic province called the southern Montana Overthrust Belt. The bedrock geologic units of the overthrust belt consist of a series of thick slabs of crustal rocks that have been sheared along low angle fault planes (thrust-faults) that moved the

stacked (imbricated) slabs eastward over underlying rocks during the formation of the Rocky Mountains approximately 65 million years ago (Alt and Hyndman 1986).

In the Rogers Pass area, these Precambrian sedimentary units are cross-cut by granite-like (quartz-monzonitic) intrusives that are several miles in diameter and approximately 35 million years old. A number of these intrusive bodies are associated with metallic ore deposits. The Heddleston District, where the UBMC is located, is associated with one of these intrusive stocks. Mineralization in the Heddleston District occurs as two distinct types of deposits including:

- a number of structurally controlled high-grade, lead-zinc–silver-bearing vein-type mineralized fault and fracture structures that were mined from the turn of the century until the early 1950's; and
- a large tonnage, lower-grade disseminated intrusive hosted (porphyry) deposit of copper-molybdenum mineralization that was never developed or brought into production.

The largest and most prominent mine in the Heddleston District was the Mike Horse Mine which occurred as vein-type mineralization associated with the Mike Horse Fault zone (McClernan 1983).

1.7.2 Site Geology

The geology of the UBMC is characterized by various bedrock units, with unconsolidated materials restricted to relatively thin accumulations of alluvium along drainage bottoms. Numerous reports have been published on the local and regional geology, including Miller, et al (1973), McClave (1998), Pardee and Schrader (1933), Krohn and Weist (1977), and McClernan (1983). The following is a summary of the geology of the UBMC.

1.7.2.1 Unconsolidated Surficial Units

The Blackfoot River valley from the headwaters area near Rogers Pass eastward was occupied by a valley glacier during the last ice age. During still stands of the glacial front, a number of end moraines of glacial debris with associated outwash plains were deposited. The glacial end moraines form where the glacial front stands in one place, with glacial advances balanced by melting of the glacial front, such that the movement of the glacier acts like a conveyor belt moving debris to the front of the glacier. End moraine deposits take the form of sinuous cross-cutting ridges that cross the valley floor and are comprised of a very poorly-sorted mixture of boulders, gravel, sand, silt, and clay. These glacially deposited features result in a poorly-drained, hummocky, terrain of merged ridges alternating with intervening hollows or swales. In the Blackfoot River valley, glacial moraines locally act as dams with wetlands, marshes, and small lakes developed on the eastern, upstream side of the moraines. Outwash plains result from large flows of glacial melt water along the front of the glacier that tend to rework and redistribute previously deposited glacial valley floor sediments (ground moraines) out in front of the end moraines as large low angle fan or apron-like alluvial deposits that cover much of the valley floor (Alt and Hyndman 1986).

Unconsolidated deposits within the Blackfoot drainage of the UBMC consist of glacial end moraines and stream-reworked outwash materials in the valley bottoms, and colluvial slope-wash sediments on slopes transitional between ridge crests and valley bottoms. Alluvial sediments have been contaminated with mine wastes ranging from rather thick deposits of mine tailings with lateral and vertical continuity in the upper end of the drainage below the Mike Horse tailings dam, to inter-bedded alluvial and tailings deposits, to thinner over-bank deposits in downstream and marsh locations. Ridge crests and upper flanks of ridges tend to be covered with residual, weathered-in place soils.

Alluvial material thicknesses in groundwater monitoring wells in the UBMC range from 8 to 30 feet thick, and average about 18 feet. The shallower alluvial deposits occur at the upstream end of the valley near the Mike Horse Mine, and the thicker deposits occur near tributary stream junctions along the Blackfoot River. Unconsolidated material thickness in groundwater monitoring wells in the vicinity of the marshes and confluences of Porcupine and Meadow Creeks range from 22 to 42.5 feet thick, and average about 29 feet.

Bedrock Geologic Units

Three general bedrock units are found at the UBMC, including the Belt Series Spokane Formation, a diorite sill, and a series of Tertiary-age igneous intrusive bodies (**Figure 6**). The Precambrian Spokane Formation includes massive, light to dark gray quartzite and argillite at the bottom, grading upward to maroon to green argillite at the top (Miller 1973). The bedding planes dip from 5^0 to 30^0 north. The Spokane Formation is generally devoid of mineralization, except along margins of mineralized veins intruded into fractures within the argillite.

The Spokane metasedimentary rocks are intruded by a flat-lying, diorite (gabbro) sill of Proterozoic age (McClave 1998). The sill is tabular in form and cuts across bedding planes of the Spokane Formation at a slight angle. The sill is well exposed in the northern two thirds of the area (upper Anaconda Creek and Shave Gulch drainages) where it reaches a thickness of 500 feet, but occurs primarily in the subsurface to the south (upper Mike Horse, Stevens, and Paymaster Creek drainages) where the thickness decreases to 200 feet due to vertical displacement by faulting. The top of the sill dips gently northward and strikes southwest-northeast. The diorite sill contains abundant chalcopyrite (copper-iron sulfide) and pyrite (iron sulfide), with the highest copper concentrations in soils within the Heddleston District occurring above sub-crops of the diorite as opposed to above mineralized veins or ore zones (McClave 1998).

A number of igneous intrusive stocks were emplaced within the older Spokane argillite and diorite sill in the central portion of the District (**Figure 6**). The igneous complex is quartz monzonite porphyry of Tertiary age. The quartz monzonite also forms linear dikes extending radially outward from the central stock, where molten rock intruded along faults and fracture zones within the country rock. Heat associated with the quartz porphyry at the time of emplacement caused hydrothermal solution to circulate through the country rock, producing the Heddleston District mineralization. The radial dikes extending outward from the central stock produced the mineralized veins first targeted for development in the district, including those at the Mike Horse, Anaconda, Paymaster, Carbonate, and other individual mines, while low grade, disseminated mineralization formed within the intrusive stock itself. Both the mineralized veins and zone of disseminated mineralization extend from south to north across the Blackfoot River drainage bottom (**Figure 6**) (McClernan 1983).

Structure

Two principal fault systems have been identified at the UBMC including the Mike Horse fault system and the Blackfoot fault system (**Figure 6**). Both systems trend northwest-southeast, and predate emplacement of the porphyry intrusive. The Mike Horse fault system is the southern-most of the two, and extends from east of Mike Horse Creek drainage, westward through Paymaster Creek drainage. The mineralized veins exploited at the Mike Horse occur within subsidiary faults associated with the Mike Horse fault system. The second fault system (the Blackfoot Fault) is located approximately 4,000 feet to the north and trends subparallel to the Blackfoot River drainage bottom (**Figure 6**). Both of these fault systems exhibit vertical displacements on the order of 400 feet (Miller 1973). Numerous smaller northwest-trending structures occur within the UBMC, as well as older northeast trending structures. These structures control the localization of vein-type mineral emplacement, at several of the historic

mines at the UBMC, including the Mike Horse, Anaconda, Paymaster and Carbonate (Pardee & Schrader 1933).

Mineralization

Multiple episodes of bedrock mineralization/alteration have occurred at the UBMC, with all mineralization related to the Tertiary-age intrusive complex. Early mineralization includes a network of base and precious metal veins (characterized as quartz/pyrite/chalcopyrite veins), occurring within the porphyry intrusive body and extending radially outward. These radial veins, which are typically fault controlled with considerable bedrock fracturing along vein margins, were the targets of early mine development in the district. Examples include the northwest-southeast trending Mike Horse, Intermediate, and Little Nell veins, which were the targets of underground development at the Mike Horse Mine. All three vein structures dip steeply (approximately 75^0) south (McClernan 1983). Pardee and Schrader (1933) report that mineralized veins at the Mike Horse Mine average five feet in thickness.

Imprinted upon this fault-controlled vein mineralization and surrounding bedrock are localized, disseminated deposits of supergene enriched copper-molybdenum mineralization (the copper-molybdenum ore zones). Two distinct copper-molybdenum ore bodies have been identified within the UBMC, including the “Number 3 Tunnel Ore Zone” located south of the Blackfoot River, and the “North Ore Zone” located north of the river (**Figure 6**). These two ore zones were the focus of an extensive mineral exploration program conducted by the Anaconda Company in the 1960s. A third ore zone has been identified a couple of miles south of the UBMC in Sandbar Creek drainage (McClave 1998).

Area Seismicity

The Intermountain Seismic Belt extends through western Montana, from the Flathead Lake region in the northwest corner of Montana to the Yellowstone National Park region where the borders of Montana, Idaho, and Wyoming meet. The Intermountain Seismic Belt continues southward through Yellowstone Park, along the Idaho-Wyoming border, through Utah, and into southern Nevada. In western Montana, the Intermountain Seismic Belt is up to 100 km wide. A branch of the Intermountain Seismic Belt extends west from the northwest corner of Yellowstone Park, through southwestern Montana, into central Idaho. This branch includes at least eight major, active faults and has been the site of the two largest known earthquakes in the northern Rocky Mountains, the August 18, 1959 Hebgen Lake, Montana, earthquake (magnitude 7.5), and the October 28, 1983 Borah Peak, Idaho, earthquake (magnitude 7.3). According to data available through MBMG, small earthquakes are common in the region, occurring at an average rate of 7 to 10 earthquakes per day (http://mbmgquake.mtech.edu/montanaseismicity.html).

No work has been undertaken to establish recent movement of fault structures in the UBMC. Although, many of the high-angle faults shown on the UBMC geologic map (**Figure 6**) could be considered geologically active, most probably have very long recurrence intervals where the return period of seismic activity is on the order of thousands of years.

Based on information from the United States Geological Survey (USGS) earthquake database website (USGS 2007), approximately 116 earthquakes with a magnitude greater than 2.0 have occurred within a radius of 62 miles (100 km) of the UBMC between 1872 and 2007 (as of 10/29/07). Earthquake epicenters ranged in distance from 26 to 159 miles (16 to 99 kilometers) of the UMBC, with magnitudes from 2.0 to 6.25. From 1872 to 1972 the USGS kept records of only the largest earthquakes using various means of detection and estimates of magnitude. There were 19 earthquakes occurring within 38 to 159 miles (24 to 99 kilometers) of the UBMC with magnitudes ranging from 4.2 to 6.25 (average 5.0). The largest magnitude earthquake

occurred 52 kilometers from the UBMC. Since 1972, the USGS has had better methods of detection and means of recording earthquakes. Ninety-seven earthquakes occurred within a 100 kilometer radius (16 to 99 km) of the UBMC ranging from 2.0 to 4.9 in magnitude (average 3.3). The closest recorded earthquake event was magnitude 3.4, about 16 kilometers from the UBMC. The waste rock repository facilities and the Mike Horse Tailings Impoundment embankment are the only mine facilities on the UBMC that could be significantly affected by seismic events.

The Uniform Building Code foundation materials standards and USGS earthquake record data were used to assess seismic risk to the Mike Horse tailing dam facility. A seismic coefficient of 0.15g (g=acceleration of gravity) was used based on the geotechnical report on the stability of the structure conducted by Dames and Moore (1975) that is summarized in the Data Summary Report (Tetra Tech 2007a). Earthquakes with a return-period of 50 years and 200-year period were assessed. The maximum credible earthquake used for the evaluation was a magnitude 6.0 occurring at distances of about 50 kilometers from the site. The probability of earthquakes occurring that have magnitudes capable of causing potential damage to the Mike Horse tailings facility are on the order of 2 percent for the 50 year and 11 percent for the 200-year return period. The Mike Horse tailings facility was drained of water late in the 2007 field season and is scheduled for removal during 2014-2015 construction seasons. There are no other facilities in the UBMC area that are likely to be significantly damaged by earthquakes with major impacts to resources.

1.8 Site Hydrology, Streambed Sediment, and Hydrogeology

1.8.1 Surface Water

The drainage network in the UBMC is characterized by a dendritic pattern. Stream flow originates as snowmelt and as periodic rain events along steep upland slopes. Infiltration from these events provides base flow to streams throughout the remainder of the year. The major tributary streams in the UBMC include, from upstream to downstream, Beartrap Creek, Mike Horse Creek, Anaconda Creek, the Blackfoot River, Stevens Gulch, Shave (or Shaue) Creek, Paymaster Creek, Pass Creek, and Swamp Gulch (**Figures 1** and **2**). The Blackfoot River is formed by the confluence of Beartrap Creek and Anaconda Creek. Numerous tributaries of lesser significance join the Blackfoot River downstream of Swamp Gulch (**Figure 2**). Other significant surface water features include the Mike Horse Tailings Impoundment on Beartrap Creek (**Figures 1** and **Figure 2**) and a large marsh system, which begins near the confluence of the Blackfoot River and Pass Creek and extends several miles downstream. Physical and hydrologic characteristics for the streams listed above are shown in **Table 5**.

A floodplain analysis of the UBMC was completed as part of ASARCO's and ARCO's early site characterization program (Envirocon 1993). The study included stream cross-section surveys and bankfull width/elevation determinations at various locations on the Blackfoot River and tributaries. Peak flows at each point resulting from the 100-year storm event were also calculated using TR20 hydrologic modeling software. Bankfull elevations and peak flows from this study are included in **Table 5**.

The Mike Horse Tailings Impoundment is a 160 acre-feet capacity reservoir impounded by the Mike Horse Tailings Dam on Beartrap Creek and has been in existence since 1941. During normal flow periods on Beartrap Creek, water accumulates in the reservoir and is released as seepage through the earthen dam. During high stream flows resulting primarily from spring runoff and/or high-intensity spring storms (including rain on snow events), and during high standing levels of water in the impoundment (greater than 69 acre-feet) reservoir water

discharges through an emergency overflow spillway pipe to Beartrap Creek via lower Mike Horse Creek (Hydrometrics 2007).

Beneficial Use

All surface waters within the UBMC are classified as B-1 waters (ARM 17.30.607) with the following identified beneficial uses (DEQ 2003):

- Growth and propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers;
- Contact recreation;
- Agriculture water supply;
- Industry water supply; and,
- Drinking, culinary, and food purposes after conventional treatment.

The Blackfoot River (above Landers Fork), Beartrap Creek, and Mike Horse Creek are listed on Montana DEQ's 303(d) list as having impaired beneficial uses for aquatic life, cold water fish, and drinking water supply. Beneficial uses are identified as impaired due to the following pollutants of concern for the Blackfoot River and Beartrap Creek: cadmium, copper, iron, lead, manganese, and zinc; with the addition of aluminum for Mike Horse Creek. These pollutants are released from areas of historic mine activities and may also in part be related to natural background conditions.

DEQ's NRIS database was searched for water rights information. Within the UBMC, 13 surface water right diversions are on file with priority dates ranging from 1892 to 1963 (**Table 6**). The purpose listed for all 13 rights is "mining." Eleven of the water rights were owned by ASARCO and are now owned by the METG, one by a private individual, and one by the USFS (for Mike Horse Dam).

1.8.2 Streambed Sediment

Sampling and analysis of streambed sediments at the UBMC has been conducted at irregular intervals over the past 15 years or more to achieve various objectives. A summary of these sampling events and their results is provided in the DSR. Analytical data for the samples are provided in appendices of that report. Streambed sediment samples were typically analyzed for total acid soluble metal concentrations; however, a limited number of samples were analyzed for additional constituents such as cyanide and total organic carbon. As discussed in the DSR, sediment data are difficult to compare between researchers because of differences in sampling techniques and temporal changes in sediment transport and deposition. For example, some researchers analyzed the sub-63 um fraction of soils, which tends to have considerably greater metal concentrations compared to bulk or sub-2 mm size fractions of the same material.

Tetra Tech reviewed historic sediment information for sampling and analyses by tributary. In many cases the source of the data or sample locations were "unknown" because: 1) while most sediment sample locations are reported in the DSR, lab reports and/or original documentation for the data are not available to cross reference to determine whether samples were collected from multiple depth increments at a given location; 2) multiple researchers collected samples from identical locations yet used different location numbers in their sample identifications, and 3) some original reports are not available or, if they were available, did not contain data to determine the exact locations from which some samples were collected or to confirm sample numbers.

A portion of the analytical data indicated to be total metal concentrations (typically reported in units of mass of metal per mass of solid) in the DSR have units of milligrams per liter in the analytical laboratory reports. It is unclear whether a typographical error exists on the laboratory reports or whether the data actually represent a type of metal mobility analysis.

Data for historic sediment samples show that metal concentrations are generally highest (up to 10 to 1,000 times greater) in upstream areas of the UBMC, near the historic mine facilities compared to downstream sediments or tributaries. Maximum sediment concentrations were observed in Mike Horse Creek, Beartrap Creek (downstream of the confluence with Mike Horse Creek), and the upper portion of the Blackfoot River (upstream of the first Upper Marsh). Elevated metals were not found in sediments from Anaconda Creek and Pass Creek.

The historic results indicate that concentrations of some metals (i.e. iron, nickel, and zinc) in these sediments have decreased with time; however, no clear temporal trends exist in the dataset as a whole (Menges, 1997 and Nagorski, et al. 2000).

1.8.3 Groundwater

Groundwater in the UBMC has been studied in areas of known mining impacts, and predominantly along the stream valley bottoms. A combination of narrow valleys limiting well placement for triangulation and the completion of wells in both bedrock and alluvium greatly limits the ability to produce a potentiometric surface map for the UBMC. However, a potentiometric surface map has been prepared for the Upper Marsh area and is discussed later in this document (Section 4.6). The general pattern of groundwater flow is from higher elevation areas, where bedrock groundwater is recharged by snowmelt and spring storm events, towards the local drainage bottoms then along the axis of the drainage. Hydrogeology and groundwater quality are variable and appear to be site specific or locally controlled in many areas of the UBMC. Groundwater occurs within fractured metasediments, igneous bedrock units, and within unconsolidated alluvium in drainage bottoms. Bedrock groundwater discharges to local stream drainages, recharging the alluvial groundwater system and ultimately sustaining base flow in local streams during periods of low precipitation. The recharge area of the UBMC watershed is relatively small, due to topography and proximity to the Continental Divide and; therefore, annual precipitation amounts and timing significantly influence base flows in area streams.

Based on invariably low yields (a few gpm or less) from bedrock monitoring wells at the UBMC, bedrock permeability is considered to be low with groundwater flow occurring predominantly through secondary fractures, joints, and fault zones. This conclusion is supported by relatively low base flow discharge (typically 22 to 50 gpm (CDM 2008)) from the Mike Horse Mine adit despite workings that include more than 30,000 lineal feet of tunnels, drifts, raises, and winzes (MSE 1997). Alluvium has a much higher permeability than bedrock due to the predominance of gravel and cobbles in the larger UBMC drainages (Beartrap Creek, Anaconda Creek, and the upper Blackfoot River).

Beneficial Use

Fifteen groundwater rights are on record within the UBMC study area (**Table 7**) (DNRC, 2011). All are located downstream of the Upper Marsh. Given their physical location along tributaries to the Blackfoot River, it is unlikely that four of the fifteen groundwater rights (WR#'s 91569-00, 127775, 52005-00, and 116746-00) receive water from the Blackfoot River valley fill deposits. It is unclear if the remaining eleven groundwater rights have the potential to receive water from Blackfoot River valley fill deposits. The nearest groundwater right listing to the UBMC is within Porcupine Gulch on the southern side of the Blackfoot River and downstream of Swamp Gulch. The location is hydraulically upgradient of the Porcupine Gulch and Blackfoot River confluence. The Porcupine Gulch groundwater right is owned by the USFS and designated for institutional

use. The two nearest groundwater rights potentially hydraulically connected to the Blackfoot River and downgradient of the Upper Marsh are located near the mouth of Surveyors Gulch, (WR #76F42722-00) and (WR# 76F30044741). Both are and designated for domestic use.

A total of 55 wells are on record with the State of Montana in the UBMC study area (GWIC 2011 & DNRC 2011). Thirty two of them are monitoring wells on record within the Facility and the remaining 23 wells (**Table 7**) are all within a half mile radius of the Facility downstream of the Upper Marsh area. These wells are listed with a variety of purpose including domestic, institutional, commercial, mining, irrigation, and stock use.

Because there is limited historical groundwater data at the UBMC, the groundwater was not classified until the 2008 RI field investigation. Data necessary to classify the groundwater was obtained during the RI by drilling a number of additional groundwater monitoring wells and periodic sampling of these wells. In accordance with ARM 17.30.1005, groundwater is classified I through IV based on its beneficial uses, and groundwater is to be classified according to actual quality or use, whichever places the groundwater in a higher class. ARM 17.30.1006 sets the standards for groundwater based upon its specific conductance. A review of both field and laboratory specific conductance data for the period of 2007 and 2008 indicates all sampled groundwater within the project area is classified as Class I groundwater with the exception of two specific areas. The upper Mike Horse waste pile area and the Carbonate mine area both exhibited Class II groundwater characteristics based on specific conductance.

2.0 SUMMARY OF HISTORICAL RECLAMATION ACTIVITIES

In 1993, ASARCO and ARCO began a reclamation program to address environmental impacts from historic mining activities at the UBMC. These activities were conducted without DEQ approval and some of the work may not meet the CECRA clean-up criteria in § 75-10-721, Montana Code Annotated (MCA).

Accumulations of mine waste, including mine waste rock and tailings from historic mining activities, were identified in portions of the UBMC. Several mine waste piles were located in drainage bottoms resulting in potential metals leaching to surface water. Beginning in 1993, mine waste piles associated with the Carbonate, Anaconda, Edith, and Paymaster mines were removed and placed in engineered repositories (**Figure 7**) to limit potential leaching and subsequent mobilization of metals to waters of the State. In all, approximately 100,000 yd^3 of mine waste were either removed from drainage bottoms and isolated in three on-site engineered repositories, or reclaimed in place. In addition to mine waste removal, ASARCO and ARCO constructed a passive water treatment system in 1996 to treat drainage from the Mike Horse adit as well as the combined discharges from an adit and shaft at the Anaconda Mine.

2.1 Previous Interim Actions (1993-1998)

The following is a site-by-site review of reclamation activities completed by ASARCO and ARCO as part of the UBMC reclamation program. DEQ provided review and comment on the project work plans and reports but did not approve any of the work. Reclamation activities were also coordinated with several other land management and regulatory agencies through project review and/or permitting. The USFS provided review of remedial design plans and approval of a Plan of Operations to allow access to National Forest System lands during reclamation activities. Environmental and/or construction permits also were obtained from the U.S. Army Corps of Engineers (Section 404 permits), the Lewis and Clark County Conservation District (Section 310 permits), and DEQ (MPDES permits, Section 3A permits and storm water discharge permits).

Figure 1 provides a site map showing the location of each mine area. The following is a site-by-site chronology of reclamation activities completed between 1993 and 1998.

2.1.1 Anaconda Mine

The Anaconda Mine is located at the headwaters of the Blackfoot River adjacent to the confluence of Anaconda Creek and Beartrap Creek. Approximately 38,800 yd^3 of mine waste was removed from the Anaconda Mine in 1994 and 1995 and placed in the Mike Horse Repository (Hydrometrics 1995a, Hydrometrics 1996b). Most of the removed mine waste was originally located on the floodplain of the Blackfoot River resulting in potential leaching of metals, and erosion and subsequent transport of mine waste to the river (Hydrometrics 1995a).

Two additional mine waste dumps located on a hillside adjacent to the Anaconda Mine were also reclaimed in 1995. The largest of the dumps was removed and placed in the Mike Horse repository. Because of its distance from any surface water drainage, the other dump was reclaimed in-place, by amending with cement kiln dust, re-grading, covering with growth medium, and applying a seed/mulch mixture (Hydrometrics 1996b). **Table 8** shows water quality improvements in the upper Blackfoot River, due in part to the Anaconda Mine reclamation.

In addition, the following remediation features were constructed: a concrete/bentonite plug was placed in the collar of the Anaconda shaft, and a permanent vehicle stream-crossing was constructed at the site, as were surface water run-on control ditches with rip-rap, and fencing (Hydrometrics 1996b).

In 1995 and 1996, a passive wetlands-based water treatment system was built at the former location of the Anaconda mine waste adjacent to the Blackfoot River and just downstream from the confluence of Anaconda Creek and Beartrap Creek. A portal-plug with piping and controls was installed in the Anaconda adit, with the water discharge directed to the water treatment system (Hydrometrics 1996b; Hydrometrics 1997a). This system was replaced in 2009 by a new microfiltration water treatment plant. The new plant's location is where the old system's Cell 6 was once located. The new system integrated the old system's Cell 4 and Cell 5 to serve as emergency retention basins for the new plant (CDM 2008).

2.1.2 Carbonate Mine

Voluntary cleanup at the Carbonate Mine (**Figures 1 and 7**) began the summer of 1993 and was completed in 1994. Unless noted, the following information was taken from the Activities Reports for 1993 and 1994 (Hydrometrics 1994 and 1995a) and the Identification of Remedial Action and Work Plan for Implementation of Remedial Action (MFG 1993a).

The following construction work was completed during 1993 and 1994a:

- 43 and ¾ yd3 of concrete were poured into and on top of an open mine shaft at the Carbonate Mine (Hydrometrics 1994).
- A surface water diversion ditch lined with rip rap was installed above the repository location.
- Approximately 15,400 yd3 of waste rock and tailings were removed from Swamp Gulch drainage (lower Carbonate mine area) and placed in a repository constructed at the upper Carbonate (material was compacted with a sheep's foot roller).
- Quicklime (1,500 tons) was added to the mine waste deposited at the upper Carbonate repository (Hydrometrics 1994).
- The repository slope was covered with a 6-inch layer of drainage gravel (except for the north slope) overlain by 12 to 18 inches of cover soil. The north slope received a 12-inch cover soil only.
- The flat portion of the repository was covered with gravel, a geosynthetic clay liner, and cover soil. The thicknesses of these materials are unknown.
- Contaminated water from the pond created when the lower Carbonate Mine waste was removed was pumped to the repository and fill material was placed in the excavated hole. The Work Plan specified that a 2-inch layer of crushed limestone would be placed over the fill material to minimize acid generation potential.
- The former tailings impoundment area was backfilled with borrow gravel and cover soil (13 to 17 inches deep), and the area graded to establish a wetland and meadow within Swamp Gulch drainage.
- The repository, wetlands, and other disturbed areas were revegetated.
- Groundwater monitoring wells were installed at the repository and in and around the Swamp Gulch removal area. Analytical results from groundwater sampled during the 1990s indicated poor water quality for groundwater upgradient, within, and downgradient of the repository/removal area. Results indicated low pH values in several wells as well as exceedences of DEQ water quality standards for cadmium, copper, iron, manganese, lead, and zinc. Comparison of the results between 1990s sampling events and the RI sampling events revealed relatively no improvement in water quality during this post-reclamation era (see the DSR (Tetra Tech 2007a) for specific analytical results).

- Final grading was completed and storm water control ditches and structures were constructed.

In 1995, the Carbonate Mine repository cap cover was compromised due to erosion. Consequently, the growth medium soil was replaced, an erosion mat placed over the eroded surface, and the area seeded and mulched during the 1995 construction season (Hydrometrics 1996b).

Surface water quality in Swamp Gulch, a perennial tributary to the Blackfoot River draining the Carbonate Mine area, has improved significantly as a result of the Carbonate Mine reclamation (**Table 9**) (see Data Summary Reports by Hydrometrics 1995a, 1996a, 1997b, 1998a).

2.1.3 Edith Mine

The Edith Mine is located along the Blackfoot River near its confluence with Shave Gulch (**Figures 1 and 7**). Approximately 5,000 yd^3 of mine waste were removed from the Edith Mine area in 1995 from several waste piles/waste areas and placed in the Mike Horse Repository (Hydrometrics 1996b). Mine waste removal areas were amended with lime-bearing material to neutralize soil acidity, and the area was seeded to promote vegetation establishment.

2.1.4 Mike Horse Mine Wastes and Repository

Reclamation activities completed at the Mike Horse Mine include excavation of mine waste and construction of a repository at the lower Mike Horse Mine in 1995 and 1996, and in-place reclamation of approximately five acres of disturbed land at the upper Mike Horse Mine in 1998 (Hydrometrics 1997b, 1998b) (**Figures 1** and **7**). The Mike Horse Repository is adjacent to the mine and was built to accommodate mine waste mainly from the Anaconda and Edith Mines, as well as a relatively small volume of mine waste from the lower Mike Horse Mine.

Construction of the Mike Horse Repository included a subsurface shallow groundwater collection and drainage system to maintain groundwater levels below the repository base, a limestone gravel drainage layer beneath the repository, amendment of the upper 18 inches of mine waste in the repository to limit long-term acid generation, a 12-inch growth medium layer on the repository slopes with vegetative cover, and a geosynthetic clay liner on the upper, flat repository crest (Hydrometrics 1995a). Approximately 45,000 yd^3 of mine waste from the Mike Horse, Anaconda, and Edith mines were placed in the Mike Horse Repository (Hydrometrics 1996b). In addition, a sludge drying bed for the pretreatment pond sediment was constructed on the top of the repository (Hydrometrics 1996b). An as-built drawing is included in the 1995 Activities Report (Hydrometrics 1996b).

Land disturbance at the upper Mike Horse Mine consisted of waste rock piles spread over steep hillsides. Reclamation included consolidation and re-grading of mine waste to minimize surface area and limit infiltration, incorporating amendments into the mine waste to raise pH and limit the solubility of metals, placement of local borrow soil over the mine waste, construction of ditches and berms to divert storm water runoff around mine waste areas, and seeding of all disturbed areas. Re-grading of the mine waste piles and establishment of a vegetative cover was intended to reduce infiltration of rainfall and snowmelt water, and erosion of mine waste, thus improving water quality in adjacent Mike Horse Creek (Hydrometrics 1998c and MSU-RRU 1998). The RI field investigations in 2007 and 2008 determined that the revegetation at the reclaimed Mike Horse waste rock-pile sites has not been re-established to desired conditions. Species present in the reclamation areas appear to be limited in diversity, are not robust, and some portions of these areas are essentially denuded. As a result of these observations, samples were collected in 2007 from the waste rock pile reclamation surfaces to determine the reasons for the poor revegetation response. This initial round of sampling identified additional

data gaps for 2008 sampling efforts that examine revegetation success (density and diversity), and soil characteristics such as acidity, and nutrient and organic carbon content.

2.1.5 Mike Horse Mine Hydrocarbon-Contaminated Soil Removal

Additional reclamation activities at the Mike Horse Mine included removal and off-site disposal of hydrocarbon contaminated soil, removal of a 1,000 gallon tank, removal of waste rock and debris from Mike Horse Creek, reconstruction of the Mike Horse Creek channel through the reclaimed area, construction of a surface water diversion system to divert Mike Horse Creek water around the disturbed area, and construction of a pond and filtration system for treatment of the Mike Horse Adit discharge water. The pond and filtration system has been fenced and signs have been installed (Hydrometrics 1997b).

2.1.6 Mike Horse/Anaconda Passive Wetland Treatment System

2.1.6.1 Water Treatment System Construction

A number of studies in the Blackfoot River drainage have documented discharge from the Mike Horse Mine Adit as a significant source of metals loading to the upper Blackfoot River (Hydrometrics 1992; MFG 1993b; MFG 1994a; MFG 1994b). ASARCO constructed a water treatment system to treat drainage from the Mike Horse Adit, as well as the combined discharges from an adit and shaft at the Anaconda Mine near the confluence of the Blackfoot River and Anaconda Creek.

Figures 1 and **7** show the location of the system. The system was constructed on the site of Anaconda mine waste near the confluence of the Blackfoot River and Anaconda Creek, following mine waste removal. This system was completed and went on-line in October 1996 (Hydrometrics 1997a). Key considerations in the design and operation of this system were: (1) availability of land under appropriate ownership and suitable for treatment system construction; (2) the lack of infrastructure (e.g. electrical power) within the UBMC; and, (3) maintenance of the rural and undeveloped nature of the area (MFG 1994b).

Original treatment plans included a second phase of wetland cells to be built on National Forest Service lands and to operate in series with the existing wetland treatment system, thus doubling the treatment system capacity. However, efforts by ASARCO to negotiate a property exchange with the USFS for the needed land were unsuccessful and ASARCO chose to complete the undersized system (ASARCO 1995). To compensate for the smaller wetlands area, ASARCO began adding a soluble organic carbon source (methanol) to the wetland system in 1999 (Hydrometrics 1999). The organic carbon was drip-fed into the upper anaerobic cell at a rate of 18 milliliters per minute, with carbon addition continuing through 2008, when the new ceramic microfiltration water treatment plant replaced the old wetland treatment system in 2009.

Components of the old wetland treatment system included: (1) a 600,000 gallon oxidation/settling pond and a sand filter bed at the Mike Horse Mine for removal of iron from the Mike Horse Adit discharge (MFG 1993b; Hydrometrics 1996b; Hydrometrics 1997a); (2) an open limestone channel at the Anaconda Mine for iron removal and alkalinity generation in the Anaconda Adit/Shaft discharge (Hydrometrics 1997a); and (3) a multi-cell constructed wetland water treatment system located at the Anaconda Mine, designed to remove metals from the combined Mike Horse Adit and Anaconda Adit discharges through sulfide generation (Hydrometrics 1997a). Details of the treatment system design are included in MFG 1994b, 1994c and 1996b. Construction details are presented in Hydrometrics 1997a. The discharge point for the new ceramic microfiltration water treatment plant is the same discharge/outfall that was used for the wetland treatment system. The discharge/outfall is to the Blackfoot River at the west end of the property. The new plant's permit was a revised version of the original

MPDES permit (MTR-0030031) for the old wetlands-based water treatment system. To eliminate duplication between two programs within DEQ, DEQ's Site Response Section has assumed administrative duties to ensure water quality compliance (DEQ 2011a).

2.1.6.2 Water Treatment System Performance

In order to evaluate performance of the UBMC mine water treatment system, water samples of the Mike Horse Adit discharge and the constructed wetland treatment system discharge were collected on an approximately monthly basis from November 1996 through July 2001. Metals removal rates through the treatment system (oxidation/settling pond and constructed wetlands system) for the monitoring period varied both on an element-specific and a seasonal basis. Metals removal rates in excess of 90 percent are typically achieved for most metals during summer months when water temperatures and wetlands biological activity are highest. Treatment efficiencies tend to decrease in the winter in response to depressed water temperatures and biological metabolism. Average monthly metals removal rates for the monitoring period were: iron-99.7 percent, lead-96.7 percent, copper-84 percent, cadmium-83 percent, and zinc-67.5 percent. Zinc removal rates are less than those for other metals due to the relatively high stability of zinc as a soluble and mobile ion under typical near-neutral pH water chemistry conditions. Observed monthly reductions in metals concentrations achieved through the water treatment system are shown in Table 2-3 located in the DSR (Tetra Tech 2007a).

Treatment of the Mike Horse and Anaconda adits discharge waters through the constructed wetlands treatment system has reduced the load, or mass, of metals entering the upper Blackfoot River (see Figure 2-6 of the DSR (Tetra Tech 2007a). Loads of copper, cadmium, lead and iron have decreased by approximately 99 percent as a result of construction and operation of the water treatment system. Zinc loading from the Mike Horse and Anaconda adits to the Blackfoot River has decreased by more than 70 percent, from an average of 45 pounds per day prior to treatment, to an average of 12.5 pounds per day since the water treatment system was brought on line. The metal load reductions result from decreased metals concentrations and flow rates from the adits (due to flooding of the mine workings) as well as metals removal through the treatment. Therefore, the overall metal load reductions are greater than the reductions in metal concentrations achieved through the treatment system alone. Nevertheless, the wetlands treatment system discharge represented a source of metals loading to the Blackfoot River as reported in the Water Quality Restoration Plan for Metals in the Blackfoot Headwaters TMDL Planning Area (TMDL-total maximum daily load; DEQ 2003). The concentrations of some metals in the system's effluent did not meet water quality standards.

Operational problems occurred at Cell 4 of the wetlands system in the couple years prior to removal of the system. Cell 4 was designed for subsurface flow to create an anaerobic environment to enhance sulfate reduction and metals removal efficiencies (Hydrometrics 2006). The problems resulted in 1) surface flow conditions in the cell, which affected system performance, and 2) increased operation and maintenance requirements (Hydrometrics 2006). Two possible causes for surface flow in the cell included: 1) possible plugging of some of the subsurface plumbing at the inlet and/or outlet, and 2) possible plugging of portions of the Cell 4 substrate. Due to the aerobic conditions, increasing the methanol feed rate would not improve treatment efficiency. ASARCO initiated maintenance repairs at Cell 4 in 2005, including unplugging of piping at Cell 4. This work was completed in 2006.

In 2009, ASARCO moved from the semi-passive wetlands system to a long-term active ceramic microfiltration treatment system to treat the Mike Horse and Anaconda adit discharge.

2.1.7 Mike Horse/Anaconda Ceramic Microfiltration Treatment System

ASARCO installed a water treatment plant to treat source water flows from adit discharges and seeps, primarily from the Mike Horse and Anaconda mines and adjacent areas including seeps at the base of the Mike Horse Repository. This water treatment plant, began operations in January 2009, and replaced the constructed wetland treatment system located adjacent to the Anaconda Mine. The new water treatment plant also bypasses the Mike Horse adit pretreatment system that includes the in-line (oxidation) system (ILS) pond and sludge drying beds. The UBMC water treatment plant incorporates ceramic microfiltration technology to primarily remove cadmium, copper, manganese, and zinc. The design flow to the plant is 168 gpm with an expected average flow of approximately 63 gpm (CDM 2008).

The source waters are collected and conveyed to the feed tank at the water treatment plant, where they are allowed to mix. The feed tank is equipped with an aeration header to oxidize iron and reduce the levels of carbon dioxide, which assists in reducing the caustic demand needed to raise the pH in the first neutralization tank. The feed tank water is pumped to the first neutralization tank, where 30% sodium hydroxide is added to raise the pH of the water from approximately 6 to between 9.5 and 9.7. Raising the pH causes many of the dissolved metals to precipitate out of solution. In addition to the sodium hydroxide, sodium sulfate is metered into the first neutralization tank to remove cadmium from solution and assist with stabilizing the cadmium in the sludge. In the second neutralization tank, potassium permanganate is metered into the tank to assist with the precipitation of manganese.

From the neutralization tanks, the water flows into the concentration tank, which provides volume for suspended solids to concentrate prior to being pumped to the sludge tanks. From the concentration tank, water is pumped through the CMF modules, where metal-bearing suspended solids are filtered out of solution.

Filtered water is sent to the pH adjust tank and solids are returned to the concentration tank and pumped to the sludge tank. In the pH adjust tank, sulfuric acid is added to the treated water to adjust the pH back down to between 6 and 9 and discharged to the Upper Blackfoot River through a discharge pipe. Solids in the sludge tank are allowed to settle and are periodically pumped to a sludge press for dewatering. The dewatered sludge is a non-hazardous waste and is stored temporarily at the treatment plant, and periodically disposed of at an appropriate facility (CDM 2008, DEQ 2012).

2.1.8 Paymaster Mine and No. 3 Tunnel

Waste rock removal was implemented at the Paymaster Mine and No. 3 Tunnel areas in 1996 (**Figures 1 and 7**). The Paymaster Mine was a relatively small operation which mined ore from three adits in lower Paymaster Creek drainage. No. 3 Tunnel was a bulk sample adit driven by the Anaconda Company for exploration of the south copper-molybdenum ore zone. Three distinct waste rock piles, totaling approximately 8,065 yd^3, were removed from the Paymaster Creek drainage bottom, and an additional 4,955 yd^3 of mine waste was removed from the Tunnel #3 area. All material was fully amended with cement kiln dust to neutralize acidity and decrease metal solubility, and placed in an engineered repository located near the Paymaster Mine (Hydrometrics 1997b and 1998b).

In addition to the Paymaster Mine and No. 3 Tunnel mine wastes, approximately 8,412 yd^3 of mine tailings from an off-site DEQ abandoned mine reclamation project was placed in the Paymaster Repository (**Figure 7**). The Big Blackfoot tailings were transported from their location approximately 25 miles west of the UBMC and placed in the Paymaster Repository by DEQ with permission from ASARCO. All material placed in the Paymaster Repository was fully amended

with lime products to neutralize the mine waste. The repository was designed for possible expansion in the future to accommodate additional mine waste, if necessary (MFG 1996c).

Remediation at the Paymaster Mine also included collection of a small volume of seasonal discharge from the historic Paymaster adit and treatment through a passive wetland treatment cell (MFG 1996c). The treatment system is located adjacent to the Paymaster Mine (**Figures 1** and **7**). Discharge from the Paymaster adit water treatment system was regulated under a MGWPCS permit (DEQ 1997). The passive wetland treatment system never discharged any water, and its operation was discontinued and the associated permit abandoned by ASARCO (DEQ 2006).

2.1.9 Capital Mine

The Capital Mine is a relatively small mine located in upper Stevens Gulch (**Figures 1 and 7**) on patented mining claims that were reclaimed by ASARCO in 1997 (Hydrometrics 1998b).

Reclamation at the Capital Mine included removal of 725 yd^3 of mine waste from the Stevens Gulch drainage bottom and placement of the waste in the Paymaster Repository. The removal area was amended with cement kiln dust. The excavation area was regraded and revegetated, and 200 feet of stream channel reconstructed. A grout seal was placed in the Capital Mine adit to eliminate seasonal discharge of water from the adit (Hydrometrics 1998b).

2.1.10 Consolation Mine

The Consolation Mine is a relatively small mine located in lower Shave Gulch (**Figures 1 and 7**) on patented mining claims that were reclaimed by ASARCO in 1997 (Hydrometrics 1998b).

The Consolation Mine consisted of two collapsed adits (upper and lower) and associated mine waste piles. The mine waste occurred as a relatively thin pile covering about 2.5 acres of hillside below each adit. Reclamation involved consolidation of the mine waste into the lower adit area by pushing the upper mine waste downhill into the adit, and hauling the lower mine waste pile uphill to the adit. Approximately 2,200 yd^3 of mine waste was placed into the prepped adit area, re-graded to match the surrounding topography, the upper 12 inches amended with cement kiln dust, covered with soil (12-inch minimum), and the entire removal area revegetated (Hydrometrics 1998b).

2.1.11 Temporary Water Quality Standards Implementation Plan

In 2004, ASARCO resumed reclamation activities in upper Mike Horse drainage under the Temporary Water Quality Standards Implementation Plan (IP; Hydrometrics 2000). Routine water quality monitoring subsequent to the 1998 in-place mine waste closure showed continued seepage of poor quality water from the base of two mine waste piles, referred to as piles 1 and 4, in upper Mike Horse drainage. In order to address the seepage of poor quality water, and potential metals loading to Mike Horse Creek, ASARCO initiated mine waste removal actions in 2004 at Waste Piles 1 and 4. Approximately 12,000 yd^3 of mine waste/soil were removed from upper Mike Horse drainage and hauled to the Paymaster Repository for permanent disposal. An estimated 3,000 yd^3 of additional mine waste/soil was removed in 2005. The 2004 Upper Mike Horse reclamation action was approved by DEQ under the Temporary Water Quality Standards and is described in the Temporary Water Quality Standards 2004 removal work plan (Hydrometrics 2004).

The Upper Mike Horse reclamation is the only Temporary Water Quality Standards reclamation activity initiated since the IP was approved in 2000. Due to the lack of progress with the IP, the BER revoked the temporary water quality standards effective December 22, 2006, and is currently applying the Montana DEQ-7 water quality standards at the UBMC.

2.1.12 Design Investigations for Future Remedial Actions

At the present time there are some remedial actions in various stages of planning for the UBMC. This includes implementation of the Final ASARCO EE/CA (Hydrometrics 2007a) and the subsequent Action Memorandum released by the USFS (USDA 2007) which will be implemented by DEQ using funds received from the ASARCO bankruptcy settlement. Some of the work completed to date includes:

- Geotechnical and geochemical properties for the soils as potential repository sites at Shave Gulch, Paymaster area, and Section 35 identified (TerraGraphics 2010a and TerraGraphics 2010b)
- Suitability of the site soils for repository construction determined (TerraGraphics 2010a and TerraGraphics 2010b)
- Geotechnical and geochemical properties for mine wastes in area between Mike Horse Dam toe and Mike Horse Creek identified (TerraGraphics 2010b)
- Water quality baseline established prior to remedial actions by sampling surface water and groundwater for existing chemical properties (TerraGraphics 2010a and TerraGraphics 2010b).
- Impoundment groundwater dewatering capture trench installed (Spectrum 2010)
- The excavation, geotechnical, and geochemical characteristics of the Mike Horse impoundment tailings identified (Spectrum 2010)
- The geotechnical and geochemical characteristics of the floodplain material identified (Spectrum 2010).

These items are being researched and evaluated outside of the DEQ RI process and; therefore, this RI will not focus on these remediation components.

3.0 REMEDIAL INVESTIGATION METHODS

Tetra Tech completed the RI at the UBMC during fall 2007 and spring/summer 2008. The purpose of the RI was to address data gaps identified in the DSR (Tetra Tech 2007a) and those identified through a review of historic files stored at the DEQ for the UBMC. The method of investigation for the fall of 2007 was based principally on filling data gaps identified in the DSR. Whereas, the 2008 investigation focused on continuing to fill data gaps identified in the DSR and filling additional data gaps identified during the fall 2007 investigation. The 2007 investigation was completed expeditiously in order to collect as much critical data as possible prior to the onset of winter so the data could be reviewed and evaluated along with data from historic files.

The major data gaps identified in the DSR report that were the focus of the 2007 Fall sampling event included the following:

- Soil data, including background samples, to determine the nature and extent of the contamination and to provide data for the preparation of ecological and human health risk assessments.
- Macroinvertebrate data to determine aquatic health of stream segments.
- Sediment data to characterize the nature and extent of contamination in sediment within the river channel bottom and to provide data for the preparation of ecological and human health risk assessments.
- Surface water quality and flow data to determine the site-wide nature and extent of surface water contamination within the Blackfoot River, including areas downstream of BRSW-16, and to provide data for the preparation of ecological and human health risk assessments.
- Surface water data to determine the nature and extent of surface water contamination within the Blackfoot River tributaries including, but not limited to, Paymaster Creek and Stevens Creek and to provide data for ecological and human health risk assessments.
- Alluvial and bedrock groundwater data, including water quality and aquifer characterization data. This task included the installation of additional monitoring wells, to determine the nature and extent of groundwater contamination and to provide data for ecological and human health risk assessments and the evaluation of remedial actions.
- Mine site inventories of previously unidentified or unsampled waste rock piles, prospects pits, and underground mines located in Stevens Creek and other areas of the UBMC.

Additional data gaps identified from the 2007 investigation that required sampling or study during the 2008 investigation included:

Mine Waste

- Waste deposit volumes: Obtain information to calculate the approximate volume of waste material and the area covered by each individual waste deposit for remedial reclamation planning purposes.
- Mine waste and water sampling: The information obtained from sites investigated during the 2007 mine inventory program indicated that there were several previously undocumented or non-sampled mine waste piles and adit discharges that required further investigation and sampling within the upper portions of tributary drainages of the UBMC.

- Anaconda Mine Area Waste Piles: The need for additional waste and waste pile sampling to delineate the perimeter of the contaminated areas was identified for three non-reclaimed mine waste areas located above the Anaconda Mine.
- Mine Waste Perimeter Sampling: The need for additional sampling to delineate the lateral extent of mine waste for select areas sampled in 2007 was identified, where results indicated metals persisted within the previously sampled areas at concentrations above the U.S. Environmental Protection Agency (EPA) Region 9 Preliminary Remediation Goals (PRGs). (DEQ now uses EPA's Regional Screening Levels (RSLs) for this type of screening but at the time this RI sampling was conducted, PRGs were used. RSLs will be referenced hereafter.)
- Acid-Base Accounting (ABA) and Synthetic Precipitation Leaching Procedure (SPLP) Testing: Analyze composite samples collected from mine waste areas during 2007 for their acid generation potential (ABA) and the risk of metal mobility (SPLP) from each area where metals exceeded one or more EPA RSLs. Ten percent of all soil samples and all composite samples from each discrete waste pile were analyzed for total metals, SPLP, and ABA to determine site-specific screening levels for risk of leaching to groundwater.
- Mine inventory: Complete the inventory of mines and mine features from areas that were not inventoried during 2007.

Floodplain Sediments

- Further delineate the lateral extent of redistributed tailings/mine waste from the 1975 tailings dam breach in preparation for remedial action planning. The number of samples and sample locations were based on a screening-level ecological risk assessment (SLERA) completed by Tetra Tech in February 2008. The lower portions of tributary streams including Paymaster, Stevens, and Shave Creeks also required streamside sampling where there was evidence of mine waste re-deposition.

Surface Water and Streambed Sediment

- Surface water quality samples and flow measurements were obtained from areas on Shave, Stevens, and Paymaster Creeks where surface water was observed to be in contact with mine waste or had the potential to receive runoff from mine waste sources. Both naturally occurring and adit seeps identified in these gulches were also sampled and a flow volume estimated.
- Spring (high flow) surface water and streambed sediment were sampled to augment the period of record for the existing surface water data set at monitoring stations previously sampled in 2007.

Groundwater

- Install additional groundwater monitoring wells to further characterize groundwater interaction between the bedrock and alluvial aquifers, and surface water.

Aquatic and Terrestrial Receptors

- Collect additional macroinvertebrate samples to evaluate stream segment health including sampling of the Upper Marsh and Blackfoot River within the marsh. Collect samples of mammals, vegetation, invertebrates, and soil from transects established along Beartrap Creek and the Blackfoot River in order to provide data for ecological and human health risk assessments

Cover Re-Vegetation Sampling

- Sample soil from areas of stressed or failed vegetation on reclaimed/removed and non-reclaimed mine waste sites to evaluate whether the soil has proper pH, nutrients and organic content to support plant growth and to provide information for future remedial design purposes. Complete cover sampling, with associated reference plots, at mine waste removal/reclamation areas to evaluate revegetation cover and identify plant species as a measure of diversity for remedial action planning purposes.

Other data gaps identified in the DSR included those related to vegetation and small mammal data. Vegetation was not sampled under the 2007 SAP because it was too late in the growing season to collect good quality vegetation data. Small mammals were not collected in 2007 because Tetra Tech believed that the data gathering activities during the 2007 fall sampling event would support the identification of potential areas of concern for small mammal sampling and allow the definition of specific transects to be sampled in 2008. Sampling of vegetation and small mammal's resources were both undertaken during 2008 sampling events.

The objectives of the 2007 fall field event were to evaluate the site during low water conditions, begin establishing the lateral extent of contamination for surface water and soils, and the lateral and vertical extent of contaminants in groundwater at the UBMC, and to provide data to support future human health and ecological risk assessments.

The following sections summarize the methods used to complete the 2007 and 2008 field events.

3.1 Surface Water Sampling

3.1.1 2007 Surface Water Sampling

Surface water was sampled at 29 locations including 17 existing sites which had been sampled by others during previous investigations and two flowing adits, one in Paymaster Gulch (PM-Adit-1) and one in Stevens Gulch (SG-Adit-1). **Figure 8** shows the sample locations and **Table 10** presents a sampling summary that specifies why each sample location was selected and included in the 2007 investigation. The table below lists the 29 sampling locations.

2007 Surface Water Sampling Locations

AW-003A	BRSW-107	BRSW-16	BRSW-36
BRSW-101	BRSW-108	BRSW-17	BRSW-39A
BRSW-102	BRSW-109	BRSW-21	BRSW-4
BRSW-103	BRSW-110	BRSW-23	BRSW-44
BRSW-104	BRSW-11	BRSW-29	BRSW-6
BRSW-105	BRSW-12	BRSW-31	BRSW-9
BRSW-106	BRSW-13	BRSW-33	

Sampling occurred in October 2007 to obtain data representative of low flow conditions and was performed in conjunction with streambed sediment and macroinvertebrate sampling at select sites (**Table 10**). Field personnel collected surface water samples during the fall 2007 investigation from stream reaches where: 1) the DSR indicated sources of metals-loading could potentially impact stream and/or sediment quality; 2) where too few samples had been collected historically to adequately characterize water quality; or 3) to evaluate background surface water quality.

Surface water sampling and flow measurement protocols were in accordance with Tetra Tech standard operating procedures and as specified in the 2007 Sampling and Analysis Plan (SAP) (Tetra Tech 2007b). Sampling consisted of measuring field parameters at the sampling station, filling and preserving sample bottles for submittal to the analytical laboratory for the analyses of

the analytes listed in the 2007 SAP, and measuring flow using an area-velocity method. A timed volumetric flow measurement was made at two stations where water flowed through a pipe (AW-003A) or culvert (BRSW-108). It should be noted lower Stevens Gulch was a losing reach of stream during the 2007 sampling event and its flow did not reach the main-stem of the Blackfoot River. For this reason, the proposed sampling location (BRSW-108) was moved upstream to the point where the Stevens Creek crosses the Paymaster access road in a culvert. Flow ceased approximately 100 feet below this road crossing.

Constituents exceeding Montana DEQ-7 water quality standards were identified in the DSR as the basis for the 2007 analytical parameters list. Tetra Tech assumes that the historical samples were collected in a similar manner and analyzed by the same or similar analytical methods such that the 2007 results can be justifiably compared with historic sampling results. Montana DEQ-7 water quality standards for metals (except aluminum) in surface water are based upon the analysis of samples following a “total recoverable” digestion procedure. As per Montana DEQ-7 water quality standards, aluminum was filtered and analyzed as dissolved, but only when the surface water sample was within a pH range of 6.5 to 9.0.

Field parameters measured during the sampling effort included dissolved oxygen, specific conductance, pH, and water temperature. Surface water samples were analyzed at the analytical laboratory for physiochemical parameters, total metals, dissolved aluminum, common cations, and common anions according to the 2007 SAP (Tetra Tech 2007b). Samples collected for dissolved aluminum were filtered in the field through a 0.45-micron disposable in-line filter using a peristaltic pump then preserved as required. Section 4 discusses the surface water analytical results.

3.1.2 2008 Surface Water Sampling

Additional surface water sampling was completed in 2008 according to the 2008 SAP Addendum (Tetra Tech 2008). The 2008 surface water sampling locations corresponded with select stations sampled during the 2007 investigation (**Figure 8**). Sampling in 2008 also included surface water sites on the Blackfoot River below the Upper Marsh to evaluate high-water conditions during spring runoff. Field personnel also sampled select surface water locations upstream of the Upper Marsh on the Blackfoot River, and one on Stevens Creek, and two on Mike Horse Creek in 2008. These upstream samples were collected where: 1) aquatic (macroinvertebrate and periphyton) sampling was proposed; and 2) at locations BRSW-4A and BRSW-44 to evaluate potential changes in surface water quality due to the 2007 reclamation by ASARCO of waste areas in the upper Mike Horse Mine area.

Two additional surface water samples (MHSW-101 and MHSW-102) were collected from Mike Horse Creek in 2008 adjacent to the 2007 mine waste reclamation area in the upper Mike Horse Mine area. The surface water samples were collected from the creek to evaluate potential impacts on water quality from seeps entering from the west bank of Mike Horse Creek below the waste reclamation area. The following table lists the 2008 sampling locations.

2008 Surface Water Sampling Locations

BRSW-101	BRSW-105	BRSW-4A	BRSW-31
BRSW-104	BRSW-106	BRSW-6	BRSW-44
BRSW-103	BRSW-107	BRSW-16	MHSW-101
BRSW-102	BRSW-108	BRSW-17	MHSW-102

Sampling, flow and field measurement methods and analytical parameters were consistent with 2007 fall investigation protocols and followed Tetra Tech standard operating procedures (SOPs) and the 2008 SAP Addendum (Tetra Tech 2008). **Table 10** lists the 2007 and 2008 surface

water and sediment sampling locations, analytical parameters, and reason for sampling specific sites.

Tetra Tech also collected surface water samples during the mine inventory work to evaluate potential impacts to surface water quality from mine features (i.e., mine waste piles, adit discharges). Section 3.5 summarizes the mine inventory surface water sampling activities for 2008.

3.1.3 2011 Surface Water Sampling

Pioneer Technical Services, Inc. (Pioneer) conducted additional surface water sampling along the Blackfoot River in November 2011 (Pioneer 2012). Analytical results from 2007 and 2008 indicated cadmium and zinc in surface water exceeded aquatic screening levels at BRSW-101, the furthest downgradient surface water and sediment location in the 2007 and 2008 investigation. The objective of the 2011 sampling was to further evaluate the nature and extent of mining-related impacts to surface water and sediment in the Blackfoot River channel downgradient of Highway 279.

Six new surface water sampling locations (with corresponding sediment samples, see below) were located downstream of Highway 279 and upstream of Hogum Creek (**Figure 8**). Pioneer's sampling, flow and field measurement methods and analytical parameters were consistent with 2007 fall investigation protocols and followed Tetra Tech standard operating procedures (SOPs) and the 2008 SAP Addendum (Pioneer 2012). **Table 10** lists the 2011 surface water and sediment sampling locations, analytical parameters, and reason for sampling specific sites. Surface water locations sampled in 2011 include:

2011 Surface Water Sampling Locations

BRSW-201	BRSW-204
BRSW-202	BRSW-205
BRSW-203	BRSW-206

3.2 Streambed Sediment

3.2.1 2007 Streambed Sediment Sampling

Streambed sediments (i.e. sediments located beneath flowing water within active stream channels) were collected at 21 of 27 surface water stations sampled on the Blackfoot River and its tributaries during the 2007 sampling event. **Figure 9** shows the 2007 streambed sediment sampling locations. Samples were collected from the 0- to 2-inch depth interval using a stainless steel trowel to scrape the surface of the streambed. Where possible, samples were also collected from deeper depth intervals (i.e. 2- to 6-inches and 6- to 12-inches) by excavating a pit in the stream bed with a shovel. To eliminate all rock greater than 2 mm in size, all sediment samples were sieved through a 2 millimeter (10-mesh) screen prior to placing them in sample jars. The 2007 SAP (Tetra Tech 2007b) provides additional sampling method details.

2007 Streambed Sediment Sampling Locations

BRSW-6*	BRSW-17	BRSW-101	BRSW-107
BRSW-9	BRSW-21	BRSW-102	BRSW-108
BRSW-11*	BRSW-33	BRSW-103	BRSW-109
BRSW-12	BRSW-36	BRSW-104	BRSW-110
BRSW-13		BRSW-105	
BRSW-16		BRSW-106	

* background sediment sample, see Section 3.10

Table 10 lists the 2007, 2008, and 2011 streambed sediment sampling locations, analytical parameters, and reason for sampling specific sites. **Figure 9** shows the sediment sampling locations. Section 4 discusses the 2007 results.

3.2.2 2008 Streambed Sediment Sampling

Tetra Tech collected streambed sediment at 12 of the 14 surface water locations sampled during the 2008 investigation. Field personnel sampled sediment at surface water locations above the Upper Marsh on the Blackfoot River, one on Stevens Creek, and two on Mike Horse Creek in 2008 to: 1) evaluate sediments during high flow; and 2) where aquatic (macroinvertebrate and periphyton) sampling was proposed to evaluate potential changes in sediment quality from the 2007 event. Sampling methods and analytical parameters were consistent with the 2007 investigation. The 2007 SAP (Tetra Tech 2007b) provides additional sampling method and analytical details. The following table lists the 2008 streambed sediment sampling locations.

2008 Streambed Sediment Sampling Locations

BRSW-6*	BRSW-101	BRSW-105
BRSW-16	BRSW-102	BRSW-106
BRSW-31	BRSW-103	BRSW-107
	BRSW-104	

* Background sediment sample, see Section 3.10

Table 10 lists the 2007, 2008, and 2011 streambed sediment sampling locations, analytical parameters, and reason for sampling specific sites. **Figure 9** shows the sediment sampling locations. Section 4 discusses the 2008 results.

3.2.3 2011 Streambed Sediment Sampling

Pioneer (2012) collected six streambed sediment samples in 2011. The sediment sample locations corresponded with six surface water sample locations located on the Blackfoot River downstream of Highway 279 and upstream of the confluence of the river with Hogum Creek (**Figure 9**). 2007 and 2008 sediment data indicated several metals exceeded ecological screening levels at sample location BRSW-101, the furthest downstream sampling location in 2007 and 2008. Field personnel collected sediment from the 0- to 2-inch depth interval. The purpose of sampling was to further evaluate mine-related impacts to sediment downstream of BRSW-101. Sampling methods and analytical parameters were consistent with the 2007 and 2008 investigations (Pioneer 2012). The 2007 SAP (Tetra Tech 2007b) provides additional sampling method and analytical details. **Table 10** lists the 2007, 2008, and 2011 streambed sediment sampling locations, analytical parameters, and reason for sampling specific sites. The streambed sediment sample locations correspond with the 2011 surface water sampling locations and are listed below. Section 4 discusses the 2011 results.

2011 Streambed Sediment Sampling Locations

BRSW-201	BRSW-204
BRSW-202	BRSW-205
BRSW-203	BRSW-206

3.3 Marsh Sediment

3.3.1 2007 Pass Creek Marsh and Upper Marsh Investigation

3.3.1.1 Marsh Grid Sampling

Tetra Tech completed marsh sediment sampling in the Upper Marsh to evaluate potential tailings deposition in the marsh from the 1975 tailings impoundment breach, evaluate human health and ecological risk associated with possible tailings deposition in the marsh, and evaluate potential impacts to water quality in the Blackfoot River. **Figure 10** shows the marsh sediment sample locations.

The Upper Marsh sampling effort was based on a grid overlay consisting of 500-foot by 500-foot grid squares and a 250-foot by 250–foot subset grid. The grid resulted in 25 Upper Marsh sediment sample locations. Two additional samples were collected from the Pass Creek Marsh to establish background marsh sediment conditions (**Figure 10**). Marsh sediment samples were collected by completing hand dug test pits using a shovel, measuring the depths excavated and collecting marsh sediment samples from the appropriate depth intervals. The following table lists the 2007 Pass Creek Marsh and Upper Marsh sediment sampling locations.

2007 Pass Creek Marsh and Upper Marsh Sediment Sample Locations

UM-0N-1000E	UM-0N-750E	UM-250S-250E	UM-0N-2500E	UM-500S-3000E
UM-0N-1500E	UM-1000S-3500E	UM-250S-2750E	UM-500N-2500E	UM-500S-3250E
UM-0N-2000E	UM-250N-2500E	UM-250S-3000E	UM-500S-2000E	UM-500S-500E
UM-0N-250E	UM-250S-1500E	UM-250S-3250E	UM-500S-2500E	UM-750S-3000E
UM-0N-500E	UM-250S-2500E	UM-250S-500E	UM-500S-2750E	UM-750S-3500E
PGBG-1	PGBG-2			

PG – Pass Creek Marsh sediment sample (background/reference sample)
UM – Upper Marsh sediment sample

Hand dug test pits were excavated to an average depth of about 30 inches and marsh sediment samples were collected beginning from the top of the mineralized marsh sediment interface (i.e. beginning at the base of the present/existing vegetative root layer) to 2 inches, 2- to 6 inches, 6- to 12 inches. The 0- to 2-inch depth interval was collected to evaluate the potential risk to human health. The remaining depth intervals were collected to evaluate the potential risk to human health and ecological receptors, evaluate vertical differences in tailings and metals deposition, and evaluate areas of potentially elevated metals concentrations in groundwater and solid media. Section 4 discusses the results of marsh sediment sampling.

3.3.1.2 Pass Creek Marsh - Background Sediment Sampling

Field personnel collected three background/reference marsh sediment samples (PGBG-1 and PGBG-2, and BRSD-5; **Figure 10**) to evaluate background metals concentrations in Pass Creek Marsh sediment for comparison with the Upper Marsh sediment samples collected during this investigation. The marsh sediment samples were collected from the 0- to 2-inch, 2- to 6-inch, and 6- to 12-inch depth intervals at each sample location. The marsh sediment samples were collected consistent with the methods described above for marsh sediment sampling in the Upper Marsh. Section 4 presents the results for the Pass Creek Marsh sediment samples.

3.3.2 2008 Upper Marsh Investigation

Additional marsh sediment sampling was performed in the Upper Marsh during the Spring 2008 investigation to fill data gaps from the 2007 investigation and to evaluate whether concentrations of metals in marsh sediment collected in 1991 by Hydrometrics have changed over time. The marsh sediment sample collection methods for 2008 were consistent with those

for the 2007 investigation. Additional marsh sediment sampling was performed to provide co-located data for ecological samples collected along transects within the marsh. Section 3.11 presents the methods of investigation to support ecological risk assessment activities.

Upper Marsh Grid Sediment Sampling

The 2008 Upper Marsh sediment sampling method was consistent with the 2007 investigation method presented in the 2007 and 2008 SAP (Tetra Tech 2007b and 2008). Tetra Tech developed a grid overlay for marsh sediment sampling in the Upper Marsh (**Figure 10**). The grid overlay is a 500-foot by 500-foot grid and a 250-foot by 250–foot subset grid. Following review of the 2007 investigation data and historic data, the grid locations listed in the table below were selected for additional marsh sediment sampling during the Spring 2008 investigation to close data gaps and to better define the area of impacted sediments in the marsh. Marsh sediment samples were collected from the 0- to 2-inch, 2- to 6-inch, and 6- to 12-inch depth intervals. **Figure 10** shows the 2008 marsh sediment sampling locations.

2008 Upper Marsh Sediment Sample Locations

UM-250N-1750E	UM-250N-2250E	UM-250S-1250E

Re-sampling of 1991 Marsh Sediment Sampling Locations

Marsh sediment samples were collected from the Upper Marsh in 1991 by Hydrometrics (Tetra Tech 2007a). Tetra Tech re-sampled marsh sediment from the approximate 1991 sample sites (see table below) to evaluate whether concentrations in the marsh sediment have changed at these locations over the last 17 years. The sampling method was consistent with Tetra Tech's 2007 marsh investigation sampling method presented in the 2007 and 2008 SAPs (Tetra Tech 2007b and 2008) and included sampling the 0- to 2-inch, 2- to 6-inch, and 6- to 12-inch depth intervals below the current root layer. The following marsh sediment sampling locations were sampled during 2008 (**Figure 10**).

1991 Marsh Sediment Sampling Locations Re-Sampled in 2008

BRSD-2	BRSD-6	BRSD-10	BRSD-24
BRSD-3	BRSD-7	BRSD-11	BRSD-25
BRSD-4	BRSD-8	BRSD-15	
BRSD-5*	BRSD-9	BRSD-16	

*Background marsh sediment sample

3.3.3 Concentration Isopleth Analyses

Data for the Upper Marsh was further analyzed using isopleth analyses in 2007 to evaluate concentration contours. The data was updated in 2008 following data collection. The Middle Marsh and Lower Marsh did not have enough data to develop isopleth maps. XRF results and global positioning satellite (GPS) data points for sample locations were entered into GIS and the spline function used to develop maps showing concentration contours. The information presented on the maps was used to evaluate areas of contamination along with metal concentration data. Section 4 presents additional details regarding the development of the concentration plots and discussion of the results. **Figures 11a** through **11c** present the isopleth concentration maps for the Upper Marsh.

3.3.4 2011 Middle and Lower Marsh Sediment Sampling

Pioneer performed marsh sediment sampling within the Middle Marsh and Lower Marsh in November 2011 to confirm/deny whether metals have impacted the marshes. Samples were collected at the "head" of each marsh, focusing on the rationale that sediments from the 1975

breach/flood would be more likely to settle more in the head of the marsh and would represent a worst-case scenario for sediment impacts to the marshes. Additional investigation details regarding the sampling are included in the 2011 fall remedial investigation report (Pioneer 2012).

Field personnel collected samples from two locations within the Middle Marsh (MMSD-201 through MMSD-202) and samples from four locations within the Lower Marsh (LMSD-201 through LMSD-204). The sample locations were located along a single cross-section for each marsh. **Figure 12** shows the sample locations.

Samples were collected from the 0- to 2-inch, 2- to 6-inch, and 6- to 12-inch depth intervals at each sample location. The middle and lower marsh sediment samples were collected consistent with the methods described above for marsh sediment sampling in the Upper Marsh. Samples were analyzed for metals and one sample from each marsh was also analyzed for ABA, and SPLP.

3.4 Groundwater

3.4.1 2007 Groundwater Investigation

During October 2007, 18 new monitoring wells were installed, developed, and sampled. Field personnel also monitored and sampled 22 existing wells (**Figures 13a and 13b**). Groundwater sampling occurred in October 2007 to obtain data representative of low groundwater conditions. Field personnel collected groundwater samples from areas where: 1) the DSR indicated potential sources of metals loading; 2) where no samples had been previously collected to measure water quality; or 3) evaluate background groundwater quality. **Table 11** lists the sampling justification for each location and the analytical parameters. The table below lists the 40 locations sampled during 2007.

2007 Groundwater Sampling Locations

LCMW-1	SWGW-101	PMGW-117	SGGW-101	MHGW-113
BRGW-101	SWGW-102	PMGW-118	SGGW-102	UMHMW-3
MPP-4	SWGW-103	PMGW-119	ANWS-1	MHGW-115
BRGW-110	UCMW-11	PMGW-120	BCMW-10	UMHMW-1D
ANMW-7	PMMW-13	PMPZ-3	BCGW-115	UMHMW-1S
LCMW-5	PMMW-14	EDP-2	MHMW-8	UMHMW-2D
LCMW-12D	PMMW-15	EDMW-2	MHGW-109	UMHMW-2S
LCMW-12S	PMGW-116	EDGW-105	MHGW-112	MW-1

Field personnel also attempted to locate well BMSP-2, a reportedly flowing exploration drill hole, within the Upper Marsh, while sampling other surface water locations. However, three different crews collecting samples in the marsh were unable to locate the well. The well has likely been abandoned or destroyed.

Groundwater sampling occurred in accordance with Tetra Tech's standard operating procedures and as specified in the 2007 SAP (Tetra Tech 2007b). This work consisted of measuring depth to water, purging, measuring field parameters, and filling and preserving sample bottles using low-flow methodologies. However, if low-flow sampling criteria could not be met, sampling was completed by hand bailing with a disposable polyethylene bailer. The two factors preventing low-flow sampling were minimal water column in the well and site inaccessibility. Monitoring wells located in drainage bottoms, near closed and reclaimed roads and in other reclaimed areas prevented vehicle access, so the hand-bailing method of sampling was implemented.

Field parameters measured during the sampling effort included dissolved oxygen, specific conductance, pH, oxidation-reduction potential, and water temperature. Groundwater samples were analyzed at the analytical laboratory for various physiochemical parameters, dissolved

metals, common cations, and common anions according to the 2007 SAP (Tetra Tech 2007b). Samples for metals analysis were field-filtered through a 0.45–micron (µm) disposable in-line filter and collected in clean laboratory-supplied bottles in accordance with standard methods and procedures. Section 4 discusses the groundwater analytical results.

3.4.2 2008 Groundwater Investigation

During July 2008 five new groundwater monitoring wells were installed, developed and sampled. In addition, six piezometers were installed and sampled within the Upper Marsh (see Section 3.4.3). Monitoring well installations were conducted in accordance with the 2008 SAP (Tetra Tech 2008). Four of the monitoring wells proposed in the 2008 SAP were not installed due the high cost of constructing access roads and preparing a drill pad, out-weighing the potential value of the data. The four wells scheduled for installation that were not installed consist of SGGW-120, SGGW-121, ANGW-102, and MHGW-120. All 40 of the wells sampled in 2007 were re-sampled along with these five new wells, six new piezometers, one additional pre-existing monitoring well, and one additional pre-existing piezometer. Groundwater sampling methods were consistent with those described for 2007 and those presented in the 2007 and 2008 SAPs (Tetra Tech 2007b and 2008).

Table 11 lists the justification for sampling each well/piezometer and the analytical parameters. The table below lists the 53 locations sampled during 2008.

2008 Groundwater Sampling Locations

LCMW-1	UCMW-11	PMMW-15	SHGW-101*	MHGW-112
BRGW-101	UMPZ-1*	PMGW-116	SHGW-102*	MHGW-113
MPP-4	UMPZ-2*	PMGW-117	SGGW-101	UMHMW-3
BRGW-110	UMPZ-3*	PMGW-118	SGGW-102	MHGW-115
ANMW-7	UMPZ-4*	PMGW-119	ANWS-1	UMHMW-1D
LCMW-5	UMPZ-5*	PMGW-120	ANMW-9*	UMHMW-1S
LCMW-12D	PGPZ-1*	PMPZ-3	BCMW-10	UMHMW-2D
LCMW-12S	PDGW-101*	PMPZ-4*	BCGW-115	UMHMW-2S
SWGW-101	PDGW-102*	EDP-2	BCGW-116*	MW-1
SWGW-102	PMMW-13	EDMW-2	MHMW-8	
SWGW-103	PMMW-14	EDGW-105	MHGW-109	

* Indicates new 2008 sampling location

Groundwater sampling was conducted in July 2008 to obtain data representative of high groundwater conditions. Field personnel collected groundwater samples where: 1) the DSR indicated potential sources of metals loading; 2) where no samples had been previously collected to measure water quality; or 3) to evaluate background groundwater quality.

During the 2008 investigation, Tetra Tech also conducted extraction tests on two wells, MPP-4 and LCMW-1, to evaluate hydraulic conductivity of the alluvial aquifer for use in assessing mass transport of contaminants. Wells BRGW-110 (adjacent to MPP-4) and BRGW-101 (adjacent to LCMW-1) were used as observation wells for the aquifer tests. **Figure 13** shows the location of the wells.

3.4.3 2011 Groundwater Investigation

Pioneer performed groundwater monitoring and sampling activities for wells in the Carbonate Mine area in November 2011 (Pioneer 2012). Pioneer sampled groundwater wells according to the SAP (Tetra Tech 2008). The purpose of the investigation was to further evaluate metal concentrations in groundwater in this area under low groundwater conditions. The objective was to collect data to better understand the causes of impacts to groundwater in the Carbonate Mine area. The wells sampled include:

2011 Groundwater Sampling Locations	
SWGW-101	LCMW-5
SWGW-102	LCMW-6S
SWGW-103	LCMW-6D
UCMW-4	LCMW-12S
UCMW-11	LCMW-12D

Figure 13 shows the locations of the wells. SWGW-101, SWGW-102, and UCMW-4 did not have enough water to pump or collect a sample. Samples from the remaining wells were analyzed by Energy Laboratories in Helena.

Based on the data collected, Pioneer developed a potentiometric surface map for the Carbonate area. The potentiometric surface map is presented in the 2011 Fall Sampling Event field activities report (Pioneer 2012).

3.4.4 Marsh Piezometer Installation and Sampling

Tetra Tech installed six piezometers, five in the Upper Marsh and one Pass Creek Marsh to evaluate surface water-groundwater interaction and geochemistry. The piezometers include the following:

2008 Marsh Piezometers	
UMPZ-1	UMPZ-4
UMPZ-2	UMPZ-5
UMPZ-3	PGPZ-1

Piezometer construction includes a 1-foot long stainless steel well point with 0.01 slot screen, schedule 40 polyvinylchloride (PVC) well casing, and schedule 40 PVC slip cap. Each piezometer was hand-driven through the marsh sediments and into the underlying sand and gravel substrate. Because of the hand-driven method of installation, no sediment samples were collected. Each piezometer was developed and sampled using a peristaltic pump and following EPA's low flow purge method, as per the SAP (Tetra Tech 2008) Small diameter (1 inch) opening of piezometers, depth to groundwater of less than four feet, and sampling for non-pH dependent metals factored into the choice of a peristaltic pump, rather than a submersible pump for the upper marsh piezometer groundwater sampling. The SAP (Tetra Tech 2008) provides additional method details. **Figure 10** and **Figure 13** show the piezometer locations. **Table 11** includes the list of analytical parameters.

3.5 Mine Inventory & Mine Inventory Stream Sampling

A total of 269 mining related features were identified during the 2007 and 2008 mine feature inventory. An additional mine feature was identified during the 2011 Pioneer investigation. The following sections present the activities for the 2007, 2008, and 2011 mine inventory work. Section 4.10 presents the results.

3.5.1 2007 Mine Inventory

Beginning in 1993, mine waste piles associated with the Carbonate, Anaconda, Edith, Paymaster, and Mike Horse mines were removed and placed in engineered repositories (**Figure 7**) or reclaimed in place to limit potential leaching and subsequent mobilization of metals to waters of the State. Section 2 provides details on the removal and reclamation efforts for each of these areas. In all, approximately 100,000 yd^3 of mine waste have been removed from these

select mine sites and isolated in three on-site engineered repositories located near the Carbonate, Paymaster and Mike Horse Mines. In addition to mine waste removal, ASARCO and ARCO constructed a passive water treatment system in 1996 to treat drainage from the Mike Horse Adit, as well as the combined discharges from an adit and shaft at the Anaconda Mine.

Despite these reclamation efforts, mine waste still exists throughout the UBMC in several of the tributary areas of the upper Blackfoot River drainage. Tetra Tech completed a preliminary mine inventory during fall 2007 to identify some of the remaining mine waste sites within the UBMC. Tetra Tech completed the 2007 inventory on mine sites in Stevens Gulch and nine other priority areas within the UBMC. However, at the end of the 2007 sampling season, many other areas containing mine wastes still needed to be investigated. **Table 12** presents a summary of mining related impacts documented during the 2007 field effort. A significant number of mining-related features such as mine waste areas, shafts, and adits were documented using a recreational-grade hand held GPS unit and photographs were taken of significant mining features in each area. The nine priority sites investigated in fall 2007 include the following:

- Carbonate No. 2 Claim – Tunnel No. 2 Adit located approximately 200 feet north of US Highway 200.
- Paymaster Claim (Patented) – No. 2 Tunnel located approximately 550 feet upstream of No. 1 Tunnel.
- Paymaster Claim (Patented) – An improperly abandoned drill hole (possibly a core hole) located approximately 200 feet upstream of Tunnel No. 1.
- Belle of the Hill Claim (Unpatented) – Tunnel located 50 feet from Blackfoot River.
- Copper Wreath Claim (Patented) – Tunnel No. 10 (potential dump site) located 75 feet northeast of Capital Mine and approximately 200 feet from Stevens Creek.
- Denver Claim (Patented) – Tunnel No. 9 (potential dump) located 75 feet west of Tunnel No. 10 and 125 feet from Stevens Creek.
- Capital Claim (Patented) – Tunnel No. 12 located 225 feet from the Denver claim, 350 feet from Capital No. 2, and 25 feet from Stevens Creek.
- Capital Claim (Patented) – Tunnel No. 11 located 75 feet southwest of Tunnel No. 12 on Stevens Creek and approximately 300 feet downstream of the Capital Mine.
- Capital Mine – located 50 feet from Snowdrift Mine and Stevens Creek.

3.5.2 2008 Mine Inventory

2008 Inventory of Mine Features

Mine inventory work continued in 2008 (**Table 12**) for those sites that were not inventoried during the fall 2007 investigation. Mine inventory work for 2008 consisted of the following activities:

- Inventory mine and mining related features that were not inventoried in 2007.
- Investigation of Mary P Mine area.
- Further investigation of mine waste areas located above the Anaconda Mine.
- Investigation of lower No. 3 Tunnel area.
- Analyzing select composite samples collected from mine waste areas in 2007.

The 2008 mine inventory focused on locating and describing mine-related features in the following four areas:

- Midnight Hill Area: Eureka, Calliope, Copper Gate, Sunlight, Sunset, Yellowstone, and Summit Fracture mines, and Tunnel site.
- Consolation Mine Area: Black Foot Belle, Golden Eagle, Sky Scraper, and the Iron Hill Mine site.
- Anaconda Mine Area: Big Dick, Little Joe, Copper Bell, and Blue Cristle Mines.
- Mary P Mine area.

Potential locations of mine features were first identified based on historic mining maps. These locations were then visited by field personnel who also identified additional sites while traversing between locations. In particular, areas along active streams were evaluated for the presence of mine wastes. Locations of mine features (mine waste areas, structures, shafts, adits, etc.) were logged using a hand-held GPS unit and described in field notebooks. The approximate size and volume of mine wastes were estimated and observations were made and noted regarding whether mine wastes were in contact with or near stream channels. Types of structures present at the inventory site, if any, were also noted. Photographs of significant features were taken for future reference.

Samples of mine wastes were collected in instances where the wastes were in proximity to surface water resources. Waste samples consisted of composite samples collected from the 0- to 6-inch depth increment and were analyzed as described the 2008 SAP (Tetra Tech 2008).

Surface water and stream sediment samples were also collected from stream reaches to evaluate potential affects from nearby mine wastes. In most cases, sample locations were positioned to provide samples upstream and downstream from the waste areas. Sample collection, laboratory analysis, and field measurement methods are described in further detail in the 2008 SAP (Tetra Tech 2008).

Some of the mine features identified in 2007 and 2008 were not proposed for further reclamation action or further study. **Table 13** provides a list of mine features that were sampled and evaluated with no significant disturbance. The criteria used to determine “no significant disturbance” are “No Threat to Physical Safety,” No Hazardous Materials or Less Than 100 cy of Excavated Rock Present,” and “No Discharge to or Contact with Surface Water.” **Table 14** provides a list of mine features that did not meet the “no significant disturbance” criteria and are areas of concern. These features were either sampled or identified as needing further evaluation.

2008 Mine Inventory Stream Sampling

Field personnel inspected each mine inventory area for mine wastes, contaminated and transported sediment, and seeps or adit discharges to surface water.

Surface water and sediment were sampled in areas where mine wastes and/or seeps/flows represented a potential concern to surface water and streambed sediment quality. The purpose was to determine if any mine waste areas in the drainages might require remedial action. Field personnel collected surface water and sediment samples in several gulches. The surface water and sediment sample collection and analytical methods were consistent with the methods used for surface water and streambed sediment samples collected from the Blackfoot River and its tributaries during the 2007 and 2008 sampling events as presented in the 2007 and 2008 SAPs (Tetra Tech 2007b and 2008). Section 4 presents the sampling results.

3.5.3 2011 Mine Inventory

3.5.3.1 Pass Creek Mine and Bobby Boy Mine

Pioneer (2012) performed an inventory (**Tables 12** and **14**) of two mines in 2011 including 1) the Pass Creek abandoned mine feature identified during the 2007/2008 inventory; and 2) the Bobby Boy Mine, located in Porcupine Gulch (**Figures 14** and **15**). The purpose of the Pass Creek work was to document the latitude and longitude of the mine feature for location on site maps, and verify 2007/2008 inventory information.

The purpose of the Bobby Boy Mine inventory work was to: 1) locate and record the location of the mine for inclusion as part of the Facility and place on site maps; and 2) evaluate potential impacts from the mine. Field personnel sampled mine waste and collected surface water and sediment samples from the Bobby Boy mine area. Samples included a 5-point composite soil sample from the perimeter of the mine waste pile, surface water and streambed sediment samples upstream and downstream of the mine, and surface/adit water and sediment at the mine adit.

Field personnel noted that the Bobby Boy Mine waste pile was located in close proximity to Porcupine Creek, and that the stream turns to subsurface flow at the waste pile and emerges again in the stream channel approximately 50 yards downstream of the waste pile (Pioneer 2012). Adit water was discharging at approximately 0.5 gpm and flowing down the access road.

3.5.3.2 Shave Gulch

Pioneer collected soil, surface water, and streambed sediment associated with the 2008 mine inventory location SH-17. A streambed sediment sample collected in 2008 downstream of the waste rock pile at SH-17 indicated a concentration of 380 milligrams per kilogram (mg/kg) mercury in the sediment sample SHSE-101 (0-2”). This sample was the only streambed sediment sample of the entire RI investigation to exhibit concentrations of mercury above the RSL. The objective of the 2011 sampling event was to further evaluate potential impacts from the waste rock pile and, mercury impacts in particular. **Figures 14** and **15** show the 2011 sample locations.

3.6 2007 Mine Waste Reclamation/Remediation Area Investigations

3.6.1 Mine Site Waste Areas

2007 Mine Site Investigation

Tetra Tech sampled several mine waste areas during the Fall 2007 investigation. In areas where mine waste had been removed historically, sampling was performed to evaluate the effectiveness of the removal action by evaluating whether metals remained in soils along the perimeters of the removal areas at concentrations that are a potential risk to human health and ecological receptors, and to evaluate whether metals may be mobilized from the area. In areas where mine waste is still present (reclaimed in place), sampling was also performed to evaluate whether metals remain in the areas at concentrations that are a potential risk to human health and ecological receptors, and evaluate whether metals have the potential to be mobilized from the waste area.

Tetra Tech sampled the perimeter of each mine waste/mine waste removal area by taking one sample for every 50 linear feet surrounding the removal area. The samples were collected from the edge of the apparent removal area, just beyond the estimated removal limits. The goal of the sampling was to focus primarily on the outside edges of the reclamation. The samples were collected from each area from the 0- to 6-inch depth interval, beginning at the base of the current root layer, if present. One to two surface soil composite samples (0- to 6-inch depth

interval) were also collected from the central portions of areas where the mine waste was reclaimed in place.

Field personnel analyzed each sample in the field using an x-ray fluorescence (XRF) detector and recorded concentrations of the metals arsenic, cadmium, copper, lead, iron, manganese, mercury, and zinc on the field log. **Appendix B** provides copies of the field XRF logs. The XRF field screening levels used for mine waste areas were RSLs for Residential Soils, and the DEQ action level for arsenic in surface soil. The screening levels are as follows:

Metal	RSL
Arsenic	*40 mg/kg
Cadmium	70 mg/kg
Copper	3,100 mg/kg
Iron	55,000 mg/kg
Lead	400 mg/kg
Manganese	1,800 mg/kg
Mercury	10 mg/kg
Zinc	23,000 mg/kg

*DEQ Action Level for Arsenic (DEQ 2005).

Note: All samples, including XRF samples, were screened for non-carcinogen metals, when practicable, in the human health risk assessment using RSLs divided by 10. Aluminum, copper, and zinc were screened using RSLs divided by 10. When divided by 10, cadmium and mercury RSLs were too low for the XRF detection limits. Therefore, the respective RSLs weren't divided by 10. In addition, iron and manganese background concentrations at the UBMC are higher than their respective RSLs divided by 10. Therefore, iron and manganese RSLs weren't divided by 10.

One sample per every 10 collected was submitted for subsequent metals analysis to the laboratory. In addition, one-half of the samples submitted for laboratory analysis were analyzed by ABA and SPLP testing methods for the purpose of calculating site specific soil screening levels for all of the metals investigated in the RI. During the planning phase of the RI, it was decided that collection of this data was necessary due to the very low generic Soil Screening Levels (SSLs) for iron and manganese and the anticipation that these generic levels could not be met is such a highly mineralized area.

Similar to the Upper Marsh data, data from each mine waste area was evaluated in 2007 and 2008 by performing an isopleth analysis in 2007 to evaluate concentration contours. The data was updated in 2008 following data collection. XRF results and GPS data points for sample locations were entered into GIS and the spline function used to develop maps showing concentration contours. The information presented on the maps was used to evaluate areas of contamination along with metal concentration data. Section 4 presents additional details regarding the development of the concentration plots and discussion of the results.

The following provides a synopsis by area, of field observations made during the mine waste area sampling performed during the Fall 2007 investigation.

- Upper Anaconda Mine Waste Removal Areas: Tetra Tech sampled two mine waste removal areas and three smaller non-reclaimed mine waste areas associated with the Anaconda Mine. These features are located on the south-facing hillside overlooking the Anaconda water treatment plant on the north side of the upper Blackfoot River, and are designated as UAW1, UAW2, UAW3, UAW4, and UAW5 (Figures 7, 16 and 17). The larger of the two reclaimed areas (UAW2) is located on the hillside overlooking wetland cell "A" from the decommissioned constructed wetlands that predate the water treatment

plant. The second reclaimed area (UAW5) is located adjacent to an existing drainage, and is associated with a collapsed historic shaft (now backfilled). The three non-reclaimed waste areas (UAW1, UAW3, and UAW4) are located northeast and up-slope of the two larger reclaimed areas. Perimeter and composite samples were collected from areas UAW2, 5, and 1. Only composite samples were collected from UAW3 and UAW4. Field personnel indicated that the additional waste areas identified (UAW1, UAW3, and UAW4) had not been reclaimed as these areas were mounded, had a lack of vegetative growth, and consisted of brightly (yellow to orange) colored wastes with a strong sulfur odor.

- Capitol Mine Waste Removal Area: Previous historical investigations (Tetra Tech 2007a) indicated that the Capital Mine is associated with two discrete mine waste removal areas. However, Tetra Tech combined the two removal areas into one soil sampling area as the individual reclaimed areas were indistinguishable during the Fall 2007 event (Figures 7, 18 and 19). Perimeter samples and a composite sample were collected from this combined location. This waste area is located immediately adjacent to the Capital Mine and a small drainage. This area and all samples collected were designated as CMWA.
- Carbonate Mine Waste Removal Area: Tetra Tech sampled soil from the perimeter of and collected one composite soil sample from the Carbonate Mine waste removal area, beneath the cover soil (approximately 13 to 17 inches thick). This area is located north of US Highway 200 and adjacent to (both east and west of) the Carbonate Mine access road (Figures 7, 20 and 21). A low-lying, wetlands area, which was a former tailings impoundment, was found to be present across approximately half of the Carbonate Mine waste area, and is located on the east side of the Carbonate Mine access road (Figure 20). This area and the samples collected were designated as CARM. This area formerly contained waste rock, as well as tailings.
- Consolation Mine Waste Removal Areas: Previous historical investigations (Tetra Tech 2007a) indicated that two mine waste piles from this area were removed, consolidated and placed in the Consolation Mine adit. One removal area is located above the Consolation Mine adit and the second is located below the adit (Figures 7, 20 and 22). Tetra Tech combined the two reclaimed removal areas during the Fall 2007 RI into one soil sampling area as the individual areas were indistinguishable from one another (Figure 20). Field personnel also collected one sample of what appeared to be mine waste from an area east of (up-slope from) the identified removal areas. Samples collected from these areas were designated as CONM.
- Edith Mine Waste Removal Areas: A figure prepared in 1995 by McCulley, Frick & Gilman, Inc. illustrates 11 mine waste piles associated with the Edith Mine that were removed, re-graded, and re-vegetated (Figures 7, 23, and 24). These reclaimed mine waste areas were combined into three investigation groups during the Fall 2007 sampling event as many of the smaller, individual removal areas were not visually distinguishable from one another. These three areas are referred to as the West Edith (WEA1), Central Edith (CEA1), and East Edith (EEA1) area waste piles (Figure 23). Tetra Tech sampled the perimeters of each of the three investigation groups.
- No. 3 Tunnel: Mine waste was removed from No. 3 Tunnel in 1996 (Figures 7, 23, and 25). Tetra Tech sampled this removal area and collected additional grab samples from two possible mine waste features north of the Paymaster access road. The two features included a very small depression, possibly a retention pond, and what is possibly a mound of fine-grained tailings. During 2007, field personnel observed that the area north

of the No. 3 Tunnel reclamation area, and north of Paymaster Road, was disturbed and appeared to possibly contain mine waste piles. A historic aerial photograph of this area also indicated the area had been heavily disturbed. Sample designation for the No. 3 Tunnel area is N3TA.

- Mary P Mine Waste Pile: One mine waste pile (MPWA1) associated with the Mary P Mine is located on the south side of the site access road to the west of the Anaconda Constructed Wetlands (Figure 7). Samples from the Mary P waste pile were collected and analyzed in 1995 for metals and acid/base potential. Therefore, no additional samples were collected from the waste pile. However, the lateral extent of the waste pile was not evaluated until 2008.
- Mike Horse Mine Waste Piles and Reclamation Areas: Five mine waste rock piles historically existed south of the Mike Horse Mine and adjacent to Mike Horse Creek (Figures 7, 26 and 27). These five waste areas encompassed approximately 3 acres. These identified waste areas were reclaimed in-place by ASARCO in 1998 (Tetra Tech 2007a). Tetra Tech collected perimeter and composite soil samples at three of the reclaimed waste rock piles during the Fall 2007 investigation. The two remaining piles were removed in 2004/2005 and the removal areas were once again reclaimed during the fall of 2007. These waste areas at the Mike Horse Mine were designated as UMH1, 2 and 3 (Figure 26).
- Paymaster Mine Waste Removal Areas: Three mine waste removal areas are historically associated with the Paymaster Mine. All three waste removal areas are located south of the Paymaster Mine and adjacent to the access road (Figure 28). ASARCO removed waste from these areas in 1996. The northernmost waste removal area currently lies beneath a constructed wetland, and was therefore not sampled during the 2007 investigation; however, the native soil beneath Cell B of the constructed wetland was sampled during the 2008 RI to evaluate the effectiveness of the 1996 waste removal action. Tetra Tech collected perimeter soil samples from the two remaining reclaimed waste removal areas. The northernmost of these two areas was designated as PMWA1, and the southernmost was designated as PMWA2.

2008 Mine Waste Reclamation/Remediation Area Investigations

Tetra Tech sampled mine waste areas to continue to evaluate the aerial extent of mine waste in each removal/reclamation area. Field personnel also sampled the native soil beneath the Paymaster Constructed Wetlands. The following sections describe the 2008 mine waste sampling activities.

Mine Waste Perimeter Sampling

Analytical results from mine waste area perimeter samples collected in 2007 indicated that the boundary of impacted soil areas was not fully delineated for several mine waste removal/reclamation areas. The 2008 RI field event focused on collection of field XRF data and laboratory analysis of soil samples for metals from these areas to further delineate the perimeter boundaries of these mine waste/reclamation areas and to further meet the three objectives for the RI identified in Section 1.2. The following table lists the 2008 mine waste area sampling areas.

Waste Area	Area Designation
Upper Anaconda 1	UAW1
Upper Anaconda 2	UAW2
Upper Anaconda 3	UAW3

Waste Area	Area Designation
Upper Anaconda 4	UAW4
Upper Anaconda 5	UAW5
Capitol Mine	CMWA
Carbonate Mine	CARM
Consolation Mine	CONM
Upper Mike Horse 1	UMH1
Upper Mike Horse 2	UMH2
Upper Mike Horse 3	UMH3
Paymaster 1	PMWA1
Paymaster 2	PMWA2

The investigation method included returning to each of these areas and further assessing the perimeter sampling locations where XRF and/or laboratory results indicated metals concentrations were greater than one or more EPA residential RSL (EPA 2011). The sampling method for these areas was as described in the 2008 SAP (Tetra Tech 2008) and is summarized below.

The general method consisted of field personnel locating the 2007 sample location that exceeded RSLs and/or DEQ arsenic action level. From this location, field personnel extended the boundary approximately perpendicular to the waste area and collected additional XRF readings from the ground surface at 25-foot lateral intervals until the XRF measurements indicated the waste area boundary had been reached. This was done by comparison of the XRF measurements for each metal with EPA RSLs and the DEQ action level for arsenic. Field personnel collected a verification soil sample from the location that most appropriately defined the lateral extent of the mine waste, based on XRF results. This final edge-of-tailings soil sample was collected from the 0- to 6-inch depth interval, below the existing root mass. The new final perimeter location was marked with a labeled wooden stake, and GPS coordinates of this location recorded with a resource-grade GPS unit. Samples collected from the final selected perimeter location were placed in a one-gallon re-sealable plastic bag then dried, as necessary and screened using a 10-mesh screen prior to verification XRF analysis. In addition, 10 percent of the verification samples were also selected for laboratory confirmation analysis for total metals, ABA, and SPLP metals.

Results of the 2008 investigation combined with the data collected during the 2007 investigation are discussed in Section 4**.** Additional site features were noted where pertinent or helpful for sample location identification and are included on all referenced figures.

3.6.2 Mike Horse Townsite and Mike Horse Repository

The Mike Horse Townsite was located on a bench overlooking the confluence of Mike Horse Creek with Beartrap Creek, and directly north of and across the creek from the Mike Horse Tailings Impoundment. Tetra Tech collected three composite samples in 2007 within the former Mike Horse Townsite area to evaluate the effectiveness of previous reclamation work. Samples MHTS-Comp1, MHTS-Comp2, and MHTS-Comp3 were collected along the approximate central northeast to southwest axis of the area. Samples collected from the area were designated “MHTS” for Mike Horse Creek Townsite. The samples were analyzed for metals.

Field personnel also collected four soil samples were collected in 2007 along a former road above the Mike Horse Repository to evaluate potential impacts from mine waste and possible airborne deposition of dust containing metals. The samples, labeled AMHR for above Mike Horse Repository, were collected laterally along the former road at 200 foot intervals. The samples were analyzed for metals.

3.6.3 Paymaster Constructed Wetlands

Field personnel used a backhoe to excavate four shallow test pits through the substrate of Cell B of the Paymaster Constructed Wetlands and into the underlying soil. The constructed wetland was constructed over top of an area formerly occupied by a mine waste pile. The mine waste pile was removed in 1996, prior to wetland construction. The purpose was to collect soil samples from the soil underlying the constructed wetland substrate to evaluate the effectiveness of a 1996 mine waste pile removal action.

Field personnel excavated through the wetland substrate then collected underlying soil samples beginning at the 0- to 6-inch, 6- to 12-inch, and 12- to 24-inch depth intervals. The area and sample name designation for this sampling activity was PMCW (**Figure 28**). Section 4 presents the results.

3.7 Floodplain Sediment

The Mike Horse Tailing Impoundment dam located on Beartrap Creek was breached during a heavy rain event in 1975. The breach resulted in the release of tailings materials into the active channels and floodplains of Beartrap Creek and the Blackfoot River, at least as far downstream as the Upper Marsh.

The cross-section of the Beartrap Creek canyon is very steep and narrow and this geometry appears to have forced the flood waters associated with the breach up onto the sidewalls of the canyon. This is evident from the debris line created by the turbulent flow of the breach, which resulted in downed trees and other debris that became entangled in the rooted tree-line when the waters receded. Obvious, thick and laterally continuous sedimentary deposits of tailings from the release are present within the stream and floodplain along Beartrap Creek and Blackfoot River. Less obvious indications of the breech are present in the sediment within the Upper Marsh and down-gradient reaches of the Blackfoot River, as indicated by lower metal concentrations observed in the marsh sediment, downgradient streambed sediment, and surface water.

The objective of the floodplain sediment investigation was to evaluate the lateral extent of impacts from the tailings breach within the floodplain of Beartrap Creek and the Blackfoot River. The initial investigation commenced in 2007 with limited sampling in 2008 and 2011 to close data gaps from the 2007 investigation.

The 2007 investigation included investigation of the upper portion of Mike Horse Creek. Mike Horse Creek has been impacted by mining activities related to the Mike Horse Mine and have included deposition of mine wastes and tailings directly to the stream, re-mobilization due to high water and flood events, and deposition of mine wastes associated with adjoining waste rock piles and repository.

“Floodplain sediments” hereinafter refer to sediment and/or sediment/soil mixtures that are either mine wastes or soils and sediments that have been impacted by mine waste (e.g, waste rock, tailings and other eroded mine waste) released to Beartrap Creek, the Blackfoot River, and Mike Horse Creek. The floodplain sediments reside within the floodplain and have the potential to become inundated with water and potentially re-mobilized during future high water and flood events, such as the flooding that occurred in 2008.

Historic soil data has been collected by other investigators for the floodplain areas directly adjacent to the streams and from specific depositional features that contain obvious mine waste. However, the lateral extent of mine waste-impacted floodplain sediment, from past mining, the impoundment breach, and other flood/high water events, was not delineated during previous investigations. Therefore, Tetra Tech’s field efforts in 2007 focused on evaluating the lateral

extent of the impacts by delineating the distal edges of mine waste-impacted floodplain sediment. Evaluation areas included the upper portion of Mike Horse Creek, Beartrap Creek from the impoundment down to the confluence of Beartrap Creek and Anaconda Creek, and the Blackfoot River from the confluence of Anaconda Creek and Beartrap Creek down to the upper marsh. The following describes the 2007 and 2008 floodplain sediment sampling activities.

3.7.1 2007 Floodplain Sediment Investigation

Field personnel sampled floodplain sediments along Mike Horse Creek, Beartrap Creek, and the Blackfoot River in 2007. The following provides a summary of the method used for sampling.

- Field personnel established a control point at the beginning of Mike Horse Creek, the Blackfoot River and Beartrap Creek for use as a reference point for all subsequent downstream measurements. Measurements for Mike Horse Creek commenced near the coffer dam and measurements on Beartrap Creek commenced at the confluence of Mike Horse Creek with Beartrap Creek. Measurements for the Blackfoot River began at the confluence of Anaconda Creek and Beartrap Creek, which is the beginning of the Blackfoot River.
- Field personnel established sampling transects at 100-foot intervals downstream from these respective control points. The transects extended on either side of the stream to the edge of visible tailings/mine waste impacts within the flood plain sediment. For Mike Horse Creek and Beartrap Creek, the transects were roughly east to west across the floodplain, and north to south across the upper Blackfoot River floodplain. A control stake was set at the visually estimated edge of tailings/mine waste (EOT) for each respective stream segment to establish a relative reference point for river/creek floodplain sediment/soil sample locations.
- River/creek floodplain sediment sample locations along each transect were measured relative to the EOT stake (e.g., floodplain sediment/soil samples collected from points closer to the stream than the EOT stake, were assigned a negative number while samples collected further away from the stream than the EOT stake were assigned a positive value. Sampling intervals along sampling transects generally consisted of -12.5 feet, 0.0 feet (at EOT) and +25.0 feet from the EOT stake. The stake locations were placed at these intervals in the attempt to verify the edge of the river floodplain sediments impacted by tailings/mine waste. Floodplain sediment samples at each location were collected from the 0- to 6-inch depth interval. Some sample locations in Beartrap Creek are high above the level of the creek due to evidence of depositional debris and possible tailings higher up on the hillside as a result of the initial pulse of water and debris from the breach.
- The EOT stakes along the creeks and Blackfoot River were surveyed using a Trimble GPX GPS device with sub-meter accuracy.

The river floodplain sediment samples were screened on site with an XRF detector with one in every 10 samples being submitted to the analytical laboratory for analysis of pH, electrical conductivity, total organic carbon, and total metals (arsenic, cadmium, copper, iron, lead, manganese, mercury, and zinc). Electrical conductivity may be used to evaluate soil/sediment properties such as the amount of soluble salts, cation-exchange capacity, and ability of the soil to support plant growth. One-half of the river floodplain sediment samples submitted to the laboratory were also analyzed for ABA and SPLP metals.

Similar to the Upper Marsh and mine waste data, data from the floodplain sediments for Blackfoot River and Beartrap Creek were evaluated in 2007 (and updated in 2008) by

performing an isopleth analysis in 2007 to evaluate concentration contours. XRF results and GPS data points for sample locations were entered into GIS and the spline function used to develop maps showing concentration contours. The information presented on the maps was used to evaluate areas of contamination along with metal concentration data. Section 4 presents additional details regarding the development of the concentration plots and discussion of the results.

Figure 29 shows an overview of Blackfoot River and Beartrap Creek extent of impacted floodplain sediments. **Figures 30** and **31** present the Blackfoot River sample locations and isopleth maps, respectively. **Figure 32** shows the Beartrap Creek sample locations and **Figure 33** presents the isopleth maps. **Figure 34** presents the Mike Horse Creek sample locations.

3.7.2 2008 Floodplain Sediment Investigation

Based on analytical results for the Fall 2007 investigation, field personnel performed additional EOT river floodplain sediment sampling as part of the Summer 2008 investigation. The number and location of samples was determined following review of 2007 investigation data and comparing the results to residential RSL concentrations. Several 2007 sample locations were in excess of the established RSL concentrations. The following table lists the locations that were sampled during summer 2008 field activities in an attempt to close data gaps and better locate the EOT boundary.

2008 Floodplain Sediment Samples

Beartrap Creek	Blackfoot River	
BCEOT-E22	BREOT-N15	BREOT-N67
	BREOT-N21	BREOT-S16
	BREOT-N22	BREOT-S19
	BREOT-N23	BREOT-S20
	BREOT-N24	BREOT-S21
	BREOT-N31	BREOT-S23
	BREOT-N36	BREOT-S32

Field personnel returned to each of the locations listed above to continue to evaluate the lateral extent of mine waste deposition along Beartrap Creek and the Upper Blackfoot River. Field personnel located each of the river floodplain sediment sample locations in the above table. Measurements were taken 25 feet laterally away from each location (away from the stream, toward the edge of the valley/hill) with a tape measure to re-locate the approximate location of the 25-foot boundary sample collected in 2007. This location was the starting location for 2008 sampling. Field personnel then extended laterally 25 more feet to the 50-foot sampling location and collected an XRF reading directly from ground surface and recorded the reading in the on the XRF field log. If the XRF reading indicated that one or more metals exceeded the RSL(s), the perimeter was extended 25 more feet and another XRF reading was collected. Field personnel continued to extend the perimeter until metal results were near or below their respective RSLs.

Once soils exhibited metals below their respective RSLs, an additional XRF reading was collected from 12.5 feet back toward the stream, splitting the distance from the furthest XRF reading and second furthest reading. If XRF results at this location exhibited metal concentrations above their respective RSLs, an XRF reading was collected from ½ the distance back toward outer-most XRF reading location. Soil samples were collected from the location that most appropriately defined the lateral extent of the mine waste, based on XRF results. The final perimeter soil sample was collected from the 0- to 6-inch depth interval at the base of the existing root mass. The new final edge-of-tailings location was marked with a labeled wooden

stake. GPS coordinates of the final perimeter location were collected with a resource-grade GPS unit.

Sample designations consisted of the area designation (see above table) followed by the lateral distance away from the initial edge-of-tailings location. For example, an XRF reading at BREOT-N24 from the ground surface 75 lateral feet from the original edge-of-tailings location BREOT-N24-0 would be labeled BREOT-N24+75 (0-6").

3.7.3 2011 Floodplain Sediment Sampling

Pioneer sampled floodplain sediment along Beartrap Creek in 2011. The objective for the sampling was to fill a data gap for site-specific soil screening in Beartrap Creek. The original samples from the RI had reporting values for SPLP results that were too high (due to a change in DEQ's SSL formula that changed in Spring 2008. The change resulted in the inability to calculate any site-specific SSLs for Beartrap Creek. Beartrap Creek was the only area in the entire RI that was affected 100 percent by DEQ's modification. Therefore, additional sampling and analysis was performed to gather sufficient data for calculation of site-specific SSLs.

Pioneer field personnel collected four soil samples (BCSD-201 through BCSD-204). The samples were analyzed for ABA, SPLP, and total metals. The samples were not analyzed by XRF. **Figure 32** shows the sample locations.

3.8 Discrete Streamside Mine Waste Deposits

During the 2007 investigation, waste samples were collected from six test pits excavated in distinct streamside waste deposit features where mine wastes and sediment had accumulated in bar/bar-like features along the upper Blackfoot River corridor (**Figure 35**). The purpose was to evaluate concentrations of mine waste/sediments in these deposits, including the vertical distribution of metal concentrations. The test pits were located according to a 2005 work plan prepared by Hydrometrics to investigate these deposits. Field personnel excavated the test pits using a backhoe and extended through the total observable depth of mine waste, until either the mechanical limits of the backhoe were reached, or until the groundwater-soil/mine waste interface was contacted.

Waste deposit samples were collected from three depth intervals over the 0-2 inch, 2-12 inch, and 12-24 inch depth intervals. In addition, samples were also collected at 12-inch depth intervals above and below the approximate native soil/sediment contact. Finally, if the native soil/sediment materials appeared impacted by leaching (e.g. stained, oxidized) of metals from overlying mine waste deposits, field personnel collected additional samples at 12-inch depth intervals deeper in the test pit until the native soil/sediment appeared to be unimpacted by leaching from the tailings. The mine waste and native soil/sediment samples were screened with an XRF detector to evaluate metal concentrations and to select one sample per test pit for laboratory analysis for total metals (arsenic, cadmium, copper, lead, manganese, mercury, and zinc), pH, electrical conductivity, total organic carbon, ABA and SPLP.

3.9 Reclamation Cover Sampling

ASARCO and ARCO began reclamation throughout the UBMC in 1993. Mine waste piles were removed in some instances and placed in engineered repositories, while other waste piles were reclaimed in place. Reclamation in these areas involved soil amendments and reseeding to stabilize soils and provide for post-mining land uses. There was a lack of information regarding the subsequent success or failure regarding reclamation revegetation in the UBMC.

Tetra Tech completed reclamation/revegetation cover sampling activities during 2008 to evaluate the success of past reclamation efforts and to provide information for planning

upcoming remedial action. The goals were to evaluate whether: 1) originally seeded vegetation species are established and continue to reproduce; 2) canopy cover of seeded sites is sufficient to protect soils and promote continued plant recruitment (ability of an area to propagate naturally introduced native and/or local seed stock); and 3) the established community is not dominated by weedy species and native plant species are able to colonize the site.

MFG (1996c) and MSU Reclamation Research Unit (1994) specified seed mixes used for upland and riparian areas during reclamation at the UBMC. The following tables present the seed mixtures.

Upland and Riparian Area Seed Mixes

The following seed mixes were used for upland and riparian reclamation work. The mixtures selected may not reflect species diversity (see Section 4.14 for further details).

UPLAND SEED MIXTURE		
Species	**Common Name**	**Rate (lb PLS/acre)**
Agropyron smithii	Western wheatgrass	6.0
Agropyron dasystachyum	Thickspike wheatgrass	4.0
Agropyron spicatum	Bluebunch wheatgrass	6.0
Bromus inermis	Smooth brome	2.5
Astragalus cicer	Cicer milkvetch	2.0
Poa compressa	Canada bluegrass	0.5
Festuca longifolia	Hard fescue	2.5
Festuca ovina	Sheep fescue	3.0
Agropyron smithii	Western wheatgrass	6.0
Total		26.5 lb. PLS/acre

lb PLS/acre – pounds “pure live seed” per acre
Winter rye (annual) was used as a living mulch and initial soil stabilizer for fall planting only.
Source: Hydrometrics 1995b, Hydrometrics 1996b

CARBONATE MINE RIPARIAN SEED MIXTURE		
Species	**Common Name**	**Rate (lb PLS/acre)**
Agrostic alba	Red top	0.5
Astragalus cicer	Cicer milkvetch	2.0
Beckmannia syzigachne	Sloughgrass	3.5
Deschampsia caespitosa	Tufted hairgrass	1.5
Festuca rubra	Red fescue	6.0
Phalaris arundinacea	Reed canarygrass	1.0
Poa compressa	Canada bluegrass	1.0
Poa pratensis	Kentucky bluegrass	1.5
Total		17.0 lb. PLS/acre

lb PLS/acre – pounds “pure live seed” per acre
Source: Hydrometrics 1995b

EDITH AND ANACONDA AREA RIPARIAN SEED MIXTURE		
Species	**Common Name**	**Rate (lb PLS/acre)**
Astragalus cicer	Cicer milkvetch	2.0
Beckmannia syzigachne	Sloughgrass	3.5
Deschampsia caespitosa	Tufted hairgrass	1.5

EDITH AND ANACONDA AREA RIPARIAN SEED MIXTURE		
Species	**Common Name**	**Rate (lb PLS/acre)**
Festuca rubra	Red fescue	6.0
Juncus effuses	Common rush	5.0
Phalaris arundinacea	Reed canarygrass	1.0
Total		24.0 lb. PLS/acre

lb PLS/acre – pounds "pure live seed" per acre
Source: Hydrometrics 1996b

CAPITAL MINE, CONSOLATION MINE, UPPER MIKE HORSE AREA, PAYMASTER AREA, AND No. 3 TUNNEL RIPARIAN SEED MIXTURE		
Species	**Common Name**	**Rate (lb PLS/acre)**
Achillea millefolium	Yarrow	2.5
Agropyron intermedium	Intermediate wheatgrass	5.0
Agropyron riparium	Streambank wheatgrass	5.0
Agrostis alba	Redtop	5.0
Agrostis tenuis	Colonial bentgrass	10.0
Astragalus cicer	Cicer milkvetch	2.5
Festuca rubra	Red fescue	10.0
Phleum pretense	Timothy	5.0
Triticum X Agropyron hybrid	Wheat X Wheatgrass	10.0
Total		55.0 lb. PLS/acre

lb PLS/acre – pounds "pure live seed" per acre
Winter rye (annual) was used as a living mulch and initial soil stabilizer for fall planting only.
Source: MFG 1997

CAPITAL MINE, CONSOLATION MINE, UPPER MIKE HORSE AREA, PAYMASTER AREA, AND No. 3 TUNNEL RIPARIAN SEED MIXTURE		
Species	**Common Name**	**Rate (lb PLS/acre)**
**Achillea lanulosa	Yarrow	5.0
Agrostis tenuis	Colonial bentgrass	10.0
Agrostis alba	Redtop	10.0
Festuca rubra	Red fescue	15.0
Phleum pretense	Timothy	10.0
Triticum X Agropyron hybrid	Wheat X Wheatgrass	15.0
Total		55.0 lb. PLS/acre

lb PLS/acre – pounds "pure live seed" per acre
Winter rye (annual) was used as a living mulch and initial soil stabilizer for fall planting only.
Source: MFG 1997

TOLERANT SEED MIXTURE		
Species	**Common Name**	**Rate (lb PLS/acre)**
**Achillea lanulosa	Yarrow	5.0
Agrostis tenuis	Colonial bentgrass	10.0
Agrostis alba	Redtop	10.0
Festuca rubra	Red fescue	15.0

TOLERANT SEED MIXTURE		
Species	**Common Name**	**Rate (lb PLS/acre)**
Phleum pretense	Timothy	10.0
Triticum X Agropyron hybrid	Wheat X Wheatgrass	15.0
Total		65.0 lb. PLS/acre

lb PLS/acre – pounds "pure live seed" per acre
** Achillea millefolium may be used if A. lanulosa is unavailable.
Source: MFG 1997

2007 PAYMASTER REPOSITORY AND UPPER MIKE HORSE AREA SEED MIX TOLERANT SEED MIXTURE		
Species	**Common Name**	**Rate (lb PLS/acre)**
Agropyron trachycaulum	Slender wheatgrass	3.0
Agropyron spicatum	Bluebunchwheatgrass	9.0
Stipa columbiania	Columbia needlegrass	3.0
Festuca idahoensis	Idaho fescue	3.0
Bromus marginatus	Mountain brome	10.0
Trifolium repens	White Dutch clover	0.5
Triticum aestivum X E.elongata	Regreen (annual nurse crop)	15.0
Total		43.5 lb. PLS/acre

lb PLS/acre – pounds "pure live seed" per acre
** Achillea millefolium may be used if A. lanulosa is unavailable.
Source: Hydrometrics 2006

For this remedial investigation, field personnel established monitoring plots on all revegetated areas that have had a minimum of two growing seasons since seeding to evaluate the effectiveness of the re-seeding efforts. **Figure 36** shows the investigation locations. Plots were established on the following sites:

- Anaconda Mine Reclamation Areas;
- Upper Mike Horse Reclamation Areas (excluding those seeded in 2007);
- Consolation Mine Reclamation Area;
- Edith Mine Reclamation Area;
- Paymaster Reclamation Area and Repository (excluding the area seeded in 2007);
- Carbonate Mine Reclamation Area and Repository;
- Capital Mine Reclamation Area; and
- Stevens Gulch Tunnel No. 3 Reclamation Area.

Field personnel placed transects in each revegetated area to quantify data variability. The number of transects depended upon the size and diversity of the reclamation area. Undisturbed reference sites with similar terrain, vegetative characteristics and site potential as those of reclamation areas were established and inventoried for comparison purposes. Reference sites provided:

- Baseline vegetation cover density;
- Baseline species diversity;
- Baseline community composition and dominant species; and

- Better information on seed mix requirements for subsequent remediation design.

Sampling was scheduled for late July 2008 to coincide with the maximum current-year growth. Cover sampling was conducted using the Point-Quadrat method to assess canopy cover and species composition. The SAP (Tetra Tech 2008) provides details on the investigation method.

In addition to evaluating vegetation cover, field personnel collected soil samples during the revegetation analysis to evaluate poor soil conditions that may be affecting vegetation success on the reclaimed areas. Soil sampling was completed for the reclamation areas where field observations indicate 10% or more vegetation appears affected by poor soil conditions. Field personnel collected the soil samples from the 0- to 6-inch depth interval. Soil samples were submitted for laboratory analysis for of pH, electrical conductivity, and metals concentrations, and the nutrient parameters total organic carbon, nitrogen, phosphorus, and potassium.

3.10 Background Soil and Sediment Sampling

3.10.1 Background Soil

Tetra Tech collected 11 background soil samples in 2007 and Pioneer collected another 19 in 2011. Background samples were collected from areas within the study area and in areas away from known or suspected areas where mining activities took place. Samples were collected from 15 areas expected to be less mineralized and from 15 areas anticipated to have greater mineralization. Selection of the sampling locations was based on geologic maps for the area. The following presents a list of the samples collected.

SAMPLES FROM LESS MINERALIZED AREAS		SAMPLES FROM HIGHER MINERALIZED AREAS	
Sample Name	**Associated Drainage/Area**	**Sample Name**	**Associated Drainage/Area**
ACBG-1	Anaconda Creek	MGBG-1	Meadow Creek
ACBG-2	Anaconda Creek	MGBG-2	Meadow Creek
BCBG-1	Beartrap Creek	PCBG-1	Paymaster Gulch
BCBG-201	Beartrap Creek	PCBG-201	Paymaster Gulch
BCBG-202	Beartrap Creek	PCBG-202	Paymaster Gulch
BCBG-203	Beartrap Creek	PSCBG-201	Pass Creek
MHBG-201	Mike Horse Creek	SGBG-1	Stevens Gulch
MHBG-202	Mike Horse Creek	SGBG-201	Stevens Gulch
PCBG-203	Paymaster Gulch	SHGBG-1	Shave Gulch
PSCBG-202	Pass Creek	SHGBG-2	Shave Gulch
PSCBG-203	Pass Creek	SWGBG-1	Swamp Gulch
SHGBG-201	Shave Gulch	SWGBG-2	Swamp Gulch
SHGBG-202	Shave Gulch	UBRBG-201	Upper Blackfoot
SHGBG-203	Shave Gulch	UBRBG-202	Upper Blackfoot
UBRBG-203	Upper Blackfoot	UBRBG-204	Upper Blackfoot

Field personnel collected the samples by hand excavating with a shovel or hand auger. Soil was collected from the 0- to 6-inch depth interval, following removal of forest duff and vegetation, if present. If vegetation was present, the sample was collected from an interval at the base of the root mass. Field personnel recorded the coordinates of each sample location using a recreational grade hand-held GPS unit. **Figures 2** and **7** show the location of each background soil sampling point.

All background soil samples were analyzed by both XRF and an analytical laboratory. Results from the 2008 samples screened with the XRF were used to select the three background soil samples with the highest metals concentrations for additional laboratory analysis for ABA and

SPLP. ABA and SPLP were analyzed to evaluate natural conditions related to acid generation and metal mobility from the soil.

The purpose of collecting the background samples was to evaluate background baseline values of metals in several drainages for comparison with metals concentrations in impacted areas of the facility. Tetra Tech used EPA's ProUCL v4.1.00 (EPA 2007a and b) to calculate background soil cleanup values for comparison with analytical results. Section 4 presents the results of the calculations.

3.10.2 Background Marsh Sediment

Tetra Tech collected background marsh sediment samples from three locations in Pass Creek Marsh in 2007 (PGBG-1 and PGBG-2) and 2008 (BRSD-5). BRSD-5 was previously sampled by others. In 2008, Tetra Tech re-sampled several historic BRSD marsh sediment sample locations in the Upper Marsh and BRSD-5 in Pass Creek Marsh to fill data gaps and for use in the ecological risk assessment. **Figure 10** shows the sample locations.

Field personnel collected the marsh sediment samples from the 0- 2-inch, 2- to 6-inch, and 6- to 12-inch depth intervals. The purpose was to evaluate metal concentrations in the Pass Creek Marsh, for comparison with the Upper Marsh sediment data, and to provide data for use in the ecological risk assessment. The marsh sediment samples were collected consistent with the rest of the Upper Marsh sediment sampling. The background marsh sediment sampling resulted in nine total metals samples for performing background soil calculations. Tetra Tech used ProUCL v4.1.00 to calculate site-specific background SSLs. Background soil calculations and results are presented in Section 4.

3.10.3 Background Streambed Sediment Sampling

Tetra Tech sampled sediment at two locations considered as background. These include BRSW-6 along Anaconda Creek above the confluence with Beartrap Creek/Blackfoot River, and BRSW-11 along Pass Creek within the Pass Creek Marsh (**Figure 9**). Field personnel sampled BRSW-6 in 2007 and 2008, and BRSW-11 was sampled only in 2007. Samples were collected from the 0- to 2-inch depth interval at each location. Samples were analyzed according to the SAP (2007 and 2008). Tetra Tech used the analytical results to calculate background sediment screening values using EPA's ProUCL v4.1.00 (see Section 4).

3.11 Ecological Risk Investigation

3.11.1 Terrestrial and Marsh Surface Investigation

Field personnel collected ecological data in both terrestrial and marsh habitats during the 2008 investigation. Terrestrial and marsh habitats, plants invertebrates, and small mammal tissue residue was collected to evaluate trophic transfer. The tissue residue data was evaluated in a food chain analyses that will consider the potential for transfer of metals from sediments, soils, plant, invertebrates, and small mammals to higher organisms, such as fish, predatory birds, waterfowl, and mammals.

Historic data and data collected during the fall 2007 investigation were used in a screening evaluation to identify areas of low, moderate, and high risk based on EPA's ecological soil screening values (http://www.epa.gov/ecotox/ecossl/). Based on these results, transects were identified for additional data collection in the terrestrial and marsh habitats. Three transects were staged in each habitat as described below. Three to five samples of plant, invertebrate, and small mammal tissue residue data were collected along each transect. Soil samples were collocated with the tissue residue data.

In the terrestrial habitat, the following transects were established (**Figure 37**):

- High Risk – Transect **BRTT1** is within the EOT boundary in the Blackfoot River floodplain. This transect crosses a dispersed tailings pile and provides a representation of risk at a high risk area.
- Moderate to Low Risk – Transect **BCTT1** is just outside of recommended EOT boundary in the Beartrap Creek floodplain. This area represents generally low risk.
- Reference – Transect **ANTTREF** is adjacent to Anaconda Creek and is in an area unimpacted by mining activities.

In the marsh habitat, the following three transects were established (**Figure 38)**:

- High Risk – Transect **UMT1** runs through the eastern portion of the marsh in a north to south direction. This transect provides a representation of risk in a high risk area.
- Moderate to Low Risk – Transect **UMT2** runs from the western edge to middle of marsh. This area represents generally low risk.
- Reference – Transect **PGREF** is located within the Pass Creek marsh in an area unimpacted by mining activities.

The following sections provide the detail regarding the collection of tissue residue data.

3.11.1.1 Terrestrial Receptor Sampling

The tissue data representative of small mammals, vegetation, terrestrial invertebrates in the upland habitat were collected along transects located within the EOT along Beartrap Creek and Blackfoot River, and in the Anaconda Creek reference area outside the edge of overbank tailings. Field sampling and laboratory analysis methodology for each terrestrial receptor is described below and was performed as described in the 2008 SAP Addendum (Tetra Tech 2008). **Figure 37** shows the terrestrial transect locations.

Vegetation Sampling

Vegetation analysis was used to evaluate the environmental risks of assimilation of contaminants to plant material. Vegetation was sampled along the terrestrial receptor transects, with samples collocated with small mammal, invertebrate, and soil samples. Three to five sampling plots were located on each transect, dependent on the location where the small mammals were collected. Vegetation plots consisted of 2 x 2 meter (m) quadrants to ensure collection of sufficient material. Plots were placed adjacent to soil/invertebrate/mammal sample locations in a location that was representative in cover and dominant species composition to the surrounding area. Vegetation samples consisted of composite samples of available grasses, forbs, and associated seeds, which are the primary diet of herbivorous birds and mammals. Samples were collected and analyzed as specified in the 2008 SAP Addendum (Tetra Tech 2008).

Small Mammal Sampling

Small mammals were collected and analyzed to evaluate the environmental risks of assimilation of contaminants to small mammals, and subsequently to carnivorous wildlife species. Because the screening evaluation showed the highest risk to insectivore mammals, the small mammal trapping targeted the shrew species for collection. Small mammals were sampled along the terrestrial receptor transects, with samples collocated with vegetation, invertebrate, and soil samples. Three to five small mammals were collected at each transect, dependent on transect length and capture availability.

Small mammals were trapped using both pit-fall traps and small Sherman live-traps. Pit-fall traps were employed to target the collection of shrew species, which are predominately invertivores. Sherman live-traps rarely result in the capture of shrew species and generally yield captures of mice and vole species, which are generally granivores and herbivores. Sherman live-traps were utilized to supplement the number of captures obtained from pit-fall traps to ensure a sufficient number of samples.

Captured animals were identified to species, age, and sex, and the weight, length, species, age, and sex of each individual were recorded. Individuals not chosen for collection were immediately released. Collection preference was for non-breeding (non-scrotal males, non-lactating and non-pregnant females) adult specimens, dependent on capture availability. Collected animals were humanely euthanized by thoracic compression. The samples were handled and analyzed per the 2008 SAP Addendum (Tetra Tech 2008).

Terrestrial Invertebrate Sampling

During the 2007/2008 winter, a screening level ecological risk assessment was conducted using 2007 site specific soil data from the Blackfoot River, Beartrap Creek, dispersed tailings, and mine waste areas. This screening level assessment indicated that the highest risk was to insectivorous avian and mammal species. Therefore, terrestrial invertebrates were collected and analyzed in 2008 to evaluate the environmental risks of assimilation of COPCs to invertebrates, and subsequently to wildlife species.

Terrestrial invertebrates were sampled along the terrestrial receptor transects, with samples collocated with vegetation, small mammals, and soil samples. Two to three invertebrate samples were collected at each transect, dependent on transect length and capture availability. Terrestrial invertebrate samples were a composite of many taxa and individuals based on availability at each site. Collectors searched at the soil level, under logs, rocks and debris, and also used a sweep net to collect invertebrates on vegetation and in the air. All invertebrates were collected, handled and analyzed as per the 2008 SAP Addendum (Tetra Tech 2008).

Soil Sampling

Soil samples were collected along terrestrial receptor transects, collocated with small mammal, vegetation, and invertebrate samples to allow direct correlation among soil and biological receptors in terms of COPC assimilation. Three to five soil samples were collected at each transect, dependent on transect length. Soil samples were collected from the 0- to 6-inch depth interval, beginning at the base of the vegetative root layer, by hand excavating with a shovel or hand auger. Forest duff was cleared from the sample location prior to excavation and sampling. Field personnel removed gravel ½-size inch and greater from the sample during collection. All samples were collected, handled, and analyzed per the 2008 SAP Addendum (Tetra Tech 2008).

3.11.1.2 Marsh Surface Sampling

The tissue data representative of small mammals, vegetation, invertebrates in the marsh habitat were collected along transects located within the upper marsh and at the Pass Creek marsh reference area not impacted by mining activities. Field sampling and laboratory analysis methodology for collection of plants, invertebrates, and small mammals within the marsh is summarized below. The 2008 SAP Addendum (Tetra Tech 2008) presents additional investigation method details. **Figure 38** presents the marsh transect locations.

Vegetation Sampling

Vegetation was sampled along the marsh transects, with samples collocated with small mammal, invertebrate, and sediment samples. Three to five vegetation samples were collected

at each marsh transect, dependent on transect length. Vegetation sampling followed the protocols used for collection of terrestrial habitat, as summarized above, and per the 2008 SAP Addendum.

Small Mammal Sampling

Small mammals were sampled along the marsh transects and collocated with vegetation, invertebrate, and sediment samples. Three to five small mammals were collected at each transect, dependent on transect length and capture availability. Small mammal sampling followed the protocols used for collection of terrestrial habitat, as summarized above, and per the 2008 SAP Addendum.

Marsh Surface Invertebrate Sampling

Marsh invertebrates were sampled along the marsh transects, collocated with vegetation, small mammals, and sediment samples. Two to three invertebrate samples were collected at each transect, dependent on transect length and capture availability. Aquatic receptor transects traversed areas with several inches to several feet of surface water and portions of higher ground above water level. Marsh invertebrate samples were a composite of the many taxa and individuals available at each site. Collectors searched through all medium available to obtain an adequate invertebrate sample size, including water, soil, vegetation, and air. Marsh invertebrate sampling followed the protocols for terrestrial invertebrate sampling, as summarized above, and per the 2008 SAP Addendum (Tetra Tech 2008).

Marsh Sediment Sampling

Marsh sediment samples were collected along aquatic receptor transects, collocated with small mammal, vegetation, and marsh invertebrate samples to allow direct correlation among soil and biological receptors in terms of contaminant assimilation. Three to five soil samples were collected at each transect, dependent on transect length. Marsh sediment samples were collected from the 0-2 inch, 2-6 inch, and 6-12 inch depth intervals, beginning at the base of the vegetative root layer, by hand excavating with a shovel or hand auger. Marsh sediment sampling for aquatic receptors followed the protocols used for terrestrial receptors, as summarized above, and per the 2008 SAP Addendum (Tetra Tech 2008).

3.11.2 2007 and 2008 Aquatic Biota Investigation

2007 Aquatic Biota Investigation

Aquatic biota samples, information about the macroinvertebrate community, and metal concentrations data within macroinvertebrates and periphyton were collected at 10 sampling locations within the UBMC Project Area (**Figure 39**).

Field personnel collected macroinvertebrates and periphyton using procedures outlined in the 2007 SAP (Tetra Tech 2007b). Macroinvertebrates were collected using a Hess or Surber sampler depending on the depth and flow rate of the stream at the sampling location. Macroinvertebrate samples were collected to characterize the benthic community and were evaluated for diversity indices, taxa composition, and calculated biotic indices. Field personnel also collected macroinvertebrates for whole-body analysis for metals (aluminum, arsenic, cadmium, copper, lead, iron, manganese, mercury, and zinc). Approximately 2.0 to 5.0 grams of macroinvertebrates were collected from each sampling site. Periphyton samples were collected from riffle and shallow water runs. Periphyton samples were analyzed for chlorophyll composition and ash free dry mass (AFDM).

Field personnel collected 12 macroinvertebrate community samples, and nine periphyton samples. The nine periphyton samples were also submitted for metals analysis.

2007 Macroinvertebrate and Periphyton Sampling Locations	
BRSW-6*	BRSW-101*
BRSW-12*	BRSW-102
BRSW-17*	BRSW-106*
BRSW-16*	BRSW-108*
BRSW-33*	BRSW-109*

*Periphyton and metal analysis

Of the 17 locations designated for sampling in the 2007 SAP (Tetra Tech 2007b), 7 locations were not sampled due to the conditions at the sample locations. The 7 locations were either located in a marshy or deep water area that was not suitable for sampling based on the sampling methodology or the project objectives, or in locations that were too dry to sample (e.g. dry channel).

2008 Aquatic Biota Investigation

Tetra Tech sampled macroinvertebrate and periphyton during the spring 2008 investigation at six locations within the project area, based on information obtained during the 2007 investigation. **Figure 39** shows the location of the stream macroinvertebrate and periphyton sampling stations. These stations are coincident with 2008 surface water and streambed sediment sampling locations. The stations were selected based on potential exposure levels, location relative to marsh inlets and outlets, river-tributary junctions, and whether the site could serve as a possible control or reference site. The sites sampled for macroinvertebrates and periphyton were:

2008 Macroinvertebrate and Periphyton Sampling Locations	
BRSW-6	BRSW-101
BRSW-16	BRSW-106
BRSW-17	BRSW-108

Macroinvertebrate community samples, macroinvertebrate tissue samples and periphyton samples were collected in June 2008 as part of the spring sampling program conducted at UBMC in order to capture any pulse disturbance associated with spring snowmelt run-off. Macroinvertebrate sampling was conducted for community indicators and tissue sampling for metals analysis. Periphyton sampling was conducted for chlorophyll composition and AFDM.

3.11.3 Marsh Sediment Bioassay Investigation

Marsh sediments were collected and analyzed in accordance with the 2008 SAP Addendum (Tetra Tech 2008). Seven bioassay sediment collection locations (BA1, BA2, BA4, BA5, BA6, and BA7) were sampled in July 2008 and included a reference sampling location (BA3 REF) in Pass Creek marsh (**Figure 39)**. BA6 was located in the Lower Marsh. Marsh sediment samples for bioassay were sent to a lab to complete a 10-day growth and survival test with *Hyalella Azteca* with analysis of the sediment for interstitial ammonia. The 10-day growth and survival test included monitoring temperature, dissolved oxygen, pH, hardness, alkalinity, and conductivity of the overlying water of the sample. The laboratory reported the monitoring parameters and performed statistical analyses on the mortality of the Hyalella Azteca in relation to the reference sample.

A portion of the marsh sediment was also sent to a lab for additional analysis. The analyses included total metals, total organic carbon, and grain size.

4.0 NATURE AND EXTENT OF CONTAMINATION

DEQ prepared a DSR (Tetra Tech 2007a) for the UBMC. This report: 1) presented a compilation of all existing and available information relevant to the UBMC; 2) evaluated the data by comparing it to appropriate screening levels; and 3) identified additional data gaps. The following sections provide a summary of the RI results for each media type investigated.

4.1 Quality Assurance/Quality Control

Tetra Tech performed data validation on laboratory analytical results for each media including soil/mine waste, sediment, surface water, groundwater, and biological (vegetation, invertebrates, mammals, etc.), as appropriate. The data validation was performed consistent with the methods prescribed in the RI SAPs (Tetra Tech 2007b and 2008). Data evaluation checklists were prepared for each laboratory analytical report. Appendix E includes copies of the laboratory report and data evaluation checklists. Data in each laboratory analytical report was evaluated for accuracy, precision, representativeness, comparability, and completeness.

Despite the large amount of data generated during this RI, relatively few analytical results required qualification. Each table of results and the data evaluation checklists present the associated qualifications. Qualifications were made for a variety of reasons. Most of the data that required qualification were qualified as estimated due to one or more of the following: matrix spike results or laboratory duplicate results outside control limits. Occasional detections of analytes in laboratory blanks or field blanks required qualification as non-detect due to blank contamination. None of the data collected and qualified during the RI were rejected. The RI data collected is considered complete, representative, and useable. The data is considered comparable to other data collected in the same manner, under similar conditions, and analyzed by the same or comparable methods.

4.2 XRF Data Versus Laboratory Data

Tetra Tech performed a general review of XRF data results relative to their corresponding laboratory data results for background soil, mine waste samples, Blackfoot River and Beartrap Creek floodplain sediments, and discrete streamside mine waste sediment. Relative Percent Difference (RPD) calculations between the laboratory results and XRF 10-mesh samples were performed to provide for a general evaluation of precision between the two methods of analysis. Where the XRF reported a non-detect value, the reported value was used in the calculation, as there were few metals samples for arsenic, copper, iron, lead, manganese, and zinc that exhibited results below the laboratory PQL. Cadmium and mercury RPDs were calculated but XRF detection limits were well above many of the laboratory concentrations reported for cadmium and laboratory results for mercury were below the laboratory detection limit. Therefore, precision between the laboratory and XRF for cadmium and mercury was poor. In addition, cadmium XRF results are expected to have interference because of the use of cadmium radiation sources in the XRF detectors that were used during sample analysis.

Using the detection limit for the other metals did not have a significant effect on the outcome of the RPDs as the values were within the overall range of the RPDs and the XRF detection limits, overall, were on the same order of magnitude as the laboratory results.

For this analysis, Tetra Tech evaluated the results with respect to low, median, and high concentrations. To do this, the median of the XRF10 results was found and divided by 3 to obtain a value that was one-third of the median concentration. The one-third value was subtracted from the median value to evaluation those results that were in the lower one-third of the data set, and the one-third value was added to the median value to evaluate those concentrations in the upper one-third of the data set. The remaining concentrations represented

the range in the middle one-third of the data set. Hence, three categories were created, the Low⅓, High⅓, and Mid⅓. “IF”/”AND” statements were developed in Excel to report those values in the lower, middle, and upper one-third ranges. Once the values in each category were identified, the RPDs were calculated for each set of corresponding laboratory and XRF10 values. The RPDs for each low, middle, and high data set was evaluated further by finding the minimum, maximum, and average RPDs for each category. **Appendix E** provides copies of the Excel spreadsheets. The following table presents the RPD results for each metal.

RPD CALCULATIONS XRF10 vs. LABORATORY RESULTS (%RPD)												
Concentration Ranges	**Background Soil**			**Mine Waste**			**Blackfoot River & Beartrap Creek Floodplain Sediments**			****Discrete Streamside Mine Waste Deposits**		
	Min	**Max**	**Avg**	**Min**	**Max**	**Avg**	**Min**	**Max**	**Avg**	**Min**	**Max**	**Avg**
Arsenic												
Low⅓	**26.2**	**26.2**	**26.2**	**1.86**	129	35.7	**3.33**	86.6	**35.0**	54.8	98.1	79.6
Mid⅓	**18.9**	49.1	36.7	**8.35**	105	47.1	**8.68**	63.7	**27.9**	**19.5**	150	78.2
High⅓	**2.17**	**27.0**	63.7	**2.35**	178	59.2	**2.45**	126	**33.1**	**14.2**	152	71.9
Cadmium												
Low⅓	*	*	*	*	*	*	*	*	*	*	*	*
Mid⅓	129	195	171	48.3	196	167	**1.82**	197	159	43.8	190	124
High⅓	*	*	*	127	178	128	**14.4**	199	84.4	**17.3**	103	65.3
Copper												
Low⅓	73.6	73.6	73.6	**0.82**	172	38.8	**0.31**	70.9	**34.8**	**1.39**	116	**38.0**
Mid⅓	**0.79**	**37.8**	**22.5**	**0.59**	61.6	**26.5**	**6.65**	45.9	**26.7**	**2.6**	82.1	**23.0**
High⅓	**4.74**	57.7	**24.2**	**0.41**	146	**24.1**	**2.12**	192	**34.8**	**2.67**	83.1	**33.6**
Iron												
Low⅓	43.9	43.9	43.9	**3.99**	64.1	42.1	*	*	*	*	*	*
Mid⅓	**6.83**	38.6	**20.3**	**2.58**	147	**31.8**	*	*	*	*	*	*
High⅓	**0.78**	40.6	**19.5**	**1.69**	130	**28.0**	*	*	*	*	*	*
Lead												
Low⅓	**16.8**	75.3	**34.4**	**0.28**	164	**27.3**	**1.86**	183	**33.4**	**3.02**	62.0	**29.5**
Mid⅓	**7.87**	**14.7**	**10.6**	**1.84**	158	**31.7**	**5.64**	**24.7**	**13.4**	**6.16**	83.9	38.1
High⅓	**0.139**	105	**30.3**	**0.39**	73.4	**26.0**	**0.57**	45.8	**18.5**	**8.37**	83.0	55.9
Manganese												
Low⅓	**24.8**	104	58.1	**0.21**	145	48.7	**3.1**	45	**24.4**	**8.73**	106	49.6
Mid⅓	**5.15**	97.2	61.4	**0.27**	97.7	**28.3**	**7.83**	76.9	**34.8**	**2.03**	100	58.6
High⅓	**18.4**	70	41.8	**0.46**	56.5	**23.6**	**3.71**	200	38.2	**7.38**	84.1	66.4
Mercury												
Low⅓	168	168	168	*	*	*	*	*	*	*	*	*
Mid⅓	159	175	169	151	181	174	170	183	177	176	184	180
High⅓	178	178	178	175	196	185	**0.42**	**8.11**	**6.20**	177	189	185

RPD CALCULATIONS XRF10 vs. LABORATORY RESULTS (%RPD)												
Concentration Ranges	**Background Soil**			**Mine Waste**			**Blackfoot River & Beartrap Creek Floodplain Sediments**			****Discrete Streamside Mine Waste Deposits**		
	Min	**Max**	**Avg**	**Min**	**Max**	**Avg**	**Min**	**Max**	**Avg**	**Min**	**Max**	**Avg**
Zinc												
Low⅓	**11**	40.8	**24.4**	**0.26**	115	**27.8**	**2.71**	105	**32.6**	**3.18**	66.1	**27.0**
Mid⅓	**4.4**	39.4	**18.4**	**4.17**	129	**28.1**	**0.46**	80.3	**28.2**	**2.0**	64.7	**31.7**
High⅓	**5.29**	**15.0**	**9.7**	**0.79**	117	37.8	**2.43**	108	**34.1**	**4.19**	69.8	**31.9**

* - Not calculated (no RPD values or constituent was not analyzed).
**XRF values used for Discrete Streamside Mine Waste Sediment calculations were not XRF10 values. The Discrete Streamside Mine Waste Sediment XRF samples were not dried or screened with 10-mesh screen prior to XRF analysis.
Shading and bold – RPDs ≤ 35% control limit

Shading in the above table represent those RPDs that were equal to or less than the field control limit of 50% and those values in bold in the above table represent those RPDs less than or equal to the laboratory control limit of 35% RPD. The majority of the average RPDs were within control limits. The fewest RPDs within control limits were those calculated for the Discrete Streamside Mine Waste Deposits and those for cadmium and mercury (see below). The RPD variability for the Discrete Streamside Mine Waste Deposits is likely a result of higher variability in the samples being analyzed since these samples were not dried or screening prior to XRF analysis. Overall, arsenic, copper, lead, and zinc appeared to have the most RPDs within the 35% and 50% control limits.

The laboratory and XRF data were compared further by developing linear regression charts for each set of data. The charts also included lines representing the soil screening values (action level/RSL/BTV) to generally evaluate where the data fell in relation to their respective soil screening values. **Appendix E** provides copies of the data and charts.

The following table presents a summary of the R^2 values generated for the linear regression charts. The R^2 values are the regression coefficients for the data. The closer the R^2 value is to 1, the better fit, or correlation. R^2 values above 0.8 are generally considered a "strong" correlation, meaning that 80% of the data can be explained by the relationship between the laboratory data and XRF data. The remaining 20% remains unexplained and is likely a result of variation within the sample (i.e. heterogeneity) or sample preparation and analysis (e.g. "nugget effect"). Obvious outliers were removed from the data set and were documented on each data set (**Appendix E**). Interestingly, all of the outliers for mine waste samples were those collected as composite samples from the central portions of the mine waste areas. The variability, again, is likely due to high variability in the samples due to heterogeneity and sample collection, preparation, and analysis methods.

LABORATORY vs. XRF10 LINEAR REGRESSION SUMMARY (R^2)								
Soil/Mine Waste/Sediment	**As**	**Cd**	**Cu**	**Fe**	**Pb**	**Mn**	**Hg**	**Zn**
Background Soil	0.607	0.0031	0.916	0.917	0.972	0.924	NC	0.97
Mine Waste	0.762	0.045	0.772	0.747	0.890	0.944	NC	0.762

LABORATORY vs. XRF10 LINEAR REGRESSION SUMMARY (R^2)								
Soil/Mine Waste/Sediment	**As**	**Cd**	**Cu**	**Fe**	**Pb**	**Mn**	**Hg**	**Zn**
Blackfoot River & Beartrap Creek Floodplain Sediments	0.773	0.902	0.972	NC	0.956	0.949	NC	0.934
Discrete Mine Waste Deposits	0.824	0.825	0.755	NC	0.965	0.556	NC	0.843

NC – unable to calculate calculated
Shading – R^2 values greater than 0.8.

The linear regression results show relatively good correlation between the laboratory results and XRF results. Of the 26 linear regressions calculated, 22 had R^2 values greater than 0.75, and 16 of the 22 had R^2 values greater than 0.8. The results indicate an overall strong correlation between the laboratory data and XRF data. Cadmium results for background soil and mine waste appeared to have the lowest correlation, as did manganese in the Discrete Mine Waste Deposit samples. The R^2 values for cadmium may be a result of the cadmium radiation source within the XRF.

Together, the RPD results and linear regression results indicate overall good precision and correlation between the laboratory and XRF10 data. The sampling completed in 2007 and 2008 was performed on an expedited basis. Overall, the XRF method used for the investigation provided a quick on-site screening method that, on average, resulted in RPDs between 35% and 50%, and linear regression results above 0.75 (75%). Changes to the screening method such as the analyses being performed under more controlled conditions (e.g. greater time for preparation, drying, and analysis), using smaller screens to analyze smaller size fractions, and longer instrument run times may result in greater precision and correlation.

Mercury evaluations were complicated by the fact that all but one of the laboratory results for mercury were <0.5 mg/kg and all XRF results were less than their corresponding XRF reporting limits, with the XRF results typically much higher than <0.5. Cadmium evaluations were also complicated as cadmium XRF results were non-detect based on the corresponding XRF reporting limits while the laboratory results were all detected above the laboratory reporting limit. The cadmium laboratory results were consistently much less than the XRF reporting limit. Additionally, the XRF detectors used for the project had cadmium radiation sources, which may create possible bias during the analyses.

In reviewing the remaining laboratory and XRF analytical data, high RPDs did not appear to follow a trend as to why some RPDs were high and some RPDs low. Sometimes the XRF data reported higher metal concentrations than laboratory results and vice versa. RPD and R^2 variability is likely due to matrix or instrument interferences, as interferences may affect detection limits and precision of the instrument. Common interferences are as follows (EPA 2004):

- Moisture content above 20% may interfere with sample analysis as moisture alters the soil matrix in relation to the XRF calibration matrix. Field personnel made an effort to dry samples before field XRF analysis. However, some samples were very wet due to prior rain and snow or were collected in wetter areas. Given the expedited time frame for sample collection, XRF analysis, and selection and submittal of samples for laboratory analysis, some samples may not have been thoroughly dried, and thus, may have had moisture content above 20%. Field personnel were drying samples in the field using portable open burners/hot plates. Other drying methods (e.g. dry and warm room with

oven(s)) and longer drying time would have likely reduced sample moisture to a greater extent.

- Sample matrix effects such as sample heterogeneity, uniformity, and particle size. Field personnel screened all XRF 10 samples to 10-mesh size prior to XRF analysis, and selection and submittal to the laboratory.
- Chemical matrix effects (e.g. iron absorption of copper x-rays).
- Position of samples in front of the probe window. The XRF window was placed directly on sample bags of soil at least 1-inch in thickness. The soil had been dried and screened to 10-mesh prior to analysis.
- Instrument resolution limitations may result in problems analyzing some elements, such as the instrument's inability to resolve energy differences. For example, the arsenic peak may overlap with the lead peak and the instrument may not accurately calculate the concentrations. This may particularly be the case where there is a lead-to-arsenic ratio of 10 to 1 or more as the lead peak will overwhelm the arsenic peak.
- RPD variability may also be due to the length of time the sample was analyzed. Given the expedited manner in which the field work was conducted, each of the XRF-Field and XRF 10 samples was analyzed with the XRF for 40 seconds. A greater analysis time of 60 to 120 seconds may have resulted in better correspondence (i.e. lower RPDs) between the XRF and laboratory results.

4.3 Establishment of Screening Levels

Data for all media sampled during the remedial investigation are compared to and/or interpreted relative to specific screening values for each media to determine the contaminants of potential concern (COPCs) in the following sections. These values are also reported in the data tables for each media and for each constituent and are summarized below.

4.3.1 Soil, Mine Waste, Floodplain Sediment, Streambed Sediment, and Marsh Sediment Screening Levels for Metals

Results for mine wastes, river floodplain soil, marsh sediment, streambed sediment, and discrete streamside mine waste deposit samples were compared to a number of soil screening values. Iron, lead, and manganese in particular were screened against background soil concentrations (Background Threshold Values or BTVs) due to their naturally occurring high concentrations. The soil and sediment screening values include the following:

- Ecological Sediment Screening Levels (ECO-SSLs);
- DEQ Action Level for Arsenic in Surface Soil;
- EPA RSLs for residential soil (EPA 2011): Aluminum, cadmium, copper, mercury, and zinc are screened to these values because UBMC background concentrations are lower than their respective RSLs;
- Soil Background Threshold Values (Soil BTVs; calculated): Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs;
- Marsh Sediment Reference Values (Marsh Sediment RVs): These are based on sampling of non-mine impacted marsh areas within the UBMC;

- Streambed Sediment Reference Values (Streambed Sediment RVs). These are based on sampling of non-mine impacted streams within the UBMC; and
- SPLP Leachate Criterion (Soil SPLP or Floodplain SPLP or Marsh SPLP): These criterion help to assess if there is a potential leaching problem that can impact surrounding sediment, soil, and water. If there is a potential leaching problem for a specific area at the UBMC, Site-Specific Soil Screening Levels (Site-Specific SSLs) for Protection of Groundwater will be developed in the Feasibility Study.

The following sections describe the development of the background Soil BTVs, the background Marsh and Streambed Sediment RVs, and the SPLP Leachate Criterion (site-specific soil screening levels for protection of groundwater). The screening level values are presented in their respective analytical results tables. Metal concentrations that exceeded their respective Soil BTVs, Marsh RVs, or Streambed Sediment RVs, and one or more of the other screening levels in their respective tables, were highlighted as exceedances.

4.3.1.1 Ecological Sediment Screening Levels

The ecological sediment screening levels were selected based on recent publications. Ecological sediment screening levels were used only for streambed sediment and marsh sediment results. The screening levels are included in their respective results tables.

- TEL: The TEL (toxic effects level) is calculated as the geometric mean of the 15th percentile concentration of the toxic effects data set and the median of the no-effects data set. As such it represents the concentration below which adverse effects are expected to occur only rarely. Freshwater TELs are based on benthic community metrics and toxicity texts results. Adverse biological effects are rarely seen below TEL. (Cubbage et. al. 1997, SAIC and Avocet 2002, SAIC and Avocet 2003)
- PAET: The PAET (probably effects threshold) is defined as the 95th percentile of values with no significant biological effects and concentrations greater than the lowest “hit” level. It is designed as an alternative value to the Apparent Effect Threshold to reduce the effects of random error. Entry is lowest, reliable value among a compilation of PAET levels for H-Hyalella Azteca bioassay or M – Microtox bioassay. (Cubbage et. al. 1997, SAIC and Avocet 2002, SAIC and Avocet 2003).
- SEL: The SEL (screening effects level) is defined as the 90-95th percentile screening level concentration based on in-situ benthic community structure. Contaminant concentration above the SEL is likely detrimental to the majority of benthic species. (Cubbage et. al. 1997, SAIC and Avocet 2002, SAIC and Avocet 2003).

Additional information regarding the above screening levels is included on the applicable streambed sediment and marsh sediment tables.

4.3.1.2 Site-Specific Background Soil and Sediment Screening Level Calculations

Tetra Tech used EPA’s ProUCL Version 4.1.00 statistical software to perform the background screening level calculations for soil, streambed sediment, and marsh sediment. The following provides a brief summary of the data used.

The background sample data was organized into three data sets for input into ProUCL. These included data sets for soil, streambed sediment, and marsh sediment. Data sets were as follows:

- Soil: The soil background data set includes results for 30 soil samples analyzed for aluminum, arsenic, cadmium, copper, iron, lead, manganese, mercury, and zinc. Mercury results were all non-detect, so they were not imported into ProUCL. The 30 soil

samples and locations are listed in Section 3.10. These background values are identified as Soil BTVs in this RI.

- Marsh Sediment: The marsh sediment background data set includes 9 marsh sediment samples analyzed for aluminum, arsenic, cadmium, copper, iron, lead, manganese, mercury, and zinc. Mercury results were all non-detect, so they were not imported into ProUCL. Aluminum and iron did not have sufficient samples for calculation of the Background Threshold Value (BTV) in ProUCL, so they were also not imported. Instead, the maximum detected concentration values for aluminum and iron from the background reference reaches were assigned as the screening values for the marsh sediment. The other six metals (arsenic, cadmium, copper, lead, manganese, and zinc) were imported into ProUCL for BTV calculations. The nine marsh sediment samples and locations are listed in Section 3.10. These background values are identified as Marsh Sediment RVs in the RI.
- Streambed Sediment: The streambed sediment background data set includes 3 streambed sediment samples analyzed for aluminum, arsenic, cadmium, copper, iron, lead, manganese, mercury, and zinc. Cadmium and mercury results were all-non-detect, and no analytes had sufficient samples for BTV calculations in ProUCL, so no samples were imported into ProUCL. Instead, the maximum detected concentration for each metal from the background reference reaches was assigned as the screening value for streambed sediment. These background values are identified as Streambed Sediment RVs in the RI.

The background soil and sediment data sets were imported into ProUCL, and the “Background” feature was used to develop upper prediction limits (UPLs) and upper tolerance limits (UTLs) for all metals as appropriate.

Tables 15, 16, and 17 present the ProUCL results tables for background soil, marsh sediment, and streambed sediment, respectively.

4.3.1.3 Dilution Attenuation Factors and SPLP Leachate Criterion for Soil/Sediment

Dilution Attenuation Factor (DAF) (no unit), is defined as the ratio of original soil leachate concentration to the receptor point concentration. A DAF of 1 means there is no dilution or attenuation at all, whereas higher DAF values correspond to greater degrees of dilution and attenuation. DEQ’s policy is to use a DAF value of 10 for Montana when a site-specific value is not available. The following DAFs will be applied at the UBMC:

- DAF 10 – Apply a default DAF 10 for all upland waste areas. The default is being applied due to incomplete information necessary to calculate a site-specific DAF.
- DAF 8 – Apply a site-specific DAF 8 for all of the UBMC floodplain soils due to their close proximity to the alluvial groundwater (see Appendix D for DEQ’s site-specific DAF calculations).
- DAF 1 – Apply a default DAF 1 in the marsh area. The default is being applied because having saturated marsh soil would assume no dilution or attenuation.

SPLP Leachate Criterion for Soil/Upland Waste Areas

The soil/mine waste leachate criterion for protection of groundwater is established for each metal by multiplying its respective DEQ-7 groundwater standard by a DAF of 10. For Iron and manganese, the EPA Tap Water Screening Level is used for the DAF 10 calculation as DEQ-7 does not have a groundwater standard for iron or manganese. The resulting number is compared against the specific SPLP results for that metal. Example: the DEQ-7 groundwater

standard for arsenic is 0.01 mg/L. When multiplied by the DAF of 10 it becomes 0.1 mg/L and will serve as the screening level for arsenic SPLP leachate results. If an arsenic SPLP result is equal to or above 0.1 mg/L, the soil that the SPLP test represents is considered as a potential impact to surrounding soil and water. If the arsenic SPLP result is below 0.1 mg/L, the soil that the SPLP test represents is not considered a potential impact to surrounding soil and water.

The SPLP Leachate Criterion for each metal screened in soil in the RI is as follows:

- Aluminum – not screened because DEQ-7 does not have a groundwater standard for aluminum
- Arsenic – 0.1 mg/L
- Cadmium – 0.05 mg/L
- Copper – 13 mg/L
- Iron – 110 mg/L (Leachate Criterion is based on EPA's Tap Water Screening Level for iron of 11 mg/L)
- Lead – 0.15 mg/L
- Manganese – 3.2 mg/L (Leachate Criterion is based on EPA's Tap Water Screening Level for manganese of 0.32 mg/L)
- Mercury – 0.02 mg/L
- Zinc – 20 mg/L

SPLP Leachate Criterion for Floodplain Sediment/Soil

Different leachate criterion is used for floodplain sediment and soil because of its close proximity to the river. Therefore, a site-specific DAF was developed for the floodplain sediment and soil. The leachate criterion for protection of groundwater is established for each metal by multiplying its respective DEQ-7 groundwater standard, or the EPA Tap Water Screening Level for iron and manganese (DEQ-7 does not have a groundwater standard for iron or manganese), by a site-specific DAF of 8. That number is compared against the specific SPLP results for that metal. Example: the DEQ-7 groundwater standard for arsenic is 0.01 mg/L. When multiplied by the DAF of 8 it becomes 0.08 mg/L and will serve as the screening level for arsenic SPLP leachate results for floodplain sediment and soil. If an arsenic SPLP result is equal to or above 0.08 mg/L, the sediment and soil that the SPLP test represents is considered a potential impact to surrounding sediment/soil and water. If the arsenic SPLP result is below 0.08 mg/L, the sediment/soil that the SPLP test represents is not considered a potential impact to surrounding sediment/soil and water.

The SPLP Leachate Criterion for each metal screened in the floodplains in the RI is as follows:

- Aluminum – not screened because DEQ-7 does not have a groundwater standard for aluminum
- Arsenic – 0.08 mg/L
- Cadmium – 0.04 mg/L
- Copper – 10.4 mg/L
- Iron – 88 mg/L (Leachate Criterion is based on EPA's Tap Water Screening Level for iron of 11 mg/L)
- Lead – 0.12 mg/L

- Manganese – 2.56 mg/L (Leachate Criterion is based on EPA's Tap Water Screening Level for manganese of 0.32 mg/L)
- Mercury – 0.016 mg/L
- Zinc – 16.0 mg/L

SPLP Leachate Criterion for Marsh Sediment/Soil

Different leachate criterion is used for marsh sediments and soil because of the constant interaction with water; it is assumed that a dilution attenuation factor greater than "1" does not exist. Therefore, the marsh sediment/soil leachate criterion for protection of groundwater is established for each metal by multiplying its respective DEQ-7 groundwater standard, or the EPA Tap Water Screening Level for iron and manganese (DEQ-7 does not have a groundwater standard for iron or manganese), by a DAF of 1. In other words, the DEQ-7 groundwater standard will serve as the leachate criterion for marsh sediment/soil. That number was compared against the specific SPLP results for that metal. Example: the DEQ-7 groundwater standard for arsenic is 0.01 mg/L. When multiplied by the DAF of 1 it remains at 0.01 mg/L and will serve as the screening level for arsenic SPLP leachate results for marsh sediment/soil. If an arsenic SPLP result is equal to or above 0.01 mg/L, the sediment/soil that the SPLP test represents is considered a potential impact to surrounding sediment/soil and water. If the arsenic SPLP result is below 0.01 mg/L, the sediment/soil that the SPLP test represents is not considered a potential impact to surrounding sediment/soil and water.

The SPLP Leachate Criterion for each metal screened in the marsh in the RI is as follows:

- Aluminum – not screened because DEQ-7 does not have a groundwater standard for aluminum
- Arsenic – 0.01 mg/L
- Cadmium – 0.005 mg/L
- Copper – 1.3 mg/L
- Iron – 11 mg/L (Leachate Criterion is based on EPA's Tap Water Screening Level for iron of 11 mg/L)
- Lead – 0.015 mg/L
- Manganese – 0.32 (Leachate Criterion is based on EPA's Tap Water Screening Level for manganese of 0.32 mg/L)
- Mercury – 0.002 mg/L
- Zinc – 2.0 mg/L

4.3.2 Acid-Base Accounting and Synthetic Precipitation Leaching Procedure

In addition to screening levels for concentrations of metals/metalloids, other screening criteria were used to interpret acid-base accounting data for soil, mine waste, and tailings samples to evaluate the potential for these materials to generate acidic leachate or run-off. These criteria, which are based on the ratio and difference between neutralization potential (NP) and acidification potential (AP), were adopted by the BLM and EPA as presented in the following table.

Acid-Base Accounting Classifications for Comparison With Soil, Mine Waste, and Tailings Sample Data	
Classification	**Criteria for Classification[1]**
Potentially Acid Generating	NP:AP < 1 and NNP < -20 tons/kton
Uncertain Acid Generation Potential	NP:AP between 1 and 3 and/or NNP[2] between -20 and +20 tons/kton
Unlikely to Generate Acid	NP:AP > 3 and NNP > +20 tons/kton

[1] From BLM (1996) and USEPA (1994).
[2] NNP: Net Neutralization Potential = NP – AP

SPLP leachate data is screened against leachate criterion (see Section 4.3.1.3) to evaluate if there are potential impacts to groundwater. The SPLP leachate data is from representative soil, floodplain sediment/soil, marsh sediment/soil, dispersed tailings, and mine waste areas. This leachate data is screened against the appropriate leachate criterion to evaluate what metals/metalloids and materials have the potential to migrate to and impact groundwater.

4.3.3 Groundwater and Surface Water – Water Quality Standards

Groundwater and surface water analytical results were compared to EPA Maximum Contaminant Levels (MCLs) and DEQ-7 water quality standards (DEQ 2010) for human health as listed in the following table. In addition to values that are protective of human health, acute and chronic aquatic life criteria were also applied to surface water. Aquatic life criteria for cadmium, copper, lead, and zinc are based on the hardness of water, which varies from location to location. These values were calculated for each surface water sample/location. The surface water analytical results tables presents the individual calculated acute and chronic values for each surface water sample collected during the site-wide surface water sampling and surface water sampling for mine inventory sites.

Summary of MCL/DEQ-7 Water Quality Standards for Groundwater and Surface Water (mg/L)								
Constituent	**Al**	**As**	**Cd**	**Cu**	**Fe**	**Pb**	**Mn**	**Zn**
Groundwater[a]								
Human Health Standard	None	0.01	0.005	1.3	None	0.015	None	2
Surface Water[a]								
Human Health Standard	None	0.01	0.005	1.3	None	0.015	None	2
Acute Aquatic Life Standard	0.75 b	0.34	HD	HD	None	HD	None	HD
Chronic Aquatic Life Standard	0.087 b	0.150	HD	HD	1.0	HD	None	HD

a -Values are based on total recoverable concentrations for surface water and dissolved concentrations for groundwater.
b - Standards for aluminum in surface water are based on dissolved analysis and only applicable to waters with pH between 6.5 to 9. Other values are based on total recoverable concentrations and apply regardless of pH.
HD = Hardness Dependent standard, specific standard calculated for each individual sample result.

4.4 Concentration Isopleth Analysis

Tetra Tech performed isopleth analyses to present visual representations of data collected for Upper Marsh (**Figures 11a** to **11c**), Blackfoot River (**Figure 31**), Beartrap Creek (**Figure 32**), and mine waste areas (**Figures 17, 19, 21, 22, 24**, and **27**). GIS was used to produce isopleths

showing metal concentration values based on XRF field soil sample data. Isopleths are lines of equal value and are commonly used to represent elevation contours. Isopleths of metal concentrations were generated using the spline function in ESRI ArcGIS Desktop 10. Isopleths generated for UBMC sites represented arsenic, cadmium, lead, manganese, zinc, and copper concentrations sampled from 2007 to 2011. Aluminum and iron were not included in the isopleth evaluation as these constituents were not measured in 2007 and the 2008 data was not sufficient enough to develop isopleths. Mercury data was not used as all results for mercury were below the laboratory detection limit.

The Spline function uses an interpolation method that estimates values using a mathematical function that minimizes overall surface curvature, resulting in a smooth surface that passes exactly through the input points (ESRI 2010). The power of the spline function is to interpolate point specific data between points resulting in isopleths or contours representing metals concentrations. This method is best for generating gently varying surfaces such as elevation, water table heights, or pollution concentrations (ESRI 2010).

Metal concentration isopleths for UMBC were based entirely on field data. Field protocol dictated that soil sample points were marked with GPS and labeled with a unique identifier. Similarly, XRF soil metal concentrations were labeled with the corresponding identifier, and were then linked to the sample location point. This process resulted in a point file that represented soil sample locations and site specific metal concentrations. Background Soil and Sediment Results

4.5 Background Soil

Tetra Tech and Pioneer collected a total of 30 background soil samples during the 2008 and 2011 sampling events. Fifteen of the background soil samples were from areas expected to be less mineralized and 15 from areas expected to have higher mineralization. **Figure 7** shows the background soil sample locations.

Background soil results were compared to DEQ Action Level for Arsenic in Surface Soil, EPA RSLs, ABA and Soil SPLP. Background soil results also were used to calculate site-specific Soil BTVs (see Section 4.3.1.2) All metals exhibited an exceedence of one or more screening levels for one or more samples. **Table 18a** presents the metals results. The exceedences are summarized below:

- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- No exceedances of EPA RSLs for aluminum, cadmium, copper, mercury, and zinc. These metals are screened to these values because UBMC background concentrations are lower than their respective RSLs.
- Iron, lead, and manganese exceeded their respective Soil BTVs. Iron, lead and manganese were screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- Arsenic, iron, and lead exceeded the Soil SPLP.

Tetra Tech also completed ABA and SPLP testing and calculations to evaluate the potential for background soil to generate acid and leach to groundwater or surface water. **Table 18b** presents the ABA and SPLP results. The following table summarizes the ABA acid generation test results.

Summary of Background Soil Acid Generation Evaluation				
Sample Depth Interval	**NP:AP**	**NP:AP[2] (t/kt)**	**NNP (t/kt)**	**Result**
ACBG-2 (0-6")	92	254	32.6	Unlikely to generate acid
UBRBG-203	46.7	156	13.7	Uncertain acid generating potential
UBRBG-204	10	33	2.7	Uncertain acid generating potential
PSCBG-203	7.1	10.2	4.3	Uncertain acid generating potential
SHGBG-1 (0-6")	57	106	30.46	Unlikely to generate acid
MGBG-1 (0-6")	10.4	4.3	22.6	Unlikely to generate acid
PCBG-201	10	33.3	2.7	Uncertain acid generating potential
PCBG-202	7.5	18.8	2.6	Uncertain acid generating potential
BCBG-203	0.007	0.0059	-1.29	Uncertain acid generating potential

t/kt – tons per kilotons NNP=NP-AP
Potentially acid generating = NP:AP[2]<1 and NNP<-20 t/kt
Uncertain acid generation potential=NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to generate acid = NP:AP>3 and NNP>+20 t/kt

ABA results indicate that background soil from the 0- to 6-inch depth interval in UBMC is unlikely to generate acid or has an uncertain acid generating potential. Soil SPLP results indicate that some lead concentrations found in the background soils have the potential to leach to surrounding soil or groundwater.

4.6 Background Marsh Sediment

Tetra Tech collected nine background marsh sediment samples (**Figure 10**) during the 2007 remedial investigation to evaluate metals concentrations of background sediment from Pass Creek Marsh (considered the reference marsh for the investigation) and to provide background data for use in the upcoming human health and ecological risk assessments. Three sample locations were sampled and three different intervals were sampled at each location from the 0- to 2-inch, 2- to 6-inch, and 6- to 12-inch depth. **Table 19a** presents the background marsh sediment metals results. All metals concentrations exhibited an exceedance of one or more screening level. The exceedances are summarized below:

- Arsenic, cadmium, copper, lead, and zinc exceeded one or more Eco-SSLs (TEL, PAET, and/or SEL).
- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- No exceedances of the Marsh Sediment RVs for aluminum, cadmium, copper, iron, lead, manganese, mercury, and zinc. These metals were screened to these values because UBMC background concentrations are lower than their respective RSLs.

Tetra Tech also completed ABA and SPLP testing and calculations to evaluate the potential for background marsh sediment to generate acid and leach to water. **Table 19b** presents the ABA and SPLP results. The following table summarizes the ABA acid generation test results.

Pass Creek Marsh Background Sediment Acid Base Accounting				
Sample ID and Depth Interval	**NP:AP**	**NP:AP[2] (t/kt)**	**NNP (t/kt)**	**Result**
BRSD-5 (0-2)	50.0	6.25	3.2	Uncertain acid generating potential

Pass Creek Marsh Background Sediment Acid Base Accounting				
Sample ID and Depth Interval	**NP:AP**	**NP:AP^2 (t/kt)**	**NNP (t/kt)**	**Result**
BRSD-5 (6-12)	18.2	82.6	3.78	Uncertain acid generating potential
PGBG-1 (0-2”)	7.89	4.16	13.1	Uncertain acid generating potential
PGBG-1 (6-12”)	10	12.5	7.2	Uncertain acid generating potential
PGBG-2 (6-12”)	0.9	9	8.0	Uncertain acid generating potential

t/kt – tons per kilotons
Potentially acid generating = NP:AP^2<1 and NNP<-20 t/kt
Uncertain acid generation potential = NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to generate acid = NP:AP^2 >3 and NNP>+20 t/kt

ABA results indicate that background sediment collected from Pass Creek marsh has an uncertain acid generating potential. SPLP results indicate that arsenic, cadmium, and lead have some potential to leach to soil/sediment and groundwater.

4.7 Background Streambed Sediment

Tetra Tech collected two background streambed sediment samples (**Figure 9**) during the remedial investigation to evaluate metals concentrations of background sediment from sample location BRSW-6 on Anaconda Creek (sampled in 2007 and 2008) and sample location BRSW-11 along Pass Creek (sampled in 2007). The background streambed sediment data was collected to provide background data for use in the upcoming human health and ecological risk assessments and for comparison with streambed sediment concentrations for samples collected during the RI. **Table 20** presents the streambed sediment results, including the results for background sediment samples BRSW-6 and BRSW-11. The following summarizes the background streambed sediment results.

- Arsenic, copper, lead, and zinc exceeded one or more Eco-SSLs (TEL, PAET, and/or SEL).
- No arsenic exceedances of the DEQ Action Level for Arsenic in Surface Soil.
- No exceedances of the EPA RSLs for aluminum, cadmium, copper, mercury, and zinc. These metals were screened to these values because UBMC background concentrations are lower than their respective RSLs.
- No exceedances of Soil BTVs. Iron, lead and manganese were screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- No exceedances of Streambed Sediment RVs.

4.8 Surface Water

4.8.1 Background Water Quality

Surface water quality data from sites upstream of historical mining activities are considered to represent background conditions. These data are available from historical investigations summarized in the DSR and from sampling conducted in fall 2007 by Tetra Tech. Sampling locations representing background conditions are listed in the following table.

Locations of Background Reference Surface Water Samples	
Tributary	**Sample Location Identification**
Anaconda Creek	BRSW-6
Pass Creek	BRSW-11

In general, background concentrations (measured as total recoverable metals) in samples from streams other than Paymaster Creek were near or below detection limits. Zinc was the most commonly detected metal, followed by iron, manganese, copper, and aluminum. Sulfate concentrations were below 10 milligrams per liter (mg/L), and pH was 7.0 or above. Individual streams exhibited slightly different metals signatures.

Surface water from Pass Creek typically exhibited detectable concentrations of iron, manganese, and zinc with occasional detections of copper. Swamp Gulch samples were similar to those from Pass Creek, but with fewer detections of those metals.

Water from Paymaster Creek differed from the infrequent, low-concentration detections of metals measured in samples from other streams. Paymaster Gulch had slightly higher than detectable concentrations of aluminum, copper, and zinc, higher concentrations of iron, manganese, and sulfate, and a pH below 7.0. Furniss (1998) postulated that the Mike Horse Fault System contributes groundwater with lower pH and higher metals concentrations to the surface flow in this segment of Paymaster Creek, as evidenced by ferricrete deposits at mid-stream locations near the fault zone. In addition, the 2007 mine waste inventory identified historical workings and mine wastes upstream of this area. Therefore, the Paymaster Gulch background location may be impacted by naturally occurring acid rock drainage and/or the historical mining activities. Because of this uncertainty, Paymaster Creek (BRSW-21) will not be used as a background reference location. Additional background surface water sampling may be needed in this area as well.

4.8.2 2007 Low Flow Surface Water Sampling

The following presents a summary of the 2007 surface water results for stream discharge, surface water analytical results, and loading analysis.

4.8.2.1 Stream Discharge

In October 2007, discharge measurements were made and surface water samples were collected at 27 locations on the Blackfoot River and tributaries including Mike Horse Creek, Beartrap Creek, Anaconda Creek, Stevens Gulch, Pass Creek and Paymaster Gulch, and discharges from two flowing mine adits (**Tables 21a** and **21b**). The results are discussed in this section.

In general, stream discharge increased and metals concentrations decreased from upstream to downstream in October 2007 (**Figure 40** and **Figure 41**). Measured flows ranged from 0.0105 cubic feet per second (cfs) at station BRSW-4 on upper Mike Horse Creek to 5.85 cfs at station BRSW-17 downstream of the Lower Marsh. Flows increased steadily from 0.0105 cfs at BRSW-4 to 1.34 cfs at BRSW-109, near the Mary P Mine. Several reaches exhibited decreasing flow as surface water was apparently lost to the alluvial aquifer. Below BRSW-109, at BRSW-9 near Stevens Gulch, flow decreased to 0.686 cfs and remained low downstream to station BRSW-36 (0.806 cfs). Further evidence of surface water loss to the shallow groundwater system in this area includes the infiltration of all the flow from the lowermost portion of Stevens Gulch into the alluvial aquifer between station BRSW-108 on Stevens Gulch and the Blackfoot River. Other losing reaches include the area between BRSW-33 and BRSW-12 (between Shave Gulch and

the Upper Marsh), the reach just downstream from the Upper Marsh (between BRSW-107 and BRSW-31), where the flow decreased from 2.05 to 1.76 cfs, and the reach from BRSW-17 to BRSW-102, mid-way between the Lower Marsh and Highway 279, where the flow decreased from 5.85 to 4.92 cfs.

4.8.2.2 Surface Water Analytical Results

In October of 2007, surface water collected from streams within the UBMC was compared with DEQ-7 surface water standards. The aquatic life standards for cadmium, copper, lead, and zinc were calculated based on sample-specific hardness. Aluminum, cadmium, copper, iron, lead, and zinc all exhibited concentrations at or above one or more of their respective human health or aquatic life DEQ-7 surface water standard(s). A summary of the results follows:

- Mike Horse Creek (BRSW-4, BRSW-4A, BRSW-44): Cadmium, lead, and zinc exceeded their respective DEQ-7 human health standard at one or more of the sampling stations. Cadmium, copper, lead, and zinc exceeded their respective DEQ-7 aquatic life standards (chronic and/or acute) at one or more of the sampling stations.
- Beartrap Creek (BRSW-23, BRSW-39A): Cadmium exceeded its DEQ-7 human health standard at one or more of the sampling stations. Cadmium, lead, and zinc exceeded their respective DEQ-7 aquatic life standards (chronic and/or acute) at one or more of the sampling stations.
- Anaconda Creek (BRSW-6, reference/background location): No concentrations were at or above any DEQ-7 standards for human health or aquatic life.
- Blackfoot River above the Upper Marsh (BRSW-29, BRSW-7, AW-003A, BRSW-109, BRSW-9, BRSW-36, BRSW-33, BRSW-12): Cadmium and zinc exceeded their respective DEQ-7 human health standard at one or more of the sampling stations. Aluminum, cadmium, copper, and zinc exceeded their respective DEQ-7 aquatic life standards (chronic and/or acute) at one or more of the sampling stations.
- Stevens Gulch (BRSW-108): No concentrations were at or above any DEQ-7 standards for human health. Cadmium, copper, lead, and zinc exceeded their respective DEQ-7 aquatic life standards (chronic and/or acute).
- Paymaster Gulch (BRSW-13, BRSW-21): No concentrations were at or above any DEQ-7 standards for human health. Cadmium, copper, iron, and zinc exceeded their respective DEQ-7 aquatic life standards (chronic and/or acute) at one or more of the sampling stations.
- Blackfoot River within the Upper Marsh (BRSW-107, BRSW-110): Lead exceeded its DEQ-7 human health standard at one or more of the sampling stations. Cadmium, copper, lead, iron, and zinc exceeded their respective DEQ-7 aquatic life standards (chronic and/or acute) at one or more of the sampling stations.
- Pass Creek (BRSW-11, reference/background location): No concentrations were at or above any DEQ-7 standards for human health. No concentrations were at or above any DEQ-7 standards for aquatic life.
- Blackfoot River from Upper Marsh to Lower Marsh (BRSW-16, BRSW-31, BRSW-103, BRSW-104, BRSW-105, BRSW-106): No concentrations were at or above any DEQ-7 standards for human health. Cadmium, copper, iron, lead, and zinc exceeded their respective DEQ-7 aquatic life standards (chronic and/or acute) at one or more of the sampling stations.

- Blackfoot River below the Lower Marsh (BRSW-17, BRSW-101, BRSW-102): No concentrations were at or above any DEQ-7 standards for human health. Cadmium exceeded its DEQ-7 aquatic life standards (chronic and/or acute) at one or more of the sampling stations.

4.8.2.3 Loading Analysis

A loading analysis was conducted to identify potential sources of metals loading to the Upper Blackfoot River (**Figure 42**). These data show that cadmium, copper, lead, manganese, and zinc loads increase with distance from the headwaters of the Upper Blackfoot River (i.e. Mike Horse Creek, stations BRSW-4 and BRSW-44) downstream to station BRSW-109 located below the water treatment facility. This indicates that the stream is impacted by metals loading from re-deposited tailings and/or other sources of loading within Beartrap Creek Canyon.

In comparison to historical data from October 2001, flows were higher in October 2007 except at the uppermost station, BRSW-4, and concentrations and loads of copper and manganese were higher in October 2007 at all locations. Compared to October 2001 data, the October 2007 concentrations and loads of cadmium, lead and zinc were lower in the upper reaches (Mike Horse and Beartrap Creeks) but higher in the downstream reaches. Exceedences of surface water standards for cadmium, manganese and zinc were more numerous and extended further downstream in October 2007, while exceedences for lead occurred at the same locations in October of both years.

4.8.3 2008 High Flow Surface Water Sampling

The following presents a summary of the 2008 surface water results for stream discharge, surface water analytical results, and loading analysis.

4.8.3.1 Stream Discharge

In June 2008, discharge measurements were made and surface water samples were collected at 16 locations on the Blackfoot River and tributaries including Mike Horse Creek, Anaconda Creek and Stevens Gulch (**Tables 21a and 21b**). The sampling included the two most upstream stations (BRSW-4 and BRSW-44) sampled in October 2007, two stations (MHSW-101 and MHSW-102) on Mike Horse Creek adjacent to a 2007 mine reclamation area, and the stations at the lower end of and downstream from the Upper Marsh (BRSW-107 through BRSW-101). The results are discussed in this section.

In general, stream discharge increased and metals concentrations decreased from upstream to downstream in June 2008 (**Figure 43** and **Figure 44**). Measured flows ranged from 1.1 cfs at station BRSW-4 on upper Mike Horse Creek to a high of 106 cfs at station BRSW-107 near the downstream end of the Upper Marsh and 105 cfs at station BRSW-101 near Highway 279.

4.8.3.2 Surface Water Analytical Results

In June of 2008, surface water collected from streams within the UBMC was compared with DEQ-7 surface water standards. The aquatic life standard for cadmium, copper, lead, and zinc were calculated based on sample-specific hardness. Cadmium, copper, iron, lead, and zinc all exhibited concentrations at or above one or more of their respective human health or aquatic life DEQ-7 surface water standard(s). A summary of the results follows:

- Mike Horse Creek (BRSW-4, BRSW-4A, BRSW-44): Cadmium, lead, and zinc exceeded their respective DEQ-7 human health standard at one or more of the sampling stations. Cadmium, copper, lead, and zinc exceeded their respective DEQ-7 aquatic life standards (chronic and/or acute) at one or more of the sampling stations.

- Anaconda Creek (BRSW-6, reference/background location): No concentrations at or above any DEQ-7 standards for human health or aquatic life.
- Stevens Gulch (BRSW-108): No concentrations were at or above any DEQ-7 standards for human health. Cadmium, copper, lead, and zinc exceeded their respective DEQ-7 aquatic life standards (chronic and/or acute) at one or more of the sampling stations.
- Blackfoot River within the Upper Marsh (BRSW-107): No concentrations were at or above any DEQ-7 standards for human health. Cadmium, copper, lead, and zinc exceeded their respective DEQ-7 aquatic life standards (chronic and/or acute).
- Blackfoot River from Upper Marsh to Lower Marsh (BRSW-16, BRSW-31, BRSW-103, BRSW-104, BRSW-105, BRSW-106): No concentrations were at or above any DEQ-7 standards for human health. Cadmium, copper, lead, and zinc exceeded their respective DEQ-7 aquatic life standards (chronic and/or acute) at one or more of the sampling stations.
- Blackfoot River below the Lower Marsh (BRSW-17, BRSW-101, BRSW-102): No concentrations at or above any DEQ-7 standards for human health. Cadmium and zinc exceeded their respective DEQ-7 aquatic life standards (chronic and/or acute) at one or more of the sampling stations.

4.8.3.3 Loading Analysis

Metal load data for the 2008 high flow sampling event indicate loads increase by up to two orders of magnitude in response to increased stream flow (**Figure 45**). Metal loads were steady between the Upper Marsh (BRSW-107) and station BRSW-104 then dropped considerably within the Lower Marsh (BRSW-103) before increasing at station BRSW-17.

4.8.4 2011 Surface Water Results

In November of 2011, six surface water samples collected from the Blackfoot River downstream of BRSW-101 (Highway 279 Crossing) were compared with DEQ-7 surface water standards. There were no metals concentrations at or above any DEQ-7 standards for human health or aquatic life. Surface water flow was recorded in 2011 (Pioneer 2011) from locations BRSW-201 through BRSW-206. The most upstream location, BRSW-206, had a flow of 3.57 cfs and the furthest downstream location, BRSW-201, had a flow of 19.6 cfs. The highest flows recorded were for the two mid-reach stations, BRSW-203 and BRSW-204. Flows for these stations were 25.4 at BRSW-204 and 24.16 at BRSW-203. BRSW-204 is just upstream the confluence of Horsefly Creek with the Blackfoot River and BRSW-203 is located just downstream the confluence.

4.8.5 Surface Water Summary

During both October 2007 and June 2008, stream discharge generally increased and metals concentrations generally decreased from upstream to downstream. Measured flows in October 2007 ranged from 0.0105 cfs at station BRSW-4 on upper Mike Horse Creek to 5.85 cfs at station BRSW-17 downstream of the Lower Marsh and in June 2008 from 1.1 cfs at BRSW-4 to 106.4 cfs at BRSW-107 downstream of the Upper Marsh. October base flow conditions showed reaches where streamflow was lost to the shallow groundwater system near the Mary P Mine, between Stevens Gulch, Shave Gulch and the Upper Marsh, and reaches downstream of the Upper Marsh. Flow in November 2011 on the Blackfoot River along the reach between BRSW-206 and BRSW-201 ranged from 3.57 cfs at the most upstream location to 25.4 cfs in the central portion of the reach.

All surface water samples collected in 2007, with the exception of BRSW-6 (Anaconda Creek reference sample), BRSW-11 (Pass Creek reference sample), and BRSW-101 (furthest downstream sample on the Blackfoot River), exceeded at least one DEQ-7 human health or aquatic life standard. The most frequent human health exceedances were cadmium, lead, and zinc, while cadmium and zinc were the most frequent aquatic life exceedances.

The surface water samples collected in 2008, with the exception of BRSW-6 (Anaconda Creek reference sample), exceeded at least one DEQ-7 human health or aquatic life standard. The human health exceedances only occurred in Mike Horse Creek with cadmium, lead, and zinc, while cadmium and zinc were the most frequent aquatic life exceedances. The 2011 surface water samples collected from BRSW-201 through BRSW-206 did not exceed any aquatic life or human health water quality standards.

4.9 Streambed Sediment

4.9.1 Historic Streambed Sediment Results

Data for historic fine-grained bed sediment samples (0-2 cm sample depth) show that metal concentrations are generally highest in upstream areas of the UBMC, near the historic mine facilities. Maximum sediment metals concentrations were observed in Mike Horse Creek, Beartrap Creek (downstream of the confluence with Mike Horse Creek), and the upper portion of the Blackfoot River (upstream of the first natural marsh). The historic results indicate that the metal concentrations in these sediments have decreased with time (Menges, 1997 and Nagorski, 2000).

4.9.2 2007 and 2008 Streambed Sediment Results

Data for streambed sediment samples collected during 2007 and 2008 field activities are reported in **Table 20** and a subset of the metal concentrations measured from the main stem of the Upper Blackfoot River are plotted in **Figures 46, 47,** and **48**.

4.9.2.1 Streambed Sediment Analytical Results

Table 20 presents the streambed sediment analytical results. The following summarizes the metals that were equal to or exceeded streambed sediment screening levels at one or more sample locations.

- Arsenic, cadmium, copper, lead, manganese, and zinc exceeded one or more ECO-SSL (TEL, PAET, and SEL).
- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- No exceedances of EPA RSLs for aluminum, cadmium, copper, mercury, and zinc. These metals were screened to these values because UBMC background concentrations are lower than their respective RSLs.
- Lead and manganese exceeded their respective Soil BTVs. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- Aluminum, arsenic, copper, iron, lead, manganese, and zinc exceeded their respective Streambed Sediment RVs.

BRSW-6 and BRSW-11 are background streambed sediment locations. Results indicated that BRSW-6 exceeded one or more ecological screening levels. BRSW-11 also had metals equal to or exceeding ecological screening levels. The furthest downstream sample collected was

BRSW-201. That sample exceeded the TELs for copper and zinc and the Streambed Sediment RV for zinc.

Increased metal concentrations were measured in sediment from the downstream Paymaster Creek location (BRSW-13) compared to the upstream location. However, these concentrations were considerably lower compared to those in main stem Blackfoot River sediments.

Concentrations of metals exceeding only the conservative TEL screening level were also measured in samples collected from the Lower Marsh (BRSW-103) and the Upper Marsh location near the confluence with Pass creek (BRSW-11, background reference sample);. It should be noted that each of these locations were sampled from slow moving waters at the edge of road fill slopes (i.e. Route 200 and the Blackfoot River forest access road). Therefore, low metals concentrations at these locations compared to other marsh sediment sample locations may be due to dilution with non-impacted fill materials.

Metal concentrations measured in streambed sediment samples collected from the main stem of the Blackfoot River are plotted as a function of location (**Figures 46, 47,** and **48**). These data are in agreement with historic observations that metal concentrations in sediment are generally greatest at upstream locations near mining related disturbances (BRSW-109) and lowest at downstream locations (BRSW-201). The recent and historic data are also in agreement that metal concentrations decrease most rapidly between the uppermost locations downstream to the outlet of the Upper Marsh at stations BRSW-107 and BRSW-110. The apparent increase in metal concentrations between upstream Upper Marsh location BRSW-110 and downstream BRSW-107 is most likely due to relatively fast moving water at the upstream location and the resultant lack of fine particles in the creek bed compared to the slower moving water and higher proportion of fine material encountered at BRSW-107.

Metal concentrations below the Upper Marsh are relatively constant except for a notable spike in aluminum, arsenic, cadmium, iron, manganese, and zinc concentrations measured at BRSW-104 in both 2007 and 2008. This station is located between the Middle and Lower Marsh, above the confluence of the Blackfoot River and Cadotte Creek.

Comparison of data collected during low flow conditions in 2007 and high flow conditions in 2008 generally show similar metal concentrations with two notable exceptions; 1) elevated arsenic was measured in 2008 samples and 2) greatly increased concentrations of arsenic, cadmium, manganese, and zinc were measured at BRSW-104 in 2008. Trends with respect to greater or lower metal concentrations observed between individual stations in 2007 were the same in 2008.

4.9.2.2 Depth-Integrated Comparison of Metal Concentrations

Figure 49 through **56** present plots of metal concentrations as a function of depth. Ten streambed-sediment sample locations were sampled at multiple depths including the 0- to 2-inch and 2- to 6-inch depth intervals, with three of the ten samples also being sampled at the 6- to 12-inch depth interval. As evident in the figures, some metal concentrations appear to be slightly higher with depth and some lower with depth. When reviewing the data in **Table 20** for the 0- to 2-inch versus the 2- to 6-inch depth intervals and the 2- to 6-inch versus 6- to 12-inch depth intervals, there does not appear to be a significant difference in metal concentration between the streambed sediment depths.

Further evaluation of the depth-integrated data in **Table 20**, indicates the number of metal concentrations that are lower in the underlying streambed sediment layer sampled is 39 whereas 46 of the comparisons made indicated higher concentrations in the underlying sediment layer. Tetra Tech evaluated the data further by calculating the relative percent differences (RPDs) in the metal concentrations between the depth intervals.

The RPDs calculated for metal concentrations between the overlying streambed sediment intervals verses the underlying sediment intervals at the ten sample locations indicated the RPDs ranged from 0.7% to 153% with an overall average RPD of 29%. Fifty-nine (59) of the 85 RPDs calculated were below 25%. Further, 71 of the 84 RPDs were less than the commonly used upper acceptable standard of 50% (when performing data evaluation), which typically accounts for sample heterogeneity in soil and sediment. Additionally, all concentration differences were in the same order of magnitude. The results of this evaluation suggest there is not a significant difference in the concentrations between the depth intervals.

The lack of significant differences between the intervals may be due to several factors, including: 1) fast-moving currents that made sampling discrete intervals difficult; 2) relatively consistent re-working and/or deposition of sediment 6 to 12 inches in depth; 3) consistent geochemical conditions between the intervals (e.g. redox conditions).

However, two locations in Paymaster Gulch (BRSW-113 and BRSW-21) resulted in RPDs that appeared to be significantly higher for metal concentrations between streambed sediment intervals. The RPDs for the two samples were consistently greater than 50% with RPDs ranging from 23.5% to155% with an average of 87.3%. The results indicate that the streambed sediment sample intervals likely represent different sediment deposits. A clearer distinction between metal concentrations in the sediment depth intervals may be due to:

- Surface water flow along Paymaster Gulch was slower than other streams sampled, which may have decreased the potential for mixing between sample depth intervals.
- The sample depth intervals may have been distinctly different (e.g. silt vs. sand, color variation due to oxidation, etc.). Distinct differences likely reduced the potential for mixing between depth intervals).
- Geochemical changes between the intervals may lead to variation in metal concentration (e.g. oxidation and precipitation of metals in the overlying layer with less oxidation in the underlying layer).

Metal concentrations for the Paymaster Gulch samples are within the same order of magnitude but do appear to suggest distinct sample intervals.

4.9.3 Streambed Sediment Summary and Conclusions

Historic streambed sediment data suggest that Anaconda and Pass Creeks were likely unaffected by mining impacts. RI sediment data identified arsenic, copper, and zinc as exceeding the TELs at both sites. These creeks are anticipated to represent background conditions for the Site.

Conversely, the main stem of the Blackfoot River, lower Paymaster Creek and Stevens Creek have elevated metal concentrations in sediment. Both the 2007 and 2008 data sets show metal concentrations that decrease with downstream distance to the outlet of the Upper Marsh. While fluctuations in metal concentrations do occur between stations below the Upper Marsh, these concentrations are relatively constant compared to locations above the marsh. A notable exception to this observation is a distinct spike in aluminum, arsenic, cadmium, iron, manganese, and zinc concentrations measured at BRSW-104 between the Middle and Lower Marsh, above the confluence of the Blackfoot River and Cadotte Creek. This spike was especially apparent during high flow conditions in 2008. Despite the spike in sediment concentrations in 2008, there were no exceedances of DEQ-7 human health standards for surface water.

No consistent overall trends in metal concentrations were observed with respect to sediment depth. Most of the differences did not appear to be statistically significant (see above section) as the majority of RPDs were within standard ranges and the metal concentrations were in the same order of magnitude between depth intervals. The Paymaster Gulch samples did appear to represent sampling of two distinct depth intervals as the RPDs were higher than those indicated by the other depth integrated samples collected in other areas of the UBMC.

4.10 Marsh Sediment

4.10.1 Upper Marsh

With respect to vegetation, the Upper Marsh is characterized by a yellow willow/sedge dominated community. The complex hydrology of the area is expressed as ponding, sub-irrigated saturated soils, and floating vegetation mats intermingled with dryer areas supporting limited spruce and lodgepole pine vegetation. The average root mat ranged from 6- to 12-inches thick. Gray (environmentally reduced) fine-grained sediments of silts, sands, and clays were encountered in the excavated sediments with high concentrations of pyrite. Upland areas, while not extensive, were often devoid of vegetation and appeared to have exposed tailings at the surface.

Two areas along the Blackfoot River were observed where the water exhibited a milky color and a white chemical precipitate/staining on the streambed substrate, characteristics often associated with high aluminum content. In addition, stream bank soil lenses with high iron content appear to be contributing rusty-red iron-oxide or ferri-hydroxide coatings to the substrate in the river. These stained areas were located within the main project area along the Blackfoot River above the Upper Marsh. Seeps down-gradient of the Upper Marsh were also noted. These seeps are outside of the primary areas of contamination and appear to precipitate metals (aluminum and iron) that are likely naturally occurring. These areas were not sampled during the RI.

The 2007 sampling effort resulted in the collection of 79 marsh sediment samples. The marsh sediment sample locations were based on a grid system placed over the Upper Marsh to provide systematic coverage. Additional marsh sediment samples were added for areas where a higher concentration of sampling points would assist with a more detailed evaluation of the area (i.e., in the delta portion of the Upper Marsh where the Blackfoot River enters). Three additional samples on this grid were collected in 2008 to close data gaps remaining from the 2007 data. Field personnel collected 14 additional marsh sediment samples in 2008 from areas close or coincident with sampling locations established in 1991 by Hydrometrics. A total of 121 Upper Marsh sediment samples were collected and analyzed during the 2007 and 2008 investigation.

Marsh sediment samples were analyzed for saturated paste pH, electrical conductivity, total organic carbon, and total metals (arsenic, cadmium, copper, iron, lead, manganese, mercury, and zinc). In addition, 35 of the marsh sediment samples were submitted to the laboratory for ABA and SPLP analysis to evaluate potential leaching ability of metals from the marsh sediments. **Table 22a** and **22b** presents the analytical results for the marsh sediments. Field observations noted the sample location, the visual presence of mine waste, sample color, and the presence of any unique features.

The following summarizes the metals that were equal to or exceeded marsh sediment/soil screening levels at one or more sample locations.

- Arsenic, cadmium, copper, lead, manganese, and zinc exceeded one or more ECO-SSL (TEL, PAET, and SEL).

- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- No exceedances of EPA RSLs for aluminum, cadmium, copper, mercury, and zinc. These metals were screened to these values because UBMC background concentrations are lower than their respective RSLs.
- Iron, lead, and manganese exceeded their respective Soil BTVs. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- Aluminum, arsenic, cadmium, copper, iron, lead, manganese, and zinc exceeded their respective Marsh Sediment RVs.
- Arsenic, cadmium, iron, lead, manganese and zinc exceeded their respective Marsh SPLPs.

Figures 11a through **11c** present metal iso-concentration (isopleth) maps for the Upper Marsh sediment data. The figures show that higher metal concentrations in sediment exist at the upgradient end of the marsh where the Blackfoot River enters the marsh and lower concentrations exist toward the margins and the down-gradient end of the marsh. This would be expected since tailings sediment from the breached impoundment would likely settle rapidly as it entered a standing body of water or low flow environment such as in the marsh. These figures also show a small area where metal concentrations are elevated with respect to surrounding sediment in the vicinity of where Swamp Gulch formerly entered the marsh near the Carbonate Mine.

Tetra Tech also completed ABA and SPLP testing and calculations to evaluate the potential for marsh sediments to generate acid. **Table 22b** presents the ABA and SPLP results. The following table summarizes the ABA acid generation test results.

Upper Marsh Sediment Acid Base Accounting				
Sample ID and Depth Interval	**NP:AP**	**NP:AP[2] (t/kt)**	**NNP (t/kt)**	**Result**
UM-0N-250 (2-6”)	0.79	0.06	-3	Uncertain acid generation potential
UM-0N-500E (0-2”)	0.82	0.04	-4	Uncertain acid generation potential
UM-0N-500E (6-12”)	0.12	0.001	-115	Potentially acid generating
UM-0N-750E (2-6”)	0.31	0.004	-52	Potentially acid generating
UM-0N-1000E (0-2”)	0.15	0.002	-74	Potentially acid generating
UM-0N-1000E (6-12”)	0.14	0.001	-95	Potentially acid generating
UM-0N-1500E (2-6”)	1.38	0.24	2.2	Uncertain acid generation potential
UM-0N-2000E (0-2”)	3.85	0.74	14.8	Uncertain acid generation potential
UM-0N-2000E (6-12”)	2.58	0.42	9.8	Uncertain acid generation potential
UM-250N-1750 (0-2”)	-0.80	-0.32	-4.5	Uncertain acid generation potential
UM-250N-1750E (6-12”)	0.83	0.35	-0.4	Uncertain acid generation potential
UM-250N-2250E (2-6”)	0.74	0.004	-50	Potentially acid generating
UM-250S-250E (0-2”)	0.00	0.00	-4.3	Uncertain acid generation potential
UM-250S-250E (6-12”)	8.33	13.89	4.4	Uncertain acid generation potential
UM-250S-500E (2-6”)	0.97	0.31	-0.1	Uncertain acid generation potential
UM-250S-1250E (2-6”)	0.00	0.00	-0.78	Uncertain acid generation potential
UM-250S-1500E (0-2”)	3.08	1.18	5.4	Uncertain acid generation potential
UM-250S-1500E (6-12”)	7.65	4.50	11.3	Uncertain acid generation potential
UM-250S-2500E (6-12”)	2.56	0.66	6.1	Uncertain acid generation potential
UM-250S-2750E (0-2”)	1.26	0.01	50	Unlikely to generate acid
UM-250S-2750E (6-12”)	0.54	0.005	-51	Potentially acid generating
UM-250S-3000E (2-6”)	0.16	0.001	-176	Potentially acid generating
UM-250S-3250E (0-2”)	7.69	5.92	8.7	Uncertain acid generation potential

Upper Marsh Sediment Acid Base Accounting				
Sample ID and Depth Interval	**NP:AP**	**NP:AP[2] (t/kt)**	**NNP (t/kt)**	**Result**
UM-250S-3250E (6-12”)	58.3	486	6.88	Uncertain acid generation potential
UM-500S-500E (0-2”)	1.16	0.17	1.1	Uncertain acid generation potential
UM-500S-500E (6-12”)	4.30	4.62	3.07	Uncertain acid generation potential
UM-500S-2000E (6-12”)	0.00	0.00	-3.2	Uncertain acid generation potential
UM-500S-2750E (2-6”)	0.88	0.004	-30	Potentially acid generating
UM-500S-3000E (0-2”)	0.48	0.001	-170	Potentially acid generating
UM-500S-3000E (6-12”)	0.90	0.09	-1	Uncertain acid generation potential
UM-500S-3250E (2-6”)	-0.73	-0.13	-9.5	Uncertain acid generation potential
UM-750S-3000E (2-6”)	1.77	0.01	100	Unlikely to generate acid
UM-750S-3500E (0-2”)	0.22	0.01	-21	Potentially acid generating
UM-750S-3500E (6-12”)	0.82	0.004	-40	Potentially acid generating
UM-1000S-3500E (2-6”)	2.00	2.00	1	Uncertain acid generating potential
BRSD-2 (2-6”)	0.02	0.00	-197	Potentially acid generating
BRSD-3 (0-2”)	0.19	0.005	-34	Potentially acid generating
BRSD-3 (6-12”)	0.00	0.00	-6.3	Uncertain acid generation potential
BRSD-4 (2-6”)	1.00	0.14	0	Uncertain acid generation potential
BRSD-6 (2-6”)	-0.04	0.00	-156	Potentially acid generating
BRSD-7 (0-2”)	0.20	0.004	-36	Potentially acid generating
BRSD-7 (6-12”)	0.00	0.00	-1.5	Uncertain acid generation potential
BRSD-8 (0-2”)	39.1	170.13	8.77	Uncertain acid generation potential
BRSD-8 (6-12”)	800	80,000	7.99	Uncertain acid generation potential
BRSD-9 (2-6”)	43.8	273	6.84	Uncertain acid generation potential
BRSD-10 (2-6”)	1.42	0.12	5	Uncertain acid generation potential
BRSD-11 (0-2”)	6.36	5.79	5.9	Uncertain acid generation potential
BRSD-11 (6-12”)	0.00	0.00	-0.07	Uncertain acid generation potential
BRSD-15 (0-2”)	10.3	26.3	3.61	Uncertain acid generation potential
BRSD-15 (6-12”)	--	--	7	Uncertain acid generation potential
BRSD-16 (2-6”)	-0.07	-0.003	-30	Potentially acid generating
BRSD-24 (2-6”)	0.46	0.003	-98	Potentially acid generating
BRSD-25 (0-2”)	0.37	0.001	-158	Potentially acid generating
BRSD-25 (6-12”)	0.36	0.002	-121	Potentially acid generating

t/kt – tons per kilotons
Potentially acid generating = NP:AP[2]<1 and NNP<-20 t/kt
Uncertain acid generation potential = NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to generate acid = NP:AP[2] >3 and NNP>+20 t/kt

ABA calculations were used to evaluate acid generation potential of the Upper Marsh sediments. The sampled sediments were collected below the vegetative root layer and were saturated at the time of collection. ABA results in combination with review of **Figure 10**, indicate that most of the samples that were potentially acid generating were those samples collected from sediments on the eastern portion of the Upper Marsh where the Blackfoot River enters the marsh, and the area where much of the initial tailings from the 1979 release would have been deposited. The other area where the most samples indicated potentially acid generating conditions were those near where Swamp Gulch enters or formerly entered the Upper Marsh (near the Carbonate Mine). These two areas are also the areas on the isopleth maps where results indicated the highest concentrations of metals in the samples, and areas where the concentrations exceeded one or more screening level. The majority of the remaining ABA results indicated an uncertain acid generation potential, with only a couple samples that were unlikely to generate acid. SPLP results indicate that arsenic, cadmium, iron, lead, manganese, and zinc found in the Upper Marsh sediments have the potential to leach into surrounding soil or groundwater.

The ABA results and SPLP results indicate that metals in sediments in the marsh have the potential to migrate to surrounding soil and water. However, the ability of these marsh tailings sediments to generate acid and mobilize metals may be inhibited by reducing chemical conditions and overlying organic mats within the Upper Marsh. These conditions are not necessarily maintained in the better drained margins of the marsh where vegetation rooted in tailings sediments appears to be impacted by acidity and elevated metal concentrations. As such, the potential for metal mobility in these areas is higher than in areas that are saturated year-round or the majority of the year. The organic content in the marsh from vegetation and degrading vegetation also likely acts as a sink for metals.

4.10.2 Middle Marsh and Lower Marsh

The objective for this sampling is to determine whether or not to include the Middle and Lower Marshes in the Facility. Samples were collected at the “head” of each marsh. The rationale is that sediments from the 1975 breach/flood would be more likely to settle in these areas and therefore, present a worst case scenario for sediment impacts in the marshes.

Pioneer collected six samples from two locations within the Middle Marsh and 12 samples from four locations within the Lower Marsh. The following summarizes the metals that were equal to or exceeded marsh sediment/soil screening levels at one or more sample locations.

Middle Marsh

- Arsenic, cadmium, copper, lead, manganese, and zinc exceeded one or more ECO-SSLs (TEL, PAET, and SEL).
- No arsenic exceedances of the DEQ Action Level for Arsenic in Surface Soil.
- No exceedances of EPA RSLs for aluminum, cadmium, copper, mercury, and zinc. These metals are screened to these values because UBMC background concentrations are lower than their respective RSLs.
- No exceedances of Soil BTVs. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- Aluminum, cadmium, copper, iron, lead, manganese, and zinc exceeded their respective Marsh Sediment RVs.
- Lead exceeded its respective Marsh SPLP.

Lower Marsh

- Arsenic, cadmium, copper, lead, manganese, and zinc exceeded one or more ECO-SSLs (TEL, PAET, and SEL).
- No arsenic exceedances of the DEQ Action Level for Arsenic in Surface Soil.
- No exceedances of EPA RSLs for aluminum, cadmium, copper, mercury, and zinc. These metals are screened to these values because UBMC background concentrations are lower than their respective RSLs.
- Manganese exceeded the Soil BTV. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- Aluminum, cadmium copper, iron, manganese, and zinc exceeded their respective Marsh Sediment RVs.

- Iron and lead exceeded their respective Marsh SPLPs.

Results indicate that Middle Marsh and Lower Marsh sediment have exceedences of screening levels. However, the Lower Marsh samples had lower metal concentrations than the sediment of the Middle Marsh. Both the Middle Marsh and Lower Marsh sediments exhibited lower metals concentrations than the sediment in the Upper Marsh. This would be expected as much of the tailings from the 1975 breach were likely settled out in the Upper Marsh with less deposition in the Middle Marsh and Lower Marsh during the event and subsequent high flow events.

Two samples, one for the Middle Marsh and one for the Lower Marsh, were analyzed for SPLP. Results indicate that lead found in the Middle Marsh sediments and iron and lead in the Lower Marsh sediments have the potential to leach into surrounding soil or groundwater. As with the Upper Marsh, the ability of these marsh tailings sediments to mobilize metals is potentially inhibited by reducing chemical conditions and overlying organic mats within the Upper Marsh. Areas that are better drained and have greater contact with atmospheric conditions have a higher potential to leach metals than those areas that have more consistent conditions of saturation and less contact with atmospheric conditions.

No ABA analyses were performed on the Middle Marsh or Lower Marsh sediments.

4.10.3 Marsh Sediment Summary

Analytical results from sediment collected from the Upper Marsh, Middle Marsh, and Lower Marsh indicate most metals analyzed exceed the ecological screening levels. Results also showed some exceedances for Marsh Sediment RVs Soil BTVs. SPLP results indicate that some of these metals have the potential to migrate to adjoining sediments, surface water, and groundwater. ABA results indicated that the eastern side of the Upper Marsh has sediment that is potentially acid generating as well as the sediment in the western portion of the marsh where Swamp Gulch enters. The remainder of the sediment in the Upper Marsh has either an uncertain acid generating potential or is unlikely to generate acid. No ABA analysis was performed on the Middle and Lower Marsh sediments.

Based on the isopleth maps (**Figures 11a** through **11c**), these same eastern and western areas exhibit the highest metal concentrations. The eastern portion of the marsh is an area where much of the tailings from the 1975 breach were deposited, and, therefore, would be expected to exhibit greater concentrations of metals. High metal concentrations near Swamp Gulch are likely a result of historic mining activities within the gulch.

The Middle Marsh and Lower Marsh sediments exhibit exceedances of ecological screening levels, Marsh Sediment RVs, and Soil BTVs. SPLP results indicate that lead may have the potential to migrate to adjoining sediments, surface water, and groundwater. Overall, the Middle Marsh and Lower Marsh exhibit lower concentrations than the Upper Marsh with the Lower Marsh exhibiting further decreases in metal concentrations. Again, this would be expected if much of the tailings from the 1975 breach settled within the Upper Marsh.

The ability of these marsh tailings sediments to generate acid and mobilize metals may be inhibited by reducing chemical conditions and overlying organic mats within the Upper Marsh. Areas that are better drained and have greater contact with atmospheric conditions have a higher potential to leach metals than those areas that are consistently saturated and have less exposure to atmospheric conditions. Organic matter within the marsh also likely acts as a sink for metals, further reducing metals mobility in the environment. Additional analyses would be required to further evaluate the geochemical conditions within the marsh.

4.11 Groundwater

4.11.1 Aquifer Testing

Aquifer tests were conducted in July 2008 at two locations along the Blackfoot River to provide data on the hydraulic properties of the alluvial aquifer and the degree of hydraulic connection between the alluvial aquifer and groundwater in the underlying bedrock. Both tests involved pumping a well completed in the Blackfoot River alluvial aquifer and monitoring the water level changes versus time in the pumping well and an adjacent well completed in bedrock beneath the alluvium. One test was conducted on alluvial well MPP-4 and bedrock well BRGW-110 located near the Mary P Mine. The second test was conducted downstream of the Upper Marsh, using alluvial well LCMW-1 and bedrock well BRGW-101. Both tests were conducted using a submersible pump to remove water from the pumping well and a data logger and pressure transducers to record water levels at regular intervals before, during, and after the pumping period. Manual measurements of water levels were also made before the start of each test and from time to time during the pumping and recovery periods.

4.11.1.1 Mary P Area

On July 29, 2008, a test was conducted using well MPP-4 (completed in the alluvial aquifer to a depth of 26.5 feet) as the pumping well and well BRGW-110 as an observation well. BRGW-110 is located approximately 7 feet from well MPP-4 and completed in bedrock with a screened interval from 31 to 41 feet. The log of well BRGW-110 indicates that the alluvium is 20 feet thick at this location and rests on highly fractured granite bedrock. The beginning water level measured in well MPP-4 indicated the saturated thickness of the alluvial aquifer at this location is approximately 10 feet. Well MPP-4 was pumped for 336.6 minutes at a rate of 3.1- to 3.5-gpm, which resulted in a time-weighted average pumping rate of 3.2 gpm).

At the end of the pumping period, a drawdown of 13.30 feet was measured in well MPP-4, and a drawdown of 3.98 feet was measured in observation well BRGW-110. The specific capacity of the pumping well was 0.24 gpm per foot of drawdown. The transmissivity estimated using the Theis method to analyze the response of the observation well to the pumping was 38 square feet per day (ft^2/d). The drawdown versus time curves for both the pumping well and the observation well deviate from the standard Theis-type curve in a manner that indicates that a recharge boundary was encountered within about 30 minutes of the start of the test, which would account for the apparently higher transmissivity estimates based on the late-time data (**Appendix D**). Analysis of the data from both wells for the recovery period after pumping stopped resulted in a transmissivity of 32 to 43 ft^2/d. The significant drawdown observed in bedrock well BRGW-110 indicates that the alluvial aquifer and the underlying bedrock are hydraulically connected and the degree of connection at this location is relatively substantial. The connection may be related to bedrock fracturing associated with the mineralized vein extending north-northeast across the Blackfoot River valley at this location. The average transmissivity and hydraulic conductivity of the alluvial aquifer at this location were estimated to be 38 ft^2/d and 3.8 feet per day (ft/d), respectively.

4.11.1.2 Upper Marsh Area

On July 30, 2008, a test was conducted using well LCMW-1 (completed in the alluvial aquifer to a depth of 26 feet) as the pumping well and well BRGW-101 as the observation well. BRGW-101 is located approximately 11 feet from well LCMW-1 and completed in bedrock with screen from 65 to 85 feet. The log of well BRGW-101 indicates the alluvium is approximately 53 feet thick at this location and is underlain by fractured black bedrock. The water level measured in well LCMW-1 indicates that the saturated thickness of the alluvial aquifer at this location is

approximately 45 feet. Well LCMW-1 was pumped for 306 minutes at a pumping rate of 16.7 gpm.

At the end of the pumping period, a drawdown of 7.31 feet was measured in well LCMW-1, and a drawdown of 0.05 foot was measured in observation well BRGW-101. The specific capacity of the pumping well was 2.3 gpm per foot of drawdown. Due to the minimal drawdown in the observation well, the transmissivity of the alluvial aquifer was estimated using the Theis method to analyze the response of only the pumping well during both the drawdown and recovery periods. This method resulted in a transmissivity range for the alluvial aquifer of 1,184 to 1,904 ft^2/d (Appendix D). The minor amount of drawdown observed in bedrock well BRGW-110 indicates that although the groundwater in the alluvial aquifer and the underlying bedrock are hydraulically connected, the degree of connection at this location is either relatively small or the hydraulic conductivity is great enough to minimize effects on the observation well. The hydraulic connection between the bedrock and the upper part of the alluvium may be limited by less-permeable layers in the alluvium, such as the silty clay layer logged at a depth of 28 to 30 feet in well BRGW-101. The average transmissivity and hydraulic conductivity of the alluvial aquifer at this location were estimated to be 1,500 ft^2/d and 33 ft/d, respectively.

4.11.2 Groundwater Wells

4.11.2.1 2007 Groundwater Sampling Results

In October 2007, groundwater levels were measured and groundwater samples were collected from 37 monitoring wells in the project area; three wells intended for sampling were dry and therefore could not be sampled. The sampled wells included 13 completed in bedrock and 24 completed in alluvium. The samples were intended to provide data from low groundwater conditions in areas where the DSR indicated potential sources of loading or where no samples had been collected historically to characterize potential sources of loading, or to evaluate background groundwater quality. **Figure 13** presents the groundwater sampling locations. The sampling results are summarized in **Tables 23a** and **23b** and on **Figures 57** and **58**.

Mike Horse Creek and Beartrap Creek Areas

Overall, groundwater samples from the Mike Horse Creek and Beartrap Creek areas exhibited higher concentrations and had more frequent exceedances of groundwater standards for the analyzed metals than did samples from wells lower in the project area. Groundwater standards for cadmium, copper, lead, and zinc were exceeded and iron and manganese were elevated (> 1 mg/L) in samples from the Mike Horse area. In samples from wells in the lower areas, the exceedances of groundwater standards were for cadmium, lead and zinc, but only rarely. Concentrations of iron and manganese were also elevated in the lower areas.

Groundwater samples from both the bedrock and alluvial aquifers in the Mike Horse Creek and Beartrap Creek canyon areas regularly exceeded the groundwater water quality standards for cadmium and zinc and, less often, copper, while manganese concentrations were elevated. The highest concentrations of cadmium, copper, lead, and zinc were observed in samples from wells UMHMW-2D and UMHMW-2S. Concentrations of total dissolved solids (TDS) and sulfate were also high in samples from these wells. Water from these wells assist with monitoring water quality related to mine tailings seepage.

Metal concentrations were generally lower in groundwater samples from the bedrock and alluvial wells farther downstream, in the lower Mike Horse Creek and the Beartrap Creek canyon areas, but groundwater from the well farthest downstream, BCMW-10 in the alluvial aquifer in lower Beartrap Creek canyon, still exceeded the groundwater standards for cadmium, lead, and zinc and had an elevated concentration of manganese. Monitoring of groundwater well MW-1 allows evaluation of bedrock groundwater and Mike Horse Fault contributions to

Mike Horse Creek upstream of the Mike Horse Mine. Alluvial well BCGW-115 is located where the Blackfoot Fault crosses the Beartrap Creek canyon. Groundwater from BCGW-115 contained non-detectable or very low concentrations of the analyzed metals.

The data indicate that historical mining activities in the upper Mike Horse Creek area continue to be a primary source contributing metals and other compounds to groundwater. The data also indicate that groundwater discharge from the two major faults crossing the area does not increase metals concentrations in groundwater in the area.

Blackfoot River Area

Groundwater in the alluvium within the Anaconda Creek drainage, above the confluence with Beartrap Creek, was monitored using well ANMW-9. Well ANWS-1 was used to monitor groundwater in the alluvium from the Anaconda Creek drainage near the confluence of Anaconda Creek and Beartrap Creek, and above the former Anaconda wetland treatment cells. Groundwater from both wells exhibited concentrations of metals near or below the laboratory analytical reporting limits, confirming that the Anaconda Creek drainage is not a source of metals in groundwater.

Well ANMW-7 is located in the Blackfoot River alluvium slightly downgradient from the former Anaconda wetland treatment cells. Groundwater from well ANMW-7 exhibited increased concentrations of cadmium, copper, and zinc in comparison to wells ANWS-1 and ANMW-9. However, the sample exhibited no metals concentrations above the DEQ groundwater standards. The results suggest that infiltration of water to the alluvial aquifer from the water treatment plant area contribute to higher metals concentrations in the alluvial aquifer. Metals in groundwater may originate from the former wetland treatment cells and mine wastes along the Blackfoot River in this area, including possible residual mine waste from the former waste pile that was removed from the wetland treatment cell area in 1995 and 1996.

Wells MPP-4 and BRGW-110 monitor the Blackfoot River alluvial and underlying bedrock aquifers, respectively, near the Mary P Mine. The October 2007 samples from those wells exhibited no metals concentrations above the DEQ groundwater standards. The concentrations of the other metals at MPP-4 were similar to those at ANMW-7. The concentrations of metals in the bedrock groundwater sample from well BRGW-110 were lower than those in the alluvial groundwater sample from well MPP-4, which indicates that groundwater discharge from the bedrock in this area would likely dilute the metals concentrations in the alluvial aquifer.

Stevens Gulch

Groundwater samples in the lower part of Stevens Gulch were obtained from alluvial well SGGW-101 and bedrock well SGGW-102. No metals were detected in either sample at concentrations above the groundwater standards. Relative to the concentrations observed in wells MPP-4 and BRGW-110 in the Blackfoot River valley, concentrations in groundwater from alluvial well SGGW-101 were lower for cadmium and zinc, higher for copper and lead, and about the same for manganese, whereas concentrations in groundwater from bedrock well SGGW-102 were higher for cadmium, copper, manganese and zinc; lead was not detected in either sample from the bedrock wells. The field-measured pH in samples from both SGGW-101 and SGGW-102 was low (3.30 and 3.99, respectively), but concentrations of sulfate, iron and TDS were moderately low and dissolved oxygen concentrations and oxidation-reduction potentials were relatively high.

Edith Mine Area

Groundwater near the Edith Mine was monitored with alluvial wells EDP-2 and EDMW-2 and bedrock well EDGW-105. Groundwater samples collected in October 2007 from all three wells

contained no metal concentrations above the groundwater standards, but they did have elevated (>1 mg/L) iron and manganese concentrations. Concentrations of all analytes were much higher in alluvial well EDP-2 than in alluvial well EDMW-2 and bedrock well EDGW-105, except for copper.

Compared to concentrations in alluvial wells upstream in the Blackfoot River valley, alluvial wells near the Edith Mine contained higher concentrations of iron and manganese, the same or lower (non-detectable) concentrations of lead, and mixed (higher and lower) concentrations of cadmium, copper and zinc. Concentrations of copper, iron and manganese in bedrock near the Edith mine were higher than in bedrock in Stevens Gulch and the Mary P Mine area. It therefore appears that groundwater from the Edith Mine area would contribute to higher concentrations of iron and manganese and might contribute to higher concentrations of copper, cadmium and zinc in the Blackfoot River alluvial aquifer.

Paymaster Gulch

Groundwater in Paymaster Gulch was monitored in October 2007 via samples from alluvial wells PMPZ-4 upstream of the Mike Horse Fault, PMMW-14 near a fault vein crossing the drainage downstream of the Mike Horse Fault, PMMW-13 near the Paymaster Mine site, and wells PMMW-15, PMGW-118, PMGW-117 and PMGW-116 downgradient of the Paymaster Repository and along the southern edge of the Upper Marsh. Bedrock groundwater quality in the area was monitored with samples from wells PMGW-119 and PMGW-120; well PMGW-119 is paired with alluvial well PMGW-118, and well PMGW-120 is near alluvial well PMMW-15.

Groundwater from alluvial wells PMPZ-4 and PMMW-14 contained elevated (>1 mg/L) concentrations of iron and manganese, but relatively low concentrations of cadmium, copper, lead and zinc. The elevated concentrations of iron and manganese may be due to historical mining-related activities upstream of PMPZ-4 and groundwater discharges from the fault. At well PMMW-13, cadmium exceeded its groundwater standard and copper and zinc were much higher than they were upstream at wells PMPZ-4 and PMMW-14, indicating that the mine area likely contributes to increased metals concentrations in the groundwater. Alluvial groundwater from well PMMW-15 didn't have any exceedances, while bedrock groundwater from well PMGW-120 exceeded the standard for copper, and had an elevated concentration of iron. There was a vertically downward hydraulic gradient from the alluvium to the bedrock at the PMMW-15 / PMGW-120 location (the alluvial water level elevation was about 2.3 feet higher than that of the bedrock), so the better-quality alluvial groundwater should have been flowing downward into the bedrock and diluting the higher metals concentrations in bedrock groundwater at that location. The PMGW-118 / PMGW-119 well pair showed alluvial groundwater with no exceedances of standards and an elevated manganese concentration, but bedrock groundwater exceeded the standard for copper and had elevated iron and manganese concentrations. The alluvial groundwater from well PMGW-117, downgradient of the proposed repository expansion area, contained a cadmium concentration above its groundwater standard and an elevated concentration of copper in comparison to other wells in the area. The furthest-downgradient alluvial well, PMGW-116, was the only well in the area at which no groundwater standards were exceeded.

Carbonate Mine Area

Groundwater in the Carbonate Mine area in Swamp Gulch was monitored with samples from four alluvial wells and one bedrock well. Groundwater samples from all the wells had elevated (>1 mg/L) concentrations of iron and manganese, and groundwater from well LCMW-12D exceeded the standard for cadmium. The sample from well LCMW-5 exceeded the groundwater standards for cadmium, lead, and zinc. The latter two wells mentioned are downgradient of the Carbonate Mine repository and in the reclamation area, and represent

groundwater leaving the area and entering the Blackfoot River alluvial aquifer. The data indicate that the Carbonate Mine area groundwater contributes to increased metals concentrations in the Blackfoot River alluvial aquifer.

The furthest-downstream well pair, alluvial well LCMW-1 and bedrock well BRGW-101, represents groundwater exiting the project area. In October 2007, the groundwater standard for cadmium was exceeded by the alluvial groundwater, while the bedrock groundwater had no exceedances of the groundwater standards. The bedrock groundwater contained significantly lower concentrations of cadmium, copper and zinc but higher concentrations of iron, manganese and sulfate than the alluvial groundwater.

4.11.2.2 2008 Groundwater Sampling Results

In July 2008, groundwater levels were measured and groundwater samples were collected from 46 monitoring wells in the project area, including 14 completed in bedrock and 27 completed in alluvium, plus five shallow piezometers installed in the uppermost alluvium in the Upper Marsh. The samples were intended to provide data from high groundwater conditions in areas where the DSR indicated potential sources of loading or where no samples had been collected historically to characterize potential sources of loading, or to evaluate background groundwater quality. **Figure 13** presents the groundwater sampling locations. The sampling results are summarized in **Table 23a** and **23b** and on **Figures 57 and 58** and are discussed below.

A combination of narrow valleys limiting well placement for triangulation and the completion of wells in both bedrock and alluvium greatly limits the ability to produce a potentiometric surface map for the UBMC. The general pattern of groundwater flow is from higher elevation areas, where bedrock groundwater is recharged by snowmelt and spring storm events, towards the local drainage bottoms then along the axis of the drainage.

Mike Horse Creek and Beartrap Creek

Similar to the October 2007 samples, the July 2008 groundwater samples from both bedrock and alluvial aquifers in the Mike Horse Creek and Beartrap Creek canyon areas regularly exceeded groundwater water quality standards for cadmium and zinc, and less often for copper and lead. The highest concentrations of aluminum, cadmium, copper, lead, and zinc were observed in samples from wells UMHMW-1S and UMHMW-2S. Elevated levels of manganese were also present in these two wells. Groundwater from wells UMHMW-1D and UMHMW-2D contained high concentrations of cadmium, lead, and zinc, plus elevated levels of iron and manganese. All of these wells monitor groundwater quality related to mine tailings seepage. As in October 2007, concentrations of the metals were lower in groundwater samples from bedrock and alluvial wells farther downstream, in lower Mike Horse Creek and the Beartrap Creek canyon areas. However, groundwater from the well farthest downstream, BCMW-10 in the alluvial aquifer in lower Beartrap Creek Canyon, still exceeded groundwater standards for cadmium, lead and zinc.

A combination of narrow mountainous valleys limiting well placement for triangulation and the completion of wells in both bedrock and alluvium limits the ability to produce a potentiometric surface map for the Mike horse Creek and Beartrap Creek canyon areas to evaluate specific flow influence on the groundwater quality. However, the data indicate that historical mining activities in the upper Mike Horse Creek area are a primary source contributing metals and other compounds to groundwater, but attenuation appears to occur along the groundwater flow path which is toward the valley bottoms and downstream along the valley axis.

Groundwater from well MW-1 (upper Mike horse Creek) didn’t exceed standards for any metals analyzed, indicating that any groundwater discharge from the Mike Horse Fault in this area does not contribute significantly to shallow groundwater contamination.

Wells BCGW-115 and BCGW-116, completed respectively in the alluvium and bedrock where the Blackfoot Fault crosses the Beartrap Creek valley, contained non-detectable or low metal concentrations below standards. The relatively good groundwater quality and the strong downward vertical hydraulic gradient between wells BCGW-115 and BCGW-116 indicate that the Blackfoot Fault is not likely to be a source of groundwater contamination to the alluvial aquifer in that area.

Wells MHGW-112 and MHGW-113 monitor groundwater in alluvium and bedrock directly down gradient of the Mike Horse Repository. Groundwater from MHGW-112 and MHGW-113 contained cadmium at concentrations greater than the groundwater standard. Zinc in MHGW-112 was elevated but below the groundwater standard. Concentrations of other analyzed metals in samples from MGHW-112 and -113 were near or below the detection limits. These wells are downgradient of the surface expression of the nearby Mike Horse Repository Seep. Wells MHGW-112 and -113 exhibit similar common ion concentrations as the nearby repository seep. However, cadmium, copper, and lead concentrations from the repository seep are generally an order of magnitude higher with slightly higher concentrations for manganese and zinc (CDM 2008). This may potentially be due to a low permeability unit beneath the repository diverting repository groundwater to the surface resulting in a surface seep. Shallow alluvial well MHGW-112 is likely representing local valley fill deposits with some influence of the upgradient seep while MHGW-113 (bedrock well) is likely representing area wide deeper groundwater.

Blackfoot River Area

As in October 2007, groundwater entering the Blackfoot River alluvial aquifer from the Anaconda Creek alluvium (well ANMW-9) and in the Blackfoot River alluvial aquifer upgradient of the Anaconda wetland treatment cells (ANWS-1) contained concentrations of metals near or below the laboratory analytical reporting limits, again confirming that the Anaconda Creek drainage is not a source of metals in groundwater. A combination of narrow mountainous valleys limiting well placement for triangulation and the completion of wells in both bedrock and alluvium limits the ability to produce a potentiometric surface map for the Anaconda Creek and Blackfoot River confluence. A potentiometric surface configuration is anticipated to indicate groundwater flow down-valley and tangentially toward the axis of the valley. The hydraulic gradient along the axis of the valley was approximately 50 feet vertically in 1,875 feet horizontally, or 0.027 foot per foot.

Mary P Mine Area

The July 2008 sample from well MPP-4 in the Blackfoot River alluvial aquifer near the Mary P Mine contained concentrations of lead above the groundwater standard, but other detected metals concentrations were below the standards. A potentiometric surface configuration is anticipated to indicate groundwater flow down-valley and tangentially toward the axis of the valley. The hydraulic gradient along the axis of the valley was approximately 29 feet vertically in 1,100 feet horizontally, or 0.026 foot per foot.

Stevens Gulch

Groundwater in the alluvial aquifer in the lower part of Stevens Gulch was sampled in July 2008 from well SGGW-101 and SGGW-102. Concentrations of the analyzed metals were similar to those in the October 2007 samples. There are currently insufficient wells within Stevens Gulch to establish a lateral hydraulic gradient however groundwater flow is expected to be down-valley and tangentially toward the axis of the valley. The water levels within SGGW-101 and SGGW-102 indicate a strong upward hydraulic gradient at this location such that bedrock groundwater is likely recharging the overlying alluvial aquifer.

Shave Gulch

Wells SHGW-101 and SHGW-102 were installed in the lowermost part of Shave Gulch in 2008 to monitor groundwater leaving the gulch. Well SHGW-101 was installed to monitor the alluvium in this area and SHGW-102 was installed to monitor the bedrock aquifer. One sample set was collected from these wells in July 2008. Alluvial groundwater exiting Shave Gulch exhibited concentrations of metals near or below the laboratory analytical reporting limits. Bedrock groundwater (SHGW-102) exiting Shave Gulch also exhibited concentrations of metals near or below the laboratory analytical reporting limits with the exception of an elevated (> 1 mg/L) manganese concentration.

Groundwater concentrations from the two wells were compared to concentrations in wells upstream in the Mary P Mine area of the Blackfoot River valley. Bedrock groundwater exiting Shave Gulch exhibited higher concentrations of iron, manganese and zinc, but lower concentrations of copper. Bedrock and alluvial groundwater exiting Shave Gulch exhibited lower concentrations of aluminum, cadmium, copper, and zinc than wells upstream in the Mary P Mine area. It therefore appears that groundwater from the Shave Gulch area would contribute to higher concentrations of iron and manganese to the Blackfoot River valley groundwater and might dilute concentrations of copper, cadmium and zinc in the Blackfoot River alluvial aquifer. The hydraulic gradient was vertically downward, suggesting that the alluvial groundwater would enter the bedrock and dilute the metals concentrations in bedrock groundwater. There are currently insufficient wells within Stevens Gulch to establish a lateral hydraulic gradient however groundwater flow is expected to be down-valley and tangentially toward the axis of the valley.

Edith Mine Area

Both the concentrations and spatial trends of groundwater quality observed in October 2007 near the Edith Mine continued to be exhibited in July 2008. Samples from alluvial wells EDP-2 and EDMW-2 and bedrock well EDGW-105 all had elevated levels (> 1 mg/L) of iron, while EDP-2 also had elevated manganese concentrations. All three wells also had detected cadmium, copper, and zinc concentrations, but were below their respective groundwater quality standards. It therefore appears that groundwater from the Edith Mine area would contribute to higher concentrations of iron and manganese and might contribute to higher concentrations of cadmium, copper, and zinc in the Blackfoot River alluvial aquifer. Groundwater flow direction is expected to be to the southwest toward the Blackfoot River and Upper Marsh complex based on groundwater elevation data. The hydraulic gradient toward the southwest was approximately 13 feet vertically in 670 feet horizontally, or 0.019 foot per foot.

Pass Creek and Upper Marsh

Groundwater entering the Blackfoot River valley from Pass Creek was monitored in July 2008 with samples from alluvial well PDGW-101 and bedrock well PDGW-102. Both wells contained elevated (>1 mg/L) concentrations of iron and relatively small to moderate concentrations of the other analyzed metals. The field-measured pH of both samples was low (4.52 and 4.14), but TDS and sulfate concentrations were similar to the groundwater sample set data from the project area. Groundwater flow direction is expected to be to the southwest toward the Blackfoot River based on groundwater potentiometric data (**Figure 13A**). The hydraulic gradient was approximately 22 feet vertically in 1,550 feet horizontally, or 0.014 foot per foot.

The five piezometers were installed in the Upper Marsh to monitor shallow alluvial groundwater conditions. Surface water was present adjacent to the piezometers at the two locations (UMPZ-3 and UMPZ-5),, and the relative elevations of the groundwater and adjacent surface water were used to determine vertical hydraulic gradients and the potential for interchange of groundwater and surface water by upward or downward flow. At piezometer UMPZ-3, the

hydraulic gradient was downward, indicating that surface water should be flowing into the shallow alluvial aquifer, and at piezometer UMPZ-5 the hydraulic gradient was upward, indicating that the shallow alluvial aquifer should be discharging groundwater to the surface.

Water-level data from the piezometers, in combination with water-level data from alluvial monitoring wells adjacent to the Upper Marsh, describe a potentiometric surface configuration indicating groundwater flow down-valley and tangentially toward the axis of the valley. The hydraulic gradient along the axis of the valley was approximately 60 feet vertically in 4,510 feet horizontally, or 0.013 foot per foot (**Figure 13A**).

Shallow groundwater in the Upper Marsh exceeded cadmium and zinc groundwater standards at the most upstream location, UMPZ-1, and arsenic exceeded its groundwater standard at UMPZ-3. Elevated concentrations of iron were found at UMPZ-2 through UMPZ-5, while manganese was elevated at UMPZ-2 through UMPZ-4.

Paymaster Gulch

Groundwater monitoring in Paymaster Gulch in July 2008 provided results generally similar to those obtained in October 2007. Reduction of concentrations resulted in changes from exceedance to non-exceedance of the groundwater standards for cadmium in wells PMGW-117 and PMMW-13, copper in wells PMGW-119 and PMGW-120. Overall, elevated (>1 mg/L) concentrations of iron and manganese were common among all wells for one or more samples. Exceedances for the other metals were few. A vertically downward hydraulic gradient from the alluvium to the bedrock remained in July 2008 at well pairs PMMW-15 / PMGW-120 and PMGW-118 / PMGW-119, despite a water-level increase of four to six feet in well pair PMMW-15 / PMGW-120 and increase of one to two feet in well pair PMGW-118 / PMGW-119. Groundwater flow direction is expected to be to the northwest bending further westerly to follow the Blackfoot River valley. The hydraulic gradient toward the river was approximately 50 feet vertically in 950 feet horizontally, or 0.053 foot per foot (**Figure 13A**).

Carbonate Mine

Groundwater in the Carbonate Mine area in Swamp Gulch was again monitored with samples from four alluvial wells and one bedrock well. Groundwater samples from all the wells had elevated (>1 mg/L) iron and manganese, and groundwater from wells UCMW-11 and LCMW-12D also exceeded the standard for cadmium. The sample from well LCMW-5 exceeded groundwater standards for four of the analyzed metals (cadmium, copper, lead, and zinc). Wells LCMW-5, UCMW-11, and LCMW-12D were at or below the laboratory detection limits for both arsenic and mercury. Wells LCMW-5, UCMW-11, and LCMW-12D are downgradient of the Carbonate Mine repository and represent groundwater leaving the area and entering the Blackfoot River alluvial aquifer (**Figure 13A**). The hydraulic gradient in the vicinity of the Carbonate Mine and repository during July 2008 was toward the southeast at approximately 70 feet vertically in 500 feet horizontally, or 0.14 foot per foot (**Figure 13A**). Groundwater flow is expected to be down-valley and tangentially toward the axis of the valley. The water levels within LCMW-12S, LCMW-12D, and LCMW-5 indicate an upward hydraulic gradient at the mouth of Swamp Gulch which is likely due to the overlying alluvial system receiving water from the underlying bedrock. The data indicate that the Carbonate Mine area groundwater contributes to increased metals concentrations in the Blackfoot River alluvial aquifer.

Blackfoot River Below Upper Marsh

The furthest-downstream well pair, alluvial well LCMW-1 and bedrock well BRGW-101, represents groundwater exiting the project area. In July 2008, no groundwater standards were exceeded in either of the wells. Except for iron and manganese, the bedrock groundwater contained significantly lower concentrations of metals than the alluvial groundwater. The

hydraulic gradient at this location is slightly upward. Based on potentiometric data from well LCMW-1, BRGW-101 and piezometers UMPZ4 and UMPZ-5, groundwater flow direction appears to be down-valley to the west and tangentially toward the axis of the Blackfoot River valley (**Figure 13A**). The hydraulic gradient was approximately 18 feet vertically in 900 feet horizontally, or 0.019 feet per foot.

4.11.2.3 2011 Groundwater Sampling Results

Pioneer collected groundwater samples from several wells in the Carbonate Mine area to evaluate water quality and potentiometric flow direction during low groundwater conditions. Groundwater results for samples collected in November 2011 by Pioneer were compared with DEQ-7 water quality standards.

Based on wells LCMW-6D, LCMW-6S, LCMW-12D, LCMW-12S, SWGW-103, and UCMW-11, groundwater flow direction was identified to be to the southwest along the axis of the valley at a gradient of approximately 0.1 feet per foot. Results of low groundwater conditions (November 2011) compared to high groundwater conditions (July 2008) indicate groundwater flow direction and gradient in the vicinity of the Carbonate Mine may change seasonally.

Four samples were collected from the lower Carbonate Mine area near the former mine waste area/reclaimed mine waste area, including LCMW-6S, and LCMW-6D, LCMW-12S, and LCMW-12D. Groundwater collected from LCMW-12D exceeded the water quality standard for cadmium, and both LCMW-12S and LCMW-12D had elevated (>1 mg/L) concentrations of iron and manganese. Groundwater collected from LCMW-6S exceeded the water quality standards for cadmium and zinc, and both LCMW-6S and LCMW-6D hand elevated concentrations of manganese.

Groundwater collected from SWGW-103, the well furthest upgradient in Swamp Gulch (**Figure 13A**), did not exceed any water quality standards. UCMW-11, below the repository, exceeded cadmium, copper, lead, and zinc water quality standards and had elevated iron and manganese concentrations.

Groundwater results from 2011 indicate that mine wastes in the repository and possible residual mine wastes or mine workings in the Carbonate Mine area may be continuing to contribute metals to the groundwater system in this area.

4.11.2.4 Groundwater Summary & Conclusions

Contaminant Distribution

In general, both the October 2007 and July 2008 groundwater samples from the Mike Horse Creek and Beartrap Creek areas contained higher concentrations and more frequent exceedances of groundwater standards for the analyzed metals than did samples from wells lower in the project area. Groundwater standards for cadmium, copper, lead, and zinc were exceeded in samples from the Mike Horse and Carbonate areas. In samples from wells in the lower areas, the standards for cadmium, lead and zinc were also exceeded, but only rarely. For the purpose of comparison, alluvial wells MW-1 (Mike Horse Creek), ANMW-9 (Anaconda Creek), PDGW-1 (Pass Creek), and SWGW-103 (Swamp Gulch) are considered background wells to the areas where those wells are located within the UBMC.

Groundwater – Surface Water Interconnection

Groundwater in the alluvial aquifer and surface water in the Blackfoot River valley and larger tributaries are intimately related, with the streams losing surface water to the alluvial aquifer system in some reaches and gaining water from it in other reaches. An assessment of the significance of this interchange was made by comparing surface water and groundwater quality at locations where both were monitored and also by comparing the loading rates for metals in

surface water and groundwater at the two locations where alluvial aquifer hydraulic properties were known (Appendix D).

Water quality comparisons were made at five locations, in order from upstream to downstream: 1) upper Mike Horse Creek between surface water stations BRSW-4 and BRSW-4A and groundwater monitoring wells UMHMW-1S/D and UMHMW-2S/D; 2) lower Beartrap Creek between surface water station BRSW-39A and groundwater monitoring well BCMW-10 3) near the Mary P Mine between surface water station BRSW-109 and groundwater wells MPP-4 and BRGW-110; 4) near the head of the Upper Marsh between surface water station BRSW-12 and groundwater monitoring wells EDMW-2, EDP-2 and EDGW-105; and 5) near the downstream end of the Upper Marsh between surface water station BRSW-13 and groundwater monitoring wells LCMW-1 and BRGW-101. October 2007 data were available for all five locations, and June-July 2008 data were available for the first and last locations. A graphical summary is presented on **Figures 57** and **58**.

At all five locations and during both sample collection events, field measurements showed higher pH and dissolved oxygen concentrations in the surface water samples. Total dissolved solids and sulfate concentrations were nearly always higher in the groundwater samples; in the few cases where this was not true, differences in concentrations were very small.

In the upper Mike Horse Creek area, where the stream gains flow from groundwater, high metals concentrations in the groundwater are an important source for the metals loads in the surface water. Cadmium, lead, and zinc exceeded water quality standards in both surface water and groundwater. For all the metals, groundwater from at least two of the four wells contained concentrations much greater than those in the surface water. Near the downstream end of Beartrap Creek, also a gaining stream reach, concentrations of TDS, sulfate and metals are substantially higher in the groundwater than in surface water, and groundwater discharges to the stream increase metals concentrations and contribute to the surface water metals load. However, comparison of bedrock groundwater quality to alluvial groundwater quality slightly upstream of this location indicates that the better-quality bedrock groundwater would not contribute to degradation of the alluvial groundwater or surface water.

At the next two locations downstream, near the Mary P Mine and the upper end of the Upper Marsh, the Blackfoot River loses water to the shallow alluvial groundwater system. In both of those areas, the surface water contains higher concentrations of cadmium and zinc than groundwater in both the alluvium and the bedrock. Near the Mary P Mine, the surface water also contains higher concentrations of lead than either source of groundwater. Near the Upper Marsh, lead concentrations in the surface water are higher than in the groundwater and copper concentrations are higher in the surface water than in one of the alluvial wells. Concentrations of cadmium and zinc in the surface water exceed water quality standards, as does lead on occasions in the shallow groundwater. From this, it appears that the Blackfoot River is a source creating higher cadmium, lead, and zinc concentrations in the groundwater in these reaches.

At the most downstream location, near the lower end of the Upper Marsh, the relative concentrations between groundwater and surface water change as flow conditions change. During October, with low streamflow, surface water concentrations of copper, lead, and zinc were higher than in the alluvial and bedrock groundwater, but the lower concentrations in the surface water during the June high streamflow reversed that trend. This stream reach gains flow from the groundwater system, so during low streamflow periods the groundwater contribution would lead to lower contaminant concentrations in the surface water. No definitive conclusion can be made regarding the balance of contaminant transfer during high streamflow periods.

Alluvial Aquifer and Surface Water Metals Loads

Groundwater and surface water quality and flow data from the Mary P Mine area (well MPP-4 and surface water station BRSW-109) and downstream of the Upper Marsh (well LCMW-1 and surface water station BRSW-31) were used to calculate the following metals loading rates in the alluvial aquifer and Blackfoot River at those locations.

Groundwater/Surface Water Loading Comparison				
Mary P Mine Area	**BRSW-109 (Blackfoot River) Oct-07**	**MPP-4 (Alluvial Aquifer) Oct-07**	**BRSW-109 (Blackfoot River) Jun-08**	**MPP-4 (Alluvial Aquifer) Jul-08**
Cadmium Load, kg/day	0.0165	0.00010	ns	0.00011
Copper Load, kg/day	0.1614	0.0027	ns	0.0041
Lead Load, kg/day	0.0403	0.00002	ns	0.0007
Manganese Load, kg/day	2.0026	0.0064	ns	0.0050
Zinc Load, kg/day	5.9416	0.0177	ns	0.0257
Below Upper Marsh	**BRSW-31 (Blackfoot River) Oct-07**	**LCMW-1 (Alluvial Aquifer) Oct-07**	**BRSW-31 (Blackfoot River) Jun-08**	**LCMW-1 (Alluvial Aquifer) Jul-08**
Cadmium Load, kg/day	0.0165	0.0056	0.2238	0.0019
Copper Load, kg/day	0.1614	0.0110	1.8022	0.0127
Lead Load, kg/day	0.0403	0.0003	0.6308	0.0003
Manganese Load, kg/day	2.0026	0.0688	8.2599	0.0523
Zinc Load, kg/day	5.9416	0.1156	58.5699	0.1098

kg/day = kilograms per day ns = not sampled

The results show that the metals loads transported through both areas by surface water in the Blackfoot River are much larger than the loads transported by groundwater in the alluvial aquifer. Because the hydraulic conductivity of the alluvium is likely to be many times greater than that of the bedrock, except perhaps in areas with high secondary permeability such as along major fault zones, the metals load transported through the bedrock is unlikely to be greater than that through the alluvial aquifer. Consequently, surface water, even during low-flow periods, is the major medium for transport of metals loads through the area.

Potential Exposure Pathways for Groundwater

Potential exposure pathways for groundwater include contact with and ingestion of water from springs and seeps discharging contaminated groundwater to the surface, discharge of contaminated groundwater to surface water during periods of low surface water flow, and wells producing contaminated groundwater. Springs and seeps occur in the upper Mike Horse Creek area, in the vicinity of the Mike Horse Tailings Impoundment, and from mine adits in the UBMC. Discharge of contaminated groundwater to surface water occurs along many reaches of the Blackfoot River and its tributaries in the UBMC, as described in the previous sections. Seventeen water supply wells are listed on the MBMG, GWIC database in the vicinity of the UBMC facility (see **Table 4**, and **Figure 5**). Three domestic wells downstream of the Upper Marsh complex and within the estimated extent of contamination (**Figure 1**) are in immediate proximity of the Blackfoot River and have been sampled by DEQ twice per year since March 2009. These locations are recorded on **Table 4** as GWIC numbers 156567 (a.k.a BRRW-1), 236272 (a.k.a. BRRW-2), and 199512 (a.k.a BRRW-3) and shown on **Figure 5**. Results of domestic water quality sampling are presented in the table below. Sampling of these wells is anticipated to continue through completion of construction activities.

Summary of Domestic Groundwater Sample Results 2009 to 2011									
Total Metals Range[ac]									
Standard[b]	**Al**	**As**	**Cd**	**Cu**	**Fe**	**Pb**	**Mn**	**Hg**	**Zn**
	--	**0.10**	**0.005**	**1.3**	**0.3**	**0.015**	**0.05**	**0.002**	**2.0**
BRRW-1	<0.03 to 0.05	<0.003	<0.00008	<0.001 to 0.004	<0.03 to 0.11	<0.0005 to 0.0007	<0.005	<0.00005	<0.1
BRRW-2	<0.03 to 0.06	<0.003	<0.00008	0.001 – to 0.013	0.03 to 0.55	<0.0005	<0.005 to 0.007	<0.00005	<0.1
BRRW-3	<0.03 to 0.26	<0.003	0.00013 to 0.00015	<0.001 to 0.009	0.14 to 1.06	<0.0005 to 0.0018	<0.005 to 0.009	<0.00005	0.01 to 0.02

a – All values reported as milligrams per liter (mg/L)
b – DEQ-7 groundwater standard (August 2012)
c – Range of values includes only those reported as total phase
Bold - Indicates value exceeds water quality standard.

Summary of Domestic Groundwater Sample Results 2009 to 2011									
Dissolved Metals Range[ac]									
Standard[b]	**Al**	**As**	**Cd**	**Cu**	**Fe**	**Pb**	**Mn**	**Hg**	**Zn**
	--	**0.10**	**0.005**	**1.3**	**0.3**	**0.015**	**0.05**	**0.002**	**2.0**
BRRW-1	<0.03	<0.003	<0.00008	<0.001 to 0.002	<0.03	<0.0005	<0.005	<0.00001 to <0.00005	≤0.01
BRRW-2	<0.03	<0.003	<0.00008	0.001 – to 0.016	<0.03	<0.0005	<0.005	<0.00005	≤0.1
BRRW-3	<0.03 to 0.04	<0.003	0.0001 to 0.00013	<0.001 to 0.006	<0.03	<0.0005	<0.005 to 0.007	<0.00005	0.01 to 0.04

a – All values reported as milligrams per liter (mg/L)
b – DEQ-7 groundwater standard (August 2012)
c – Range of values includes only those reported as dissolved phase
Bold - Indicates value exceeds water quality standard.

Metals concentrations in these three domestic wells are generally low. Well BRRW-1 has exhibited total metals concentrations of aluminum, copper, lead, and zinc all of which have been below their respective standards. The remaining metals of arsenic, cadmium, manganese, and mercury have been below their respective laboratory detection limits for the period of record. Total metals concentrations in water from wells BRRW-2 and BRRW-3 have all been below their respective standards. The iron concentration (1.06 mg/L; total metals) was slightly elevated (>1 mg/L) in BRRW-3 during one sampling event. Arsenic and mercury have been below the laboratory detection limit in all samples from both BRRW-2 and BRRW-3 for the period of record.

It is unclear whether several domestic wells located closer to the Upper Marsh complex in the vicinity of Surveyors Gulch are hydraulically connected to the Blackfoot River valley fill deposits. Although these closer wells are not known to be impacted by historic mining activity, it is possible that these wells could produce impacted groundwater. The lack of sampling of these wells is identified as a data gap and sampling is recommended in Section 6.

4.12 Mine Inventory

The following sections summarize data obtained during the 2007 and 2008 mine inventories. All features located and described during the inventories are listed in **Table 12** and shown on

Figure 2 and sampling locations are shown on **Figures 14** and **15**. Surface water, streambed sediment, and mine waste samples were collected during 2008 activities from locations where waste rock piles or tailings could potentially impact water quality (**Figures 14** and **15**). **Table 13** presents features that did not represent significant disturbance and **Table 14** presents mine features viewed as potential trouble spots. This determination was made based on visual observation of run-off channels and/or other erosion features extending from the mine feature(s) to downgradient streams of floodplains. Data from XRF screening were also used to help identify locations for sample collection. Samples of waste material were collected for archival purposes and/or submittal for acid-base accounting and metal mobility testing.

4.12.1 Mine Inventory Features and Analytical Results

Numerous adits and a smaller number of shaft locations were identified during mine inventory activities. Most adits and shafts were caved and were not accessible to humans or wildlife. Exceptions to this are noted in **Table 12** with one notable exception being feature number PC-21 (2008 field notebook ID # 642). This adit had a portal measuring 3-feet by 3-feet in a rock face located in proximity to Highway 200 near Rogers Pass. For safety reasons, field personnel did not enter the adit to determine the length of the adit; however, human entry would be possible. This location was re-visited in 2011 by Pioneer personnel to document its location. No samples were collected from soil or water associated with the feature. The Existing Conditions Map (**Figure 2**) shows all mine inventory locations, including the location of feature PC-21.

Many adits and shafts were associated with waste rock piles, some of which were of considerable size. A small number of adits were either discharging water during the site visit or were believed to discharge water seasonally as indicated by iron-oxide stains leading from the portal and following inferred drainage channels. While numerous waste rock piles and some discharging adits were present most of these features were located well away from surface water. Waste rock dumps and adit discharges that could potentially impact surface water were located principally in the Stevens Gulch and Paymaster Creek drainages.

Significant features and conditions observed at the inventoried sites are discussed below according to the area in which they are located. Results of water quality and streambed sediment analyses are also presented.

Tables 24a and **24b** present the mine inventory surface water results. **Table 25** presents the mine inventory streambed sediment results and **Tables 26a** and **26b** present the mine inventory mine waste analytical results.

4.12.1.1 Anaconda Creek

Surface water (**Tables 24a** and **24b**) and streambed sediment samples (**Table 25**) ACSW-101 and ACSE-101 (0-2”), respectively, were collected from a location on Anaconda creek upgradient of an area of disturbance. It appeared that a collapsed adit and waste rock pile may be present in proximity to the stream. However, extensive earth moving activity associated with road construction made it difficult to confirm the presence of mine related disturbance.

Comparison of analytical data for these samples with those previously collected from a downstream background surface water and streambed sediment station on Anaconda creek (BRSW-6; **Tables 21a** and **21b**) shows similar water quality at both sites with neutral pH with both sites meeting surface water quality standards. These results indicate that the observed disturbance is not impacting water quality in Anaconda Creek as analytical results indicate no exceedences of water quality standards. Total metal concentrations, in streambed sediment from ACSE-101 (0-2”) exceeded the TEL ecological screening levels for arsenic and copper but did not exceed any other screening level.

4.12.1.2 Belle of the Hill

The Belle of the Hill Mine is located along the Blackfoot River across from the Mary P Mine and at the toe of the valley slope. No adit or mine workings are visible. Approximately 700 yd^3 of waste rock extends from the toe of the valley slope at the site. Changes in vegetation at the site indicated the presence of an intermittent spring. Vegetation vigor and diversity appeared good in this area. Several small [(25 square foot (ft^2)] prospect pits were observed upslope of the mine area. No samples were collected.

4.12.1.3 Blackfoot Tributary

A small waste pile (feature BR-39, 2008 field notebook ID# 610) was found in contact with surface water in a small unnamed tributary to the Blackfoot River. Water immediately below this waste pile was sampled (BTSW-101). Water from this location had a neutral pH and met all DEQ-7 water quality standards except the chronic aquatic standard for cadmium and acute and chronic standards for zinc.

4.12.1.4 Carbonate No. 3 Area

A prospect pit and adit were observed north of Meadow Creek Road off of US Highway 200 in the Carbonate No. 3 area. A small 11 yd^3 waste rock pile was associated with a 9,375 ft^2 prospect pit and adit. Cement footings were located adjacent to the excavated pit. To the east of this site, a level bench was observed that contained several large cement footings and occupied an area of 5,213 ft^2. No mine waste was observed in this area. Two small roads branched from Meadow Creek Road 100 feet from the junction with US Highway 200. No samples were collected.

4.12.1.5 Chambers Gulch

A disturbance consisting of a large waste rock pile, a collapsed and seeping adit portal, and collapsed wooden structures were observed along the west bank of Chambers Gulch (feature CG-02, 2008 field notebook ID# 559). The toe of the waste rock dump was in direct contact with stream waters. Surface water samples were collected upstream (CGSW-101) and downstream (CGSW-103) of the waste pile as well as from the adit seepage (CGSW-102). Analytical data show that water at the upstream and downstream locations met water quality standards.

Adit seepage was estimated to flow at a rate of less than 0.002 cfs (<1 gpm) and infiltrated into the waste rock pile preventing direct contact with surface water in Chambers Gulch. Concentrations of metals in the adit seepage (CGSW-102) was not acidic; but exceeded the DEQ-7 human health standards for arsenic, cadmium, and lead. Iron and manganese concentrations were also elevated (>1 mg/L). Cadmium, copper, iron, lead, and zinc exceeded one or more DEQ-7 aquatic life standards. Adit seepage was estimated to flow at a rate of less than 0.002 cfs (<1 gpm) and infiltrated into the waste rock pile preventing direct contact with surface water in Chambers Gulch.

CGWA-101 was collected from the mine waste pile. The sample exhibited arsenic above the DEQ Action Level for Arsenic, and iron and lead above Soil BTVs. The soil sample was not analyzed for ABA or SPLP.

4.12.1.6 Pass Creek

A large land disturbance located at the head of Pass creek appeared to be the site of historic mine reclamation work. A small runoff channel was located approximately 20 feet from a caved adit at the base of the disturbed hillside. Water from this channel (PCSW-101) exceeded the DEQ-7 chronic aquatic life standard for cadmium and exceeded both the acute and chronic aquatic life standards for zinc.

Closer to the confluence of Pass creek with the Blackfoot River a collapsed adit, dispersed waste rock, and what appeared to be the remnants of a hand-dug water well or shaft opening (collapsed) were located within the floodplain (feature PC-01, 2008 field notebook ID# 500). Surface water and streambed sediment samples were collected from Pass Creek upstream (PCSW-103 and PCSE-103(0-2”)) and downstream (PCSW-104 and PCSE-104(0-2”)) of the waste rock pile. Water quality was similar at both locations and of good quality with no exceedances of DEQ-7 water quality standards. Streambed sediment metal concentrations were similar at both locations. Arsenic, lead and zinc exceeded the TEL ecological screening level at both PCSE-103 and PCSE-104, while only zinc exceeded its Streambed Sediment RV. Copper also exceeded the TEL for sample PCSE-104 (0-2), but is below its Streambed Sediment RV. There were no exceedances of the DEQ Action Level for Arsenic or EPA RSLs.

A sample of water was also collected from the well/shaft (PCSW-102). This feature consisted of a timber lined, square hole measuring roughly 5 feet square by 2 feet deep and was filled with iron-stained forest litter and water. Bubbles sporadically percolated upward through the water column. This water was acidic (pH = 3.88) and had elevated (>1 mg/L) concentrations of iron and manganese. Cadmium, copper and zinc exceeded the DEQ-7 acute and chronic aquatic life standards, and iron exceeded the chronic aquatic life standard.

4.12.1.7 Paymaster

The mine waste inventory found numerous small prospect pits and exploration trenches on the ridgeline above the main adit portals for the Paymaster Mine. One pit measured 16 feet in diameter and 15 feet deep. The associated waste rock pile was 106 yd^3. The largest disturbed area inventoried as part of the Paymaster was located approximately 500 feet south of the end of the access road that runs adjacent to the Paymaster adit reclamation areas (believed to be the Paymaster No. 1 Tunnel and Paymaster No. 2 Tunnel). The excavated trench at this location was 3,060 ft^2 in size and extended from the access road to the waste rock pile. The waste rock pile associated with this area was 1,288 yd^3. The toe of the waste rock pile was 5 feet from Paymaster Creek and likely contributes sediment to the creek during high flow and precipitation events.

Mining features were located infrequently from the aforementioned trench uphill to the historic cabin site. A small side channel to Paymaster Creek was identified approximately 100 feet upstream of the cabins. It was unclear whether the channel (75 feet long) was associated with historic mining activity or not. Paymaster Creek is intermittent from approximately 50 feet below the cabin site to the head of the drainage. An exploration drill pad was found approximately 300 feet above the cabin. A wildlife wallow was located adjacent to the intermittent stream channel just upstream of the exploration drill pad.

Two mine sites were located in the head of the Paymaster Creek drainage. The upper most area consisted of a trench measuring 18 yd^3 and a waste rock pile (167 yd^3). The larger of the two sites was located in the head of the intermittent portion of Paymaster Creek. The historic adit entrance no longer exists but an area of moss indicates were the entrance was likely located. An exploratory drill pad now occupies the site with a cut slope (1,950 ft^2) and a mine waste pile that extends from the edge of the pad 130 feet down-slope. A small exploration drill road crosses at the toe of the waste rock pile, effectively separating the waste rock pile from the origin of the intermittent channel of Paymaster Creek. The waste rock pile contains approximately 2,689 yd^3 of material.

Mine waste was observed in the flood plain in two areas. At site PM-35 (2008 field notebook ID# 627) a collapsed adit and waste rock pile were located along the west bank of Paymaster creek. At site PM-37 (2008 field notebook ID# 629) a collapsed adit was located just east of an access road with waste rock incorporated in to the road fill slope and extending into the

floodplain on the east side of the creek. Seepage from the road fill slope was pooled and flowing across the surface of the waste rock dump. Due to the proximity of these features, surface water and streambed sediment samples were collected from the seep (PMSW-101), downstream of the waste piles (PMSW-102 and PMSE-102(0-2”)), and upstream of the waste rock piles (PMSW-103 and PMSE-103(0-2”)).

Comparison of analytical data for the upstream and downstream surface water locations (PMSW-102 and PMSW-103, respectively) sampled on Paymaster Creek show similar concentrations at both stations. Cadmium, copper, iron, and zinc concentrations were equal to or exceeded one or more DEQ-7 aquatic life water quality standards. Both locations have acidic water ranging from 2.96 to 3.22. Actual metal concentrations at each location are similar; however, copper, iron, and manganese concentrations are slightly greater at the downstream location.

Streambed sediment metal concentrations (PMSE-102; PMSE-103) were similar at each location and were below ecological screening levels (i.e. PELs, PAETs, and TELs) for all metals except mercury, which exceeded all three ecological screening level values but were below its EPA RSL. Iron and mercury also exceeded the Streambed Sediment RVs. Iron was the only exceedence of a human health screening level. Seepage (PMSW-101) collected from the top of the east waste rock pile was acidic (pH = 4.5) and exceeded the acute and/or chronic aquatic life standards for aluminum, cadmium, copper, iron, lead, and zinc. Despite poor water quality in the seepage, flow was minimal at less than 1 gpm (<0.002 cfs). The metal concentrations in the waste rock pile (PMWA-102) were below the DEQ Action Level for Arsenic (DEQ 2005) and the EPA RSLs (EPA 2012). ABA and SPLP data are available for this waste material and ABA analysis shows that the material is potentially acid generating. However, SPLP results indicate that mine wastes from the waste area are unlikely to leach metals. **Tables 26a** and **26b** present the mine waste results.

Paymaster Creek is known to be the location of acid rock drainage (ARD) that may be naturally occurring (Furniss 1998). As such, acidic waters and iron-staining are present along much of the entire length of the stream, even in areas where no mine related disturbances are apparent. Additionally, although there were mercury detections in the sediment above and below the waste rock pile, mercury was not detected in the waste rock pile. Sediment samples further downstream also were non-detect for mercury. Past investigations of Paymaster Creek support metals concentrations may be naturally elevated in portions of the drainage due to naturally-occurring ARD (Furniss 1998). Therefore, eliminating mining related sources may not result in achievement of sediment- or water quality goals for metals. Although mercury detections in sediment (both up and downstream) exceed ecological screening levels, detections are isolated and don’t warrant further investigation.

4.12.1.8 Porcupine Gulch

Bobby Boy Mine is located in Porcupine Gulch and includes a partially collapsed adit and waste dump that extends into Porcupine Gulch. Surface water in the gulch flows around the toe of the waste dump (Pioneer 2012). The waste pile, adit water and sediment, and surface water upstream and downstream of the waste dump were collected in 2011. All the metals concentrations in the mine waste sample (PBBS WP 200) were below the respective screening levels..

ABA analysis identified the waste as having uncertain acid generating potential. However, SPLP analysis identified lead with a leachable concentration that indicates it has the potential to migrate to surrounding soil and water.

Adit water (PBBS-201) exhibited cadmium, lead, and zinc above DEQ-7 human health standards. Cadmium, copper, iron, lead, and zinc also exceeded one or more of the DEQ-7 aquatic life water quality standards. Sediment associated with the adit (PBBS SED 201) exhibited arsenic, cadmium, copper, lead, manganese, and zinc above one or more ecological screening levels. Arsenic, cadmium, iron, lead, manganese, and zinc also exceeded their respective streambed sediment RVs. There were no exceedances of the DEQ Action Level for Arsenic or EPA RSLs.

Both the surface water samples collected downstream (PBBS-200) and upstream (PBBS-202) of the mine feature met DEQ-7 water quality standards. Streambed sediment sample (PBBS SED 200) collected downstream of the mine feature exceeded one or more ecological screening levels for arsenic, cadmium, copper, lead, manganese, and zinc. The streambed sediment sample also exhibited arsenic, cadmium, iron, lead, manganese, and zinc above Streambed Sediment RVs. The streambed sediment sample (PBBS SED 202) collected upstream of the mine feature only exhibited arsenic above the TEL ecological screening level. There were no exceedances of the DEQ Action Level for Arsenic or EPA RSLs.

4.12.1.9 Shave Gulch

Two collapsed adits with associated waste rock piles were identified along the hillside banks of Shave Gulch creek. One (SH-43, 2008 field notebook identification 586) was located to the east of Shave Gulch creek approximately 700 feet below the confluence of Chambers Gulch with Shave Gulch creek. At this site, adit seepage mixed with natural seepage above the waste rock pile and flowed across the waste and into a small unnamed tributary, which then flowed into Shave Gulch creek. The tributary appeared to be perennial. An access road traversed the top of the waste rock dump below the adit portal. Surface water and streambed sediment samples were collected from the adit flow (SHSW-103 and SHSE-103 (0-2”)) as well as surface water from the tributary at a location below the toe of the waste rock dump (SHSW-104). A soil sample that included ABA and SPLP was also collected from the waste rock dump (SHWA-102).

The waste rock pile sample SHWA-102 exceeded the DEQ action level for arsenic and the Soil BTVs for iron and lead. The ABA results show that the waste pile is potentially acid generating and the SPLP testing indicates that the lead concentration in the leachate has the potential to impact surrounding soil and groundwater.

Adit seepage water (SHSW-103) was near-neutral (pH = 6.2) but contained concentrations of arsenic, cadmium, and lead that exceeded DEQ-7 human health standards. Iron and manganese concentrations were also elevated (>1 mg/L). Concentrations of cadmium, copper, iron, lead, and zinc also exceeded the DEQ-7 acute and/or chronic aquatic life water quality standards. Flow from the adit was measured at 2.6 gpm (0.006 cfs); however, additional flow was contributed by surrounding seeps very near the adit portal. A streambed sediment sample (SHSE-103) collected from the same location as the water sample appeared to contain some fined-grained mine waste, that likely originated from migration of mine waste from a nearby adit seepage pool on the waste rock dump. Concentrations of arsenic, cadmium, copper, lead, manganese, and zinc in the streambed sediment sample exceeded one or more ecological screening levels. In the same sample, arsenic copper, lead, manganese, and zinc exceeded the streambed sediment RVs. Arsenic exceeded its DEQ action level, while manganese exceeded its Soil BTV.

Surface water sample SHSW-104 was collected below the waste rock pile, at a location approximately 350 feet downstream of the leaking adit. Flow at this location was measured at 7.5 gpm (0.017 cfs) showing that a 5 gpm contribution from surrounding seeps joined the adit flow between the two sample locations. Surface water at this location below the waste rock dump exceeded the chronic aquatic life water quality standards for cadmium and lead.

The second mine feature observed in Shave Gulch (SH-17, 2008 field notebook ID# 548) consisted of a collapsed adit and waste rock pile located on a hillside to the west of the creek. The toe of the waste rock pile was about 75 feet from Shave Gulch creek. No samples were collected from this waste pile, but sediment and surface water samples associated with the waste pile were collected.

Surface water and streambed sediment samples were collected above the point where runoff from the waste rock pile would potentially enter the creek (SHSW-102 and SHSE-102(0-2”)) and also downstream of where runoff would enter (SHSW-101 and SHSE-101(0-2”)). Water quality at each of these locations was similar with most metals having identical concentrations at each site. No DEQ-7 water quality standards were exceeded at SHSW-102; however, copper exceeded the DEQ-7 acute and chronic aquatic life standards in the sample from SHSW-101. Arsenic, cadmium, copper, lead, mercury, and zinc exceeded one or more of the ecological screening levels in the streambed sediment samples.

Because of the elevated (380 mg/kg) mercury result at the SHSE-101 location, Pioneer personnel returned to the mine inventory location SH-17 to further evaluate mercury concentrations in the sediment. Pioneer collected one composite sample from the mine waste pile (SGWP 200) and six streambed sediment samples (SG Sed 100 through SG Sed 105) from the stream below the waste pile. The waste rock pile sample had no exceedances of human health screening levels. ABA shows that the waste pile is potentially acid generating, and the SPLP testing indicates that the iron concentration in leachate has the potential to impact surrounding soil and water.

The streambed samples were located at 1-foot intervals, horizontally, such that three samples were collected on either side of the stream centerline. No mercury was detected at or above the laboratory PQL in these follow up samples.

4.12.1.10 Stevens Gulch

Field investigations in the Stevens Gulch drainage resulted in 93 recorded sites relating to past mining activity. Of these, 35 sites are exploration drill pad locations that were dispersed throughout the drainage. This section first describes drill pads and then discusses other mine features in order of their position starting near the head of the drainage and progressing downstream.

The drill pad footprint was similar for most sites resulting in a high cut bank, a pad area approximately 100 feet by 40 feet and a fill slope (approximately 11 yd^3) located downhill of the exploration road and drill pad cuts. Drill cuttings piles and other residual exploratory material were frequently located along the downhill edge of the drill pad at most sites. The down-gradient path of fluids (water) used during drilling, and subsequent runoff from the waste piles is visible at most of the drill pads and appears to inhibit under-story vegetation growth. Timber growing in the debris appears unaffected by the drilling waste. Debris flows from some drill pads extend as much as 500 feet down-slope with widths of approximately 20 feet and a depth of approximately 0.5 feet.

Old cut timbers and other building materials were observed at a few of the drill pad sites. The timbers were likely used to level the drill rig or less likely may be remnants of past mining activity other than drilling. No adits were identified at any of the drill pad sites. Two openings, probably large washed out drill hole collars, located on pad sites, may pose physical hazards. One of the openings was approximately 12 inches in diameter at the surface and expanded to nearly 2 feet in diameter at a depth of 10 feet below ground surface. Total depth of the opening is unknown. The other opening was 6-inches in diameter; the total depth of the second opening is also unknown.

One drill pad had a 4-inch drill pipe/casing (2007 field notebook ID# 468), protruding from the toe of the cut slope at a 45-degree angle, which was producing low volumes of artesian water which infiltrated to the subsurface nearby. Alder growth in the vicinity of the pipe did not appear to be negatively affected by the water. Water collected from the pipe (SG-55SW) exceeded DEQ-7 human health standards for arsenic and had elevated (>1 mg/L) iron and manganese concentrations. The DEQ-7 chronic aquatic life standard for iron was also exceeded.

Two large waste rock piles were located at the head of Stevens Gulch. The first area was identified as the Viking Mine site. The adit to the mine was collapsed. The estimated mine waste footprint and volume for the waste rock pile is approximately 750,000 square feet (ft^2) and 20,000 yd^3 respectively. Stevens Creek was dry below the mine waste pile at the time of the 2007 and 2008 investigations; however, white mineral staining was evident on streambed substrate within the downstream channel. The waste rock pile encroached upon and locally blocked the stream channel, which likely contributes mine waste to the channel during precipitation events. Iron staining was evident over a small area (10 feet x 15 feet) on the road near the collapsed adit. A second large waste rock pile was observed on the ridge separating Stevens Gulch from Mike Horse Creek. Mine waste at the second waste rock pile did not appear to be in contact with any surface water or dry stream channels. The waste rock pile was associated with a large cut slope and was approximately 5,440 yd^3 in volume. Several old exploration trenches were located slightly down-slope of the second waste rock pile. The trench covered approximately 1,500 ft^2. No samples were collected.

Stevens Creek first surfaced intermittently above the Capital Mine adit and was only accessible for sampling in a limited number of areas. The farthest upstream location sampled (SGSW-101) was located approximately 300 feet above the Capital Mine adit. Streambed sediment samples were collected at each of these sites except for the farthest upstream location where fine grained sediments were not present. Surface water data (SGSW-102, -103, -105, -106, and -107) indicate a slight increase in metal concentrations with decreasing downstream distance, particularly between stations SGSW-105 and SGSW-106 (near collapsed adit, 2008 field notebook ID# 651). This area is characterized by braided channels flowing over and around a series of terraces and berms with iron and aluminum oxide staining visible and increasing with distance downstream to a location about 300 feet upstream of feature SG-100 (2008 field notebook ID# 653).Numerous mine and mine reclamation related disturbances exist along this reach of the Stevens Creek channel below the Capital Mine reclamation area. For this reason, despite efforts to locate surface water and streambed sediment sample locations such that impacts from discreet sources could be monitored, it is likely that multiple or diffuse sources influenced water quality at each sampling location.

Analytical data show that water at SGSW-101 had neutral pH. Copper in the surface water sample exceeded DEQ-7 acute and chronic aquatic life water quality standards, while lead exceeded its DEQ-7 chronic aquatic water quality standard. No DEQ-7 human health water quality standards were exceeded at this location.

Station SGSW-102 was located below the Capital Mine reclamation and below a seasonal run-off channel that entered the creek after incising an existing waste rock pile (feature SG-93, 2008 field notebook ID# 630). Surface water at this location did not exceed any DEQ-7 water quality standards.

Surface water locations SGSW-103, -105, -106, and -107, as reported in **Tables 24a** and **24b,** consistently exceeded DEQ-7 chronic aquatic water quality standards for cadmium and lead, while DEQ-7 acute and chronic aquatic water quality standards were exceeded for copper and zinc.

Metal concentrations in streambed sediment decreased with distance downstream to station SGSE-107. Arsenic, cadmium, copper, lead, and zinc exceeded one or more ecological screening levels (i.e. SELs, PAETs, and TELs) for locations SGSE-102 through SGSE-103 and SGSE-105 through SGSE-107. Arsenic, copper, iron, lead, and zinc exceeded the Streambed Sediment RVs for each of the same locations. Arsenic exceeded its DEQ Action Level, while iron and lead exceeded their respective EPA RSLs. **Table 25** presents the mine inventory streambed sediment results.

Sample SGSE-107 is located just below a suspected breached tailings dam located in an open marshy area located at feature SG-100 (2008 field notebook ID# 653). Fine-grained yellow, red, and grey material was present at the surface and to a depth of at least 6 inches at this location. These suspected mine tailings appear to have been, at one time, confined by a dam or portion of a road bed which has since breached allowing the tailings to wash downstream. The same fine-grained yellow-red material was observed in a 1 to 4-inch thick layer at the downstream site SG-96 (2008 field notebook ID# 633).

The lateral extent of the mine tailings floodplain material was not determined but mine waste samples SGWA-103 and SGWA-104(0-6) were collected. SGWA-103 exceeded the DEQ Action Level for Arsenic in Surface Soil. SGWA-104 (0-6') exceed the DEQ Action Level for Arsenic in Surface Soil and the Soil BTV for lead. **Tables 26a** and **26b** present the mine waste results.

Two open mine adits were located in Stevens Gulch just below the Capital Mine reclamation site. The first adit (SG-48) was collared in a rock outcrop. The rock outcrop runs adjacent and parallel to the stream channel for approximately 50 feet. The dimensions of the adit portal were approximately 3 feet by 4 feet and the adit extended more than 30 feet into bedrock where it opened up into a 7-foot high chamber. No water was issuing from the portal, nor was any staining observed at the adit portal that might indicate historical flow from the adit. Mine wastes were observed within the floodplain along almost the entire length of Stevens Creek from this first adit to a point at which Stevens Creek intersects the Blackfoot River. Some iron-oxide staining was observed in Stevens Creek. The source of the staining to the creek bottom is likely from multiple sources; however, there is approximately 28 yd^3 of waste rock located within 50 feet of the first adit, which could be a possible source of iron-staining.

The second adit (SG-50) is located approximately 400 feet northeast of the first adit and occurs nearly 200 feet upslope and away from Stevens Creek. The adit portal was caved and only a small portion of the original adit opening (1 foot x 2.5 feet) was visible. Timber was visible at the adit portal and supported the overhanging rock at the entrance. Two small waste rock piles containing approximately 29 yd^3 were crossed by an access road that separated the mine adit from the main waste rock pile that was estimated to contain as much as 1,000 yd^3 and was located 60 feet down-slope of the adit portal. The main waste rock pile was located adjacent to an ephemeral stream channel and may contribute sediment to Stevens Creek during spring runoff.

A notable feature of Stevens Gulch is located between the Paymaster access road and the ATV road above it, approximately 250 feet downstream of feature SG-94 (2008 field notebook ID# 631) where a collapsed adit occurs. An iron-rich spring originating near this adit has deposited a yellowish orange precipitate to form a cone measuring about 6 feet in diameter by 4 feet tall. Spring water is pooled at the top of the cone and flows over the sides. The creek bed turns red in color below the spring and appears similar to the iron-rich reaches of Paymaster Creek.

The water (SGSW-104) and precipitate (SGSE-104 (0-2)) from this spring were sampled, respectively. Arsenic exceeded DEQ-7 human health water quality standards in surface water sample SGSW-104, while iron and manganese concentrations were elevated (>1 mg/L). In the same sample, iron and zinc exceeded the one or more DEQ-7 aquatic life standards.

Sediment/precipitate collected from the top of the cone (SGSE-104 (0-2") exceeded all ecological screening levels for arsenic and the DEQ Action Level for arsenic and the Soil BTV for iron.

A discharge located approximately 70 feet from Stevens Creek produced enough water that a small pond has formed that was approximately 6 inches deep covering an area of about 750 ft^2 (site SG-71, 2007 field notebook ID# 482). The area had a faint sulfur smell and gas bubbles were present at the spring source. Herbaceous vegetation surrounding the pond appeared to have good vigor; similarly, shrubs adjacent to the area appeared healthy. No samples were collected.

Field reconnaissance and a historic aerial photograph indicated that the No. 3 Tunnel area north of Paymaster Road may have dispersed mine wastes. Field personnel inspected the lower portion of the No. 3 Tunnel area to evaluate whether environmental or human safety hazards were present and to locate a drainpipe that DEQ indicated may have been installed prior to remedial efforts in the late 1990's to address flow from the tunnel. The lower No. 3 Tunnel area showed some evidence of earth moving activity such as road construction and shallow prospect pit excavation; however, no additional mine related features or hazards were observed and the drainpipe could not be located.

4.12.2 Mine Inventory Summary and Conclusions

A total of 269 mining related features were identified during the 2007/2008 mine feature inventory. Nineteen of these pose possible environmental or human health risks due to their environmental/geochemical characteristics or associated physical hazards (**Tables 12**, **13**, and **14**). This table also provides the footprint of each area in acres, a volume of materials estimate, and the distance to nearest surface water.

The tables also include information about the features that could potentially impact surface water during times of high-run off, precipitation or snow-melt due to proximity or contact of these features with surface water channels. Dry conditions encountered during the mine inventory resulted in no observable transport of acidic or metal rich leachate, run-off, or sediments from mine wastes into nearby streams. Similarly, a few waste rock piles were located in run-off channels that were dry during 2008 mine inventory monitoring activities. It is possible that impacts could occur in these areas during higher flow/infiltration events.

Water quality at most of the seeps sampled was generally near neutral pH. and impaired by metals above DEQ-7 acute and chronic aquatic life, and human health water quality standards. Most metal concentrations in sediment samples associated with the seeps also exceeded ecological screening levels, but rarely exceeded human health screening levels.

With the exception of Stevens Creek and Paymaster Creek, the surface water and sediment quality in most of the drainages is good and meets their respective standards and screening levels.

4.13 Mine Waste

4.13.1 Historic Mine Waste Sampling

Mine wastes, including redeposited waste rock and tailings above the Upper Marsh, have been sampled during various characterization efforts beginning in the late 1980s. Soil samples have also been collected from beneath removed mine waste deposits, from areas where soils are intermixed with mine waste, and from non-impacted areas representing natural background conditions. **Figure 7** show the location of the mine waste areas.

A summary of historic mine waste sampling, by area within the UBMC, is provided in the DSR and the complete dataset for most samples are presented in appendices and tables of that report. Data for samples collected by Hydrometrics from 1991 through 2004 are reported in Appendix B of the UBMC EE/CA prepared by Hydrometrics (2007a). Data for 210 soil samples are reported in laboratory reports in Appendix C of the DSR. These reports are an archive of historic data extending back to 1987; however, sample locations and descriptions are not provided in the archive. These original documents were reviewed as part of the winter 2008 work to determine the relevance of the sample sites and their results with respect to current levels of contamination at the UBMC Facility.

Most historic soil samples were analyzed for total whole-rock metal concentrations although a description of the methods used are not available for all samples. Similarly, ABA was performed on a subset of the historic samples to assess the potential for acid generation, but it is not clear whether the samples were analyzed using the now common modified Sobek procedure or if they were analyzed using another method.

Data exist for Toxicity Characteristic Leaching Procedure (TCLP) results for five samples, dissolved metal concentration data measured during leach testing of 12 samples, run-off samples collected from five waste areas, and metal concentrations measured in extracts [5 percent acetic acid] from 39 samples. While these data are useful for assessing potential loading to surface water it is not clear how they compare to more recently accepted methods for evaluating metal mobility such as the Synthetic Precipitate Leaching Procedure (SPLP).

4.13.2 Mine Waste Investigation Results

Soil screening and sampling conducted during the 2007 and 2008 RI was completed for identified mine waste areas in an effort to characterize and evaluate the lateral extent and volume of potentially acidic and metal-laden soils. **Figure 7** shows each waste area and **Figures 16, 18, 20, 23, 26,** and **28** present the sample locations and estimated aerial extent of waste impacts. In 2007, field personnel visually estimated the perimeter of mine waste impacts and collected samples around the waste perimeter at 50-foot linear intervals and from the 0- to 6-inch depth interval (beginning beneath the root layer or litter, if present). In 2008, field personnel returned to those waste areas where the results from the 2007 investigation indicated that metals in the soil exceeded EPA RSLs and/or the DEQ action level for arsenic. Section 3 presents the method of investigation.

Evaluation of the nature and extent of contamination in these areas is summarized below with XRF data and laboratory confirmation analysis for the following metals: arsenic, cadmium, copper, iron, lead, manganese, mercury and zinc. In 2008, iron was also measured by both XRF and the analytical laboratory, and aluminum was analyzed by the laboratory (the XRF did not report aluminum concentrations). Cadmium was not measured in 2008 since the XRF had a cadmium source and was not set up to record cadmium. To supplement the cadmium data, select samples were analyzed at the laboratory for cadmium.

Where no laboratory data was available, concentrations reported for XRF results that had been dried and screened with a 10-mesh screen were used for final estimation of the extent of impacted soils. If neither XRF 10 data nor laboratory data was available, XRF-Field data were applied. Field XRF data logs are attached in **Appendix B. Tables 27a** and **27b** present XRF Field, XRF 10, and laboratory analytical results.

Analytical results were compared to EPA RSLs, Soil BTVs, DEQ Action Level for Arsenic in Surface Soil, and ABA and Soil SPLP for protection of groundwater.

4.13.3 Upper Anaconda Mine Waste Areas Sample Results

The 2007 and 2008 investigation included sampling two reclaimed waste areas (UAW2 and UAW5) and three unreclaimed waste piles (UAW1, UAW3, and UAW4) in the Anaconda Mine area (**Figure 16).** In 2007, the mine waste perimeters for UAW2 and UAW5 were sampled via visual inspection of the approximate reclaimed waste area boundary. Field personnel also collected some perimeter samples from UAW1, and composite samples from waste in all five areas. Field work in 2008 included returning to each mine waste area to further delineate the extent of mine waste as several perimeter sample locations at UAW1, UAW2, and UAW5 needed further assessment.

The extent of mine waste at the two mine waste piles UAW3 and UAW4 was also evaluated using XRF for field screening; however, no samples were collected from UAW3 and UAW4 for XRF 10 or laboratory analysis since their boundaries overlapped with boundaries for UAW1, UAW2, and/or UAW5 and the goal was only to delineate the boundary of these two areas. Coordinates for sample locations for UAW3 and UAW4 were not recorded with a GPS and XRF sample locations are not shown on **Figure 16**.

Tables 27a and **27b** present the XRF and laboratory analytical results for the samples collected during the RI. The soil within this mine waste area had pHs that ranged from 1.9 to 6.3. A review of metal concentrations with soil screening levels indicate the following exceedances:

- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- No exceedances of EPA RSLs for aluminum, cadmium, copper, mercury, and zinc. These metals were screened to these values because UBMC background concentrations are lower than their respective RSLs.
- Iron and lead exceeded their Soil BTVs. Iron, lead and manganese were screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- Cadmium, lead, manganese and zinc exceeded their respective Soil SPLPs.

Review of the isopleth map for the Upper Anaconda Mine Waste Area (**Figure 17**) shows arsenic concentrations appear highest in the northern portion of the waste area, in and surrounding UAW1, UAW 3, and UAW4, as well as the southern portion of the waste area near the base of the slope in the area above the water treatment plant. These areas along with a large area on the western side of the waste area appear to have arsenic concentrations that exceed the DEQ Action Level for arsenic. Lead and iron appeared to exhibit the most widespread concentrations above Soil BTVs.. Based on the isopleth maps and evaluation of the results against appropriate screening levels, the impacted area is mostly well defined and confined within the boundary studied. Exceptions include the area on the west that adjoins the large rock outcrop and the area to the south that adjoins the water treatment plant.

Several samples from the Upper Anaconda Waste areas were submitted for laboratory analysis of ABA and SPLP (**Table 27b**). Calculations were completed to evaluate the potential for remaining mine waste to generate acid. SPLP results indicate that cadmium lead, and manganese have the potential to leach from the soil with possible migration to adjoining soil, surface water, and groundwater. The following table summarizes the ABA results.

2007 and 2008 Anaconda Mine Waste Areas Acid Base Accounting				
Sample ID and Depth Interval	**NP:AP**	**NP:AP2 (t/kt)**	**NNP (t/kt)**	**Result**
UAW1-COMP 1 (0-6”)	0	0	-150	Potentially acid generating

2007 and 2008 Anaconda Mine Waste Areas Acid Base Accounting				
Sample ID and Depth Interval	**NP:AP**	**NP:AP2 (t/kt)**	**NNP (t/kt)**	**Result**
UAW2-200 (0-6”)	0.1	0.01	-9	Uncertain acid generating potential
UAW2-250 (0-6”)	-0.13	0.0169	-17	Uncertain acid generation potential
UAW2-COMP 1 (0-6”)	1.6	0.32	3	Uncertain acid generation potential
UAW3-COMP 1 (0-6”)	0.007	0.0001	-129	Potentially acid generating
UAW4-Comp1 (0-6”)	-0.028	0.00078	-216	Potentially acid generating
UAW5-Comp1 (0-6”)	1.176	1.383	0.6	Uncertain acid generating potential
UAW1-150+75 (0-6”)	108.3	11728.9	12.88	Uncertain acid generating potential

t/kt – tons per kilotons
Potentially acid generating = NP:AP<1 and NNP<-20 t/kt
Uncertain acid generation potential = NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to generate acid = NP:AP >3 and NNP>+20 t/kt

ABA results for the composite samples indicate that the remaining waste material at waste piles UAW1, UAW3, and UAW4 is potentially acid generating. Remaining mine waste at UAW2, and UAW5 has an uncertain acid generating potential. The potential for the mine wastes to generate acid indicates that there is a potential for the sulfide minerals in the mine waste/impacted soil to generate acid and mobilize metals, thereby having the potential to impact water quality. However, UAW1, UAW3, and UAW4 are located approximately 1,200 feet above the valley floor, on a hillside, above the water treatment plant, Blackfoot River and Anaconda Creek. All three piles are also distal to the intermittent stream near UAW5.

The actual potential for mine wastes to impact surface water or groundwater in the Upper Anaconda Mine area ultimately depends on the depth to groundwater, possible pathways to surface water or groundwater (e.g. fractured bedrock) in the area of the mine wastes, and metal mobility in the environment. Surface water collected from Anaconda Creek surface water at sampling station BRSW-6, below UAW1, UAW3, and UAW4, meets all DEQ-7 water quality standards and suggests that leachate is not reaching Anaconda Creek. However, the local geology, Anaconda mine workings, and the location of the water treatment plant footprint make it difficult to assess if leachate from the waste piles is impacting the Blackfoot River and/or groundwater in that area.

Two vein or fault veins are present in the Upper Anaconda Mine area and could act as possible pathways for leachate to reach groundwater and/or surface water. The mine workings sit directly below and down slope from the waste piles and could also act as possible pathways to groundwater and/or surface water. The cells that support the water treatment plant were part of the old wetland treatment system that was replaced by the water treatment plant in 2009. The location of the cells is where the majority of the Anaconda mine waste used to be located prior to the wetland cells construction. The water treatment plant currently treats a seep emanating from one of the cells and the source of the seep is not immediately clear. Additional investigation is needed to evaluate the existing conditions and the possible sources that may be impacting groundwater and surface water in this area.

Upper Anaconda Waste Area Summary and Conclusions

Results of historical, 2007 and 2008 field investigations indicated the presence of five discrete mining related features within the Upper Anaconda Waste Area. The extent of impacted soils encompasses a large area that contains all five identified mine waste features, and areas adjacent to these features at both up, down, and cross-slope locations (**Figure 16**). Much of the

Upper Anaconda Waste Area shows signs of impacts through the visual presence of mine wastes, staining/oxidation, stressed vegetation, or lack of vegetation.

The results of these investigations also indicate that surface soils associated with mine waste removal areas and in-situ mine waste in the Upper Anaconda exhibit metals concentrations above screening levels.

The boundary of impacted soils adjacent to UAW5 appears to be limited on the west side by an intermittent stream and a talus pile resulting from outcrops present on the west side of the stream (see **Figure 16**). The extent of impacted soils for the Upper Anaconda Waste Area, in general, is limited to the south by the new water treatment facility (**Figure 16**).

Samples collected from non-reclaimed waste piles UAW1, UAW3, and UAW4 indicate the waste is potentially acid generating. Acid generated from these waste piles may dissolve and mobilize metals, causing impacts to surface water and/or groundwater, and thereby, affecting water quality. However, these waste piles are located on the hillside approximately 1,200 feet above the valley floor and the Blackfoot River and Anaconda Creek. Additional investigation is needed to evaluate whether or not these waste piles are impacting groundwater and/or surface water in this area.

Tetra Tech used the data obtained from the historic sampling and the results of the 2007 and 2008 investigations of the mine waste to estimate the volume of impacted materials associated with the five identified features within this area. Volume was calculated based on two scenarios for estimating the boundary of mine waste impacts: 1) the estimated total extent of mine waste impacts as delineated with the XRF during the 2007/2008 field efforts; and 2) the estimated extent of mine waste/soil that exceeded one or more soil screening level as delineated through the concentration isopleth analysis. The assumed depth of impacts is 2 feet below ground surface (bgs) for impacted soil beneath the piles and existing ground surface.

This selected depth assumes that bedrock occurs at a depth of approximately 2 feet bgs and soil amendment would be implemented to a depth of 1.5 to 2 feet bgs. The following table presents the estimated area and volume of impacts for the two scenarios.

Upper Anaconda Mine Waste Area Mine Waste/Impacted Soil Volume Estimate			
Mine Waste Impact Boundary Type	**Estimated Depth of Mine Waste/Soil Impacts**	**Estimated Area**	**Estimated In-Place Volume of Mine Waste/Impacted Soil**
Total Area of Mine Waste Impacts	2 ft	317,988 ft^2 (7.3 acres)	635,976 ft^3 (23,555 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	248,292 ft^2 (5.7 ac)	496,584 ft^3 (27,588 yd^3)

ft – feet
ft^2 – square feet
ft^3 – cubic feet
yd^3 – cubic yards
Total Area of Mine Waste Impacts – mine waste boundary delineated based on 2007/2008 field XRF results
Area Exceeding AAL/RSL/BTVs – based on isopleth concentration analysis

4.13.4 Capital Mine Waste Area Sample Results

Sampling activities completed in 2007 identified one mine waste removal area associated with the Capital Mine. Mine waste samples from this area were designated as CMWA. The waste area is bisected by Stevens Creek and extends laterally downstream from the site access road (**Figure 18).**

The general perimeter of the removal/reclaimed area was delineated during the 2007 investigation through 1) visual determination and sampling of the estimated edge of the area and, 2) collection of GPS coordinates (see **Figure 18**). Eight perimeter samples and two composite samples were collected during the 2007 investigation. The 2007 XRF and laboratory data indicated soil/mine waste remaining in the Capital Mine area exhibited concentrations of arsenic and lead above soil screening levels. Therefore, additional perimeter investigation was performed in 2008 to further define the waste area boundaries. The investigation in 2008 also indicated a potential remaining waste pile present near the northern edge of the historic removal area (**Figure 15**).

Tables 27a and **27b** present the XRF and laboratory analytical results for the samples collected during the RI. The soil within this mine waste area had pHs ranging from 2.1 to 7.7. Review of metal concentrations with soil screening levels indicate the following exceedances:

- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- No exceedances of EPA RSLs for aluminum, cadmium, copper, mercury, and zinc. These metals were screened to these values because UBMC background concentrations are lower than their respective RSLs.
- Iron and lead exceeded their Soil BTVs. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- Lead exceeded the Soil SPLP.

The isopleth map for the Capital Mine Waste Area (**Figure 19**) shows concentration contours. Arsenic concentrations above the DEQ Action Level and lead concentrations above its Soil BTV are wide-spread across the waste area. Based on the isopleth maps and evaluation of the results against appropriate screening levels, the impacted area appears relatively well defined and confined within the boundary studied. Exceptions include the area on the north for arsenic and, to a lesser extent, lead.

Three soil samples from the Capital Mine Waste area were submitted to the laboratory for ABA and SPLP analysis (**Table 27b**), two in 2007 and one in 2008. Calculations were completed using ABA results to evaluate the potential for remaining metals-impacted soil to generate acid. The table below summarizes the ABA acid generation results.

2007 and 2008 Capital Mine Acid Base Accounting				
Sample ID and Depth Interval	**NP:AP**	**NP:AP2 (t/kt)**	**NNP (t/kt)**	**Result**
CMWA-Comp1 (0-6”)	0.018	0.0003	-55	Potentially acid generating
CMWA-Comp2 (0-6”)	2.67	7.13	75	Unlikely to generate acid
CMWA-0+12.5 (0-6”)	1.73	3.0	8	Uncertain acid generating potential
CMWA-250+50 (0-6”)	4.65	21.62	1.57	Uncertain acid generating potential

t/kt – tons per kilotons
Potentially acid generating = NP:AP<1 and NNP<-20 t/kt
Uncertain acid generation potential = NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to generate acid = NP:AP >3 and NNP>+20 t/kt

ABA results indicate remaining impacted soils associated with the reclaimed areas range from unlikely to generate acid to potentially acid generating. SPLP results indicate that lead has the potential to leach from the soil with possible migration to adjoining soil, surface water, and groundwater.

Capital Mine Waste Area Summary and Conclusions

Results of historical, 2007 and 2008 field investigations indicated the presence of one reclaimed/removal feature associated with the Capital Mine Waste Area. The results of these investigations also indicated that surface soils associated with mine waste removal areas exhibit some metals at concentrations above respective soil screening levels. The extent of impacted soils encompasses a relatively small area that is adjacent to the removal feature at up, down and cross-slope locations, spanning both sides of Stevens Creek (**Figure 18**). The boundary of impacted soils extends slightly into forested/vegetated areas adjacent to the removal area. While vegetation appeared to be moderate to sparse within the removal area itself, the adjacent areas contain what appears to be healthy vegetation and tree stand. A potential waste pile was identified during the 2008 investigation at the northern terminus of the removal area. The field XRF results for a sample screened from this pile indicate concentrations and exceedances of screening levels are consistent with samples collected from the main waste area.

Tetra Tech used the data obtained from the historic sampling and the results of the 2007 and 2008 investigations of the mine waste to estimate the volume of impacted materials associated with the identified mine waste within this area. Volume was calculated based on two scenarios for estimating the boundary of mine waste impacts: 1) the estimated total extent of mine waste impacts as delineated with the XRF during the 2007/2008 field efforts; and 2) the estimated extent of mine waste/soil that exceeded one or more soil screening level as delineated through the concentration isopleth analysis. The assumed depth of impacts is 2 feet below ground surface (bgs) for impacted soil beneath the piles and existing ground surface.

This selected depth assumes that bedrock occurs at a depth of approximately 2 feet bgs and soil amendment would be implemented to a depth of 1.5 to 2 feet bgs. The following table presents the estimated area and volume of impacts for the two scenarios.

Capital Mine Waste Area Mine Waste/Impacted Soil Volume Estimate			
Mine Waste Impact Boundary Type	**Estimated Depth of Mine Waste/Soil Impacts**	**Estimated Area**	**Estimated In-Place Volume of Mine Waste/Impacted Soil**
Total Area of Mine Waste Impacts	2 ft	14,374 ft^2 (0.33 acres)	28,748 ft^3 (1,065 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	14,374 ft^2 (0.33 acres)	28,748 ft^3 (1,065 yd^3)

ft – feet
ft^2 – square feet
ft^3 – cubic feet
yd^3 – cubic yards
Total Area of Mine Waste Impacts – based on 2007/2008 field XRF results
Area Exceeding AAL/RSL/BTVs – based on isopleth concentration analysis

4.13.5 Carbonate Mine Waste Area Sample Results

Sampling activities completed in 2007 identified one mine waste removal area associated with the Carbonate Mine. This area was designated as CARM, and is located down slope of the Carbonate Mine Waste Repository location (**Figure 20**). The removal area spans both sides of the Carbonate Mine access road, and is bound on the south by U.S. Highway 200. Additionally, a wetlands area associated with Swamp Gulch is present within the eastern half of the reclaimed area (see **Figure 7** and **20**). This wetland area was the former site of the Carbonate mine tailings impoundment.

Soil samples from the former mine tailings impoundment area were collected from the zero to six-inch interval, with the zero point beginning below the soil root mass and/or duff, if present. XRF data for soil metals concentrations were collected from the apparent perimeter of the mine waste removal/reclaimed area, with 10 percent of samples submitted to the laboratory for analysis of metals. Additionally, composite samples were also collected.

The general perimeter of the removal/reclaimed area was delineated during the 2007 investigation using visual determination of the estimated edge of the area and collection of GPS coordinates (see **Figure 20**). Twenty-three perimeter samples and two composite samples were collected during this investigation.

Tables 27a and **27b** present the XRF and laboratory analytical results for the samples collected during the RI. The soil within this mine waste area had pHs that ranged from 5.3 to 6.6. A review of metal concentrations with soil screening levels indicate the following exceedences:

- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- No exceedances of EPA RSLs for aluminum, cadmium, copper, mercury, and zinc. These metals were screened to these values because UBMC background concentrations are lower than their respective RSLs.
- Iron, lead, and manganese exceeded their respective Soil BTVs. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- Lead exceeded the Soil SPLP.

The isopleth map for the Carbonate Mine Waste Area (**Figure 21**) shows concentration contours. Arsenic concentrations above the DEQ Arsenic Action Level for Surface Soil and lead concentrations above the Soil BTV appeared isolated to two areas, one area appeared along Swamp Gulch Road and the other in the north-northeast portion of the reclaimed area (**Figure 20**). All but two of the sampling locations were below the soil BTV for manganese. Based on the isopleth maps and evaluation of the results against appropriate screening levels, the impacted area appears relatively well defined and confined within the boundary of the former waste removal area..

One sample from the Carbonate Mine Waste was submitted for laboratory analysis of ABA and SPLP (**Table 27b**). The following table summarizes ABA results.

Carbonate Mine Waste Area Acid/Base Accounting				
Sample Depth Interval	**NP:AP**	**NP:AP[2] (t/kt)**	**NNP (t/kt)**	**Result**
CARM-400 (0-6”)	30.43	926	6.77	Uncertain acid generation potential

t/kt – tons per kilotons
Potentially acid generating = NP:AP<1 and NNP<-20 t/kt
Uncertain acid generation potential = NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to generate acid = NP:AP >3 and NNP>+20 t/kt

The ABA results (uncertain acid generating potential) indicate it is unclear whether the mine waste would generate acid that in turn would leach and mobilize metals to surface water or groundwater. However, the SPLP testing done on the sample indicates that lead and manganese have the potential to leach from the soil. The SPLP cadmium result was less than the laboratory PQL, suggesting that cadmium does not leach to surrounding soil and waters.. However, cadmium in Carbonate mine area wells exceeds DEQ groundwater standards.

Additional SPLP and ABA testing may be needed to better characterize the potential of not only lead mobility, but mobility of additional metals such as cadmium, copper, and zinc. Additional hydrogeologic studies may also be needed to further evaluate the fate and transport of these metals in the system.

Carbonate Mine Waste Area Summary and Conclusions

Results of historical, 2007 and 2008 field investigations indicated that soils *beneath the cover soil* associated with the mine waste removal area exhibited metals concentrations above several soil screening levels. The extent of impacted soils encompasses a large area that extends both sides of the Carbonate Mine access road (**Figure 20**). The general perimeter of the removal area, delineated in 2007, contained metals concentrations at its perimeter in excess of appropriate screening levels.

The soils identified adjacent to the previous removal area are of uncertain acid generating potential; however, SPLP results indicate there is some potential for leaching of metals from the soil/mine waste. The pH measured for soil/mine waste in this waste area were near neutral. The uncertain acid generating potential of the materials in this area indicate that it is unclear whether acid could be generated and mobilize trace metals from the remaining impacted soils that impact surface water or groundwater. Stressed vegetation was present along the western portion of the removal area adjacent to stressed timber, however a wetlands with apparently thriving vegetation is present on the eastern half. Further investigations may be needed to evaluate the fate and transport of metals in the system.

Tetra Tech used the data obtained from the historic sampling and the results of the 2007 and 2008 investigations of the mine waste to estimate the volume of impacted materials associated with the identified mine waste within this area. Volume was calculated based on two scenarios for estimating the boundary of mine waste impacts: 1) the estimated total extent of mine waste impacts as delineated with the XRF during the 2007/2008 field efforts; and 2) the estimated extent of mine waste/soil that exceeded one or more soil screening level as delineated through the concentration isopleth analysis. The assumed depth of impacts is 2 feet below ground surface (bgs) for impacted soil beneath the piles and existing ground surface.

This selected depth assumes that bedrock occurs at a depth of approximately 2 feet bgs and soil amendment would be implemented to a depth of 1.5 to 2 feet bgs. The following table presents the estimated area and volume of impacts for the two scenarios.

Carbonate Mine Waste Area Mine Waste/Impacted Soil Volume Estimate			
Mine Waste Impact Boundary Type	**Estimated Depth of Mine Waste/Soil Impacts**	**Estimated Area**	**Estimated In-Place Volume of Mine Waste/Impacted Soil**
Total Area of Mine Waste Impacts	2 ft	117,612 ft^2 (2.7 acres)	176,418 ft^3 (6,534 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	30,928 ft^2 (0.71 acres)	61,856 ft^3 (2,291 yd^3)

ft – feet
ft^2 – square feet
ft^3 – cubic feet
yd^3 – cubic yards
Total Area of Mine Waste Impacts – based on 2007/2008 field XRF results
Area Exceeding AAL/RSL/BTVs – based on isopleth concentration analysis

4.13.6 Consolation Mine Waste Area Sample Results

The Consolation Mine Waste Area was designated as CONM for the RI investigation. CONM is located east of Shave Gulch Creek and spans both sides of the Consolation Mine Access road

(**Figure 20**). The general perimeter of the removal/reclaimed area was delineated during this investigation using a visual estimate of the edge of the area and collection of GPS coordinates. Twenty-one perimeter samples, two composite samples, and a waste pile sample were collected during this investigation.

Tables 27a and **27b** present the XRF and laboratory analytical results for the samples collected during the RI. The pH of soil from this area ranged from 2.6 to 7.5. Review of metal concentrations with soil screening levels indicate the following exceedences:

- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- No exceedances of EPA RSLs for aluminum, cadmium, copper, mercury, and zinc. These metals were screened to these values because UBMC background concentrations are lower than their respective RSLs.
- Iron and lead exceeded the Soil BTVs. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- Lead exceeded the Soil SPLP.

Review of the isopleth map for the Consolation Mine Waste Area (**Figure 22**) indicate arsenic, iron, and lead impacted soils within the reclaimed area were still present at the Consolation Mine Waste Area. Arsenic concentrations above the DEQ action level and lead and iron concentrations above Soil BTVs are wide-spread across the waste area. The isopleths show two areas with metals that appear consistently higher than the surrounding area, including the west half of the waste area and a smaller area on the east. The western portion includes samples collected below the road that cuts through the lower portion of the waste area. Based on the isopleth maps and evaluation of the results against appropriate screening levels, the impacted area appears relatively well defined and confined within the boundary studied. An exception to this is the eastern side of the waste area where lead exceeds its Soil BTV.

Three samples from the Consolation Mine Waste area were submitted for laboratory analysis of ABA and SPLP (**Table 27b**).

Calculations were completed from these results to evaluate the potential for remaining metals-impacted soils to generate acid. The following table summarizes the ABA acid generation results:

Consolation Mine Waste Acid Base Accounting				
Sample ID and Depth Interval	**NP:AP**	**NP:AP[2] (t/kt)**	**NNP (t/kt)**	**Result**
CONM-COMP 1 (0-6”)	3	1.5	4	Uncertain acid generation potential
CONM-COMP 2 (0-6”)	14	4.67	39	Unlikely to generate acid
CONM-750 (0-6”)	0.12	0.014	-7.5	Uncertain acid generation potential
CONM-250+25 (0-6”)	0	0	-0.58	Uncertain acid generation potential
CONM-750+6 (0-6”)	0	0	-0.03	Uncertain acid generation potential
CONM-Pile1	0.07	0.005	-14	Uncertain acid generation potential

t/kt – tons per kilotons
Potentially acid generating = NP:AP<1 and NNP<-20 t/kt
Uncertain acid generation potential = NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to generate acid = NP:AP >3 and NNP>+20 t/kt

Five of six ABA results indicate that soil/mine waste has uncertain acid generating potential. The one other result is unlikely to generate acid. However, when considering the SPLP test

results, lead does have the potential to leach from the mine waste/impacted soil and migrate to adjoining soil, surface water, and groundwater..

Consolation Mine Waste Area Summary and Conclusions

The results of these investigations indicate that surface soils associated with the mine waste removal area exhibited arsenic, iron, and lead concentrations above their respective soil screening levels. The extent of impacted soils encompasses a large area that extends beyond both sides of the Consolation Mine access road (**Figure 20**). The boundary of impacted soils is limited along the western perimeter by Shave Creek and an intermittent stream adjoining Shave Gulch. A waste pile is present at the southeastern most perimeter extent of the reclaimed area (**Figure 9**).

The soils identified adjacent to the removal area are either of uncertain acid generating potential or unlikely to generate acid. However, leach test results demonstrate that lead has the ability to leach from the soil/mine waste and migrate to surface water and/or groundwater. Much of the area within and adjacent to the Consolation Mine Waste Area shows signs of mine waste impacts through staining/oxidation, stressed vegetation, or the lack of vegetation.

Tetra Tech used the data obtained from the historic sampling and the results of the 2007 and 2008 investigations of the mine waste to estimate the volume of impacted materials associated with the identified mine waste within this area. Volume was calculated based on two scenarios for estimating the boundary of mine waste impacts: 1) the estimated total extent of mine waste impacts as delineated with the XRF during the 2007/2008 field efforts; and 2) the estimated extent of mine waste/soil that exceeded one or more soil screening level as delineated through the concentration isopleth analysis. The assumed depth of impacts is 2 feet below ground surface (bgs) for impacted soil beneath the piles and existing ground surface.

This selected depth assumes that bedrock occurs at a depth of approximately 2 feet bgs and soil amendment would be implemented to a depth of 1.5 to 2 feet bgs. The following table presents the estimated area and volume of impacts for the two scenarios.

Consolation Mine Waste Area Mine Waste/Impacted Soil Volume Estimate			
Mine Waste Impact Boundary Type	**Estimated Depth of Mine Waste/Soil Impacts**	**Estimated Area**	**Estimated In-Place Volume of Mine Waste/Impacted Soil**
Total Area of Mine Waste Impacts	2 ft	75,359 ft^2 (1.73 acres)	150,717 ft^3 (5,582 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	56,628 ft^2 (1.3 acres)	113,256 ft^3 (4,195 yd^3)

ft – feet
ft^2 – square feet
ft^3 – cubic feet
yd^3 – cubic yards
Total Area of Mine Waste Impacts – based on 2007/2008 field XRF results
Area Exceeding AAL/RSL/BTVs – based on isopleth concentration analysis

4.13.7 Edith Mine Waste Area Sample Results

Field personnel sampled three waste areas associated with the Edith Mine during the 2007 investigation. These waste areas include the East Edith Area (EEA), West Edith Area (WEA) and Central Edith Area (CEA). Field personnel analyzed soil samples from 18 perimeter locations and one composite sample from EEA, 16 perimeter locations and 3 composite samples from CEA, and 11 perimeter locations and two composite samples from WEA.

Tables 27a and **27b** present the XRF and laboratory analytical results for the samples collected during the RI. The pH of soil from this area ranged from 2.9 to 7.6. The results indicate metals impacted soils within the reclaimed area were still present at the Edith Mine Waste Area above one or more soil screening levels. Comparison of waste area metal concentrations with soil screening levels indicate the following exceedences:

- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- No exceedances of EPA RSLs for aluminum, cadmium, copper, mercury, and zinc. These metals were screened to these values because UBMC background concentrations are lower than their respective RSLs.
- Iron and lead exceeded their respective Soil BTVs. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- No exceedances of any Soil SPLPs.

The isopleth map for the Edith Mine Waste Area (**Figure 24**) shows concentration contours. Note that the West Edith and Central Edith waste areas are combined in the map. One arsenic, one lead, and three iron results exceeded their respective screening levels. All of the results that exceeded their screening levels were collected from the Central Edith area. Based on the isopleth maps and evaluation of the results against appropriate screening levels, the impacted area appears well defined and confined within the boundary studied.

Two samples from the Central Edith Mine Waste area were submitted for laboratory analysis of ABA and SPLP.

Edith Mine Waste Acid Base Accounting				
Sample ID and Depth Interval	**NP:AP**	**NP:AP[2] (t/kt)**	**NNP (t/kt)**	**Result**
CEA-1-3-COMP 1 (0-6”)	14.3	3.56	53.0	Unlikely to generate acid
CEA-1-3-COMP 2 (0-6”)	29.0	29.0	28.0	Unlikely to generate acid

t/kt – tons per kilotons
Potentially acid generating = NP:AP<1 and NNP<-20 t/kt
Uncertain acid generation potential = NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to generate acid = NP:AP >3 and NNP>+20 t/kt

ABA results from the two composite samples collected from the Central Edith Area indicate the soil/residual mine wastes in this area are unlikely to generate acid and mobilize metals through acid drainage. The SPLP results indicate that it is unlikely that metals will leach from the soil/residual mine waste and into surrounding soil and/or water.

Edith Mine Waste Area Summary and Conclusions

The Edith Mine Waste Area includes three investigation areas where mine waste was formerly removed. Mine Horse Road borders the waste areas on the north and the Upper Marsh on the west (**Figure 23**). A waste pile is present at the southeastern most perimeter extent of the reclaimed area. The results of these investigations indicate that surface soils associated with the previous mine waste removal areas exhibited some metals concentrations above their respective soil screening levels.

The ABA data identified soils within the previous removal area as unlikely to generate acid, while SPLP results indicate that it is unlikely that metals will leach from the soil/residual mine

waste and into surrounding soil and/or water. The areas within and adjacent to the mine waste removal area were moderately vegetated in 2007 during the RI.

Tetra Tech used the data obtained from the historic sampling and the results of the 2007 and 2008 investigations of the mine waste to estimate the volume of impacted materials associated with the identified mine waste within this area. Volume was calculated based on two scenarios for estimating the boundary of mine waste impacts: 1) the estimated total extent of mine waste impacts as delineated with the XRF during the 2007/2008 field efforts; and 2) the estimated extent of mine waste/soil that exceeded one or more soil screening level as delineated through the concentration isopleth analysis. The assumed depth of impacts is 2 feet below ground surface (bgs) for impacted soil beneath the piles and existing ground surface.

This selected depth assumes that bedrock occurs at a depth of approximately 2 feet bgs and soil amendment would be implemented to a depth of 1.5 to 2 feet bgs. The following table presents the estimated area and volume of impacts for the two scenarios.

Edith Mine Waste Area Mine Waste/Impacted Soil Volume Estimate			
Mine Waste Impact Boundary Type	**Estimated Depth of Mine Waste/Soil Impacts**	**Estimated Area**	**Estimated In-Place Volume of Mine Waste/Impacted Soil**
Total Area of Mine Waste Impacts	2 ft	138,956 ft^2 (3.19 acres)	277,912 ft^3 (7,720 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	2,744 ft^2 (0.063 acres)	5,489 ft^3 (203 yd^3)

ft – feet
ft^2 – square feet
ft^3 – cubic feet
yd^3 – cubic yards
Total Area of Mine Waste Impacts – based on 2007/2008 field XRF results
Area Exceeding AAL/RSL/BTVs – based on isopleth concentration analysis

4.13.8 No. 3 Tunnel Waste Area Sample Results

No. 3 Tunnel Waste Area is located along Paymaster Road and adjoins Stevens Gulch. Wastes were removed from this area in 1996 and placed in the Paymaster Repository. Field personnel sampled 22 perimeter locations, collected three composite samples, and sampled four additional mine waste features in the No. 3 Tunnel area (N3TA) during the 2007 investigation (**Figure 10**). Field personnel also investigated the area north of N3TA below Paymaster Road. Historic photographs indicated the area had been disturbed at one point in time and the use of the area was unclear. Field personnel inspected the area and reported that the area had appeared disturbed but that there was no apparent mine wastes identified in the area.

Tables 27a and **27b** present the XRF and laboratory analytical results for the samples collected during the RI. The pH of soil ranged from 4.7 to 5.8. The results indicate that arsenic, iron, and manganese in the mine waste and adjoining soil were above their respective soil screening levels. Review of metal concentrations with soil screening levels indicate the following exceedences:

- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- No exceedances of EPA RSLs for aluminum, cadmium, copper, mercury, and zinc. These metals were screened to these values because UBMC background concentrations are lower than their respective RSLs.

- Iron and manganese exceeded their soil BTVs. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- No exceedances of Soil SPLPs.

Three features sampled that were outside of the reclaimed area included a detention pond, and two small piles of soil. All three of the samples collected outside the reclaimed area indicate that it is unlikely that metals will leach from the soil/residual mine waste and into surrounding soil and/or water.

Review of the isopleth map for the No. 3 Tunnel Waste Area (**Figure 25**) shows arsenic and manganese concentrations above respective screening levels are concentrated in two primary areas of the waste area. Arsenic and manganese appear highest in the north central and southeastern portions of the area. Based on the isopleth maps and comparison of the results to soil screening levels, the impacted area appears relatively well defined and confined within the boundary studied. One exception is the concentrations of metals to the southeast. This is an area just below Paymaster Road and between the road and Stevens Creek. Additional sampling in this area may be needed to determine a final boundary.

Two samples from the No. 3 Tunnel Area were submitted for laboratory analysis of ABA and SPLP (**Table 27b**).

No. 3 Tunnel Mine Waste Acid Base Accounting				
Sample ID and Depth Interval	**NP:AP**	**NP:AP[2] (t/kt)**	**NNP (t/kt)**	**Result**
N3TA-COMP 1 (0-6”)	2.67	1.78	2.5	Uncertain acid generation potential
N3TA-100-EOT (0-6”)	0	0.6	-0.6	Uncertain acid generation potential

t/kt – tons per kilotons
Potentially acid generating = NP:AP<1 and NNP<-20 t/kt
Uncertain acid generation potential = NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to generate acid = NP:AP >3 and NNP>+20 t/kt

The ABA results (uncertain acid generating potential) indicate it is unclear whether the mine waste would generate acid that in turn would leach and mobilize metals to surface water, groundwater, or make them available to ecological receptors. The SPLP test results indicate that it is unlikely that metals will leach from the soil/residual mine waste and into surrounding soil and/or water.

No. 3 Tunnel Waste Area Summary and Conclusions

The No. 3 Tunnel (**Figure 23**) waste area results indicate that surface soils associated with the mine waste exhibited arsenic and manganese concentrations above respective soil screening levels. Samples collected from three mine features associated with the waste area did not have any exceedances of soil screening levels. The isopleth maps (**Figure 25**) indicated that the highest metal concentrations were in the north-central and southeast portions of the waste.

ABA data indicate an uncertain potential to generate acid, while SPLP data indicate that it is unlikely that metals will leach from the soil/residual mine waste and into surrounding soil and/or water.

Mine wastes were removed from the area in 1996. It is unknown how deep current mine impacts extend. Tetra Tech estimates that mine waste may impact soil up to 2 feet deep. Tetra Tech used the data obtained from the historic sampling and the results of the 2007 and 2008 investigations of the mine waste to estimate the volume of impacted materials associated with

the identified mine waste within this area. Volume was calculated based on two scenarios for estimating the boundary of mine waste impacts: 1) the estimated total extent of mine waste impacts as delineated with the XRF during the 2007/2008 field efforts; and 2) the estimated extent of mine waste/soil that exceeded one or more soil screening level as delineated through the concentration isopleth analysis. The assumed depth of impacts is 2 feet below ground surface (bgs) for impacted soil beneath the piles and existing ground surface.

This selected depth assumes that bedrock occurs at a depth of approximately 2 feet bgs and soil amendment would be implemented to a depth of 1.5 to 2 feet bgs. The following table presents the estimated area and volume of impacts for the two scenarios.

No. 3 Tunnel Mine Waste Area Mine Waste/Impacted Soil Volume Estimate			
Mine Waste Impact Boundary Type	**Estimated Depth of Mine Waste/Soil Impacts**	**Estimated Area**	**Estimated In-Place Volume of Mine Waste/Impacted Soil**
Total Area of Mine Waste Impacts	2 ft	117,612 ft^2 (2.7 acres)	235,224 ft^3 (8,712 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	28,314 ft^2 (0.65 acres)	56,628 ft^3 (2,097 yd^3)

ft – feet
ft^2 – square feet
ft^3 – cubic feet
yd^3 – cubic yards
Total Area of Mine Waste Impacts – based on 2007/2008 field XRF results
Area Exceeding AAL/RSL/BTVs – based on isopleth concentration analysis

4.13.9 Mary P Mine Waste Pile Sample Results

The Mary P Mine waste pile resides in a narrow strip of land between Mike Horse Creek Road and a steep hillside (**Figure 7** and **30**). Field personnel evaluated the extent of mine waste in the area. Tetra Tech collected 15 soil samples in 2008 from the perimeter surrounding the Mary P Mine waste pile to evaluate the extent of impacts from the waste pile.

Tables 27a and **27b** present the XRF and laboratory analytical results for the samples collected during the RI. The pH of soil from this area was measured at 4.2. The results indicate arsenic, iron, and lead in the mine waste and adjoining soil were above respective soil screening levels. Review of metal concentrations with soil screening levels indicate the following exceedences:

- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- No exceedances of EPA RSLs for aluminum, cadmium, copper, mercury, and zinc. These metals were screened to these values because UBMC background concentrations are lower than their respective RSLs.
- Iron and lead exceeded their Soil BTVs. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- No exceedances of any Soil SPLP.

Isopleth concentration maps were not prepared as coordinates for the perimeter samples were not recorded during the RI field effort. However, the mine waste pile is present and bound within a small area on the north by Mike Horse Road and on the south by the hillside, with the east and west sides tapering into the hillside. The mine waste pile and adjoining impacted area is estimated to be approximately 0.19 acres in size.

One sample from soil adjoining the Mary P Mine Waste Pile was submitted for laboratory analysis of ABA and SPLP.

Mary P Mine Waste Pile Acid Base Accounting				
Sample ID and Depth Interval	**NP:AP**	**NP:AP[2] (t/kt)**	**NNP (t/kt)**	**Result**
MPWA-200+0 (0-6")	-6.81	-15	-3.44	Uncertain acid generation potential

t/kt – tons per kilotons
Potentially acid generating = NP:AP<1 and NNP<-20 t/kt
Uncertain acid generation potential = NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to generate acid = NP:AP >3 and NNP>+20 t/kt

ABA results indicate the mine wastes from this area have an uncertain potential to generate acid, create acid drainage, and mobilize metals. The SPLP results indicate that it is unlikely that metals will leach from the soil/residual mine waste and into surrounding soil and/or water.

Mary P Mine Waste Pile Summary and Conclusions

The Mary P Waste Pile is bound within a narrow strip of land between Mike Horse Road and adjoining hillside. The mine waste appeared to impact adjoining soil at the time of the RI field work. Analytical results for samples collected from the mine waste pile and surrounding soil indicate arsenic, iron, and lead are present above respective soil screening levels. ABA results were not conclusive as to whether the mine wastes generate acid or have the ability to generate acid drainage. Leach testing also indicates that it is unlikely that metals will leach from the soil/residual mine waste and into surrounding soil and/or water.

The volume of the mine waste area and surrounding soil were estimated based on field observations. For the following volume calculations, Tetra Tech assumes the lateral impacts from east to west are estimated at approximately 120 feet by 60 feet in the north to south direction. The mine waste pile is estimate to be 7 feet tall with a diameter of 40 feet at the base and 20 feet at the top. The estimated depth of mine wastes and soil impacts is 3 feet below ground surface. Field truthing of these estimates, or surveying of the area, will be required for accurate volume estimates. However, based on the above assumptions/estimates, the rough estimated volume of mine wastes and adjoining impacted soil is 903 yd^3 for the Mary P Mine Waste Pile:

Mary P Mine Waste Pile Volume Estimate of Mine Waste/Impacted Soil					
Waste Pile Volume					
Mine Waste Pile Height	Diameter of Top of Waste Pile	Diameter of Bottom of Waste Pile	Estimated In-Place Volume of Mine Waste/Impacted Soil		
7 ft	20 ft	40 ft	2,800 ft^3 (103 yd^3)		
Estimated Volume of Soil Impacts Beneath and Surrounding the Pile					
Estimated Depth of Mine Waste Impacts Beneath Pile and to Surrounding Soil		Estimated Width East to West	Estimated Width North to South	Estimated Area	Estimated Volume of Impacts
3 ft		120 ft	60 ft	7,200 ft^2	21,600 ft^3 (800 yd^3)

ft – feet

Mary P Mine Waste Pile Volume Estimate of Mine Waste/Impacted Soil
ft^2 – square feet ft^3 – cubic feet yd^3 – cubic yards Volume waste pile: $V = \frac{\pi}{12} h \left(D^2 + Dd + d^2\right)$ *D* – diameter of base of pile, *d* – diameter at top of pile

4.13.10 Paymaster Mine Waste Area Sample Results

Two reclaimed areas for the Paymaster Mine (PMAW1 and PMWA2) were sampled in 2007 and 2008. The areas are located adjacent to (west of) Paymaster Gulch (**Figure 28**). The removal areas are located up-slope on the west side of the access road. The general perimeters of the two removal/reclaimed areas were delineated during the 2007 investigation using a visual estimate of the edge of the removal area and collection of GPS coordinates (**Figure 28**). Field personnel collected six perimeter samples and two composite samples from PMWA1, and six perimeter samples and one composite sample from PMWA2 were investigated to evaluate concentrations on the visually-designated perimeter boundary. Some of the samples exhibited concentrations of arsenic, iron and lead above respective soil screening levels; therefore, field personnel returned to the two areas during the 2008 investigation to further evaluate the extent of mine waste impacts.

Tables 27a and **27b** present the XRF and laboratory analytical results for the samples collected during the RI. The pH of soil ranged from 3.7 to 6.7. The results indicate arsenic and iron in the mine waste and adjoining soil were above respective soil screening levels. Comparison of measured metal concentrations to soil screening levels indicate the following exceedances for PMWA1 and PMWA2:

- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- No exceedances of EPA RSLs for aluminum, cadmium, copper, mercury, and zinc. These metals were screened to these values because UBMC background concentrations are lower than their respective RSLs.
- Iron exceeded the Soil BTV. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- Lead exceeded the Soil SPLP.

Results from each waste area indicate similar exceedences with comparable concentrations exhibited in the samples.

Four samples from the Paymaster Mine Waste area were submitted for laboratory analysis of ABA and SPLP (**Table 27b**). Calculations were completed from these results to evaluate the potential for remaining metals-impacted soils to generate acid. The following table summarizes the ABA acid generation results:

2007 and 2008 Paymaster Area Acid Generating Evaluation				
Sample ID and Depth Interval	**NP:AP**	**NP:AP2 (t/kt)**	**NNP (t/kt)**	**Result**
PMWA1-50 (0-6”)	0.83	0.69	-0.4	Uncertain acid generation potential
PMWA1-Comp1 (0-6”)	4	16	3	Uncertain acid generation potential
PMWA1-Comp2 (0-6”)	1	1	0	Uncertain acid generation potential
PMWA2-Comp1	4	16	3	Uncertain acid generation potential

t/kt – tons per kilotons
Potentially acid generating = NP:AP<1 and NNP<-20 t/kt
Uncertain acid generation potential = NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to generate acid = NP:AP >3 and NNP>+20 t/kt

ABA results indicate remaining impacted soils associated with the reclaimed areas are of uncertain acid generating potential. While it is unclear whether the wastes generate enough acid for acid drainage, the SPLP testing does indicate that lead may mobilize from the mine waste and into surrounding soil and/or water.

Paymaster Mine Summary and Conclusions

Results of historical, 2007 and 2008 field investigations indicated the presence of two removal/reclaimed areas within the Paymaster Mine Waste Area which have been designated as PMWA1 and PMWA2 (see **Figure 28**). The results of these investigations also indicated that surface soils associated with the previous mine waste removal areas exhibit arsenic and iron concentrations above respective screening levels. The extent of impacted soils encompasses two small areas associated with the removal areas located up-slope and west of the Paymaster Mine access road (**Figure 28**). Both areas are located adjacent to Paymaster Creek. Impacted soil distributions extend laterally from upslope to down-slope locations, but do not appear to intersect Paymaster Creek at either removal area.

The soils identified within both removal areas are of uncertain acid generating potential but lead has the ability to mobilize in the environment based on SPLP testing. Areas within the Paymaster Mine waste removal areas show signs of impacts through the presence of staining/oxidation, stressed vegetation, or the lack of vegetation.

Tetra Tech used the data obtained from the historic sampling and the results of the 2007 and 2008 investigations of the mine waste to estimate the volume of impacted materials associated with the identified mine waste within this area. Volume was calculated based on two scenarios for estimating the boundary of mine waste impacts: 1) the estimated total extent of mine waste impacts as delineated with the XRF during the 2007/2008 field efforts; and 2) the estimated extent of mine waste/soil that exceeded one or more soil screening level as delineated through the concentration isopleth analysis. The assumed depth of impacts is 2 feet below ground surface (bgs) for impacted soil beneath the piles and existing ground surface.

This selected depth assumes that bedrock occurs at a depth of approximately 2 feet bgs and soil amendment would be implemented to a depth of 1.5 to 2 feet bgs. The following table presents the estimated area and volume of impacts for the two scenarios.

Paymaster Mine Waste Areas Mine Waste/Impacted Soil Volume Estimate			
Mine Waste Impact Boundary Type	**Estimated Depth of Mine Waste/Soil Impacts**	**Estimated Area**	**Estimated In-Place Volume of Mine Waste/Impacted Soil**
PMWA1			
Total Area of Mine Waste Impacts	2 ft	4,356 ft^2 (0.10 acre)	8,712 ft^3 (323 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	2,178 ft^2 (0.05 acres)	4,356 ft^3 (161 yd^3)
PMWA2			
Total Area of Mine Waste Impacts	2 ft	5,663 ft^2 (0.13 acre)	11,325 ft^3 (429 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	2,178 ft^2 (0.05 acres)	4,356 ft^3 (161 yd^3)

ft – feet
ft^2 – square feet
ft^3 – cubic feet
yd^3 – cubic yards
Total Area of Mine Waste Impacts – based on 2007/2008 field XRF results
Area Exceeding AAL/RSL/BTVs – based on isopleth concentration analysis

4.13.11 Upper Mike Horse Mine Waste Area Sample Results

Field personnel investigated three mine waste removal areas (UMH1, UMH2, UMH3) in the Upper Mike Horse area in 2007 and 2008 (**Figure 26**). UMH1 and UMH2 are located across the drainage and east of the Mike Horse Mine access road and Mike Horse Creek. UMH3, the largest of the three reclaimed areas sampled, is located up-slope of the Mike Horse Mine access road, and west of Mike Horse Creek. During the 2007 investigation, ten perimeter samples and one composite sample from UMH1, and fourteen perimeter samples and two composite samples from UMH2, and sixteen perimeter samples and three composite samples from UMH3 were collected. Samples and field XRF data from the 2008 investigation were collected from transects starting at five original perimeter locations at UMH1, thirteen original perimeter locations at UMH2, and three original perimeter locations at UMH3. No samples were collected in 2008 from the UMH1-00, 50, 100 or 150 locations due to their proximity to the roadbed and the eastern edge of the adjacent reclaimed area. This area is assumed to contain soils with metals above soil screening levels between the original perimeter locations and the adjacent reclaimed area based on the 2007 data.

Tables 27a and **27b** present the XRF and laboratory analytical results for the samples collected during the RI. The pH of soil ranged from 3.7 to 6.7. The results indicate arsenic, iron, lead, and manganese in the mine waste and adjoining soil were above respective soil screening levels. Metal concentrations between the three mine waste areas were comparable. Comparison of measured metal concentrations to soil screening levels indicate the following exceedances for UMH1, UMH2, and UMH3:

- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- No exceedances the EPA RSLs for aluminum, cadmium, copper, mercury, and zinc. These metals were screened to these values because UBMC background concentrations are lower than their respective RSLs.
- Lead and manganese exceeded their Soil BTV. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.

- Lead exceeded the Soil SPLP.

Isopleth concentration maps were developed for the Upper Mike Horse Mine waste areas (**Figure 27**). As shown on the isopleth map, arsenic, lead, and manganese that exceed respective soil screening levels in the waste areas are wide-spread.

Seven samples from the Upper Mike Horse Mine waste areas were submitted for laboratory analysis of ABA and SPLP (**Table 27b**). Soil pH ranged from 4.5 to 7.6. Calculations were completed from these results to evaluate the potential for remaining metals-impacted soils to generate acid. The following table summarizes the ABA acid generation results:

2007 and 2008 Upper Mike Horse Mine Area Acid Generation Evaluation				
Sample ID and Depth Interval	**NP:AP**	**NP:AP[2] (t/kt)**	**NNP (t/kt)**	**Result**
2007 Investigation				
UMH1-Comp (0-6")	15	225	14	Uncertain acid generation potential
UMH2-Comp 1(0-6")	3.5	12.25	5	Uncertain acid generation potential
UMH2-Comp2 (0-6")	2.67	7.13	10	Uncertain acid generation potential
UMH3-Comp2 (0-6")	2.75	7.57	15	Uncertain acid generation potential
UMH3-Comp3 (0-6")	0.08	0.0064	-12	Uncertain acid generation potential
2008 Investigation				
UMH2-400+25 (0-6")	200	40,000	1.99	Uncertain acid generation potential
UMH3-400+25 (0-6")	200	40,000	1.99	Uncertain acid generation potential

t/kt – tons per kilotons
Potentially acid generating = NP:AP<1 and NNP<-20 t/kt
Uncertain acid generation potential = NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to generate acid = NP:AP >3 and NNP>+20 t/kt

ABA results indicate remaining impacted soils associated with the reclaimed areas are of uncertain acid generating potential. While it is unclear whether the soils in the reclaimed areas generate enough acid for acid drainage, SPLP results indicate that lead may mobilize from the reclaimed areas and into surrounding soil and/or water.

Upper Mike Horse Mine Waste Area Summary and Conclusions

The 2007 and 2008 field investigations indicated the presence of five removal/reclaimed areas within the Upper Mike Horse Mine Waste Area. Three of these areas, designated as UMH1, UMH2 and UMH3, were sampled during the 2007 and 2008 investigations (see **Figure 26**). The other two areas had mine waste removed and were reclaimed and re-seeded by ASARCO in 2007.

The results of these investigations indicated that surface soils associated with mine waste removal areas exhibit arsenic, lead, and manganese concentrations above respective soil screening levels. The extent of impacted soils appears wide-spread based on the isopleth maps and also appear to encompass one large area that includes UMH1, UMH2, and UMH3 (**Figure 26** and **27**). The access road into the Upper Mike Horse area also appears to contain metals above the RSLs based on field XRF data. Mike Horse Creek runs through the approximate center of this delineated area, and is likely being impacted by remaining mine waste.

The soils identified within the sampled removal areas are of uncertain acid generating potential. While there is an uncertain potential for acid generation, SPLP testing indicates that lead has the potential to mobilize through the environment to adjoining soil and water. Areas within Upper Mike Horse Mine Waste areas show signs of impacts through the presence of staining/oxidation, stressed vegetation, and/or the lack of vegetation. High metals readings

were also recorded for vegetated areas (small pockets of timber) between reclamation areas, and appeared stressed.

Tetra Tech used the data obtained from the historic sampling and the results of the 2007 and 2008 investigations of the mine waste to estimate the volume of impacted materials associated with the three identified features within this area. Volume was calculated based on two scenarios for estimating the boundary of mine waste impacts: 1) the estimated total extent of mine waste impacts as delineated with the XRF during the 2007/2008 field efforts; and 2) the estimated extent of mine waste/soil that exceeded one or more soil screening level as delineated through the concentration isopleth analysis. The assumed depth of impacts is 2 feet below ground surface (bgs) for impacted soil beneath the piles and existing ground surface.

This selected depth assumes that bedrock occurs at a depth of approximately 2 feet bgs and soil amendment would be implemented to a depth of 1.5 to 2 feet bgs. The following table presents the estimated area and volume of impacts for the two scenarios.

Upper Mike Horse Mine Waste Areas Mine Waste/Impacted Soil Volume Estimate			
Mine Waste Impact Boundary Type	**Estimated Depth of Mine Waste/Soil Impacts**	**Estimated Area**	**Estimated In-Place Volume of Mine Waste/Impacted Soil**
UMH1			
Total Area of Mine Waste Impacts	2 ft	23,958 ft^2 (0.55 acre)	47,916 ft^3 (1,775 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	21,780 ft^2 (0.5 acres)	43,560 ft^3 (1,613 yd^3)
UMH2			
Total Area of Mine Waste Impacts	2 ft	77,101 ft^2 (1.77 acre)	154,202 ft^3 (5,711 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	65,340 ft^2 (1.5 acres)	130,680 ft^3 (4,840 yd^3)
UMH3			
Total Area of Mine Waste Impacts	2 ft	89,734 ft^2 (2.06 acre)	179,467 ft^3 (6,647 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	74,052 ft^2 (1.7 acres)	148,104 ft^3 (5,485 yd^3)

ft – feet
ft^2 – square feet
ft^3 – cubic feet
yd^3 – cubic yards
Total Area of Mine Waste Impacts – based on 2007/2008 field XRF results
Area Exceeding AAL/RSL/BTVs – based on isopleth concentration analysis

4.13.12 Mike Horse Townsite and Mike Horse Repository

Tetra Tech collected three composite samples from the Mike Horse Townsite to evaluate the effectiveness of previous reclamation work. The samples include MHTS-Comp1, MHTS-Comp2, and MHTS-Comp3 (**Figure 34**). Analytical results indicate that only arsenic exceeded its soil screening level.

Field personnel collected four soil samples collected from the road above the Mike Horse Repository. The samples include AMHR-0, AMHR-200, AMHR-400, and AMHR-600 (**Figure 34**). Analytical results indicate that there were no exceedances of any soil screening levels.

Tables 27a and **27b** present the XRF and laboratory analytical results for the samples collected during the RI. The results indicate that, with the exception of arsenic, metals concentrations in the mine waste and adjoining soil were below respective soil screening levels. Comparison of measured metal concentrations to soil screening levels indicate the following exceedances for the Mike Horse Townsite:

- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- No exceedances of EPA RSLs for aluminum, cadmium, copper, mercury, and zinc. These metals were screened to these values because UBMC background concentrations are lower than their respective RSLs.
- No exceedances of Soil BTVs. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- No samples were analyzed for Soil SPLP.

Metal concentrations for the area above the Mike Horse Repository exceeded the following soil screening levels:

- No arsenic exceedances for DEQ Action Level for Arsenic in Surface Soil.
- No exceedances of EPA RSLs for aluminum, cadmium, copper, mercury, and zinc. These metals are screened to these values because UBMC background concentrations are lower than their respective RSLs.
- No exceedances for any Soil BTVs. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- No samples were analyzed for Soil SPLP.

None of the samples analyzed from the Mike Horse Townsite or samples from the road above the Mike Horse Repository were selected for ABA or SPLP testing.

Mike Horse Townsite and Mike Horse Repository Summary and Conclusions

Reclaimed soil within the Mike Horse Townsite area was sampled to evaluate residual metal concentrations. Results indicate that arsenic concentrations exceed the DEQ Action Level for arsenic. The results for the road that was sampled above the Mike Horse Repository showed no exceedances of any screening levels.

4.13.13 Paymaster Constructed Wetland Investigation

Historic Paymaster Sampling

ASARCO completed pre-excavation soil/mine waste sampling in the Paymaster Mine waste pile area (PM-1 area) in 1993 (MFG 1996a) and post-excavation soil sampling following removal of the waste pile (Hydrometrics 1997b). The waste pile was formerly located adjacent to the Paymaster adit and at the current location of the Paymaster Constructed Wetland treatment system.

Summary of Historic PM1 Pre- and Post-Excavation Soil and Mine Waste Results (mg/kg)										
Sample & Depth Interval	**Media**	***Al**	**As**	**Cd**	**Cu**	**Fe**	**Pb**	**Mn**	**Hg**	**Zn**
DEQ Action Level/RSLs/Soil BTVa		**77,000b**	**40a**	**70b**	**3,100b**	**58,270c**	**1,109c**	**4,893c**	**23b**	**23,000b**
Pre-Excavation Results										
PM1 (0-2”)	SSS	13,933	**226**	<1	134	**282,875**	106	69	--	65
PM2 (0-2”)	SSS	6,540	**312**	<	483	**81,875**	**2,485**	77	--	199
PM3 (0-2”)	SSS	17,568	**100**	<1	275	**102,325**	96	217	--	46
PM6 (0-2”)	MW	7,410	**50**	3	376	16,755	**1,841**	37	**1,950**	521
PM6 (0-12”)	US	11,208	**2,505**	<1	189	**255,050**	231	46	**66**	66
PM6 (20-24”)	MW	9,890	**247**	3	152	18,580	880	19	**2,165**	477
PM7 (0-2”)	MW	5,778	**268**	<1	2,110	54,550	**2,293**	23	**3,500**	63
PM7 (24-30”)	MW	3,278	**158**	<1	1,614	**168,150**	**2,165**	11	**38,000**	117
PM8 (0-2”)	MW	7,340	**99**	<1	348	44,100	**1,126**	33	**280**	20
PM8 (24-30”)	MW	7,288	**64**	<1	96	33,750	1,063	46	**150**	23
Post-Excavation Results										
Pile 1, North	US	5,300	**480**	--	310	**140,000**	350	63	<1	94
Pile 1, South	US	8,300	**100**	--	260	**89,000**	340	140	<1	78

-- Not analyzed
Bold – value meets or exceeds one or more soil screening level
a – DEQ action level for arsenic in surface soil (DEQ 2005)
b – EPA RSLs for residential soil (June 2011)
c –Soil Background Threshold Value (calculated using ProUCL)
SSS – surrounding surficial soil collected from soil surrounding the Paymaster waste pile
US – underlying soil horizon - collected from soil beneath the Paymaster waste pile
MW – mine waste collected from the Paymaster waste pile
*Aluminum – not calculated because there is no DEQ groundwater quality standard for aluminum

Review of the metal concentrations after removal of the waste pile, with current soil screening levels, indicate the following exceedances:

- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- No exceedences of EPA RSLs for aluminum, cadmium, copper, mercury, manganese, and zinc. These metals were screened to these values because UBMC background concentrations are lower than their respective RSLs. Note: cadmium was not sampled as part of post-excavation confirmation sampling. However, pre-excavation sampling indicates that cadmium concentrations were very low – non-detect to 3 mg/kg (see the above table for the sampling results).
- Iron exceeded the Soil BTV. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- No samples were analyzed for SPLP.

ASARCO also collected one soil sample from beneath the Paymaster Mine waste pile at location PM6. The PM6 soil sample exhibited arsenic and iron concentrations well above the

screening levels. The arsenic and iron concentrations in the soil sample from soil underlying the waste pile were 10 times and 13 times, respectively, greater than the concentrations exhibited by the overlying mine waste samples collected from the mine waste pile. The arsenic and iron concentrations in this sample are similar in magnitude to some of the underlying soil horizon samples collected from the same area in 2008 (see the following section).

2008 Paymaster Constructed Wetland Investigation

The following sections present the results of the 2008 investigation to investigate soil underlying the Paymaster Constructed Wetland substrate.

Test Pit Sampling Results

Tetra Tech excavated test pits in the Paymaster Constructed Wetlands during the 2008 investigation to obtain soil samples from below the substrate of Cell B of the treatment system. The soil underlying the Cell B substrate that was sampled in 2008 is herein after referred to as "underlying soil" in the following discussions. **Figure 7** shows the location of the constructed wetlands and **Figure 28** shows the paymaster test pit locations.

The purpose of the 2008 sampling event was to evaluate the effectiveness of the 1996 removal of the preexisting mine waste pile at this same location. Four test pits were excavated into Cell B because it: 1) never received adit/treatment water, and 2) is no longer considered for use in possible treatment of the Paymaster adit flow. ASARCO abandoned its MGWPCS permit for the treatment system because the system was not discharging any water out of Cell B. As part of DEQ's requirements for abandonment, the connectivity between Cell A and Cell B was decommissioned (DEQ 2006b). No test pits were excavated in Cell A because it was used as an evaporation cell for the adit flow. Cell A is lined with a geosynthetic clay liner (MFG 1996c) and is still operating as an evaporation cell. A very small flow (<1 gpm) of water from the Paymaster adit enters from a pipe in the southwest corner of Cell A and evaporates within that general area.

Test pits were excavated in Cell B as follows (**Figure 28**):

- PAYCW-1 was excavated in the southwest corner;
- PAYCW-2 was excavated east of center on the south side;
- PAYCW-3 was excavated in the northeastern corner; and
- PAYCW-4 was excavated west of center on the north side of Cell B.

Each of the test pits was oriented in a north-south direction, perpendicular to the long east-west oriented berms defining the wetland cell. The substrate and underlying soil were in direct contact with each other (i.e. there was no liner separated the two materials). A thin clayey soil was present in some test pits at the substrate/underlying soil contact. Cell B wetland substrate encountered during excavation consisted of brown sandy gravel and occasional cobbles. Cell B wetland substrate was 2 feet thick in PAYCW-1, 2.5 feet thick in PAYCW-2, 4 feet thick in PAYCW-3, and 3 feet thick in PAYCW-4.

Underlying soil was generally yellow-orange in color and consisted of compact sandy gravel with some of the soil materials exhibiting ferricrete cementation. Iron-oxide staining was observed beginning at the substrate/underlying soil contact. Tetra Tech collected soil samples from the 0- to 6-inch, 6- to 12-inch, and 12- to 24-inch depth intervals beginning at the approximate top of the underlying soil, below the substrate/underlying soil contact.

Seeps were encountered in the southwest corner of PAYCW-1, southwest corner of PAYCW-2, the northeast corner of PAYCW-3, and northwest side of PAYCW-4. Reddish iron-oxide

precipitates formed instantaneously on soil and rock in each of the test pits where the seeps flowed, indicating oxidation was actively occurring as the water was exposed to atmospheric oxygen. Due to the decommissioning of the weir system (connectivity) between Cell A and Cell B (DEQ 2006 and MFG 1996c), the water from the seeps is likely from shallow groundwater and not water from Cell A of the decommissioned treatment system.

The observed oxidation of metals in water from the seeps strongly suggests that the water flowing in the seeps was chemically reduced and carrying large amounts of ferric iron in solution. When the waters were exposed to atmospheric oxygen, the ferric-iron (Fe^{2+}) was oxidized to ferrous-iron (Fe^{3+}), whose solubility in water is lower by a factor of three when compared with ferric iron. This oxidation reaction therefore, produced supersaturated conditions that in turn resulted in the chemical precipitation of what were likely reddish colored ferri-hydroxide complexes.

A fifth test pit (PAYRD-1) was excavated in the road west of the wetland cells to further evaluate the possible sources of seeps. Road fill was 2.5 feet thick. Water was encountered in the test pit at 2.5 feet bgs, at the fill/underlying soil contact. Water in the test pit is possibly from water that was present in the shallow borrow ditch located on the west side of the road. Water in the borrow ditch appeared to originate from seeps along the toe of the adjoining hillside slope on the west. Water was also present in the borrow ditch at the time of the fall 2007 investigation.

Underlying Soil Analytical Results

Underlying soil samples were analyzed for aluminum, arsenic, cadmium, copper, iron, lead, manganese, mercury, and zinc. **Table 28** presents analytical results for all underlying soil collected from beneath Cell b substrate. The following presents a summary of the results that exceeded soil screening levels.

- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- No exceedances of EPA RSLs for aluminum, cadmium, copper, mercury, and zinc. These metals were screened to these values because UBMC background concentrations are lower than their respective RSLs.
- Iron exceeded the Soil BTV. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- No samples were analyzed for SPLP.

Paymaster Constructed Wetland Area Summary and Conclusions

ASARCO performed soil sampling at the Paymaster waste pile (PM-1), located next to the Paymaster adit, in 1996 to evaluate concentrations of metals in the mine waste, surrounding surficial soil, and underlying soil beneath the waste pile. Results indicated the underlying soil contained concentrations of several metals above current RI soil screening levels in the mine waste samples collected from the mine waste pile formerly within the footprint of the constructed wetlands. Concentrations of the metals in the mine wastes were much higher than the concentrations observed in the post excavation samples. Mercury in particular was detected at concentration well above soil screening levels in the mine waste; however, following excavation, the post-excavation samples indicated no mercury above the laboratory PQL.

As part of the 2008 remedial investigation, Tetra Tech excavated four test pits in Cell B of the Paymaster Constructed Wetlands to evaluate the effectiveness of the removal of mine waste pile PM-1 in 1996. Substrate thickness of Cell B ranged from 2 to 4 feet thick. Iron oxide staining was present at the approximate substrate/underlying soil contact and oxidation of groundwater occurred immediately as seeps from the test pit walls encountered atmospheric oxygen.

Underlying soil results indicated that arsenic and iron exceeded respective soil screening levels. Copper, iron, zinc, and manganese exhibited similar concentrations to those measured in the former mine waste, with the exception of a few outliers. Lead in the mine waste was observed to be higher than those measured during the RI and similar to the concentrations post-removal. Many of the arsenic concentrations for the RI samples were similar to those measured in the mine waste and post-removal soil samples. Mercury concentrations in the RI samples were not detected at or above the laboratory PQL, similar to those collected from the post-removal surface.

High iron concentrations, low pH and ferricrete deposits are naturally occurring in Paymaster Gulch. The high iron concentrations and ferricrete cementation of some of the underlying soil material observed in the test pits during the 2008 investigation are likely due to naturally occurring iron-oxide precipitation. The concentrations are of equal or less magnitude than the concentration (255,050 mg/kg) exhibited by the single underlying soil sample collected in 1996 prior to the construction of the Paymaster wetlands.

Well PMMW-13 is located in the Paymaster Mine area. Samples from the well in 2007 and 2008 did not exhibit concentrations of arsenic or mercury above the laboratory PQLs. However, aluminum, cadmium, copper, iron, lead, manganese, and zinc were detected above the laboratory PQL. Cadmium in the 2007 sample exceeded its groundwater standard, while iron and manganese concentrations were elevated.

Reduced groundwater that seeped out of test pit walls resulted in iron oxidation once the water encountered atmospheric oxygen. Field parameter measurements in 2007 and 2008 support that groundwater is likely reduced. A low pH was recorded in 2007, and low Eh and dissolved oxygen was recorded in 2007 and 2008, all of which suggest possible reduced conditions and support field observations of rapid precipitation of Fe^{2+} to Fe^{3+} in the seeps. These observed conditions indicate that the area is likely saturated with iron in the pore water, groundwater, and soil and that oxygen in soil appears to be present at least at shallow depths below ground surface (e.g. presence of iron oxide staining and some ferricrete in test pit soils).

Results for surface water and groundwater samples collected in 2007 and 2008 from the Paymaster area indicated no detection of arsenic concentrations at or above the laboratory PQL. The concentration of arsenic in soil in the Paymaster area does not appear to impact groundwater or surface water near the Paymaster Mine. As described above, within the underlying soil of the test pits there was an abundance of iron-oxide precipitates. Arsenic may be complexed with the iron, reducing its ability to migrate in groundwater. Arsenic is less soluble under oxidized conditions in surface water.

Additional studies of groundwater and surface water would be needed to further evaluate and understand subsurface geochemical conditions and reactions in the Paymaster Mine area. Oxidation-reduction reactions are very complex and many factors influence subsurface geochemical conditions, such as pH, temperature, organic material, metals/metalloids present, and oxygen concentrations (Langmuir 1997 and Fetter 1999). This data would be needed to evaluate what affect removal of the constructed wetland may have on the current and future surface and subsurface conditions of the area.

4.14 Floodplain Sediments

Mine waste deposition adjacent to and along the Beartrap Creek and Blackfoot River floodplains are a result of the 1975 Mike Horse Tailings Impoundment breach, and other subsequent flood/high water events following this event. Mine wastes along Mike Horse Creek are the result of deposition of mine wastes directly to the stream and erosion from adjoining mine waste piles.

Previous sampling performed in along Beartrap Creek and the Blackfoot River floodplains focused on distinct depositional features comprised of concentrated tailings and dispersed tailings. However, no previous sampling was completed to evaluate the maximum lateral extent of mine waste deposition adjacent to Beartrap Creek and Blackfoot River, and no investigation has been performed to evaluate mine wastes along the upper portion of Mike Horse Creek.

Therefore, the purpose of soil sampling activities during the 2007 RI and follow-up soil sampling in 2008 was to evaluate the lateral extent of mine waste impacts within the floodplains of these drainage systems. The floodplain sediments investigation involved analysis of floodplain materials via XRF-Field screening and XRF 10 methods as well as select samples by the analytical laboratory.

Figure 29 provides an overview map showing the extent of impacts to floodplain sediments from the confluence of Beartrap Creek with Mike Horse Creek to the Upper Marsh. **Figure 30** present the estimated extent of impacts to floodplain sediment along Blackfoot River and shows individual sample locations. **Figure 32** depicts the estimated extent of impacts to floodplain sediment along Beartrap Creek, and **Figure 34** shows the estimated extent of impacts to floodplain sediment along Mike Horse Creek.

Tables 29a and **29b** present the Blackfoot River floodplain analytical results. **Table 30a** and **30b** present the Beartrap Creek floodplain sediment analytical results. **Tables 27a** and **27b** present the floodplain sediment results for Mike Horse Creek.

4.14.1 River and Creek Floodplain Sediment Results

4.14.1.1 Blackfoot River

During the 2008 investigation, 67 locations were sampled adjacent to both the north and south sides of the Blackfoot River channel. Sampling along the Blackfoot River extended from the headwaters of the Blackfoot River, at the confluence of Beartrap Creek and Anaconda Creek (adjacent to the former Anaconda Constructed Wetlands) approximately 6,700 feet downstream, to the southeastern (upstream) edge of the Upper Marsh. **Figures 29** and **30** show the sample locations and approximate extent of impacted floodplain sampling.

XRF and laboratory analytical results and a Screening Level Ecological Risk Assessment (SCLERA) indicated that the initial sampling in 2007 successfully delineated the general extent of these impacts; however, 14 locations along the Blackfoot River had to be revisited in 2008 to refine the extent of floodplain tailings. Field personnel performed follow-up river floodplain sediment sampling in summer 2008 to further evaluate the extent of mine waste impacts at these 14 locations. **Tables 29a** and **29b** present the 2007 and 2008 analytical results.

Field personnel used professional judgment in determining the lateral extent of tailings in the field for two locations. These locations included BREOT-S21 and BREOT-S32. At the location of BREOT-S21, XRF field readings indicated that soils were above ecological risk screening levels at the 2008 zero location and continued to the north side of Mike Horse Creek Road and adjacent to the Mary P mine waste pile. Therefore, field personnel discontinued lateral sampling at this location.

A transect running west of sample location BREOT-S32 was also field screened by XRF during the 2008 investigation. This transect passed through a low area located between the west side of Mike Horse Road and the east side of Stevens Gulch (**Figure 30**). A sample was collected from BREOT-S32+300 within this area; however, XRF readings indicated that arsenic and lead remained above ecological risk screening levels. This area appeared to have a wide extent of tailings deposited throughout the forest along and adjacent to the west side of Stevens Creek. The tailings appeared to originate upstream, from Stevens Gulch rather than as tailings

deposited along the Blackfoot River. Therefore, field personnel discontinued sampling in this area at BREOT-S32+300.

DEQ and field personnel subsequently walked further up Stevens Gulch to inspect for a potential source of mine wastes for the mine wastes associated with the BREOT-S32+300 area. No obvious source of mine wastes was discovered. Further evaluation is needed to fully define the nature and extent of wastes in the lower Stevens Gulch area.

The 2007 and 2008 results indicate the lateral extent of impacted river floodplain sediment within the Blackfoot River floodplain appears to be limited to the toe of the topographic slope of the ridges located north and south of the eastern third of the Blackfoot River (**Figure 30**), and similar breaks in slopes forming ridges located north and south of the eastern third of the Blackfoot River (**Figure 29** and **Figure 30**). A wider lateral dispersal of tailings is apparent over the westernmost two-thirds of the area adjacent to the Blackfoot River due to the widening of the floodplain near Shave Gulch as it enters the southeastern portion of the Upper Marsh.

Table 29a presents the metals results. The following summarizes the metal concentrations that exceed one or more soil screening level.

- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- Cadmium, and copper exceeded their EPA RSLs. Aluminum, cadmium, copper, mercury, and zinc were screened to these values because UBMC background concentrations are lower than their respective RSLs.
- Iron, lead, and manganese exceeded their Soil BTVs. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- Cadmium, lead, and manganese exceeded their Floodplain SPLPs.
- Mercury was not detected in any sample above the laboratory PQL. Soil collected from the Blackfoot River floodplain exhibited a pH ranging from 2.1 to 5.6.

An isopleth concentration map (**Figure 31**) developed using Blackfoot River floodplain sediment data generally shows the highest concentrations in the central portions of the floodplain along the river with a decrease in concentration away from the river, as would be expected. Concentrations appear highest and more dense on the western portion of the river above the Upper Marsh, whereas higher concentrations on the eastern portion of the river appear more irregular and in patches. This may be due to the narrower canyon in the upper portions of Blackfoot River and a widening toward the confluence with Shave Gulch and the Upper Marsh and, therefore, more deposition occurring once flows begin to decrease. Because XRF values were used, some “hot spot” areas may be attributable to high detection limits and the use of those values in the spline calculations.

Select samples from the floodplain were submitted for laboratory analysis of ABA and SPLP (**Table 29b**). In many cases, detection limits for the 2007 results were not low enough to detect metal concentrations at or above the laboratory PQL. While not having a reportable concentration prevented comprehensive leachability statistical analysis (regression analysis, etc.), enough samples did exceed detection limits so that basic screening by comparing leachate concentrations to leachate screening criterion could be performed. Detection limits for the 2008 samples were lowered for evaluation of metal leachability. Analytical results, using both data sets, indicate that arsenic, cadmium, copper, lead, and zinc in the floodplain soil may have the ability to mobilize and impact adjoining soil and water, including groundwater.

Calculations were completed from the ABA results to evaluate the potential for remaining metals-impacted soils to generate acid. The following table summarizes the ABA acid generation results.

Blackfoot River Floodplain Sediments Acid Generation Evaluation				
Sample ID and Depth Interval	**NP:AP**	**NP:AP[2] (t/kt)**	**NNP (t/kt)**	**Result**
BREOT-N11+25 (0-6”)	18.8	58.6	5.68	Uncertain acid generation potential
BREOT-N12-12.5 (0-6”)	0	0	-25	Potentially acid generating
BREOT-N23-0 (0-6”)	-0.016	-0.0001	-310	Potentially acid generating
BREOT-N28+25 (0-6”)	4.71	2.77	6.3	Uncertain acid generation potential
BREOT-N30-12.5 (0-6)”	0.083	0.0069	-11	Uncertain acid generation potential
BREOT-N37+25 (0-6”)	8.97	11.5	6.22	Uncertain acid generation potential
BREOT-N47-12.5 (0-6”)	-0.97	-0.312	-6.1	Uncertain acid generation potential
BREOT-N56-12.5 (0-6”)	-0.032	-0.0005	-64	Potentially acid generating
BREOT-N60+25 (0-6”)	5.38	4.14	5.7	Uncertain acid generation potential
BREOT-N63-0 (0-6”)	5.4	2.73	5.4	Uncertain acid generation potential
BREOT-S1+25 (0-6”)	12.8	32.9	4.61	Uncertain acid generation potential
BREOT-S20+75 (0-6”)	27.4	27.4	7.46	Uncertain acid generation potential
BREOT-S21+25 (0-6”)	-0.10	-0.01	-11	Uncertain acid generation potential
BREOT-S27-0 (0-6”)	0	0	-12	Uncertain acid generation potential
BREOT-S29+25 (0-6”)	0	0	-10	Uncertain acid generation potential
BREOT-S37+25 (0-6”)	1.86	0.437	3.7	Uncertain acid generation potential
BREOT-S38-12.5 (0-6”)	0,22	0.0008	-221	Potentially acid generating
BREOT-S41-12.5 (0-6”)	0.11	0.0003	-257	Potentially acid generating
BREOT-S48+25 (0-6”)	0.86	0.24	-0.5	Uncertain acid generation potential
BREOT-S50+25 (0-6”)	0.28	0.08	-2.6	Uncertain acid generation potential
BREOT-S54-0 (0-6”)	0.48	0.23	-1.1	Uncertain acid generation potential
BREOT-S55-12.5 (0-6”)	2	2	1	Uncertain acid generation potential

t/kt – tons per kilotons
Potentially acid generating = NP:AP<1 and NNP<-20 t/kt
Uncertain acid generation potential = NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to generate acid = NP:AP >3 and NNP>+20 t/kt

ABA results indicate Blackfoot River floodplain sediments can be classified as either uncertain acid generating potential or potentially acid generating. Therefore, at least some of the floodplain sediments are likely to have the potential to generated acid and create acidic drainage. Metals leached from the sediments under acidic conditions may impact surrounding soil or water. The SPLP results further support that arsenic, cadmium, lead, manganese, and zinc have the ability to migrate from these sediments and impact the environment.

4.14.1.2 Beartrap Creek

Sampling in 2007 included collection of data and river floodplain sediment/soil from 26 locations adjacent to the east side and 27 locations adjacent to the west side of the Beartrap Creek channel. Sampling along Beartrap Creek extended approximately from the confluence of Mike Horse Creek with Beartrap Creek to approximately 2,600 feet downstream (north of) the confluence of Beartrap and Anaconda Creeks. **Figures 29 and 32** show sample locations and approximate extent of impacted floodplain sediment along Beartrap Creek.

XRF and laboratory analytical results and a Screening Level Ecological Risk Assessment (SLERA) indicated that the initial sampling in 2007 successfully delineated the general extent of these impacts; however, one location adjacent to Beartrap Creek required additional sampling to further evaluate the extent of impacts to the floodplain (see **Table 14**). Field personnel performed follow-up river floodplain sediment/soil sampling in summer 2008 to further evaluate

the extent of mine waste impacts at these 15 locations. **Table 14** presents the 2007 and 2008 analytical results. The 2007 and 2008 results indicate the lateral extent of impacted creek floodplain sediment within the floodplain of Beartrap Creek appears to be limited to the toe of the topographic slope forming the ridges located east and west of Beartrap Creek (**Figure 29** and **32**).

Table 30a presents the analytical results. The following summarizes the metal concentrations that exceed one or more soil screening level.

- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- Cadmium exceeded the EPA RSL. Aluminum, cadmium, copper, mercury, and zinc are screened to these values because UBMC background concentrations are lower than their respective RSLs.
- Iron, lead, and manganese exceeded their Soil BTVs. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- Manganese exceeded its Floodplain SPLP.

Mercury was detected in one in-situ XRF field sample (BCEOT-E22+70 (0-6”); however, when the same sample was dried and sieved and analyzed by XRF, mercury was not detected above the instrument detection limit. Mercury detected in the in-situ sample was likely a result of variability due to field and instrument conditions (see Section 4.2). Soil collected from the Beartrap Creek floodplain exhibited a pH ranging from 2.1 to 6.2.

The results further indicate the lateral extent of impacted river floodplain sediment/soil within the floodplains for both drainage systems appear to be limited to the toe of the topographic slope forming the ridges located east and west of Beartrap Creek (**Figure 32**), and similar breaks in slopes forming ridges located north and south of the eastern third of the Blackfoot River (**Figure 29** and **Figure 32**). A wider lateral dispersal of tailings is apparent over the northern one-third of the Beartrap Creek area due to the widening of the floodplain near the confluence with Anaconda Creek as it forms the beginning of the Blackfoot River.

An isopleth concentration map (**Figure 33**) developed using Beartrap Creek floodplain sediment data generally shows the highest concentrations in the central portions of the floodplain along the river with a decrease in concentration away from the river, as would be expected. Concentrations appear highest and more dense on the northern portion of the river near the confluence with Anaconda Creek, whereas higher concentrations on the upstream portion of Beartrap Creek appear more irregular and in patches. This may be due to the extremely narrow canyon in the upper portions of Beartrap Creek and a widening toward the confluence with Anaconda Creek and, therefore, more deposition occurring once flows begin to decrease. Because XRF values were used, some “hot spot” areas may be attributable to high detection limits and the use of those values in the spline calculations.

Select samples from the floodplain were submitted for laboratory analysis of ABA and SPLP (**Table 30b**). In most cases, detection limits for the 2007 results were not low enough to detect metal concentrations at or above the laboratory PQL. Not having reportable concentrations prevented comprehensive leachability statistical analysis (regression analysis, etc.), and since very few samples exceeded detection limits, basic screening by comparing leachate concentrations to leachate screening criterion was not possible. No SPLP samples were collected during the 2008 investigation. This left an SPLP data gap that was addressed in 2011 by collecting four additional samples from Beartrap Creek.

Calculations were completed from the ABA results to evaluate the potential for remaining metals-impacted soils to generate acid. The following table summarizes the ABA acid generation results.

Beartrap Creek Floodplain Sediments Acid Generation Evaluation				
Sample ID and Depth Interval	**NP:AP**	**NP:AP[2] (t/kt)**	**NNP (t/kt)**	**Result**
BECOT-E5+25 (0-6")	0.14	0.01	-12	Uncertain acid generation potential
BCEOT-E19-12.5 (0-6")	0.08	0.0005	-138	Potentially acid generating
BCEOT-W13-0 (0-6")	2.9	0.934	5.9	Uncertain acid generation potential
BCEOT-W17+25 (0-6")	0.64	0.14	-1.7	Uncertain acid generation potential
BCEOT-W22-12.5 (0-6")	0.24	0.0015	-121	Potentially acid generating
BCEOT-W23+25 (0-6")	11.1	24.7	4.6	Uncertain acid generation potential
BCEOT-W25-12.5 (0-6")	0.4	0.0001	-356	Potentially acid generating
BCSD-201	-0.03	-0.0001	-247	Potentially acid generating
BCSD-202	0.11	0.0001	-652	Potentially acid generating
BCSD-203	-0.05	-0.001	-40	Potentially acid generating
BCSD-204	0	0	-67	Potentially acid generating

t/kt – tons per kilotons
Potentially acid generating = NP:AP<1 and NNP<-20 t/kt
Uncertain acid generation potential = NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to generate acid = NP:AP >3 and NNP>+20 t/kt

ABA results indicate Beartrap Creek floodplain sediments can be classified as either uncertain acid generating potential or potentially acid generating. Most of the floodplain sediments are likely to have the potential to generate acid and create acidic drainage. SPLP results further support that cadmium, copper, lead, manganese, and zinc have the potential to leach from these sediments into surrounding soil and water, including groundwater.

4.14.1.3 Mike Horse Creek

Thirty-one samples were collected along the east and west sides of Mike Horse Creek. Floodplain sediment sampling along Mike Horse Creek extended from just below the coffer dam to the U.S. Forest Service access road that accesses the Mike Horse tailings impoundment. **Figure 34** shows the sample locations and approximate extent of impacted floodplain sampling along Mike Horse Creek. **Tables 27a** and **27b** presents the analytical results. No follow-up sampling was needed in 2008.

Table 27a presents the metals analytical results. The following summarizes the metal concentrations that exceed one or more soil screening level.

- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- Cadmium exceeded the EPA RSL. Aluminum, cadmium, copper, mercury, and zinc were screened to these values because UBMC background concentrations are lower than their respective RSLs.
- Iron, lead, and manganese exceeded their Soil BTVs. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- Arsenic and lead exceeded their respective Floodplain SPLPs.

Soil collected from the Mike Horse Creek floodplain exhibited a pH ranging from 5.2 to 6. Results indicate the floodplain along the upper portion of Mike Horse Creek remains impacted by mine wastes.

One sample from the floodplain was submitted for laboratory analysis of ABA and SPLP (**Table 27b**). Detection limits for the 2007 results were not low enough to evaluate the leachability of metals for floodplain sediments along Mike Horse Creek. However, mine wastes adjoining the creek in the Upper Mike Horse area exhibited concentrations of metals during SPLP testing that indicate metals in soil/mine waste in this area have the potential to leach from the material and potentially migrate to adjoining soil and water. Because the floodplain sediments are comprised of mine wastes from the Upper Mike Horse area, floodplain sediments are anticipated to have similar properties.

Calculations were completed from the ABA results to evaluate the potential for remaining metals-impacted soils to generate acid. The following table summarizes the ABA acid generation results.

Beartrap Creek Floodplain Sediments Acid Generation Evaluation				
Sample ID and Depth Interval	**NP:AP**	**NP:AP[2] (t/kt)**	**NNP (t/kt)**	**Result**
MHCS-700-E25 (0-6")	23.5	138	3.83	Uncertain acid generation potential

t/kt – tons per kilotons
Potentially acid generating = NP:AP<1 and NNP<-20 t/kt
Uncertain acid generation potential = NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to generate acid = NP:AP >3 and NNP>+20 t/kt

The ABA results from the floodplain sediment sample indicated an uncertain acid generation potential, consistent with the ABA results for soil/mine waste adjoining the Mike Horse Creek floodplain in the Upper Mike Horse Mine area. While it is uncertain whether the floodplain sediments generate acid in quantities to produce acid mine drainage and mobilize metals, the SPLP results from mine wastes adjoining the floodplain indicate mobility of metals is possible. Arsenic and lead would be the most likely metals to leach into surrounding soil/sediment and water.

4.14.2 Floodplain Sediment Impacts Summary and Conclusions

Floodplain sediment sampling performed during 2007 and 2008 allowed Tetra Tech to evaluate the extent of tailings impacts along Beartrap Creek and Blackfoot River resulting principally from the 1975 breaching of the Mike Horse tailing impoundment. The results indicate that streamside impacts from metals extend over the entire floodplain of Mike Horse Creek, Beartrap Creek, and Blackfoot River. The impacts extend across the entire floodplain of each drainage, from the toe of the slopes of the adjoining mountains. In areas along Beartrap Creek close to the Mike Horse Tailings Impoundment, it appears that some tailings may have been deposited up the valley slopes bounding the floodplain during the breach event. The results also indicate that floodplain sediment impacts extend over the entire floodplain on the Blackfoot River from the river to the toe of the valley slope on both the northern and southern sides of the river. The lateral extent of impacts also appears to widen as Beartrap Creek approaches its confluence with Anaconda Creek, and shortly after Stevens Gulch enters the Blackfoot River drainage and continues downstream until the Blackfoot River enters the Upper Marsh.

ABA and SPLP results indicate floodplain sediments along the Blackfoot River have primarily an uncertain acid generating potential while floodplain sediments along Beartrap Creek have a potentially acid generating potential. SPLP testing indicated that all metals, except mercury, in the floodplain sediments along both streams have the potential to leach from the sediments and migrate to adjoining soil and water, including groundwater. SPLP testing from mine wastes

within the Upper Mike Horse area that adjoin Mike Horse Creek indicate that floodplain sediments likely also have the potential to leach from the floodplain sediments.

Tetra Tech prepared preliminary estimates of the volume of mine waste-impacted floodplain sediments present within the Beartrap Creek and upper Blackfoot River drainages. The volumes were calculated by obtaining an approximate area through GIS analysis, based on the 2007 and 2008 sampling results. The estimates also used an excavation thickness of 4 feet for Beartrap Creek and Blackfoot River, consistent with the estimated thickness for removal in the EE/CA (Hydrometrics 2007a). The estimated average thickness for Mike Horse Creek was 2 feet, given the bedrock outcrops along the creek in several places. The actual thickness will depend upon location-specific deposition of mine wastes and depth to underlying soil. The estimated volume of impacted soils for all three of these drainage systems is presented in the following table.

Estimated Volume of Mine Waste Impacted Floodplain Sediments			
Stream	**Estimated Area**	***Average Thickness of Mine Wastes / Intermixed Mine Wastes (ft)**	**Estimated Volume of Impacted Alluvium/Soil**
Mike Horse Creek	45,738 ft^2 (1.1 ac)	3	137,214 ft^3 (5,082 yd^3)
Beartrap Creek	323,498 ft^2 (7.4 ac)	4	1,293,992 ft^3 (47,925 yd^3)
Blackfoot River	2,089,381 ft^2 (48 (ac)	4	8,357,524 ft^3 (309,538 yd^3)

* Average thickness based on historic and 2007 dispersed tailings, and 2007 edge of tailings data
ft^2 – square feet
ft – feet
yd^3 –cubic yards

4.15 Discrete Streamside Mine Waste Deposits

4.15.1 Historic Sampling of Dispersed Tailings

The DSR (Tetra Tech 2007a) and EE/CA (Hydrometrics 200b7) present details about historic sampling in Beartrap Creek and Blackfoot River drainages. Historic dispersed tailings sampling is summarized by drainage in the following two sections.

4.15.1.1 Beartrap Creek

ASARCO sampled dispersed tailings within Beartrap Creek in 2000 and 2001. The 2000 sampling activities involved collecting five composite samples from the 0- to 18-inch depth interval of fine-grained material from the intermixed tailings/alluvium. These include sample sites BTC-1 through BTC-5. Another composite sample was collected from the older, forested terrace bench (BTC-6). ASARCO also collected two discrete samples (FL-1 and FL-2), one from each lobe of the Flosse and Louise mine waste dump within the Beartrap Creek drainage.

ASARCO's 2001 sampling activities included using a backhoe to complete four test pits (BTC-CT1, BTC-CT2, BTC-CT4, and BTC-CT6). The purpose of excavating test pits was to evaluate the depth and chemical characteristics of concentrated, well defined and discrete tailings deposits. Intermixed tailings/native sediments (dispersed tailings) were again characterized in 2001 through excavation of 11 backhoe test pits. Test pits BTC-TP1 through BTC-TP9 (with the exception of BTC-TP5) were excavated in coarse alluvium comprising the more recent alluvial terrace. ASARCO excavated BTC-TP5, BTC-TP10, and BTC-TP11 in the remnants of the older forested terrace bench that borders much of the drainage bottom.

Based on the results of the investigations two main types of mine waste deposits exist within the Beartrap Creek Drainage below the Mike Horse Tailings Dam (Tetra Tech 2007a and Hydrometrics 2007a). These include:

- Concentrated tailings deposits: These are comprised of surficial, highly concentrated, oxidized mine tailings deposits that occur in relatively small, isolated and discrete areas.
- Dispersed tailings deposits: These deposits generally include fine- to medium-sand-sized pyritic tailings inter-layered with other relatively clean alluvial sediments.

The EE/CA (Hydrometrics 2007a) presents a summary of metal results for the tailings deposits. Average concentrations of metals for the concentrated tailings and dispersed tailings deposits indicated that copper, lead, manganese, and zinc had overall higher concentrations within the dispersed tailings than the concentrated tailings.

Results of the investigation indicated that the concentrated tailings have a lower paste pH and have greater acid-generating potential than the tailings inter-layered with cleaner alluvial deposits. Sediment underlying the concentrated tailings also had elevated concentrations of manganese and zinc. Elevated metal concentrations present in the underlying alluvial sediments is likely due to leaching from overlying tailings/intermixed tailings.

The EE/CA (Hydrometrics 2007a) present volume estimates for the complete removal of tailings/impacted materials in the Beartrap Creek drainage below the dam. The EE/CA estimated an average thickness of dispersed tailings of 4 feet with a total volume of dispersed tailings of approximately 60,000 yd^3, which includes removal of 1 foot of underlying soil).

4.15.1.2 Blackfoot River

ASARCO performed mine waste mapping and sampling for the upper Blackfoot River in 2001. The investigation resulted in the identification of a large area containing concentrated tailings (Shave Creek Tailings) at the confluence of Shave Creek with the Blackfoot River. The Shave Creek Tailings are yellow to orange in color, and are largely comprised of sandy material. The tailings occur in an area with sparse vegetation, consisting of conifer trees, willows, grass, and weeds. The Shave Creek tailings are distributed over an area of about 5-acres.

The investigation also identified several areas of shallow dispersed fine-grained tailings along the Blackfoot River that generally have a thickness of 12-inches or less. These areas include (**Figure 35**):

- An area approximately 600 feet downstream of the water treatment plant and cut by recent erosion of the Blackfoot River.
- Small groups of dispersed tailings near the head of the Upper Marsh.
- Two areas down-gradient of Shave Creek tailings, between surface water monitoring locations BRSW-33 and BRSW-12.

Two areas of coarse-grained, tan to yellow tailings and covering approximately 0.75-acres in size were also identified along the Blackfoot River. The coarse tailings range from 2 to 4 feet thick. These areas include (**Figure 35**):

- Larger deposits of coarser tailings located immediately downstream of the water treatment plant and that are bisected by the Blackfoot River.
- Large deposit approximately 600 feet upstream (east) of Shave Creek Tailings.

ASARCO collected 16 samples from the Shave Creek Tailings area and two samples from dispersed fine-grained tailings and one sample from coarse tailings. The EE/CA presents a

summary table of the analytical results for the Shave Creek Tailings and dispersed tailings along the Blackfoot River. Shave Creek Tailings exhibit paste pHs in the range of 2.2 to 3.9 and similar pHs for the fine-grained dispersed tailings. ABA results indicate the Shave Creek tailings and dispersed tailings are potentially acid generating.

The EE/CA (Hydrometrics 2007) recommended complete removal of all mine waste along the Blackfoot River. The EE/CA estimated a volume of 45,000 yd^3 of mine waste, including 1 foot of underlying soil, for removal.

4.15.2 2007 Dispersed Streamside Mine Waste Deposit Sampling

Tetra Tech completed an investigation of dispersed mine waste areas along the Blackfoot River in 2007. Soil samples were collected from six test pits excavated in dispersed mine waste areas that had not been previously investigated to evaluate metal content in several mine waste depositional features along the Blackfoot River (**Figure 35**). The test pits were located in mine waste features were inter-layered with native alluvial deposits. **Tables 31a** and **31b** present the analytical results.

Tetra Tech compared the analytical results with soil screening levels (**Table 31a**). **Figure 35** shows the test pit locations for discrete streamside mine waste deposits. The following summarizes the metals that exceed screening levels.

- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- Cadmium and zinc exceeded the EPA RSLs. Aluminum, cadmium, copper, mercury, and zinc are screened to these values because UBMC background concentrations are lower than their respective RSLs.
- Iron, lead, and manganese exceeded their Soil BTVs. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- Lead and manganese exceeded their Floodplain SPLP.

Results indicate all metals analyzed exceeded one or more soil screening level. With a few exceptions, the results clearly show a decrease in metal concentrations with depth. However, even at the greatest depths sampled in some test pits, results still indicate metals exceed one or more soil screening level.

One sample from each test pit was analyzed for ABA and SPLP (**Table 31b)**. The streamside mine wastes exhibit paste pHs ranging from 1.9 to 7.1. SPLP detection limits for the 2007 results were not low enough in many cases to evaluate the leachability of metals as most metals were not detected at or above the laboratory PQL. However, the 2007 SPLP dispersed tailings results had enough metals detections to indicate that, at a minimum, cadmium, lead, manganese, and zinc have the potential to leach from the streamside mine waste and migrate to adjoining soil and water, including groundwater. Arsenic, based on the Floodplain SPLP results (all non-detect, but detection limit is too high), may also leach from these wastes.

ABA calculations were completed to evaluate the potential for the discrete streamside mine waste to generate acid. The following table summarizes the ABA acid generation results.

2007 Discrete Streamside Mine Waste Acid Generation Evaluation				
Sample Depth Interval	**NP:AP**	**NP:AP[2] (t/kt)**	**NNP (t/kt)**	**Result**
UBDT-TP-1 (2-12”)	0.067	0.0003	-196	Potentially acid generating
UBDT-TP-2 (2-12”)	0.294	0.002	-113	Potentially acid generating

2007 Discrete Streamside Mine Waste Acid Generation Evaluation				
Sample Depth Interval	**NP:AP**	**NP:AP[2] (t/kt)**	**NNP (t/kt)**	**Result**
UBDT-TP-3 (36-48”)	1.67	0.174	6.4	Uncertain acid generation potential
UBDT-TP-4 (0-2”)	0.141	0.0008	-146	Potentially acid generating
UBDT-TP-5 (0-2”)	0.127	0.001	-96	Potentially acid generating
UBDT-TP-6 (0-2”)	0.17	0.001	-125	Potentially acid generating

t/kt – tons per kilotons
Potentially acid generating = NP:AP<1 and NNP<-20 t/kt
Uncertain acid generation potential = NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to generate acid = NP:AP>3 and NNP>+20 t/kt

Results of the acid generation potential testing indicates that the discrete streamside mine waste are potentially acid generating. This suggests that there is a potential for the sulfide minerals in the streamside mine waste to generate acid and mobilize metals and potentially impact water quality, underlying sediments and other down-stream receptors. SPLP results support the ABA results in that the testing indicated the ability of several metals to leach from the mine waste.

4.15.3 Dispersed Streamside Mine Waste Summary and Conclusions

Historic results and results for the 2007-2008 remedial investigation indicate that concentrated streamside mine wastes (tailings inter-layered with alluvium and soil) in the Beartrap Creek and Blackfoot River floodplains exhibit metal concentrations above multiple soil screening levels. Analytical results indicate that the streamside mine waste and underlying alluvium or soils sampled during 2007 directly impact, or indirectly impact through leaching of metals, the alluvium and underlying native soil along the Blackfoot River. Results indicate that several metals in the streamside mine waste impact alluvium/soil up to 5 feet bgs.

SPLP results from the tailings indicate the ability of several metals to leach from the mine wastes and into surrounding soil and water. Further, ABA test results of these mine wastes indicate that these deposits have the potential to generated acid. Acid generated from these deposits may in turn dissolve and mobilize metals; causing impacts to surface water and/or groundwater quality. Many of these areas have visual signs of impacts evidenced by iron-oxide staining, the presences of precipitated metal salts, and a lack of vegetation.

Tetra Tech used the data obtained from the historic concentrated and dispersed tailings, the 2007-2008 dispersed tailings, and edge of streamside tailings/over bank deposits to estimate the volume of impacted materials in the Beartrap Creek and Blackfoot River floodplains. Section 4.12, above, presents the volume estimates.

4.16 2008 Reclamation Cover Sampling

ASARCO and ARCO began reclamation throughout the UBMC in 1993. Mine waste piles were removed in some instances and placed in engineered repositories, while other waste piles were reclaimed in place. In all, approximately 100,000 yd^3 of mine waste was reclaimed. Final reclamation in all of these areas involved soil amendments and reseeding to stabilize soils and provide for post-mining land uses. Cover monitoring was used to evaluate if the following goals have been achieved as a result of reclamation activities:

- Seeded vegetation established and continues to reproduce;
- Canopy cover of seeded sites is sufficient to protect soils and promote continued plant recruitment; and

- The established community is not dominated by weedy species and native plant species are able to colonize the site.

Tetra Tech proposed in the RI work plan that monitoring plots be established on all revegetated areas with a minimum of two growing seasons since seeding (Tetra Tech 2007c). Plots were established on the following reclamation areas (**Figure 36**):

- Anaconda Mine areas (UAW2 and UAW5);
- Upper Mike Horse areas (UMH1, UMH2, UMH3 excluding those seeded in 2007, and MHTS);
- Consolation Mine (CONM);
- Edith Mine (EEA, CEA, WEA areas);
- Paymaster areas (PM1, PM2)
- Paymaster Repository (excluding the area seeded in 2007);
- Carbonate Mine (CARM)
- Carbonate Repository (CR);
- Capital Mine (CMWA); and
- No. 3 Tunnel (N3TA).

Three transects were placed in revegetated areas to capture data variability. In smaller areas (i.e., PM1 and PM2) or in areas such as the Edith Mine where there were multiple areas to sample, only one or two transects were needed to adequately capture community composition in these areas. Determinations on the number of samples required were made in the field.

Initial estimates in the field indicated the need for 48 plots located in 14 discrete reclamation areas. Eight reference plots were also established representing three distinct vegetation communities for comparison purposes (see table below).

Undisturbed reference sites with similar vegetative characteristics and site potential as those of reclamation areas were established and monitored for comparison purposes. Reference sites provided:

- Baseline vegetation cover;
- Baseline species diversity;
- Baseline community composition and dominant species; and
- Information for seed mix requirements for subsequent remediation design.

Reference areas were located in forest types, a grassland meadow, and wetland area to reflect the site potential on reclamation sites. Tree species are beginning to colonize some reclamation sites and will continue to do so; however, herbaceous species dominate current plant communities and will for some time.

In addition, Area-wide observations were made at sites revegetated in 2007. The purpose of these observations was to identify: 1) barren areas were seeding has clearly failed, 2) areas showing signs of soil erosion or areas with the potential to erode, and 3) patches of vegetation showing signs of toxicity (i.e., discoloration, or deformed growth

The field investigation was timed to coincide with the maximum current year growth and occurred in mid-July. Sampling was conducted from July 7, 2008 to July 18, 2008. Cover

sampling was conducted using the Point-Quadrat method to assess canopy cover and species composition. The 35 mm slide method was used for quality control purposes. A field notebook in combination with data sheets was used to record sampling metadata such as monitoring data, field conditions and site impressions. The following section discusses the monitoring methods in detail. The SAP (Tetra Tech 2008) provides further details on the investigation and field methods.

The following sections provide a brief introduction and cover and soil sample results are presented by reclamation area. These sections will be followed by a statistical evaluation of the data, summary of cover data along transects, and observations.

Student's two-tailed t-test was used to test the hypothesis:

- Ho: Percent vegetative cover at reclamation sites is equal to percent vegetation cover at reference site
- H1: Percent vegetative cover at reclamation sites is less than or greater than percent vegetation cover at reference site

The alpha level (α) was 0.05. The Shapiro-Wilk test was used to test that sample populations came from a normally distributed population with α = 0.05. Sample population logarithm was compared to reference population logarithm for non-normally distributed samples. Populations were normalized by the number of sample transects to a scale of 10 (**Appendix B**)

4.16.1 Cover & Reference Transect Results

Tetra Tech botanists established 38 cover monitoring transects and 10 reference transects to assess vegetation conditions at the seven reclamation areas and three repositories listed above (**Figure 36**). **Table 32** presents the cover soil analytical results.

Plants were well developed and robust during the monitoring event owing, in part, to abundant spring snow pack and precipitation. Reclamation sites were dominated by herbaceous species, predominately seeded grasses. Reference sites were selected to represent coniferous forest types, a grassland meadow, and riparian vegetation as indicated in table below. Reference sites were placed in undisturbed, representative vegetative communities.

List of Reclamation and Reference Sites		
Reclamation site	**Reference site**	**Representative Vegetation type**
Capital mine waste area (CMWA)	Consolation reference Carbonate repository	Lodgepole pine forest
Carbonate mine waste area (CARM)	Pass Creek	Riparian
Carbonate repository	Carbonate repository Consolation reference	Lodgepole pine forest
Edith areas (EEA, CEA, and WEA)	Shave Gulch	Grassland meadow
Consolation mine waste area (CONM)	Consolation reference Carbonate repository	Lodgepole pine forest
Upper mike horse mine waste areas (UMH1, UMH2, and UMH3) and town site (MHTS)	Consolation reference Carbonate repository	Lodgepole pine forest
Paymaster mine waste areas (PM1, PM2) and repository	Consolation reference Carbonate repository	Lodgepole pine forest
No. 3 Tunnel mine waste area (N3TA)	Consolation reference Carbonate repository	Lodgepole pine forest
Upper Anaconda mine waste areas (UAW2, UAW5)	Upper Anaconda	Douglas fir forest

Selection of reference sites is a subjective process, but it must consider several criteria. Chambers and Brown (1983) state that while reference areas must consider proposed post disturbance land use and the approved revegetation plan, accounting for site conditions (i.e., elevation, precipitation, slope, and aspect), plant and seasonal varieties in vegetation, post reclamation management, soil characteristics, and site potential (having the capability to realistically produce comparable vegetation) is critical. Reference areas selected for this study were all located in the UBMC. As such, it is likely all sites experienced some disturbance related to mining activity (i.e., select timber cutting for mine and structure timbers). Despite the relatively recent disturbance, selected reference sites were representative of forest conditions throughout the area. Comparison of reference site species composition and distribution are consistent with habitat type descriptions of Pfister and others (1977).

Reference sites sampled were best described as lodgepole pine (*Pinus contorta*)/grouse whortleberry (*Vaccinium scoparium*), community type or Douglas fir (*Pseudotsuga menziesii*)/dwarf huckleberry (*Vaccinium caespitosum*) habitat type (Pfister and others 1977). Lodgepole pine/grouse whortleberry occurs on relatively cold dry sites and all exposures near and east of the Continental Divide (Pfister and others 1977). These forest types are generally even-aged and almost exclusively lodgepole pine dominated. Soils are generally gravelly sandy loams to silts with acidic reactions (Pfister and others 1977). In contrast, Douglas fir/dwarf huckleberry forest type is found on warm, moist but well-drained benches and slopes. While afternoon temperature may be high in summer, many of these sites experience cold air accumulations referred to as “frost pockets.” East of the Continental Divide lodgepole pine is the dominant seral tree species (Pfister and others 1977). Soils in these stands are similar to those found in the lodgepole community types described above (Pfister and others 1977).

Although currently herbaceous-dominated, forest sites were selected as a reference for comparison because, given time tree species will eventually re-colonize most sites within the UBMC. This type transition is just beginning as lodgepole pine and Douglas fir seedlings are establishing themselves at most sites. Tree re-colonization would be beneficial from an ecological standpoint, indicating a site was moving toward its ecological potential. However, from an engineering point of view, tree re-colonization on repository sites may be detrimental. Tree roots would likely penetrate deep within the cap creating preferential paths for water and air to reach repository materials.

Two sites, the Edith Mine waste areas (EEA, CEA, and WEA) and Carbonate Mine waste area, are not capable of supporting coniferous forest. The Edith Area, while surrounded by conifers, is predominately a series of three (EEA, CEA, and WEA) small grassland meadows. These meadows are located on a floodplain bench comprised of a mosaic of conifer species and small upland grass meadows. It is unlikely the site will permanently convert to a forest vegetation type. The old Paymaster road bed runs through portions of CEA and it appears recreation and stream access along this access point provides chronic low level disturbance. Similarly, a gravel road accesses the EEA and is a likely source of continued disturbance (**Figure 36**). Shave Gulch was selected as the reference grassland meadow. Observations made in the field indicated this area is also subject to chronic recreation disturbance.

The Carbonate Mine waste area occupies a wetland near the confluence of Swamp Gulch and the Upper Marsh on the north side of Highway 200. Transects incorporated the upland transition area as well as wetland vegetation. Standing water was present during sampling along some transects indicating yearlong inundation in some portions of the waste area. Pass Creek Marsh was selected as the representative reference site for the Carbonate reclamation area. Similar to the Carbonate Mine waste area, standing water was encountered on transects in this area. In

addition, the upland transition zone at Pass Creek Marsh was sampled as part of the reference area.

4.16.1.1 Cover Soil Sample Results

Field personnel collected soil samples from the Edith, Consolation, Paymaster, Upper Mike Horse, Mike Horse Town Site, and Anaconda reclamation areas to evaluate soil conditions that may be influencing vegetation success on reclaimed areas. Soil samples were collected in reclamation areas where vegetation cover was lacking and/or vegetation was showing signs of stress (i.e., discoloration, and stunted or deformed growth). These areas include: WEA, EEA, CONM, UAW2 and UAW5, UMH1, UMH2, UMH3, Upper Mike Horse area reseeded and reclaimed in 2007, MHTS, PM2, Paymaster Repository, and the Consolation Mine reference area (**Table 32, Figure 36**). Composite samples, consisting of four to six subsamples, were collected from each of these reclamation areas. For comparison purposes composite soil samples were collected from the lodgepole pine forest reference area at the Consolation reference area. Soil samples were submitted for laboratory analysis of pH, electrical conductivity, and metal content, and for the nutrient parameters total organic carbon, nitrogen, phosphorus, and potassium; and metals (**Table 32**).

Proper soil pH is essential for successful revegetation. Plant establishment and growth is typically best on soils with pH ranging from about 5.5 to 6.5 (Brady and Weil, 1999). Forest soils are often slightly acidic due to conifer needle decomposition and mineral leaching. Lodgepole pine and Douglas fir are adapted to these conditions with suitable site pH values ranging from 5.0 to 7.5 and 5.5 to 7.5, respectively (NDSU 2008). At lower and in some cases higher pH values, metals present in the soil can become soluble in phytotoxic concentrations. Conversely, some plant nutrients are immobilized at higher pH values and are subsequently unavailable for uptake by plants. If it is necessary to increase soil pH, a site-specific liming requirement can be calculated based on soil pH, cation exchange capacity, and the type of liming amendment used. Brown et al. (2003) reported that the typical lime amendment rates for soil is 2 to 4 tons per acre for slightly acidic soils but could range to as much as 10 or more tons per acre for highly acidic soils.

Acidic mine soils at high elevation are often lacking in primary nutrients needed for plant establishment with nitrogen being the most limiting (Brown et al. 2003). Brown et al. recommend incorporation of 100 lb/acre nitrogen and 200 lb/acre phosphorous into the upper 6 inches of the soil profile during initial fertilization. Assuming a one acre by 6-inch deep volume of soil weighs 2 million pounds (based on a bulk density of 1.3 Mg/m^3), this equates to 50 mg of nitrogen per kilogram of soil and 100 mg phosphorous per kilogram of soil. Brown et al. also recommend subsequent surface applications of nitrogen at 100 lb/acre (50 mg/kg), if needed. Lower amounts of re-fertilization with phosphorous or potassium may be beneficial.

Total soil organic matter content generally reflects site productivity in western-montane forests (Page-Dumroese and others 1991). Organic matter is also important for successful plant establishment and growth. Sufficient organic matter content in soils: 1) provides nutrient binding sites to prevent leaching of nutrients from the root zone, 2) promotes soil aeration and water retention, and 3) can release additional nitrogen to the soil as it decomposes. Typical agricultural soil in Montana ranges from 1 to 4 percent organic matter (McCauley *et al.* 2003). Less organic matter is typically found in high elevation soils due to a relatively short growing season that results in less growth and decay of fibrous root systems in the upper soil profile. The optimal amount of organic matter in soil depends partially on the size of the organic matter. Brown et al (2003) reported that 0.25 to 0.5% soil organic matter is typically adequate for plant establishment and growth in high elevations if organic matter used has a fine particle size, such

as peat. More coarse material such as compost or plant residues require up to 1% of organic matter incorporation.

4.16.2 Reclaimed Sample Areas

4.16.2.1 Capital Mine Waste Area

The Capital Mine waste area (**Figure 36**) was reclaimed in 1997 with an upland species mix of fescue, wheatgrass, and bentgrass, among other species (Hydrometrics 1998b, MFG 1997). There is 45 percent vegetative cover established 11 years after seeding. Cover at the site was not significantly different than the reference area sampled.

Arrowleaf ragwort *(Senecio triangularis)* and sheep fescue (*Festuca ovina)* were abundant. Other species encountered within the reclamation area included stinging nettle (*Urtica dioca*), common dandelion (*Taraxacum officinale*), bedstraw (*Galium sp*.), fireweed (*Epilobium angustifolium*), sedge (*Carex* sp.), columbine (*Aquilegia flavescens*), paintbrush (*Castilleja* sp.), chickpea milkvetch (*Astragalus cicer*), Virginia strawberry (Fragaria virginia), and alsike clover (*Trifolium hybridum*). The adjacent area was surrounded by lodgepole pine forest. Bare ground accounted for approximately 10 percent of the non-vegetated portion of the area while rock covered 6 percent and litter covered approximately 40 percent. No visible signs of erosion were present and weedy species were not encountered.

Soil samples were not collected at the Capital mine waste area as vegetation was well established and diverse. A small area (approximately 100 square feet) with sparse vegetation was noted; however, given vegetation will likely improve soil samples were not taken. The following table summarizes the field results for the Capital reclamation area.

Summary of Capital Mine Field Results				
Vegetation Type	Capital Mine Waste Area		Reference Areas	
	Hits	Cover (%)	Hits	Cover (%)
Vegetated Totals	90	45.00	213	53.25
Wood	0	0.00	1	0.25
Litter	79	39.50	179	44.75
Rock	12	6.00	6	1.50
Bare Ground	19	9.50	1	0.25
Non-Vegetated Totals	110	55.00	187	46.75
Number of Quadrants	200		400	
Number of Transects	2		4	

Notes: Hits = Number of hits or the total number of species hits per sampling area.
[A] Indicates *p-values* significant to the 0.05 level.

4.16.2.2 Carbonate Mine Waste and Repository Areas

The Carbonate Mine waste area (riparian) (**Figure 36**) was reclaimed in 1994 with a grass mix predominately comprised of fescue and sloughgrass (Hydrometrics 1995b). The mix included reed canarygrass, a long-lived, rhizomatous, introduced species that has been listed as a noxious weed in some states due to its aggressive and persistent colonization along streambanks throughout the West (USDA 2011). Sloughgrass and reed canarygrass are well adapted to saturated soil conditions seasonally found in riparian areas. There is 67 percent vegetative cover established 14 years after seeding. Cover at the site was significantly less than the comparable reference area.

Vegetated cover in the Carbonate Mine waste area (wetland) (**Figure 36**) was 79 percent. Baltic rush (*Juncus balticus*) and reed canary grass (*Phalaris arundinacea*) were the dominant species. Other recorded species included Kentucky bluegrass (*Poa pratensis*), water sedge (*Carex aquatilis*), and panicled bulrush (*Scirpus microcarpus*). Incidental species were slender cinquefoil (*Potentilla gracilis*), thickspike wheatgrass (*Agropyron dasystachyum*), and field horsetail (*Equisetum arvense*). Litter dominated non-vegetated cover with 21 percent while bare ground accounted for just 1 percent and rock was not sampled. This area had several occurrences of weedy species that included yellow sweetclover (*Melilotus officinalis*), reed canary grass, Canada thistle (*Cirsium arvense*). Spotted knapweed (*Centaurea stoebe*) was observed along the access road to the site. No signs of erosion were present. The following table summarizes the field results for the Carbonate mine reclamation area.

Summary of Carbonate Mine Field Results				
Vegetation Type	**Carbonate Mine Waste Area (riparian)**		**Reference Area**	
	Hits	**Cover (%)**	**Hits**	**Cover (%)**
Vegetated Totals	200	66.67[A]	191	95.50
Wood	0	0.00	0	0.00
Litter	98	32.67	9	4.50
Rock	0	0.00	0	0.00
Bare Ground	2	0.67	0	0.00
Non-Vegetated Totals	100	33.33	9	4.50
Number of Quadrants	300		200	
Number of Transects	3		2	

Notes: Hits = Number of hits or the total number of species hits per sampling area.
[A] Indicates *p-values* significant to the 0.05 level.

Vegetation at the Carbonate Repository was well established and is comparable to the reference area. The repository was seeded in 1994 with an upland fescue/wheatgrass mix (Hydrometrics 1995b). Fourteen years after reclamation the site has 55 percent vegetation cover, which is not significantly different than the reference mean vegetation cover.

The Carbonate Repository is dominated by hard fescue (*Festuca longifolia*). Weed species included yellow sweetclover, smooth brome (*Bromus inermis*), houndstongue (*Cynoglossum officinale*), Canada thistle, and spotted knapweed. Butter and eggs (*Linaria vulgaris*) an aggressive weedy species was found in the area. Other species present in the reclaimed area included wood's rose (*Rosa woodsii*), big sagebrush (*Artemisia tridentata* Nutt. var. *vaseyana),* and white sagebrush (*Artemisia ludoviciana)*. Litter accounted for 21 percent of the non-vegetated cover, followed by 1 percent bare ground. Signs of erosion were not observed.

Soil samples were not collected at the Carbonate Mine waste area or repository as vegetation was well established and diverse. However, the Cabonate Mine waste area was sampled as part of the Mine Waste Areas Investigation (**Section 4.11.6**; **Table 27a**).The sampling results indicate arsenic, iron, lead, and manganese in the mine waste and adjoining soil were above respective soil screening levels. The following table summarizes the field results for the Carbonate Repository.

Summary of Carbonate Repository Field Results				
Vegetation Type	**Carbonate Repository**		**Reference Areas**	
	Hits	**Cover (%)**	**Hits**	**Cover (%)**
Vegetated Totals	164	54.67	213	53.25
Wood	0	0.00	1	0.25
Litter	119	39.67	179	44.75
Rock	0	0.00	6	1.50
Bare Ground	17	5.67	1	0.25
Non-Vegetated Totals	136	45.33	187	46.75
Number of Quadrants	300		400	
Number of Transects	3		4	

Notes: Hits = Number of hits or the total number of species hits per sampling area.

[A] Indicates *p-values* significant to the 0.05 level.

4.16.2.3 Edith Mine Waste Area

Three main Edith Mine waste areas (EEA, CEA, and WEA) (**Figure 36**) are part of the Edith Mine reclamation area. Due to the overall size of the Edith Mine reclamation areas, vegetation transects were placed to adequately represent the area and named as east (EEA), west (WEA), and central (CEA) Edith Mine areas. Due to the similarity between sites, and consistency among site potential and current vegetation community, the EEA, WEA, and CEA monitoring results were grouped for the Edith Area (see table below). Edith Mine waste areas were revegetated in 1995 with an upland mix of fescue and wheatgrass and one introduced legume, cicer milkvetch (Hydrometrics 1996b). There is 35 percent vegetative cover established 13 years after seeding. Cover at the site was significantly less than the reference area sampled.

All the sites surrounding the reclamation areas were surrounded by mature lodgepole pine forest. Vegetation on site was dominated by western wheatgrass (*Agropyron smithii*) and sheep fescue. Litter (52 percent) and bare ground (6 percent) comprised the majority of non-vegetated cover. Rock accounted for 5 percent of non-vegetated cover. Spotted knapweed and Canada thistle were observed in the area. No signs of erosion were found.

Three composite soil samples were collected from barren areas of EEA and WEA (**Figure 36**). Two samples from EEA did not exceed soil screening levels for any metal and pH was 6.0 for both samples. The soil sample collected from WEA exhibited a pH of 4.0 but did not exceed any soil screening levels for metals (**Table 32**).

Summary of Edith Mine Field Results				
Vegetation Type	**Edith Mine Waste Area**		**Reference Area**	
	Hits	**Cover (%)**	**Hits**	**Cover (%)**
Vegetated Totals	209	35.42 [A]	97	48.50
Wood	5	0.85	0	0.00
Litter	306	51.86	90	45.00
Rock	32	5.42	0	0.00
Bare Ground	38	6.44	13	6.50
Non-Vegetated Totals	381	64.58	103	51.50

Summary of Edith Mine Field Results				
Vegetation Type	Edith Mine Waste Area		Reference Area	
	Hits	Cover (%)	Hits	Cover (%)
Number of Quadrants	590		200	
Number of Transects	6		2	

Notes: Hits = Number of hits or the total number of species hits per sampling area.
One quadrat in the Central East Area occupied by a mature lodgepole pine stem was not recorded
[A] Indicates *p-values* significant to the 0.05 level.

4.16.2.4 Consolation Mine Waste Area

The Consolation Mine waste area (**Figure 36**) was reclaimed in 1998 with an upland species mix of fescue, wheatgrass, and bentgrass, among other species (Hydrometrics 1998b, MFG 1997). There is 14 percent vegetative cover established 10 years after seeding. The Consolation Mine reclamation area had the lowest cover value of all reclamation areas monitored during the sampling event; as expected, vegetation cover at the site was significantly less than the reference area sampled.

Dominant species consist mainly of sheep fescue and chickpea milkvetch. Other plants observed in the reclamation area included fireweed, white hawkweed (*Hieracium albiflorum*), snowberry (*Symphoricarpos occidentalis*), and red raspberry (*Rubus idaeus*). Musk thistle (*Carduus nutans*) was observed and mechanically removed in transect two. Other weedy species present were red clover and common dandelion. Lodgepole pine was recruiting well throughout the reclamation area. No sign of erosion disturbance was observed. The table below summarizes the field cover results for the Consolation mine reclamation area.

Two composite soil samples (one above the access road and one below the access road) were collected from the Consolation reclamation area (**Figure 36**; **Table 32**). Soil pH was low in one sample (4.7) and neutral for the other (6.1). Soil samples from the Consolation Mine waste area exceeded soil screening levels for arsenic, iron, and lead.

Summary of Consolation Mine Field Results				
Vegetation Type	Consolation Mine Waste Area		Reference Areas	
	Hits	Cover (%)	Hits	Cover (%)
Vegetated Totals	42	14.00 [A]	213	53.25
Wood	24	8.00	1	0.25
Litter	94	31.33	179	44.75
Rock	85	28.33	6	1.50
Bare Ground	55	18.33	1	0.25
Non-Vegetated Totals	258	86.00	187	46.75
Number of Quadrants	300		400	
Number of Transects	3		4	

Notes: Hits = Number of hits or the total number of species hits per sampling area.
[A] Indicates *p-values* significant to the 0.05 level.

4.16.2.5 Upper Mike Horse Waste Areas (excluding the areas seeded in 2007)

Sampled revegetated sites in the Upper Mike Horse area include UMH1, UMH2, UMH3, and Mike Horse Townsite (MHTS) (**Figure 36**). The reclaimed areas were all located in the fairly

steep and narrow drainage of the Mike Horse Mine drainage. Site conditions (i.e., aspect, slope, and soils) vary, depending on the individual reclamation area, which may have resulted in different site condition and vegetation response.

Upper Mike Horse waste areas and town site (**Figure 36**) were reclaimed in 1998 with an upland species mix of predominately fescue, wheatgrass, and bentgrass (Hydrometrics 1998b, MFG 1997). Ten years following reclamation all four sites have significantly less vegetation cover than the reference area. Percent vegetation cover for UMH1, UMH2, UMH3, and MHTS was 40, 15, 28, 31, respectively.

Table 32 presents the analytical results for soil samples collected from the area. Soil samples were taken from seven locations in the Upper Mike Horse Mine area from areas that had been re-vegetated. Analytical results indicate reclaimed soil in the Upper Mike Horse area had pH of soil ranging from 3.1 to 7.0 and exceeded soil screening levels for arsenic, iron, and lead. Mike Horse Townsite soil sample exhibited concentrations of arsenic and lead above their respective soil screening levels.

The following presents a summary of observations at each waste area.

- Cover at the Upper Mike Horse Waste Area 1 (UMH1) was comparatively robust with 40 percent cover. Sheep fescue and common yarrow were co-dominant on UMH1. Chickpea milkvetch was well represented. Vegetation was patchy with areas of bare ground and rock (21 and 20 percent cover, respectively). A lack of fine soil particles and organic matter were observed in barren areas (see table below).
- Cover at Upper Mike Horse Waste Area 2 (UMH2) was sparse with 14 percent vegetated cover. Yarrow and chickpea milkvetch were the dominant species. Litter and rock comprised the majority of cover on UMH2. The area was relatively steep, rocky and shaded for much of the day making for less than ideal growing conditions (see table below).
- Cover at Upper Mike Horse Waste Area 3 (UMH3) was moderate at 28 percent. Sheep fescue and yarrow were the dominant species. Similar to UMH2, UMH3 was rocky and steep; however, UMH3 receives full sun light for a portion of the day (see table below).
- The Mike Horse Townsite had moderate herbaceous cover with 31 percent cover. Bare ground was also prevalent at 36 percent. Forbs were present in the area with fireweed (*Chamerion angustifolium*), red sandspurry (*Spergularia rubra*), stonecrop (*Sedum lanceolatum*), and common mullein (*Verbascum thapsus*) present. Spotted knapweed was also observed (see table below).

Summary of Mike Horse Area UMH1 Field Results				
Vegetation Type	**Mike Horse Mine Waste Area 1 (UMH1)**		**Reference Areas**	
	Hits	**Cover (%)**	**Hits**	**Cover (%)**
Vegetated Totals	80	40.00 [A]	213	53.25
Wood	2	1.00	1	0.25
Litter	57	28.50	179	44.75
Rock	40	20.00	6	1.50
Bare Ground	21	10.50	1	0.25
Non-Vegetated Totals	120	60.00	187	46.75
Number of Quadrants	200		400	
Number of Transects	2		4	

Notes: Hits = Number of hits or the total number of species hits per sampling area.
[A] Indicates *p-values* significant to the 0.05 level.

Summary of Mike Horse Area UMH2 Field Results				
Vegetation Type	Mike Horse Mine Waste Area 2 (UMH2)		Reference Areas	
	Hits	Cover (%)	Hits	Cover (%)
Vegetated Totals	44	14.67 [A]	213	53.25
Wood	0	0.00	1	0.25
Litter	51	17.00	179	44.75
Rock	126	42.00	6	1.50
Bare Ground	79	26.33	1	0.25
Non-Vegetated Totals	256	85.33	187	46.75
Number of Quadrants	300		400	
Number of Transects	3		4	

Notes: Hits = Number of hits or the total number of species hits per sampling area.
[A] Indicates *p-values* significant to the 0.05 level.

Summary of Mike Horse Mine UMH3 Field Results				
Vegetation Type	Mike Horse Mine Waste Area 3 (UMH3)		Reference Areas	
	Hits	Cover (%)	Hits	Cover (%)
Vegetated Totals	28	28.00 [A]	213	53.25
Wood	0	0.00	1	0.25
Litter	30	30.00	179	44.75
Rock	15	15.00	6	1.50
Bare Ground	27	27.00	1	0.25
Non-Vegetated Totals	72	72.00	187	46.75
Number of Quadrants	100		400	
Number of Transects	1		4	

Notes: Hits = Number of hits or the total number of species hits per sampling area.
[A] Indicates *p-values* significant to the 0.05 level.

Summary of Mike Horse Town Site Field Results				
Vegetation Type	Mike Horse Townsite (MHTS)		Reference Areas	
	Hits	Cover (%)	Hits	Cover (%)
Vegetated Totals	62	31.00 [A]	213	53.25
Wood	0	0.00	1	0.25
Litter	52	26.00	179	44.75
Rock	14	7.00	6	1.50
Bare Ground	72	36.00	1	0.25
Non-Vegetated Totals	138	69.00	187	46.75
Number of Quadrants	200		400	
Number of Transects	2		4	

Notes: Hits = Number of hits or the total number of species hits per sampling area.
[A] Indicates *p-values* significant to the 0.05 level.

4.16.2.6 Paymaster Mine Waste Areas and Repository (excluding the area seeded in 2007)

The Paymaster Mine sites were initially reclaimed in 1997 with an upland species mix of predominately fescue, wheatgrass, and bentgrass (Hydrometrics 1998b, MFG 1997). Eleven years after reclamation waste areas 1 (PM1) and 2 (PM2) (**Figure 36**) had 27 and 36 percent cover, respectively; significantly lower percent vegetation cover than the reference area.

Sheep fescue was the dominant species at both Paymaster reclamation areas. Other recorded species included red clover, bearberry (*Arctostaphylos uva-ursi*), western wheatgrass, and yellow sweetclover. Incidental species included white hawkweed, fireweed, Virginia strawberry, pearly everlasting (*Anaphalis margaritacea*), alder (*Alnus incana*), and silvery lupine (*Lupinus argenteus*). Lodgepole pine regeneration was observed on the south side of the Paymaster reclamation areas. Knapweed was found on the access road roadbed adjacent to the reclamation areas. Litter was the dominant non-vegetated cover at PM1 and PM2 (44 and 35 percent, respectively). Signs of erosion were not visible. The following tables present a summary of the field results for PM1 and PM2.

Soils were sampled at the PM2 area. Soil pH was 5.3. Iron exceeded its Soil BTV (**Figure 36 and Table 32**). The PM2 area, as well as PM1, was also sampled as part of the Mine Waste Areas Investigation (**Section 4.11.11**; **Table 27a**).The sampling of these two areas was more extensive for this investigation and the results indicate arsenic and iron in the mine waste and adjoining soil were above respective soil screening levels in both areas.

Summary of Paymaster Mine Area 1 (PM1) Field Results				
Vegetation Type	**Paymaster Mine Waste Area 1 (PM1)**		**Reference Areas**	
	Hits	**Cover (%)**	**Hits**	**Cover (%)**
Vegetated Totals	27	27.00 [A]	213	53.25
Wood	12	12.00	1	0.25
Litter	44	44.00	179	44.75
Rock	9	9.00	6	1.50
Bare Ground	8	8.00	1	0.25
Non-Vegetated Totals	73	73.00	187	46.75
Number of Quadrants	100		400	
Number of Transects	1		4	

Notes: Hits = Number of hits or the total number of species hits per sampling area.
[A] Indicates *p-values* significant to the 0.05 level.

The Paymaster Repository was well vegetated with 59 percent cover at 11 years post reclamation. Percent vegetation cover at the repository was not significantly different than the reference area. Sheep fescue and wheatgrass (*Agropyron*) species are the dominant grasses. Kinnikinnick was also well represented. Bare ground was not prevalent (8 percent) and no signs of erosion were observed. The table below summarizes the field results for the Paymaster Repository.

Soil pH ranged from 4.9 to 6.4 in the two composite soil samples (PMR-RV1; PMR-RV2) collected from the repository. Iron and lead exceeded their respective soil screening levels.

Summary of Paymaster Mine Area 2 (PM2) Field Results				
Vegetation Type	**Paymaster Mine Waste Area 2 (PM2)**		**Reference Areas**	
	Hits	**Cover (%)**	**Hits**	**Cover (%)**
Vegetated Totals	36	36.00 [A]	213	53.25
Wood	15	15.00	1	0.25
Litter	35	35.00	179	44.75

Summary of Paymaster Mine Area 2 (PM2) Field Results				
Vegetation Type	Paymaster Mine Waste Area 2 (PM2)		Reference Areas	
	Hits	Cover (%)	Hits	Cover (%)
Rock	8	8.00	6	1.50
Bare Ground	6	6.00	1	0.25
Non-Vegetated Totals	64	64.00	187	46.75
Number of Quadrants	100		400	
Number of Transects	1		4	

Notes: Hits = Number of hits or the total number of species hits per sampling area.
[A] Indicates *p-values* significant to the 0.05 level.

Summary of Paymaster Repository Field Results				
Vegetation Type	Paymaster Repository		Reference Areas	
	Hits	Cover (%)	Hits	Cover (%)
Vegetated Totals	177	59.00	213	53.25
Wood	0	0.00	1	0.25
Litter	86	28.67	179	44.75
Rock	13	4.33	6	1.50
Bare Ground	24	8.00	1	0.25
Non-Vegetated Totals	123	41.00	187	46.75
Number of Quadrants	300		400	
Number of Transects	3		4	

Notes: Hits = Number of hits or the total number of species hits per sampling area.
[A] Indicates *p-values* significant to the 0.05 level.

4.16.2.7 No. 3 Tunnel Mine Waste Area

The No. 3 Tunnel was revegetated in 1997 with an upland species mix of predominately fescue, wheatgrass, and bentgrass (Hydrometrics 1998b, MFG 1997). There is 42 percent vegetative cover established 11 years after seeding. Cover at the site was not significantly different than the reference area sampled.

At the time of the 2008 investigation, the vegetation cover at the No. 3 Tunnel area was well established and comparable to the reference area. The reclaimed area has many native forbs colonizing the site. Sheep fescue was the dominant grass species on the reclamation area. Pussytoes (*Antennaria racemosa*) was well represented across the area. Other recorded species included penstemon (*Penstemon procerus*), yarrow, and threadleaf sedge (*Carex filifolia*). A number of three foot lodgepole pine were scattered throughout the reclaimed area. Moss cover was prevalent on the reclaimed area. Litter dominated non-vegetated cover (48 percent). Knapweed was found at two of the three transects. Signs of erosion were not observed. Soil samples were not collected at No. 3 Tunnel area as vegetation was well established and diverse.

Summary of No. 3 Tunnel Field Results				
Vegetation Type	No. 3 Tunnel Mine Waste Area		Reference Areas	
	Hits	Cover (%)	Hits	Cover (%)
Vegetated Totals	126	42.00[A]	213	53.25
Wood	0	0.00	1	0.25
Litter	144	48.00	179	44.75
Rock	8	2.67	6	1.50
Bare Ground	22	7.33	1	0.25
Non-Vegetated Totals	174	58.00	187	46.75
Number of Quadrants	300		400	
Number of Transects	3		4	

Notes: Hits = Number of hits or the total number of species hits per sampling area.
[A] Indicates *p-values* significant to the 0.05 level.

4.16.2.8 Anaconda Mine Waste Area

The Anaconda Mine waste areas were revegetated in 1995 with an upland mix of fescue and wheatgrass and one introduced legume, cicer milkvetch (Hydrometrics 1996b). There is 57 percent vegetative cover established 13 years after seeding. Cover at the site was not significantly different than the reference area sampled.

Two main waste areas (UAW2 and UAW5) are part of the Anaconda mine reclamation area (**Figure 36**). While UAW2 and UAW5 are spatially distinct, the sites are highly similar in vegetation composition and site potential, as such, monitoring results were grouped for the Anaconda area (see table below). Vegetated cover in the Anaconda mine reclamation area was high (57 percent), and was dominated by sheep fescue and chickpea milkvetch. Other species present included western wheatgrass, penstemon, tiny trumpet (*Collomia linearis*) and timothy (*Phleum pretense*). The Anaconda waste areas were surrounded by mature lodgepole pines with a portion of the reclaimed area supporting regenerated lodgepole pine. Knapweed and cheatgrass (*Bromus tectorum*) were observed in the reclaimed area.

A composite soil sample was collected in UAW2 in a barren area near the stream channel in the southwest corner of the reclamation area (**Figure 36**). The soil sample exhibited a pH of 3.1. Arsenic in one of the soil samples from the Anaconda Mine Waste Area exceeded its DEQ Action Level.

Summary of Anaconda Mine Waste Area Field Results				
Vegetation Type	Anaconda Mine Waste Area		Reference Areas	
	Hits	Cover (%)	Hits	Cover (%)
Vegetated Totals	286	57.20	116	58.00
Wood	6	1.20	0	0.00
Litter	173	34.60	65	32.50
Rock	19	3.80	8	4.00

Summary of Anaconda Mine Waste Area Field Results				
Vegetation Type	Anaconda Mine Waste Area		Reference Areas	
	Hits	Cover (%)	Hits	Cover (%)
Bare Ground	16	3.20	11	5.50
Non-Vegetated Totals	214	42.80	84	42.00
Number of Quadrants	500		200	
Number of Transects	5		2	

Notes: Hits = Number of hits or the total number of species hits per sampling area.
[A] Indicates *p-values* significant to the 0.05 level.

4.16.3 Area-Wide Observations

Area wide monitoring was conducted for the Paymaster Repository and Upper Mike Horse areas seeded in 2007 (**Figure 36**):

Area-wide monitoring was conducted to document vegetation establishment and signs of surface erosion that may adversely affect establishment of vegetation and introduce sediment that might contribute to the degradation of surface water quality. Area-wide monitoring was limited to areas seeded in 2007 as vegetation was not sufficiently established to warrant cover transect monitoring. Recommendations for future maintenance in the form of reseeding, refertilization, lime applications, or other reclamation amendments are presented in the *Recommendations* section below. Field personnel assessed reclamation areas for any pooling or ponding of water, lack of vegetation establishment, and erosional features such as rills or gullies.

Paymaster Repository

The 2007 revegetation at this site was sparse and unevenly distributed. Cover was estimated at less than 15%. Germination of annual rye (Secale sp.), sheep fescue, western wheatgrass, penny cress, nettles, yellow sweetclover, silvery lupine, and common dandelion was observed. Generally, no signs of erosion were observed; however, a small rill was forming near the east end of the Paymaster Repository, near a small parking area.

Upper Mike Horse

The 2007 revegetation in this area was sparse and had an estimated cover value of less than 5 percent. However, chickpea milkvetch, hard fescue, Douglas fir, and Lodgepole pine were present in small patches on the upper edges. Signs of rill erosion were observed and water appears to be pooling near the roadbed, creating an area barren of vegetation.

4.16.4 Reclamation Cover Summary and Conclusions

Generally, revegetated areas are well established and tree species are beginning to volunteer into the sites. However, some areas of concern do exist. In particular, vegetation at the Consolation waste area, Upper Mike Horse waste areas and town site, and Paymaster waste areas was not establishing itself as well as expected. This may be attributed to a combination of factors. As described above, organic matter is important in soil texture formation and nutrient availability. Low levels of organic matter were observed at both the Consolation and Upper Mike Horse areas. Furthermore, soil pH plays a major role in plant establishment and growth. While plant species can establish and grow in acidic conditions their growth form and productivity are affected. Soil samples at all three sites had a pH below 5.0, potentially impacting vegetation

establishment and growth. Similarly, species can tolerate high nutrient levels by means such as chelation and metal sequestration while not exhibiting optimum growth.

A number of the reclamation cover sites had soil samples that exceeded soil screening levels for metals (**Table 32**). High levels of metal uptake in plants could result in phytotoxicity and eventual death. The ecological risk assessment will further evaluate potential phytotoxicity.

In addition to the issues discussed above, several other concerns were documented. Soil erosion was seldom noted in revegetated areas despite low vegetated cover values. High litter levels undoubtedly contribute to the soil stability, but of greater importance was the pervasive occurrence of soil fungi and moss. It is well documented that soil fungi play an important ecological roll related to water dynamics, nutrient cycling, and invasive weed suppression (Belnap et al 2001). Moss provides valuable soil cover and creates micro-sites for seed germination helping reduce soil erosion from reclaimed sites. Soil stability at the Upper Mike Horse waste areas is questionable. High surface rock fragment content was observed for these areas and contributes greatly to erosion control on site. The addition of coir (coconut fiber) soil matting would improve soil stability through improved water infiltration, create micro sites favorable for seed germination, and improve surface water quality by reducing the amount of sediment entering Mike Horse Creek.

The Carbonate waste area was unique because it was the only reclamation site with wetland/riparian vegetation. The wetland community adjacent to Pass Creek was selected as a wetland reference site because vegetation communities were similar between the sites. Percent vegetative cover at Carbonate was significantly less than the Pass Creek reference site but greater than any other reference or reclaimed site sampled. This may indicate that while the Carbonate site has reached its vegetative cover potential the site's vegetation cover will never match that of the Pass Creek reference site due to limitations such as ground water depth and topography. It may also possible that the exceedances of arsenic, iron, lead, and manganese at the reclamation site are impacting the vegetative cover. These conditions should be reviewed further when determining if the Carbonate waste area has achieved reclamation success.

Vegetative ground cover at the Paymaster Repository, Capital Mine waste areas, Carbonate Repository and Upper Anaconda waste areas did not differ significantly from their respective reference areas.

The Draft Solid Minerals Reclamation Handbook (BLM 2001) recommends that species selected for revegetation should include a mix not only of individual species but also of life forms appropriate to the area. The document goes on to state that a variety of species increases chances of success under variable site and climatic conditions. Seed mixes used at the Upper Blackfoot Mining Complex were dominated by grass species, predominately wheatgrass and fescue species. Only two forb species were included in the various seed mixes, common yarrow and cicer milkvetch. The seed mix appears to be designed primarily to provide rapid ground cover.

Noxious weed infestation is a major problem throughout Montana. Several of the reclamation areas sampled at the UBMC, while not infested, have established noxious species such as spotted knapweed and Canada thistle. Many of the plants observed were adjacent to travel corridors, likely introduced from recreation and work vehicles.

4.17 Ecological Risk Sampling

The following sections present the terrestrial and marsh transects investigations and aquatic investigations.

4.17.1 Terrestrial and Marsh Surface Investigation

Vegetation, invertebrates, and small mammals were sampled during the 2008 investigation in terrestrial and marsh habitats to address data gaps identified through review of historic information for the site, 2007 sampling results, and a screening level ecological risk evaluation. The ecological receptors of vegetation, invertebrates, and small mammals were sampled in the terrestrial and marsh habitats and submitted to the laboratory for tissue analysis. Collocated soil samples were collected to evaluate soil COPC concentrations, which will be compared to measured tissue COPC concentrations in the ecological receptors and will assist in evaluating trophic transfer within the terrestrial and marsh habitats.

Field personnel collected vegetation, invertebrate, small mammal, and soil samples at terrestrial and marsh transects between July 23 and 28, 2008. Results of field observations and laboratory analysis are discussed in the following sections.

4.17.1.1 Terrestrial Receptor Sampling

This section summarizes field and laboratory results of ecological receptors (vegetation, invertebrates, and small mammals) and soil sampling within the terrestrial habitat. Tetra Tech compared metal concentration results in soil with US EPA Ecological Soil Screening Levels (Eco-SSL) developed for assessing risk of the contaminant in the soil to vegetation, birds and mammals, and invertebrate receptors. No screening values for vegetation, small mammal, or invertebrate tissue concentrations have been developed; therefore, determinations of risk cannot be made at this time. However, metal concentrations in each of these receptors will be included in a food chain model and a full evaluation of risk will be completed during the ecological risk assessment.

Laboratory results of metals concentration in vegetation, small mammal, and invertebrate tissue will be discussed in general terms in the following sections. A discussion and evaluation of the results with respect to soil metal concentrations is included in the terrestrial and marsh investigation summary and conclusions section.

Vegetation Sampling

Three vegetation samples were collected along three terrestrial transects (**Figure 37**). ANTREF is a reference site; BC and BR are transects where risk was indicated based on the results of an ecological screening evaluation conducted in September 2007 (BC - moderate to low risk, BR – high risk). Dominant vegetation species collected from transect BR include bluegrass species (*Poa* spp.), purplestem aster (*Symphyotrichum puniceum*), sedge species (*Carex* spp.), and Oregon grape (*Mahonia repens*). Dominant species collected from transect BC include white spirea (*Spiraea betulifolia*), black huckleberry (*Vaccinium membranaceum*), and bearberry (*Arctostaphylos uva-ursi*). Dominant species collected from the reference transect ANTTREF include ragwort species (*Senecio* spp.), smooth brome (*Bromus inermis*), purplestem aster, Timothy grass (*Phluem pretense*), and varileaf cinquefoil (*Potentilla diversifolia*).

Table 33 presents the metal concentrations in vegetation tissue samples from terrestrial transects ANTREF, BC, and BR. The following table summarizes the results.

Summary of Terrestrial Vegetation Tissue Results			
Metal	**Observed Range of Concentrations (mg/kg)**		
	BC	**BR**	**ANTREF**
Aluminum	64.6 – 222	13.0 – 19.2	11.4 – 18.1
Arsenic	<0.7 – 3.1	<0.7 - <0.7	<0.7 - <0.7
Cadmium	0.31 – 1.05	0.66 – 1.05	<0.05 – 0..25
Copper	4.56 – 6.39	8.66 – 9.82	5.06 – 10.8

Summary of Terrestrial Vegetation Tissue Results			
Metal	Observed Range of Concentrations (mg/kg)		
	BC	BR	ANTREF
Iron	104 – 729	54.9 – 101	45.8 – 69
Lead	1.89 – 14.7	<0.25 – 3.39	<0.25 – 0.82
Manganese	521 – 3,230	21.2 – 171	18.8 – 60.7
Mercury	<0.003 - <0.003	<0.003 - <0.003	<0.003 - <0.003
Zinc	64.3 – 84.4	88.6 – 225	22.3 – 39.0

mg/kg – milligrams/kilogram, BC –Beartrap Creek terrestrial transect, BR –Blackfoot River terrestrial transect, ANTREF –Anaconda Creek terrestrial transect

Mercury concentrations were below the laboratory detectable limit for all samples. Overall, the reference transect (ANTREF) exhibited lower metal concentrations across the board. Transect BC (moderate to low risk) had notably higher concentrations of aluminum, iron and manganese. Zinc levels were notably higher in BR (high risk).

Small Mammal Sampling

Three small mammal samples were collected at each terrestrial transect. Species collected include masked shrew, deer mouse, meadow vole, boreal red-backed vole, least chipmunk and red squirrel.

Trace metal concentrations in small mammal tissue from terrestrial transect samples are shown in **Table 34**. The following table summarizes the range of concentrations of metals in the samples for each terrestrial transect.

Cadmium and mercury levels were below the detectable limit for all samples. Arsenic was below the detectable limit in both BC and ANTREF samples and lead was below the detectable limit in all ANTREF samples. Generally, metal concentrations in small mammal samples from all three transects occurred within similar ranges. Some small scale trends include higher aluminum levels in the reference transect and high arsenic and lead levels in BR (high risk).

Summary of Terrestrial Small Mammal Tissue Results			
Metal	Observed Range of Concentrations (mg/kg)		
	BC	BR	ANTREF
Aluminum	<8.0 – 17.7	8.0 – 17.4	11.3 – 28.5
Arsenic	<2.5 - <2.5	<2.5 – 3.7	<2.5 - <2.5
Cadmium	<0.2 - <0.2	<0.2 - <0.2	<0.2 - <0.2
Copper	1.92 – 3.33	3.62 – 5.53	2.32 – 5.34
Iron	77.8 – 168	95.5 – 148	93.9 – 157
Lead	<0.75 – 7.66	2.83 – 5.17	<0.75 - <0.75
Manganese	1.56 – 6.28	1.99 – 4.92	1.07 – 6.95
Mercury	<0.033 - <0.033	<0.033 - <0.033	<0.033 - <0.033
Zinc	30.8 – 164	59.3 – 376	33.5 – 351

mg/kg – milligrams/kilogram, BC –Beartrap Creek terrestrial transect, BR –Blackfoot River terrestrial transect, ANTREF –Anaconda Creek terrestrial transect

Terrestrial Invertebrate Sampling

Three invertebrate samples were collected from the terrestrial transects ANTREF and BR, while only two samples were collected from transect BC due to a lack of specimens captured. Trace metal concentrations in invertebrate tissue samples from the terrestrial transects are shown in **Table 35**. The following table summarizes the invertebrate sample results.

Summary of Terrestrial Invertebrate Tissue Results			
Metal	Observed Range of Concentrations (mg/kg)		
	BC	BR	ANTREF
Aluminum	196 – 214	40.4 – 415	21.9 - 304
Arsenic	41.9 – 50.2	8.19 – 24.3	0.62 – 9.73
Cadmium	0.46 – 1.46	2.01 – 9.46	0.76 – 1.04
Copper	20.9 – 38.6	27.9 – 68.0	34.9 – 46.4
Iron	465 – 774	336 – 5,570	98.3 – 373
Lead	4.9 – 16.0	9.24 – 102	0.51 – 2.02
Manganese	117 – 173	80 – 636	40 – 103
Mercury	<0.1 - <0.1	<0.1 - <0.1	<0.1 - <0.1
Zinc	163 – 224	196 – 386	156 – 197

mg/kg – milligrams/kilogram, BC –Beartrap Creek terrestrial transect, BR –Blackfoot River terrestrial transect, ANTREF –Anaconda Creek terrestrial transect

Mercury concentrations were below the detectable limit for all samples. Overall, the reference transect (ANTREF) exhibited lower metal concentrations across the board. Metal concentrations were generally highest in BR (high risk). One exception was the comparatively much higher levels of arsenic in the two BC (moderate to low risk) samples.

Soil Sampling

Three soil samples were collected from each Terrestrial Transect from the 0- to 6-inch depth interval and were analyzed for metal content. Trace metal concentrations in soil samples from the Terrestrial Transects are shown in **Table 36**. The following table summarizes the soil results.

Summary of Terrestrial Soil Analytical Results			
Metal	Observed Range of Concentrations (mg/kg)		
	BC	BR	ANTREF
Aluminum	12,600 – 17,800	7,670 – 11,600	11,200 – 12,700
Arsenic	7.6 – 35.2	23.9 – 101	12.3 – 15.2
Cadmium	0.62 – 1.45	1.33 – 8.62	0.738 – 0.917
Copper	10.3 – 99.6	59.8 – 264	31.6 – 42.4
Iron	12,900 – 23,200	18,000 – 44,100	14,400 – 15,800
Lead	25.8 – 264	68.1 – 1,840	23.7 – 81.3
Manganese	673 – 1,150	720 – 1,390	428 – 564
Mercury	<0.5 - <0.5	<0.5 - <0.5	<0.5 - <0.5
Zinc	81.4 – 165	174 – 764	64.4 – 106

mg/kg – milligrams/kilogram, BC –Beartrap Creek terrestrial transect, BR –Blackfoot River terrestrial transect, ANTREF –Anaconda Creek terrestrial transect

Mercury concentrations were below the detectable limit for all samples. Metal concentrations across the board were generally lowest in the reference transect (ANTREF), were intermediate in value in the BC transect (moderate to low risk) and were much higher in the BR transect (high risk). One exception is that aluminum levels were generally lower in BR than the other two transects.

Table 36 presents the available US EPA Eco-SSLs for the metals analyzed. Available Oak Ridge National Laboratory (ORNL) soil screening levels are also listed in **Table 36** and were used for comparisons when Eco-SSL values were not available (Efroymson, et al. 1997a and Efroymson, et al. 1997b). The Eco-SSLs are protective levels at which contaminants in the soil should not pose a risk to receptors that commonly come into contact with the soil or ingest biota

that live in or on the soil. Contaminants that occur at concentration levels above the Eco-SSL help identify COPCs and/or areas of soil contamination that warrant further evaluation in a baseline ERA.

Comparison with the plant screening levels indicated soil concentrations were greatly exceeded at all transects for aluminum (ORNL levels) and were exceeded at all transects for zinc (ORNL levels). The BR transect consistently exceeded plant Eco-SSLs for arsenic, copper and lead. Plant Eco-SSL for manganese was exceeded at BR and BC. This suggests that aluminum, zinc, arsenic, copper, lead and manganese should be further evaluated to determine potential risk to plants, especially in the area of transect BR. It is important to note that the reference transect consistently exceeded screening values for plants in aluminum and zinc (ORNL levels for both), indicating a potential risk to plants in the study area. Soil samples collected from the reference transect are presumed to be free of contamination and would represent natural background conditions. Cadmium levels were below plant Eco-SSL at all locations, implying it is not a potential hazard to plants in the study area and therefore could potentially be dropped from further risk analysis to plants. No plant Eco-SSL were available for iron.

The Eco-SSLs for mammal receptors were exceeded by all samples for cadmium and were consistently exceeded by BR samples for copper and lead. This suggest that cadmium may pose a potential hazard to mammals at all sites and that copper and lead contaminants may pose a potential hazard in the area of transect BR, and that these contaminants should be further evaluated in the baseline ERA. Cadmium levels in the reference transect consistently exceeded mammal Eco-SSL, indicating cadmium naturally occurs above the mammal Eco-SSL in the study area. However, cadmium levels were much higher than the mammal Eco-SSL in BR. No mammal Eco-SSL were available for aluminum, iron, manganese, mercury, or zinc.

The Eco-SSLs for invertebrates were exceeded in one sample in BR for arsenic and lead. Invertebrate Eco-SSLs were consistently exceeded for copper at BR and for zinc (ORNL levels) at BR and BC. This suggests that arsenic, copper, lead, and zinc levels in the areas near the BR and BC transects should be further evaluated in the baseline ERA to determine potential risk to invertebrates. Cadmium levels were much below invertebrate Eco-SSL at all locations, implying it is not a hazard to invertebrates in the study area and could potentially be dropped from further risk analysis to invertebrates. No invertebrate Eco-SSLs were available for aluminum, iron, or manganese.

4.17.2 Marsh Surface Sampling

The following summarizes field and laboratory results of ecological receptors (vegetation, invertebrates, and small mammals) and sediment sampling within the marsh habitat (**Figure 38**). Tetra Tech compared the metal concentrations in soil samples with US EPA Eco-SSLs developed for assessing risk of the contaminant in the soil to vegetation, birds and mammals, and invertebrate receptors. Because no screening values for vegetation, small mammal, or invertebrate tissue concentrations have been developed, metals concentrations in these receptors will be discussed in general terms in the following sections. A discussion and evaluation of the results with respect to soil metal concentrations is included in the terrestrial and marsh investigation summary and conclusions section**.** Information on metal concentrations in vegetation, mammals, and invertebrates will be included in a food chain model and a full risk evaluation will be completed during the ecological risk assessment.

Vegetation Sampling

Vegetation samples were collected along three marsh transects. PGREF is a reference site, and UMT1 and UMT2 are transects where risk was indicated based on the results of an ecological screening evaluation conducted in September 2007 (UMT2 - moderate to low risk, UMT1 – high

risk). Dominant vegetation species collected from transect UMT1 include field horsetail (Equisetum arvense), bluegrass species (*Poa* spp.), and sedge species (*Carex* spp.). Dominant vegetation collected from transect UMT2 include bluegrass species (*Poa* spp.), and sedge species (*Carex* spp.). Dominant vegetation collected from transect PGREF include sedge species (*Carex* spp.), rush species (*Juncus* spp.), Virginia strawberry (*Fragaria virginiana*), willow species (*Salix* spp.), bigleaf aster (*Eurybia macrophylla*), and star false Solomon's seal (*Maianthemum stellatum*).

Metal concentrations in vegetation tissue samples from marsh transects are reported in **Table 33**. The following table summarizes the observed ranges of metal concentrations for each transect.

Summary of Marsh Vegetation Analytical Results			
Metal	**Observed Range of Concentrations (mg/kg)**		
	PGREF	**UMT1**	**UMT2**
Aluminum	27.1 – 40.6	18.3 – 106	15 – 25.6
Arsenic	<0.7 - <0.7	<0.7 - <0.7	<0.7 - <0.7
Cadmium	<0.05 – 1.49	0.74 – 5.21	0.24 – 0.63
Copper	4.88 – 5.68	7.02 – 20.0	3.84 – 7.11
Iron	74.6 – 168	87.5 – 416	118 - 631
Lead	<0.25 - <0.25	3.18 – 24.3	0.85 – 5.01
Manganese	59.5 – 236	249 – 419	255 – 341
Mercury	<0.003 - <0.003	<0.003 - <0.003	<0.003 - <0.003
Zinc	26.4 – 66.9	188 – 661	55.6 – 245

mg/kg – milligrams/kilogram, PGREF – Pass Creek Marsh-reference transect, UT1 – Upper Marsh transect #1, UT2 – Upper Marsh transect #2

Arsenic and mercury levels were below the detectable limit for all samples and lead was below the detectable limit in PGREF samples. Overall, the reference transect (PGREF) exhibited lower metal concentrations than UMT1 and UMT2. UMT1 (high risk) exhibited the overall highest concentrations of the three transect. Two UMT1 vegetation samples, UMT1VE02 and UMT1VE03, registered the highest concentrations of aluminum, cadmium, copper, lead, manganese, and zinc of all marsh transect samples. The third UMT1 vegetation sample, UMT1VE01, was consistently lower in metal concentrations and was located at the outer edge of the marsh, near the topographic incline leading to the surrounding uplands.

Small Mammal Sampling

Five small mammal samples were collected from marsh transect PGREF, three samples were collected from transect UMT1. No small mammal samples were collected from UMT2 due to a lack of trap success. Species collected from PGREF and UMT1 include masked shrew, deer mouse, and meadow vole.

Table 34 presents the trace metal concentrations in small mammal tissue from the marsh transects. The following table summarizes the observed ranges of metal concentrations for each transect.

Mercury levels were below the detectable limit in all samples and arsenic levels were at or below the detectable limit of 2.5 mg/kg for all samples. Overall, metal concentrations in samples from the reference transect (PGREF) were much lower than those from UMT1 (high risk). Two of the three UMT1 samples had very high metal concentrations across the board. However, the third UMT1 sample (UMT1MA02) had much lower metal concentrations compared to all samples for nearly all the metals analyzed. All three UMT1 small mammal samples were collected from the same sample point location.

Summary of Marsh Small Mammal Analytical Results		
Metal	Observed Range of Concentrations (mg/kg)	
	PGREF	UMT1
Aluminum	11.3 – 29.4	<8.0 – 53.3
Arsenic	<2.5 - <2.5	<2.5 – 2.5
Cadmium	<0.2 - <0.2	<0.2 – 0.98
Copper	2.54 – 3.97	1.48 – 11.7
Iron	112 – 139	46.8 – 958
Lead	<0.75 – 1.2	<0.75 – 25.9
Manganese	2.53 – 7.23	1.77 – 80.0
Mercury	<0.003 - <0.003	<0.003 - <0.003
Zinc	23.9 – 158	44.8 – 537

mg/kg – milligrams/kilogram, PGREF – Pass Creek Marsh-reference transect, UMT1 – Upper Marsh transect #1

Marsh Surface Invertebrate Sampling

Three invertebrate samples were collected from each Marsh Transects. Trace metal concentrations in invertebrate tissue samples from the Marsh Transects are shown in **Table 35**. The following table summarizes the observed ranges of metal concentrations for each transect.

Summary of Marsh Invertebrate Analytical Results			
Metal	Observed Range of Concentrations (mg/kg)		
	PGREF	UMT1	UMT2
Aluminum	114 – 3,060	749 – 1,660	1,120 – 2,770
Arsenic	1.26 – 6.56	10.2 – 26.2	2.76 – 8.73
Cadmium	0.87 – 4.29	11.2 – 14.7	1.9 – 12.9
Copper	23.3 – 116	137 – 227	29.2 – 137
Iron	288 – 5,660	3,590 – 9,580	3,900 – 7,200
Lead	1.2 – 34.1	163 – 440	27.6 – 152
Manganese	52.6 – 532	697 – 1,790	183 – 1,100
Mercury	<0.1 - <0.1	<0.1 - <0.1	<0.1 - <0.1
Zinc	204 – 236	798 – 2,080	210 – 939

mg/kg – milligrams/kilogram, PGREF – Pass Creek Marsh-reference transect, UMT1 – Upper Marsh transect #1, UMT2 – Upper Marsh transect #2

Mercury levels were below the detectable limit in all samples. Overall, the reference transect (PGREF) exhibited the lowest levels of metal concentrations, while UMT2 (moderate to low risk) exhibited intermediate levels of metal concentrations, and UMT1 (high risk) exhibited high levels of metal concentrations. One sample in each PGREF and UMT2 had relatively high levels of aluminum, which increased their relative concentrations to near or above the concentrations observed for UMT1.

Marsh Sediment Sampling

Sediment samples on the marsh transects were collected from the 0-2 inch, 2-6 inch, and 6-12 inch depth intervals. Marsh sediment samples were analyzed for total metal content and for pH and electrical conductivity. One-half of all marsh sediment samples were also analyzed for ABA and SPLP.

Trace metal concentrations in sediment samples from the Marsh Sediment Transects are shown in **Table 37a**. The following table summarizes the marsh sediment results.

Summary of Marsh Sediment Analytical Results			
Metal	**Observed Range of Concentrations (mg/kg)**		
	PGREF	**UMT1**	**UMT2**
Aluminum	4,990 – 13,300	4,420 – 11,200	8,840 – 13,200
Arsenic	7.06 – 17.4	13 – 128	11.3 – 54.2
Cadmium	0.52 – 1.58	1.3 – 19.2	0.31 – 8.93
Copper	12.8 – 49.8	79 – 662	59.2 – 249
Iron	9,470 – 14,900	12,000 – 42,500	10,500 – 42,800
Lead	31.2 – 86.0	61.9 – 2,440	45.2 – 1,030
Manganese	156 – 727	256 – 4,910	158 – 1,390
Mercury	<0.5 - <0.5	<0.5 - <0.5	<0.5 - <0.5
Zinc	101 – 216	301 – 2,830	174 – 585

mg/kg – milligrams/kilogram, PGREF – Pass Creek Marsh-reference transect, UMT1 – Upper Marsh transect #1, UMT2 – Upper Marsh transect #2

Mercury levels were below the detectable limit of 0.5 mg/kg for all samples. Metal concentrations across the board were generally lowest in transect PGREF (reference site), were intermediate in value in the UMT2 transect (moderate to low risk) and highest in the UMT1 transect (high risk). Lead, manganese, and zinc exhibited very high concentrations in UMT1 compared to the other two transects.

Available US EPA Eco-SSL are listed for the metals analyzed in **Table 37a**. ORNL values are also listed, which may be used when US EPA values are not available. The Eco-SSLs are protective levels at which contaminants in the soil should not pose a risk to receptors. Contaminants that occur above the Eco-SSL identify COPCs and/or areas of soil contamination that warrant further evaluation in a baseline ERA.

Eco-SSLs for plant receptors were exceeded by most samples in UMT2 and UMT1 for arsenic and copper. Plant screening values were consistently exceeded in UMT1 for lead and manganese (Oak Ridge National Laboratory (ORNL) levels). The ORNL value for zinc was exceeded by all samples in each transect, including the reference transect, implying that these levels occur naturally in the study area. However, zinc levels were much higher in UMT1 and UMT2 than in the reference transect. This suggest that arsenic, copper, lead, manganese, and zinc should be considered further in a baseline ERA to determine risk to plant receptors. Cadmium levels did not exceed the Eco-SSL for any sample, suggesting cadmium is not a potential hazard to plants and therefore cadmium could be dropped from further risk analysis to plant receptors. No plant screening values were available for iron.

The Eco-SSL for mammal receptors was consistently exceeded in UMT1 for arsenic. Mammal Eco-SSLs were exceeded by most samples in each transect for cadmium and lead. Although baseline cadmium and lead levels in the reference transect exceeded the Eco-SSLs, indicating these exceedence levels occur naturally in the study area, cadmium and lead levels in UMT1 were generally much higher than the mammal Eco-SSLs. The mammal Eco-SSL was exceeded by all UMT1 and UMT2 samples for copper. This suggests that arsenic, cadmium, copper, and lead levels should be further evaluated in the baseline ERA to determine risk to mammals, especially in the areas of UMT1 and UMT2. No mammal Eco-SSLs were available for aluminum, iron, manganese, mercury, or zinc.

Eco-SSLs for invertebrates were exceeded by several samples in UMT1 for arsenic and lead. The invertebrate Eco-SSL was exceeded by most samples in UMT1 and UMT2 for copper. The screening value for zinc (ORNL levels) was exceeded by all samples, in each transect. Although baseline zinc levels in the reference transect exceeded screening levels, indicating they occur naturally in the study area, zinc concentrations in UMT1 samples were much greater

than the ORNL levels. This suggests that arsenic, copper, lead, and zinc should be further considered in the baseline ERA to determine risk to invertebrates in areas of UMT1 and UMT2. Cadmium levels did not exceed the Eco-SSL for any samples, indicating cadmium does not pose a risk to invertebrates at the study area. No invertebrate Eco-SSLs were available for aluminum, iron, or manganese.

In addition to exceeding the ECO-SSLs soil screening levels, the following summarizes the metals that exceed other applicable screening levels.

- Arsenic exceeded the DEQ Action Level for Arsenic in Surface Soil.
- No exceedences of EPA RSLs for aluminum, cadmium, copper, mercury, and zinc. These metals were screened to these values because UBMC background concentrations are lower than their respective RSLs.
- Lead and manganese exceeded the Soil BTVs. Iron, lead and manganese are screened to these values because UBMC background concentrations are higher than their respective EPA RSLs.
- Aluminum, arsenic, cadmium, copper, iron, lead, manganese, and zinc exceeded their respective Marsh Sediment RVs.
- Arsenic, iron, lead, and manganese exceeded their Marsh SPLPs.

Marsh transect samples were also analyzed for ABA and SPLP (**Table 37b**). The data was used to evaluate potential acid generation of the metals sulfides in the sediment. Soil pH ranged from 3.7 to 6.8. SPLP results indicated that arsenic, lead, and manganese have the potential to leach from the soil with possible migration to adjoining soil, surface water, and groundwater. The following table summarizes the ABA acid generation results.

Summary of Marsh Transect Sediment Acid Generation Evaluation				
Sample	**NP:AP**	**NP:AP^2 (t/kt)**	**NNP (t/kt)**	**Result**
PGREFTS01 (0-2”)	1,000	100,000	9.99	Uncertain acid generation potential
PGREFTS01 (6-12”)	14.5	23.4	8.38	Uncertain acid generation potential
PGREFTS02 (2-6”)	9.29	6.63	11.6	Uncertain acid generation potential
PGREFTTS03 (0-2”)	12.4	12.8	11.0	Uncertain acid generation potential
PGREFTS03 (6-12”)	7.69	5.92	8.7	Uncertain acid generation potential
UMTT1TS01 (2-6”)	2	0.67	3	Uncertain acid generation potential
UMTT1TS02 (0-2”)	0.40	0.002	-137	Potentially acid generating
UMTT1TS02 (6-12”)	0.34	0.004	-61	Potentially acid generating
UMTT1TS03 (2-6”)	0.38	0.004	-62	Potentially acid generating
UMTT2TS 01 (0-2”)	5.26	9.23	2.43	Uncertain acid generation potential
UMTT2TS02 (0-2”)	40	267	5.85	Uncertain acid generation potential
UMTT2TS02 (6-12”)	24.2	73.5	7.67	Uncertain acid generation potential
UMTT2TS03 (2-6”)	0.82	0.11	-1.3	Uncertain acid generation potential

t/kt – tons per kilotons
NNP=NP-AP
Potentially acid generating = NP:AP^2<1 and NNP<-20 t/kt
Uncertain acid generation potential = NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to generate acid = NP:AP>3 and NNP>+20 t/kt

ABA results indicate that Pass Creek Marsh (reference marsh) has uncertain acid generation potential. SPLP results indicate that arsenic and lead may leach from Pass Creek sediment and into surrounding sediment and/or water. Three of four results for Upper Marsh transect UMT1

indicate the sediment along this transect are potentially acid generating, and may leach metals into surrounding sediment and/or water. Results for Upper Marsh transect UMT2 indicate that the sediment have uncertain acid generation potential. SPLP results indicate that arsenic, lead, and manganese may leach from the sediment along this transect and into surrounding sediment and/or water.

4.17.3 Terrestrial and Marsh Surface Investigation Summary and Conclusions

Metal concentrations in the ecological receptors of vegetation, small mammals, and invertebrates were determined through laboratory analysis across three transects (high risk, moderate to low risk, and a reference area) in both terrestrial and marsh habitats. Metal concentrations in collocated soil samples were also analyzed to allow direct correlation among soil and biological receptors in terms of assimilating COPC. For some metals, concentration levels were not detected above the laboratory method minimum detection limit. Most notably, mercury was not detected above the laboratory detection limit in any receptor in any location. Cadmium was not measured above the detection limit in any small mammal sample in the terrestrial habitat and arsenic was not detected in any small mammal or vegetation sample in the marsh habitat. For those metals that were detected, concentrations in each receptor were generally highest in the high risk transects, were at intermediate levels in the moderate to low risk transects, and were lowest in the reference transects in both terrestrial and marsh habitats. Overall, concentrations of each metal in the ecological receptors of vegetation, small mammals, and invertebrates were less than the concentration of that metal in the soil. This suggests that bio-concentration of the metals analyzed has not occurred with the current receptors. A more detailed analysis of assimilation of the metals from the soil to the ecological receptors will be conducted during the ecological risk assessment (ERA).

Soil metal concentrations were compared with ORNL and EPA Eco-SSLs to determine which COPCs and/or areas warrant further evaluation in the Baseline ERA to determine risk to the ecological receptor. Potential risks of aluminum, arsenic, copper, lead, manganese, and zinc to plant receptors should be considered in the high and the moderate to low risk transects in both the terrestrial and marsh habitat. Soil cadmium concentrations were below the plant screening values across the board and therefore could be potentially dropped from further analysis in assessing risk to plant receptors. Although mercury was not detected above the minimum detection limit of 0.5 mg/kg in any soil sample, ORNL plant screening value is 0.3 mg/kg, therefore further analysis of mercury may be warranted. No plant screening values were available for comparison for iron.

Potential risks of arsenic, cadmium, copper, and lead to mammal receptors should be further considered in the high and moderate to low risk transects in both the terrestrial and marsh transects. Cadmium and lead should be considered in both the terrestrial and marsh reference transect. No mammal Eco-SSLs values were available for aluminum, iron, manganese, mercury, or zinc.

Potential risks of arsenic, copper, lead, and zinc to invertebrate receptors should be further considered in the high and moderate to low risk transects in both the terrestrial and marsh habitats. Zinc should be considered in the reference area of the marsh habitat. Soil cadmium concentrations were below the invertebrate Eco-SSL across the board and therefore could be potentially dropped from further analysis in assessing risk to invertebrate receptors. No invertebrate Eco-SSL values were available for aluminum, iron, and manganese.

Analysis of soil samples in the marsh habitat indicate that there is potential for sulfide minerals in the dispersed tailings near UMT1 to generate acid and mobilize metals and potentially impact water quality and the ecosystem in the marsh habitat. A complete and detailed evaluation of

COPC contamination and risks to ecological receptors at the study area will be completed during an ERA.

4.18 Aquatic Investigation

4.18.1 2007 Aquatic Biota Sampling Results

4.18.1.1 2007 Macroinvertebrate Community Sampling

Macroinvertebrate communities at the UBMC were identified during 2007 at select sampling locations in the Upper Marsh and Lower Marsh, in Stevens Gulch, and along the Blackfoot River (**Figure 39**). Field personnel collected subsamples of macroinvertebrates to obtain a count of 300 individuals in order to minimize laboratory analysis time rather than identifying all individuals in a sample, which could number in the thousands. Key measures from the macroinvertebrate community samples include relative abundance, species richness and diversity and biotic indices such as the Montana Department of Environmental Quality Biotic Index (MT Biotic Index).

The Shannon-Weaver diversity index is a measure of the evenness and richness of a community. Generally, the higher the index score, the more diverse a sampled population is (Allan 1995). The metals tolerance index score is generated by using assigned metals tolerance values to families/orders of macroinvertebrates. Families/orders of macroinvertebrates that are more tolerant of metals have a higher value, while families/orders that are not tolerant, have a lower value. Metals tolerance index values of 4.0 or more are indicative of communities that are experiencing some impact from metals (McGuire 1996).

Fine sediment biotic index scores are derived by examining the relative tolerance of sediment sensitive taxa that decrease in number as the amount of sedimentation increases. For this index, a lower score is indicative of higher sedimentation and lower overall habitat quality available to macroinvertebrates sensitive to sedimentation (Relyea 2000, Stagliano 2006). Fine sediment biotic index scores presented in the following table are weighted averages based on the number of identified individuals that have a fine sediment tolerance value. The MT Biotic Index is calculated similarly to the metals tolerance index, but whose focus is on organic pollution. Individual taxa are assigned at pollution tolerance value of 0-10, where 0 is representative of taxa that are least tolerant of pollution and 10 represents taxa that are tolerant of pollution. Through the calculation of the MT Biotic Index, scores that are closer to 10 indicate a stream reach has been subjected to organic pollution, while scores closer to 0 indicate sites that have not been subjected to organic pollution (Feldman et al 2006).

Tables 38a through **28n** presents the full taxonomic data. Samples that contained significantly less than 300 individuals are representative of sites that generally have poor water quality or habitats that are not capable of supporting an extensive macroinvertebrate community. After review of the 2007 macroinvertebrate taxonomic community sampling results, several sampling sites exhibited conditions that do not provide optimal macroinvertebrate habitat. These sampling locations include BRSW-108, BRSW-109, BRSW-13, and BRSW-21. This conclusion was based solely on abundance and richness measures. The following table summarizes 2007 key macroinvertebrate community data.

2007 Macroinvertebrate Taxonomic Community Results								
Site	Macroinvertebrate Measure or Index							
	Corrected Abundance	EPT Abundance	Species Richness	EPT Richness	Shannon-Weaver H' (log 10)	Metals Tolerance Index	Fine Sediment Biotic Index	MT Biotic Index
BRSW -101	300	163	40	17	1.3	2.97	4.45	3.43
BRSW -102	300	82	38	17	1.09	2.99	4.27	4.76
BRSW -17	300	149	37	14	1.26	3.80	4.54	3.72
BRSW -106	296	250	25	11	0.80	2.76	3.66	1.52
BRSW -108	73	54	17	6	0.84	1.45	4.38	1.91
BRSW -109	29	18	8	4	0.68	5.38	4.07	1.11
BRSW -12	300	204	24	7	0.84	1.75	4.01	1.94
BRSW -13	28	7	10	3	0.82	3.24	2.57	4.96
BRSW -16	300	219	24	9	0.93	2.31	4.14	2.16
BRSW -21	122	90	11	5	0.53	1.56	2.08	2.82
BRSW -33	300	134	23	10	0.85	3.49	4.11	3.35
BRSW -06	300	121	39	12	1.34	3.34	4.53	4.27

EPT – Ephemeroptera/Plecoptera/Trichoptera

DEQ Multimetric Macroinvertebrate Index (MMI) scores were generated from macroinvertebrate data using the DEQ MMI protocols. Metric results were then scored using the DEQ bioassessment criteria and each sample categorized as unimpaired or impaired according to threshold values. For mountain regions, a MMI score greater than or equal to 63 indicates an unimpaired stream segment, while a MMI score less than 63 indicates an impaired stream segment.

The following table shows the MMI scores generated using the data collected as part of the fall 2007 effort and the threshold assessment of whether the results indicated there was impairment or no impairment. Specific measures used to generate the MMI score were: Ephemeroptera Richness; Plecoptera Richness, Percent Ephemeroptera/Plecoptera/Trichoptera (EPT), Percent Non-Insect Individuals, Percent Predators, Burrower Taxa Percent and Biotic Index.

2007 Multimetric Macroinvertebrate Index Scores and Determinations		
Site	MMI Score	Impairment Determination
BRSW-101	72.0	Unimpaired
BRSW-102	63.7	Unimpaired
BRSW-17	73.5	Unimpaired
BRSW-106	64.0	Unimpaired

2007 Multimetric Macroinvertebrate Index Scores and Determinations		
Site	**MMI Score**	**Impairment Determination**
BRSW-108	69.6	Unimpaired
BRSW-109	66.4	Unimpaired
BRSW-12	45.6	Impaired
BRSW-13	69.9	Unimpaired
BRSW-16	63.8	Unimpaired
BRSW-21	64.7	Unimpaired
BRSW-33	70.4	Unimpaired
BRSW-06	71.6	Unimpaired

It is important to note that at sites BRSW-108, BRSW-109, BRSW-13 and BRSW-21 (**Figure 39**) an insufficient number (less than 300) macroinvertebrates were collected to give a high degree of confidence in the MMI score generated. A detailed analysis of limiting factors for aquatic macroinvertebrates was not conducted and their full influence cannot be determined given the data collected. In general, macroinvertebrate populations can be stunted through lack of food sources or a lack of accessible habitat. The 2007 aquatic biota analysis summary section discusses the dynamics of the macroinvertebrate population as observed as part of this risk assessment. However, the scores where a sufficient number of macroinvertebrates were collected would seem to indicate that various sampling locations are close to the impaired threshold (a score of 63). These locations include BRSW-102, BRSW-106 and BRSW-16 with scores of 63.7, 64.0 and 63.8; respectively. **Table 38a** through **Table 38n** present the full macroinvertebrate taxonomic community analysis data.

4.18.1.2 2007 Macroinvertebrate Tissue Sampling

Macroinvertebrate tissue samples were collected at 10 sampling locations in the fall of 2007. Of the 10 locations sampled, seven sites had at least one exceedence of the Threshold Effects Level (TEL) and/or the Probable Effects Level (PEL). The TEL is calculated as the geometric mean of the 15th percentile concentration of the toxic effects data set and the median of the no-effect data set. As such it represents the concentration below which adverse effects are expected to occur only rarely. The PEL is calculated as the geometric mean of the 50th percentile of impacted, toxic samples and the 85th percentile of the non-impacted samples. It is the level above which adverse effects are frequently expected. Freshwater TELs and PELs are based on benthic community metrics and toxicity tests results.

Sampling where at least one exceedence occurred is shown in the following table. Values in the table are shown based on a dry weight basis. Metals and individual tissue results that did not exceed one or more screening level are not represented in the table.

2007 Macroinvertebrate Tissue Analytical Results in Relation to TEL and PEL Criteria					
Site	**Method**	**Total Cadmium (mg/kg)**	**Total Copper (mg/kg)**	**Total Lead (mg/kg)**	**Total Zinc (mg/kg)**
TEL		**0.6**	**35.7**	**35**	**123**
PEL		**3**	**197**	**91**	**315**
BRSW-102	SW-846 – 6020	0.98	4.03	0.92	162
BRSW-17	SW-846 – 6020	1.83	6.17	1.53	301

2007 Macroinvertebrate Tissue Analytical Results in Relation to TEL and PEL Criteria					
Site	**Method**	**Total Cadmium (mg/kg)**	**Total Copper (mg/kg)**	**Total Lead (mg/kg)**	**Total Zinc (mg/kg)**
TEL		**0.6**	**35.7**	**35**	**123**
PEL		**3**	**197**	**91**	**315**
BRSW-16	SW-846 – 6020	0.67	19.4	4.93	159
BRSW-106	SW-846 – 6020	1.25	40.8	15.4	262
BRSW-12	SW-846 – 6020	3.61	119	133	599
BRSW-33	SW-846 – 6020	0.92	51.4	128	188
BRSW-108	SW-846 – 6020	2.01	75	50.3	1200

TEL -Threshold Effects Level PEL -Probable Effects Level

Macroinvertebrate tissue samples from locations BRSW-12 and BRSW-108 exhibited the greatest metals contamination by exceeding either the TEL and/or PEL screening levels for cadmium, copper, lead, and zinc. Of the macroinvertebrate tissue samples that exceeded at least one metal, tissue collected from BRSW-102 exhibited the lowest amount of metals with total cadmium and total zinc over the TEL values. **Table 38a** through **Table 38m** presents the full macroinvertebrate tissue analysis data.

4.18.1.3 2007 Periphyton Sampling and Analysis

Tetra Tech collected periphyton samples from nine of the 2007 sampling locations (**Figure 39**). The samples were analyzed by the laboratory for chlorophyll composition and ash-free dry mass (AFDM). Chlorophyll composition was determined by measuring the relative weight of chlorophyll a, chlorophyll b, chlorophyll c and pheophytin with the use of a spectrophotometer and then converted to a measure of mass to be more easily understood. Ash-free dry mass was calculated by vacuum filtering a sample past a filter, weighing the filter, drying the filter at a high temperature and then weighing the filter again to determine change. This change is the relative weight of any inorganics and water from the sample. The remaining weight on the filter is the weight of the associated biomass of the sample. The recorded biomass and the amount of chlorophyll can be used to assess the relative amount of primary productivity from the stream reach.

Factors that have been found to influence the amount of periphyton in a stream include the nutrient load in a stream, the amount of sunlight the stream is receiving and the number of grazers feeding on the periphyton (Rosemond et al 2000). These variables change throughout the growing season but typically periphyton assemblages are in greater concentration when nutrients are readily available, increased amounts of sunlight are hitting the stream and grazer populations are lower.

The following table summarizes collected periphyton data. Periphyton samples were collected during the initial day of field work, and were subsequently preserved with Lugol's solution. Preservation with Lugol's solution is the correct method for periphyton samples that are to be submitted for taxonomic analysis, however, based on the number of sample containers available, it was determined that analysis for chlorophyll composition and AFDM would provide better means to assess primary productivity as it is related to metals contamination at the sampling locations. For the chlorophyll composition analysis, the preservation of the sample with Lugol's solution spoils the sample since chlorophyll is measured with the use of a spectrophotometer. An attempt to recollect a usable sample at BRSW-102 was made in October

2007, but the access gate was locked; therefore, no periphyton sample from this location was submitted for analysis.

Summary of 2007 Periphyton Analytical Results					
Site	**Chlorophyll a (µg)**	**Chlorophyll b (µg)**	**Chlorophyll c (µg)**	**Pheophytin (µg)**	**Ash-Free Dry Mass (g)**
BRSW-101	53.3	18.9	12.5	11.8	0.325
BRSW-102	--	--	--	--	--
BRSW-17	24.0	5.7	3.9	7.6	0.121
BRSW-16	25.6	6.5	5.8	4.6	0.172
BRSW-106	5.3	0.5	0.1	1.0	0.051
BRSW-12	58.5	4.5	3.2	<0.1	0.206
BRSW-33	24.0	2.1	0.8	<0.1	0.052
BRSW-108	3.6	0.4	<0.1	0.3	0.056
BRSW-109	15.6	2.9	2.2	<0.1	0.118
BRSW-06	10.4	1.5	<0.1	0.5	0.052

(µg) – micrograms (g) – grams (--) no data/not analyzed

The relative weights of chlorophyll at BRSW-101, BRSW-17, and BRSW-16 are higher at other sites which indicate that there are higher amounts of primary productivity at these periphyton collection sites. AFDW for the same sites generally support the chlorophyll analysis, but would also indicate that BRSW-12 has a relatively high level of primary productivity based on the AFDW measure and the chlorophyll a measure.

4.18.1.4 2007 Aquatic Biota Analysis Summary

Macroinvertebrate taxonomic community analysis indicates that sites sampled in the fall of 2007 all could be classified into a moderately impaired category. For example, while sampling location BRSW-109 had the lowest MT Biota Index score of 1.11, indicating that the site has experienced little organic pollution, it also had the highest Metals Tolerance Index score of 5.38, indicating that the site is affected by higher metals pollution. BRSW-12, which was the only site sampled that rated as impaired in the DEQ MMI, had a relatively low scores for the Metals Tolerance Index and the MT Biotic Index with scores of 1.75 and 1.94, respectively, which indicates minimal effects from the pollution for which those matrices measure.

Macroinvertebrate tissue analysis identified sampling locations BRSW-12 and BRSW-108 as locations with higher metals pollution based on analytical results that indicated metals concentration exceeded the TEC and/or PEC for all metals that had a least one exceedence.

As with the macroinvertebrate taxonomic community analysis, the periphyton analysis shows some moderate results with only a few sampling locations that clearly demonstrated relative high or low primary productivity. BRSW-101 had relatively high levels of chlorophyll composition and AFDW mass, and overall had the highest levels of primary productivity of any sampling locations sampled in the fall of 2007. BRSW-108, conversely, had the lowest relative primary production of any locations sampled. BRSW-12, while having the highest amount of chlorophyll a measured, had relatively low measures of the other chlorophyll pigments analyzed for, but may be due, in part, to differing algal speciation in the stream reaches sampled in addition to reduced primary productivity.

4.18.2 2008 Aquatic Biota Sampling

4.18.2.1 2008 Macroinvertebrate Community Sampling

Tetra Tech performed the same analysis for the 2008 aquatics data as for the 2007 aquatics data. The following table summarizes key portions macroinvertebrate community data. **Table 38a** through **Table 38m** presents the full taxonomic data. **Figure 39** depicts the sampling locations.

2008 Summary Macroinvertebrate Taxonomic Community Results								
Site	Macroinvertebrate Measure or Index							
	Corrected Abundance	EPT Abundance	Species Richness	EPT Richness	Shannon-Weaver H' (log 10)	Metals Tolerance Index	Fine Sediment Biotic Index	MT Biotic Index
BRSW-06 (Reference)	300	197	49	28	1.31	2.93	4.59	2.39
BRSW-101	137	50	22	9	0.94	2.73	3.83	2.88
BRSW-106	47	27	20	7	0.96	3.00	4.04	2.68
BRSW-108	54	14	13	4	0.83	2.94	2.00	4.63
BRSW-16	28	24	5	3	0.34	6.60	4.04	0.79
BRSW-17	300	62	28	12	0.60	4.51	3.32	4.36

Community samples were collected at all six sampling locations in triplicate. Four of the six samples collected did not reach the targeted subsampling count of 300 macroinvertebrate individuals; however, information from key measures of the macroinvertebrate community still provide important information on the stream conditions. These data also provide a general indication of stream health in that a sufficient number of individuals could not be collected to make a 300 subsample.

Community sampling efforts yielded useful data for all six locations sampled, and biological metrics were calculated from the data using the MMI protocols (Jessup et al. 2005, Feldman 2006). Metric results were then scored using the Montana DEQ bioassessment criteria and each sample categorized as non-impaired or impaired according to threshold values. For mountain regions, a MMI score greater than or equal to 63 indicates an unimpaired stream segment, while a MMI score less than 63 indicates an impaired stream segment.

The following table shows the MMI scores generated using the data collected as part of the fall 2008 effort and the threshold assessment of whether the results indicated there was impairment or no impairment. Specific measures used to generate the MMI score were: Ephemeroptera Richness; Plecoptera Richness, Percent EPT, Percent Non-Insect Individuals, Percent Predators, Burrower Taxa Percent and Biotic Index.

2008 Multimetric Macroinvertebrate Index Scores and Determinations		
Site	MMI Score	Impairment Determination
BRSW-06 (Reference)	92.15	Unimpaired
BRSW-101	65.72	Unimpaired
BRSW-106	74.96	Unimpaired
BRSW-108	47.59	Impaired
BRSW-16	71.40	Unimpaired

2008 Multimetric Macroinvertebrate Index Scores and Determinations		
Site	**MMI Score**	**Impairment Determination**
BRSW-17	54.27	Impaired

It is important to note that at sites BRSW-101, BRSW-106, BRSW-108 and BRSW-16 (**Figure 39**) that an insufficient number (less than 300) of macroinvertebrates were collected to give a high confidence in the metric score generated. A detailed analysis of limiting factors for aquatic macroinvertebrates was not conducted and their full influence cannot be determined given the data collected. In general, macroinvertebrate populations can be stunted through lack of food sources or a lack of accessible habitat. The 2008 aquatic biota analysis summary section discusses the dynamics of the macroinvertebrate population as observed as part of this risk assessment. It is possible that field data collection was conducted at a time in the year that did not allow for the re-establishment of macroinvertebrate populations after the late winter weather that was experienced at the project area.

4.18.2.2 2008 Macroinvertebrate Tissue Sampling

Macroinvertebrate tissue samples were collected at only three of the six designated sampling locations due to a lack of macroinvertebrate individuals present to constitute a full sample of 5 grams (g). Sites where a full sample could be collected in a reasonable amount of effort hours were BRSW-06, BRSW-17 and BRSW-101. Effort hours were calculated by taking the number of samplers present and multiplying that by the time that was spent trying to collect a full sample. Sample sizes were 5.1g, 4.3g and 5.3 (wet weight) for BRSW-06, BRSW-17 and BRSW-101, respectively.

At BRSW-16, 0.3g of macroinvertebrates were collected in 1.5 effort hours. At BRSW-108, 0.0g of macroinvertebrates were collected in 1.0 effort hours; and at BRSW-106 1.3g of macroinvertebrates were collected in 3.75 effort hours. Two separate sampling events were conducted at BRSW-106. One sampling effort was completed during the initial aquatic biota sampling done in June 2008 and another was done during the ecological risk sampling in July 2008. A second effort was made at BRSW-106 in July 2008 because although sufficient habitat seemed to be available to support a macroinvertebrate community large enough to supply a five gram sample, a sufficient macroinvertebrate sample could not be collected during either sampling event.

The following table summarizes values from macroinvertebrate tissue analysis that exceeded the Threshold Effects Level (TEL), and/or the Probable Effects Level (PEL) criteria. The TEL is calculated as the geometric mean of the 15th percentile concentration of the toxic effects data set and the median of the no-effect data set. As such it represents the concentration below which adverse effects are expected to occur only rarely. The PEL is calculated as the geometric mean of the 50th percentile of impacted, toxic samples and the 85th percentile of the non-impacted samples. It is the level above which adverse effects are frequently expected. Freshwater TELs and PELs are based on benthic community metrics and toxicity tests results. **Table 39** presents the analytical results from all sampling locations.

2008 Macroinvertebrate Tissue Analytical Results in Relation to TEL and PEL Criteria					
Site	**Method**	**Total Cadmium (mg/kg)**	**Total Copper (mg/kg)**	**Total Lead (mg/kg)**	**Total Zinc (mg/kg)**
TEL		**0.6**	**35.7**	**35**	**123**
PEL		**3**	**197**	**91**	**315**
BRSW-06	SW-846 – 6020	0.94	22.6	2.63	196
BRSW-17	SW-846 – 6020	3.04	39.0	7.6	855
BRSW-101	SW-846 – 6020	1.63	20.1	1.89	323

TEL -Threshold Effects Level PEL -Probable Effects Level

Periphyton samples were collected from all sampling locations and analyzed for chlorophyll composition and AFDM. Chlorophyll composition was determined by measuring the weight of chlorophyll a, chlorophyll b and chlorophyll c. Ash Free Dry Mass was calculated by vacuum filtering a sample past a filter, weighing the filter, drying the filter at a high temperature and then weighing the filter again to determine change. This change is the relative weight of any inorganics and water from the sample. The remaining weight on the filter is the weight of the associated biomass of the sample. The recorded biomass and the amount of chlorophyll can be used to assess the relative amount of primary productivity from the stream reach. The table below summarizes collected periphyton data. **Table 39** presents all periphyton data.

2008 Periphyton Analytical Results					
Site	**Chlorophyll a (µg)**	**Chlorophyll b (µg)**	**Chlorophyll c (µg)**	**Pheophytin (µg)**	**Ash-Free Dry Mass (g)**
BRSW-16	1.6	<0.1	0.5	2.0	0.0052
BRSW-108	0.4	0.3	0.1	0.4	0.0013
BRSW-06	2.0	0.2	0.4	<0.1	0.0082
BRSW-106	1.2	0.3	<0.1	<0.1	0.0023
BRSW-17	1.2	0.1	<0.1	<0.1	0.0037
BRSW-101	0.4	0.2	0.8	0.2	0.0028

(µg) – microgram (g) – gram

4.18.2.3 2008 Aquatic Biota Analysis Summary

Macroinvertebrate taxonomic community analysis suggests that sites BRSW-06 (reference site; **Figure 39**), BRSW-101 and BRSW-106 have a higher overall macroinvertebrate community based on calculated indices such as the Shannon-Weaver diversity index, Metals Tolerance Index, Fine Sediment Biotic Index and the Montana Biotic Index. Site BRSW-108 showed a low diversity score and a low Fine Sediment Biotic Index score, which is indicative that the level of sedimentation at that site is having an effect on the macroinvertebrate community; in addition, the Montana Biotic Index score indicates that BRSW-108 is also experiencing some effects from organic pollution. While these scores suggest that BRSW-108 is showing signs of detrimental effects, the Metals Tolerance Index is the same as the reference site indicating that negative effects are not from metals in the water. At BRSW-16 the Fine Sediment Biotic Index and Montana Biotic Index scores imply a stream section that is minimally affected by sedimentation and organic pollution and a Metals Tolerance Index score that signifies a stream reach impacted by metals. The Metals Tolerance Index score was also elevated above the reference site at BRSW-17 (6.6) among the 2008 samples. BRSW-17 had a MMI impaired rating of 54.27.

Metal concentrations in macroinvertebrate tissues were sampled at locations BRSW-06, BRSW-17, and BRSW-101 where a sufficient mass of macroinvertebrates could be collected in

a reasonable amount of time while maintaining adherence to the submitted scope of work. BRSW-17, which had an impaired MMI rating, had elevated concentrations of arsenic, cadmium, copper, lead, manganese, and zinc when compared to the reference location. Metal tissue concentrations at BRSW-101 exceeded the reference location (BRSW-06) for cadmium and zinc.

Periphyton samples for chlorophyll composition and AFDM were collected to measure the relative amount primary production occurring within each stream reach. Overall, BRSW-108 had the lowest amount of primary productivity and BRSW-06 had the highest amount.

The reference site (BRSW-06) had the highest MMI score, was more robust throughout other macroinvertebrate community measures and had the highest relative amount of primary productivity. BRSW-17 had the highest concentration of metals in macroinvertebrate tissues and had an MMI impaired rating of 54.27. The tissue results will be evaluated further in the baseline ecological risk assessment.

4.18.3 2007 and 2008 Aquatic Biota Sampling Summary and Conclusions

Macroinvertebrate taxonomic community analysis from the fall 2007 to spring 2008 investigations indicated that sampling locations with drastic changes in macroinvertebrate abundance from the two sampling periods included BRSW-101, BRSW-106 and BRSW-16. Despite the change in abundance, the calculated metric scores remained similar. At sites where abundance numbers remained relatively similar, calculated metric scores were also similar, except for the diversity index score at BRSW-17 which dropped 0.6 points from 1.26 to 0.6. For the MMI scores, the biggest overall change was seen at BRSW-108, where the impairment determination shifted from unimpaired to impaired from the fall of 2007 to the spring of 2008. A large shift was also seen at the reference site (BRSW-06) where the numerical score went from 71.6 in the fall of 2007 to 92.2 in the spring of 2008.

Primary productivity dropped for all sampling locations sampled in the spring of 2008 when compared to fall 2007 measurements. This is most likely due to a difference in seasonality rather than a degradation of conditions at all sampling locations. This is further highlighted by the relatively small changes seen in other aquatic biota components measured as part of the sampling regime.

It could be presumed that if the quality and abundance of the aquatic biota community were solely dependent on the concentration of metals contaminants in the water column that higher quality and more abundant aquatic biota community members would be present at the UBMC during the spring run-off, at a time when metals contaminants are most diluted due to the increased water present in the stream channels. During late summer and fall periods when stream flows are at their typical lowest, following the same logic, concentrations of metals contaminants would be at a relatively higher concentration and the quality and abundance of aquatic biota community members would be further depressed when compared to spring time values. There were only two 2008 locations for which total abundance were sufficient to calculate a MMI impairment rating. The overall change between the 2007 and 2008 MMI scores at locations BRSW-06 and BRSW-17 are based in part on the percent of Ephemeroptera and Plecoptera taxa (EPT). At the reference location, percent EPT increased from 45 to 73 percent and at BRSW-17 a decrease was seen from 55 to 22 percent.

Ephemeroptera and Plecoptera taxa are generally sensitive to environmental contamination such as reduced dissolved oxygen, unstable substrates, and contamination due to heavy metals and other toxicants. A decline in abundance of these taxa indicates a degradation of environmental conditions. A decline in the Percent EPT metric also indicates environmental contamination; sensitive and specialist individuals of the mayfly, stonefly, and caddisfly insect

orders will emigrate or perish as conditions worsen. An abundance of Ephemeroptera, Plecoptera, and Trichoptera (EPT) indicate good water quality conditions, as the three taxa are sensitive to pollution. Because the minimum target of 300 as required for the MMI calculation was only reached at some of the locations, there some uncertainty in drawing conclusions based on indices calculated for locations for which less than 300 individuals were collected. The data collected as part of the 2007 and 2008 sampling periods suggest, but do not empirically support, that metals contamination as it is related to concentration and seasonal flow variances is driving the quality and abundance of the aquatic biota community.

4.18.4 Marsh Sediment Bioassay

Northwest Aquatic Sciences laboratory performed the 28-day Hyallela azteca (*H. azteca*) growth and survival test for sediment collected from seven locations in the Upper Marsh and one sample from Pass Creek Marsh (the reference marsh). Test results from the 28-day *H. azteca* growth and survival bioassay revealed significant statistical differences at bioassay locations when compared to the reference location (BA3-REF). Although the percent mortality of test sediments of BA7 and BA5 were less than 10%, they were statistically significantly greater than that of the reference sediment, BA3-Ref. The percent mortality of test sediment BA4 at 56.3% was also statistically significantly greater than that of the reference sediment. Two test sediments, BA2 and BA1, resulted in 100% mortality. The mean individual dry weight of test sediments BA7, BA5 and BA4 were statistically significantly less than that of the reference (Northwest Aquatic Sciences 2008). Percent mortality and dry weights of *H. azteca* specimens used in the bioassay can be seen in **Table 40**. **Table 41** presents the metal analytical results and **Figure 39** shows the sample locations.

In addition to running a 28-day growth and survival bioassay using sediments collected from the identified bioassay sediment collection locations, metals analysis was conducted on the sediments. Sediment exceeded screening levels for arsenic, cadmium, copper, lead and zinc at all bioassay sampling locations. Sediment from BA4 exhibited the highest value for arsenic, while sediment from BA1 exhibited the highest values for cadmium, copper, lead and zinc.

The results of the bioassays support that the most toxic sediments exist at the upgradient end of the marsh where the Blackfoot River enters the marsh. This would be expected since tailings sediment from the breached impoundment settles rapidly as it entered a standing body of water in the marsh. There is also a small area where metal concentrations are elevated and sediment is toxic in the vicinity of where Swamp Gulch formerly entered the marsh. Sediments are less toxic toward the margins and at the down-gradient end of the marsh. No toxicity was observed in sediment collected from the lower marsh.

5.0 CONCEPTUAL SITE EXPOSURE MODEL

The Conceptual Site Exposure Model (CSEM) is an integral part of the RI process that is used to organize and synthesize what is known about the UBMC (EPA 2001), and then is used as a framework for the analysis of contaminant migration and exposure pathways for receptors.

The CSEM presented in this section was prepared to illustrate potential mechanisms of exposure for human and ecological receptors to impacted media at the UBMC. The CSEM is based on historically and RI collected data that provides information on sources of contaminants at the UBMC. The methods of collection of these data were described in Section 3.0, and the nature and extent of contamination of various affected media were identified and discussed in Section 4.0 of this report.

The CSEM, as developed in this section, identifies Contaminants of Potential Concern (COPCs), and then examines primary and secondary sources, release and transport mechanisms, migration pathways for exposure of human and ecological (terrestrial and aquatic) receptors, and attenuation mechanisms. The CSEM is presented as a flow chart in **Figure 59**. These parameters are then used to generate a site-specific, block-diagram, representation of the conceptual model (**Figure 60**) for contaminant migration and exposure pathways at the project site.

5.1 Contaminants of Potential Concern

At the UBMC, nine metals have been identified as COPCs: aluminum, arsenic, cadmium, copper, iron, lead, manganese, mercury, and zinc. COCs will be identified in the human health and ecological risk assessments.

The analytical results for historical data sets (Tetra Tech 2007a, Hydrometrics 2007a) and samples collected for this RI report (Section 4, and various tables identified in the text and found in Volume I: Text, Figures, Tables) were used to identify COPCs in various medium including soil, mine waste (waste rock and tailings), sediment (streambed, marsh, and concentrated and dispersed tailings), surface water, groundwater and benthic macroinvertibrates and periphyton, vegetation, and small mammals. Potential metal contaminants have been identified and discussed (Section 4 of this report) for each media (for example, sediment) and for various exposure areas within the UBMC. For each media and exposure area, analytical results for metals detected in UBMC samples have been compared with naturally occurring background concentrations. Metals that exceed concentrations at representative background locations and that exceed literature-based screening levels for various human and ecological receptors are identified as COPCs.

Beneficial uses for surface waters within the UBMC have been identified by DEQ, and include recreational use, use for agricultural and industrial water supplies, and use for drinking, culinary, and food purposes after conventional treatment. The COPCs described above also affect the water quality in Mike Horse Creek, Beartrap Creek, and the upper Blackfoot River (above Landers Fork – a major tributary that flows into the Blackfoot River from the north) such that these stream segments are listed on DEQ's 303(d) list as having impaired beneficial uses for aquatic life, cold water fish, and drinking water supply. Beneficial uses are identified as impaired due to the following pollutants of concern for the Blackfoot River and Beartrap Creek: cadmium, copper, iron, lead, manganese, and zinc; with the addition of aluminum for Mike Horse Creek. These pollutants are released from areas containing historic mine wastes and adit discharges, and in at least one specific geographic area within the UBMC, may also be related to natural background conditions.

Abundant data are available demonstrating that these streams have at least a 17-year history of water quality impairment, including biological studies of Beartrap Creek, Mike Horse Creek, and the upper Blackfoot River above Landers Fork. These studies indicated that these streams were moderately to severely impaired in the early 1990s in their ability to support aquatic life, primarily by the metals listed above.

5.2 Sources and Release Mechanisms of Contamination

The Conceptual Site Exposure Model (**Figure 59**) contains several primary and secondary sources known to have released COPCs at the UBMC. Primary and secondary release mechanisms are the physiochemical processes that break down or release contaminants and cause them to move along migration (exposure) pathways, impacting multiple media and leading to exposure of receptors.

5.2.1 Sources

5.2.1.1 Primary Sources

Primary sources of COPCs (**Figure 59**) include mine waste materials (waste rock and tailings) located on both public and private lands within the UBMC. These materials are primary sources of potential metals loading to surface water and groundwater. Primary mine waste sources identified in the UBMC include:

- Mine waste rock piles and potential ineffectively reclaimed mine waste areas;
- Mine tailings (behind the tailings dam);
- Acidic metal-laden discharges from mine portals and adits; and
- Other mining disturbed areas.

5.2.1.2 Secondary, Tertiary, and Quaternary Sources

Secondary, tertiary, and quaternary sources (**Figure 59**) of contaminants are various media that become contaminated as a result of migration of the contaminants from a primary, secondary, or tertiary release source. Secondary, tertiary, and quaternary mine waste sources identified in the UBMC include:

Outdoor air – particulates (secondary, tertiary, and quaternary source)

Contaminants can be redeposited as particulates (fugitive dust) by wind erosion of mine waste tailings and material surfaces. Particulate deposition also can occur from vehicles that place suspended soil materials into the air.

Groundwater/pore water (secondary and tertiary source)

Contaminants transported in solution or suspension in groundwater can contaminate surface water through groundwater-surface water interaction (i.e. losses of groundwater to surface water), as it discharges through seeps and springs and as it contributes base flow to streams. Infiltration, percolation and leaching from primary sources by groundwater can result in the dissolution of metal contaminants and the release of acidity that can migrate through groundwater. Even low-level contamination in the aqueous phases can pose a significant risk to receptors. Groundwater flow can transport contaminants vertically into the lower unconfined or deeper confined bedrock aquifers.

Surface water (secondary and tertiary source)

- Contaminants transported in solution or suspension in surface water can contaminate groundwater through surface water-groundwater interaction (i.e. losses of surface water to groundwater).
- Infiltration, percolation and leaching from primary sources by surface water can result in the dissolution of metal contaminants and the release of acidity that can migrate into surface water. Even low-level contamination in the aqueous phases can pose a significant risk to ecological receptors.
- Surface water flow can transport contaminants horizontally through streams/rivers and by overland-flow to down-gradient or downstream.

Sediments (secondary and tertiary source)

Physical erosion, transport/resuspension and redeposition of mine wastes by surface water can create zones or deposits of contaminated wastes. Numerous deposits of this type have been identified at the UBMC and include:

Discreet deposits of relatively concentrated tailings/mine waste;

- Intermixed and interbedded zones of alluvial materials and tailings/mine waste;
- Fine-grained tailings dispersed throughout alluvial sediments;
- Surficial fine-grained over-bank deposits/floodplain sediments;
- Marsh sediments; and
- In-stream sediments.

Soil (secondary source)

Primary sources have the potential to contaminate surface soils and other unconsolidated subsurface media (sub-soils and regolith) by leaching of metals and acidity. This leaching can, in turn, result in additional leaching of contaminants from the soil itself. Contaminated soil can also be transported on- or off-site by surface water erosion, blowing dust, or mechanical transport (tracking of contaminated soil through vehicle traffic).

Food Chain (tertiary and quaternary source)

Plants can absorb metals from soil/sediment through their roots, leaves, or stems, and can store these chemicals in their tissues. Metals that have bioaccumulated in plant tissues can then be transported to receptors that eat the plants. Invertebrates can ingest and absorb (direct contact) metals. Metals that have bioaccumulated in invertebrates can then be transported to receptors that eat the invertebrates. Fish and amphibians can ingest (either directly or through prey) or absorb metals, as well as uptake metals through their gills. Metals that have bioaccumulated in fish and amphibians can then be transported to receptors that eat them.

5.2.2 Release Mechanisms

The primary release mechanisms (**Figure 59**) are wind suspension and vehicle traffic, infiltration and percolation, discharge, surface runoff and flooding, and infiltration and mixing. These mechanisms cause contaminants to move along migration or exposure pathways creating secondary sources of COPCs. The secondary and tertiary release mechanisms are wind suspension of floodplain sediments/soils (secondary and tertiary), biota uptake (secondary and tertiary), wind suspension and vehicle traffic (secondary), infiltration and percolation (secondary), and surface runoff and flooding (secondary). These mechanisms cause

contaminants to move along migration or exposure pathways creating tertiary or quaternary sources of COPCs.

5.2.2.1 Wind Suspension and Vehicle Traffic (Primary and Secondary Release Mechanism)

Contaminants can be eroded, transported and redeposited as particulates (fugitive dust) by wind erosion of mine waste tailings and material surfaces. Vehicles also can place suspended soil materials into the air.

5.2.2.2 Infiltration and Percolation (Primary and Secondary Release Mechanism)

Infiltration of storm water (including snowmelt) and leaching of contaminants may also contribute to contaminant transport from sources into shallow groundwater.

5.2.2.3 Surface Runoff and Flooding (Primary and Secondary Release Mechanism)

Surface water runoff and erosion of mine waste represents a common release mechanism for contaminants to surface water throughout the UBMC. Erosion of mine waste by precipitation, storm water and snowmelt, and its subsequent release to surface waters, is evidenced by failed tailing dams, erosional gullies and alluvial sedimentary aprons present on the surface of, or near mine waste deposits. Waste deposits located adjacent or proximal to surface water are even more susceptible to erosion through scouring and undercutting of mine waste deposits located in stream banks adjacent to active channels. Erosion of surficial materials (soils, mine wastes, etc.) has also resulted in secondary sources of contaminants that are located within stream sediments.

5.2.2.4 Infiltration and Mixing (Primary Release Mechanism)

Infiltration of storm water (including snowmelt) and leaching of contaminants may also contribute to contaminant transport from sources into subsurface soil. Sampling has shown native soils underlying the mine waste to depths of one to several feet also contain elevated concentrations of some metals, indicating leaching and redeposition of metals vertically into the soil profile from the mine waste sources.

5.2.2.5 Wind Suspension of Floodplain Sediment/Soil (Secondary and Tertiary Release Mechanism)

Contaminants can be eroded, transported and redeposited as particulates (fugitive dust) by wind erosion of mine waste tailings and material surfaces.

5.2.2.6 Biota Uptake Sediment (Secondary and Tertiary Release Mechanism)

Contaminants can be transported through plants and animals that are exposed to contaminated sediment. Plants can absorb metals from sediment through their roots, leaves, or stems, and can store these chemicals in their tissues. Metals that have bioaccumulated in plant tissues can then be transported to receptors that eat the plants. Aquatic invertebrates can ingest and absorb (direct contact) metals. Metals that have bioaccumulated in invertebrates can then be transported to receptors that eat the invertebrates. Fish and amphibians can ingest (either directly or through prey) or absorb metals, as well as uptake metals through their gills. Metals that have bioaccumulated in fish and amphibians can then be transported to receptors that eat them.

5.2.2.7 Biota Uptake Soil (Secondary Release Mechanism)

Contaminants can be transported through plants and animals that are exposed to contaminated soil. Plants can absorb metals from soil through their roots, leaves, or stems, and can store these chemicals in their tissues. Metals that have bioaccumulated in plant tissues can then be

transported to receptors that eat the plants. Terrestrial invertebrates can ingest and absorb (direct contact) metals. Metals that have bioaccumulated in invertebrates can then be transported to receptors that eat the invertebrates. Contaminated soil also may be consumed through the daily routine of foraging, grooming, and burrowing by birds and mammals Invertivorous and carnivorous animals also consume soil contained in the gut of their prey. Some animals, such as ground-feeding birds and deer, may deliberately ingest soil to meet their mineral requirements.

5.2.3 Potential Receptors

Exposure pathways to humans and ecological receptors from mine waste sources of contaminants are primarily related to direct contact, inhalation, soil or water ingestion, or fish consumption (**Figures 59 and 60**). Potential human receptors are likely to be recreationalist (fishermen, hunters, rock-hounds and ATV motorcycle riders) and less likely to be residents. The main sources present in the UBMC are currently located away from permanent residents. Results from sampling of existing drinking water wells indicate that no contaminants currently exceed MCLs. There are no drinking water intakes located within surface water that exceeds MCLs. Therefore, consumption of groundwater or surface water is not considered a significant, current exposure pathway for humans; however, this exposure pathway should be retained as surface water and groundwater resources could be developed and used in the future. The baseline risk assessment presents detailed evaluations of site risk to human and ecological receptors.

Ecological receptors include aquatic life and wetlands. The aquatic receptors are of concern as they are often used as barometers of the health of aquatic habitat, are an important part of the food chain, and may occur in spawning areas for migrating fish. The exposure of aquatic ecological receptors to metal-laden stream sediments, surface water or consumption of surface water/sediment is considered to be a complete exposure pathway. Wetlands are of concern because they typically support a diverse ecological community.

Plants are receptors that might re-colonize waste dumps or areas of contaminated soils or sediments and are exposed to metals contaminants primarily from root uptake. These plants are often weakened or absent due to uptake of metals and low pH of waste materials. Potential receptors of impacted soils, sediments, and water, which are included in the CSEM (**Figure 59**), include humans, aquatic life, plants, birds, fish, and animals.

5.3 Attenuation Mechanisms

Contaminants of concern are attenuated by some natural mechanisms at the UBMC. Some of these mechanisms include:

- Sorption of metals on soil and mineral surfaces;
- Chemical precipitation as oxide and metal-bearing hydroxide complexes (i.e. ferricretes);
- Attenuation by sorption and precipitation in wetlands;
- Dilution with uncontaminated surface or groundwater; and
- Increase of pH and reduction in metal solubility by buffering with alkaline solutions.

5.4 Graphical Site-Specific Conceptual Model

5.4.1 Introduction

A graphical source-pathway conceptual block-model diagram is shown in **Figure 60**. This model was developed to provide a visual aid in identification of potential sources of metals and potential pathways of movement of these metals from source materials into surrounding media such as soils, groundwater, surface water, and sediments.

The source-migration pathway conceptual model illustrates that the primary sources of contaminants are:

- Metal-laden discharges of contaminated groundwater from adits;
- Contaminants leaching from metal-laden mine waste rock and tailings; and
- Other mining disturbed areas that are exposed to the atmospheric conditions.

These sources likely interact with infiltrating precipitation, and surface or groundwater to mobilize contaminants.

Secondary sources of contaminants include air, soils, surface and groundwater, and stream sediments that have been redistributed downstream from primary sources, for example, those mobilized by the failure of the tailings dam (1975) at the Mike Horse Tailings Impoundment.

A number of features and relationships are illustrated on the source-pathway conceptual model block-diagram (**Figure 60**). The following includes a description of the primary features on the conceptual model.

- Blue arrows: indicate the flow of surface water runoff containing dissolved metals into soil and groundwater;
- Red arrows indicate areas where metal salts deposited by evaporation from mine and groundwater seeps are dissolving and being transported by surface water;
- Grey arrows show areas where contaminated sediments have been redeposited and are contributing leached contaminants to surface water;
- Bright green arrows indicate areas where contaminated groundwater is discharging from historically operated mine adits; and
- Purple arrows indicate areas where contaminated groundwater is discharging to springs and surface water.

Reclaimed and unreclaimed mine waste rock piles, the Mike Horse Tailings Impoundment, redistributed contaminated tailing sediments of various types, repository sites, and ferricrete deposits within the UBMC are also shown on **Figure 60**.

The sections below discuss precipitation and recharge, source migration pathways and exposure pathways that are illustrated in the source-pathway conceptual model (Figure 59).

5.4.2 Precipitation, Discharge and Recharge

The majority of precipitation at the UBMC falls as snow in the late fall, winter and early spring, and as rain in late spring and summer storms. The upper Blackfoot River is characterized by rapidly increasing flow rates and short periods of sustained flow during the snowmelt event. As much as 90 percent of the Blackfoot River's discharge volume occurs between mid-May and early July. The Blackfoot River and its tributaries locally receive water that sustains base flow conditions from groundwater seepage from fractured and faulted bedrock. Discharges of

groundwater from adits (Mike Horse, Anaconda, Paymaster and other scattered smaller adits) also contribute small, but varying amounts of flow to the upper Blackfoot River.

Recharge of aquifers at the UBMC is somewhat limited by its high elevation, small upgradient topographic collection basin for recharge, and its physiographic position near the continental divide. Recharge of groundwater in shallow aquifers of unconsolidated sediments comes from direct infiltration of snowmelt, runoff, and from the discharge of groundwater from bedrock, where fractures discharge as springs adjacent to or beneath alluvial material. Shallow groundwater in colluvium discharges directly to shallow alluvial aquifers in the Blackfoot River and its tributaries' valleys. Recharge to bedrock occurs primarily as direct infiltration of snowmelt and runoff, particularly where fractures or faults are exposed at the surface, such as along the Mike Horse and Blackfoot Fault systems. Colluvial and alluvial groundwater also discharges to underlying bedrock through infiltration into fractures. Presumably downstream in the hydrologic system, shallow colluvial-hosted groundwater discharges directly to the upper Blackfoot River.

5.4.3 Source Migration Pathways

Source areas in the headwaters of the upper Blackfoot River contain the tailings impoundment, a number of waste rock dumps, and secondary deposits of sediment transported from the breaching of the Mike Horse Dam and other over-bank flow events. In an oxidizing weathering or shallow groundwater environment, these sulfide minerals weather and release sulfuric acid to the waters, which in turn increase the solubility of the metals. There are also historic underground adits with a perennial discharge of water with demonstrated poor quality including the Mike Horse, Anaconda and Paymaster mine adits, and other smaller adits with minor discharges that have been recently identified during mine inventory surveys in peripheral upland valley portions of the UBMC.

Mineral-bearing vein deposits are also exposed to atmospheric oxygen within mine workings. The deposits are enriched in sulfide minerals, principally pyrite, chalcopyrite, sphalerite, galena, marcasite and molybdenite, with varying amounts of base and precious metals (Ag, As, Cd, Cu, Fe, Pb, Mn, Mo, and Zn). When exposed to oxygen in the atmosphere, these sulfide minerals oxidize, releasing sulfate, iron, and acidity, which in turn increases the solubility of other metals. Infiltration, surface water runoff and groundwater ultimately transport these metals to area streams.

Physical erosion of materials occurs where waste rock or contaminated soil is exposed at the surface, such as at mine waste rock dumps in adit areas. Surface runoff carries metal-laden soil to stream channels, where it is entrained in the sediment bed-load of the creek. The mobility of the metals in the streambed is dependent on the chemistry of the water in the stream.

Metals will dissolve into surface water flowing across metal-laden material exposed at the surface. Metal-bearing minerals in surficial materials are generally oxidized by exposure to water and atmospheric oxygen, which releases soluble metal salts that are highly mobile under acidic conditions. In addition, slope-wash from snowmelt or rain exposed to contaminated surface material will dissolve metals and transport them laterally to an adjacent stream or downward into underlying soil and groundwater.

Groundwater can enter underground mine workings where workings intersect saturated bedrock fractures transmitting groundwater. The addition of atmospheric oxygen within the workings can enhance the dissolution of metals. Mine workings frequently act as conduits for groundwater, allowing the water to collect underground and come in contact with mineralized rock and then discharge directly to surface water. This has historically occurred from the Mike Horse, Anaconda, and Paymaster mines and other recently discovered smaller underground workings occurring on the periphery of the district.

Groundwater can transport dissolved contaminants to surface water at seeps and springs or anywhere where groundwater directly discharges to the creek or river. Surface water can also transport metals to groundwater as it infiltrates into bedrock.

One of the principal controls of water quality in the upper reaches of Paymaster Creek may be the precipitation of iron and aluminum oxyhydroxide minerals, with co-precipitation and adsorption of metals to these phases to form ferricrete deposits (Furniss 1998). Where these reactions occur, they may control the concentration of metals in the stream, maintaining equilibrium between the secondary metal oxyhydroxides with dissolved metals in the overlying water column.

Additional loading of contaminants to surface water, can be attributed to the influx and mixing of groundwater along the upper Blackfoot River, but it is difficult to identify specific areas, with the exception of seeps in the valley walls and shallow colluvial deposits located near the Mike Horse and Anaconda workings, where groundwater with low pH and high metals content are discharging. Because the surface water and groundwater are interconnected at the Site, removal of key primary sources of contamination at the surface will likely improve water quality such that water quality standards may be attained.

As water flows down the upper Blackfoot River, less acidic surface and groundwater with more alkalinity enters the river through tributaries and changes the chemistry of the water, raising the pH and diluting metal concentrations. As a result, settling of colloidal metals, co-precipitation of dissolved metals with ferric-hydroxides, or reduction and sorption of metals in marshes and wetlands produce decreased metals concentrations in surface water.

5.5 Potential Remedial Action Objectives

Remedial action objectives are site-specific goals developed to protect human health and the environment. These objectives specify the contaminants of concern; identify release mechanisms, migration routes, receptors and exposure pathways. In addition, the objectives typically identify an acceptable concentration for each contaminant for the various exposure pathways. Historical data generated for various media have been combined with the 2007 and 2008 RI data for incorporation into this comprehensive RI Report. Measured concentrations of constituents from the UBMC for various media (including mine wastes, soils, surface water, surface water sediments, groundwater, benthic macroinvertebrates and periphyton, vegetation, and small mammals) were compared with EPA RSLs ; DEQ Action Level for Arsenic in Surface Soil; Soil BTVs ; Streambed Sediment RVs, Marsh Sediment RVs, Soil, Floodplain, and Marsh SPLP leachate criterion derived from collocated soil metals concentrations and SPLP results; ABA results; Montana DEQ-7 water quality standards (DEQ 2010); and the previously identified ecological risk screening criteria specified in Section 6.

Remedial action requirements and site-specific cleanup levels will be established based on the RI, migration pathway evaluation, risk assessments, fate and transport (leaching to groundwater) analysis, and identification of Environmental Requirements, Criteria or Limitations (ERCLs) identified in the FS process.

6.0 CONCLUSIONS AND RECOMMENDATIONS

This section summarizes conclusions concerning the nature and extent of contamination in various media from the UBMC, provides recommendations for future work, and outlines the next two major steps identified in the process leading up to the ultimate clean-up of the UBMC site. The two major steps include:

A human health and ecological risk assessment that will evaluate risks and identify unacceptable risks to human health and the environment associated with exposure to mining-related impacts at the UBMC, and

A FS that develops, screens, and evaluates alternatives to remediate environmental contamination with the ultimate goal of minimizing or eliminating the risks to human health and the environment.

6.1 Conclusions

6.1.1 Surface Water

During both October 2007 and June 2008, stream discharge and metals concentrations generally increased between the headwaters of the Blackfoot River and the vicinity of the Upper Marsh. Metals concentrations then decreased downstream of the Upper Marsh. Stream flow measured in October 2007 ranged from 0.0105 cfs at station BRSW-4 on upper Mike Horse Creek to 5.85 cfs at station BRSW-17 downstream of the Lower Marsh. In June 2008 stream flows ranged from 1.1 cfs at BRSW-4 to 106.4 cfs at BRSW-107 downstream of the Upper Marsh. October base flow conditions showed reaches where flow was lost to the shallow groundwater system near the Mary P Mine, between Stevens Gulch, Shave Gulch and the Upper Marsh, and reaches downstream of the Upper Marsh. Not all stations monitored in October 2007 were monitored in June 2008, but losing reaches observed during the high flow monitoring event included the reach just downstream of the Upper Marsh and reaches within or adjacent to the Middle and Lower Marshes. Flow measurement in the marsh areas may not have accounted for all flow due to broadly dispersed flow conditions and therefore any decreased flow in these areas may be due to measurement limitations rather than losses into the shallow groundwater system.

All surface water samples collected in 2007, with the exception of BRSW-6 (Anaconda Creek reference sample) and BRSW-101 (furthest downstream sample on the Blackfoot River), exceeded at least one DEQ-7 human health or aquatic life standard. The most frequent human health exceedances were cadmium, lead, and zinc, while cadmium and zinc were the most frequent aquatic life exceedances. The surface water samples collected in 2008, with the exception of BRSW-6 (Anaconda Creek reference sample), exceeded at least one DEQ-7 human health or aquatic life standard. The most frequent human health exceedances were cadmium and lead, while cadmium and zinc were the most frequent aquatic life exceedances. In both 2007 and 2008, iron and manganese concentrations were often elevated in surface water. The 2011 surface water samples collected from BRSW-201 through BRSW-206 (downstream from Highway 279) did not exceed any aquatic life or human health water quality standards.

6.1.2 Streambed Sediment

Recent and historic streambed sediment data confirm that Anaconda and Pass Creeks are unaffected by mining impacts, while the main stem of the Blackfoot River and Stevens Creek have considerably elevated metal concentrations in recent streambed sediment samples. Many of the streambed sediment samples in these two streams exceed screening levels for select

metals. Data sets for these two streams also show metal concentrations that decrease with downstream distance toward the outlet of the Upper Marsh.

While metal concentrations in streambed samples fluctuate between stations below the Upper Marsh, these metal concentrations are much lower and fluctuate less than those measured above the marsh. A notable exception to this observation is a distinct spike in aluminum, arsenic, cadmium, iron, manganese, and zinc concentrations measured at BRSW-104 between the Middle and Lower Marsh, above the confluence of the Blackfoot River and Cadotte Creek. This spike was especially apparent during high flow conditions in 2008.

No consistent overall trends in metal concentrations were observed with respect to sediment depth.

6.1.3 Marsh Sediment

Analytical results from sediment collected from the Upper Marsh, Middle Marsh, and Lower Marsh indicate all metals analyzed exceed the ecological screening levels, the Site-Specific SSLs, and Marsh Sediment BTVs for marsh sediment. SPLP results indicate that some of these metals have the potential to migrate to adjoining sediments, surface water, and groundwater. ABA results indicated that the eastern side of the Upper Marsh has sediment that is potentially acid generating as well as the sediment in the western portion of the marsh where Swamp Gulch enters. The remainder of the sediment in the Upper Marsh has an uncertain acid generating potential.

The ability of these marsh tailings sediments to generate acid and mobilize metals may be inhibited by reducing chemical conditions and overlying organic mats within the Upper Marsh. Areas that are better drained and have greater contact with atmospheric conditions have a higher potential to leach metals than those areas that are have more consistent conditions of saturation and less contact with atmospheric conditions. Organic matter within the marsh also likely acts as a sink for metals, further reducing metals mobility in the environment. Additional analyses would be required to further evaluate the geochemical conditions within the marsh.

These data suggest that impacts to surface water in the Upper Marsh appear to be relatively minor, as concentrations appeared to decline through the marsh. The marsh is likely acting as a sink where metals are being reduced and form complexes with other metals and organics; thereby, becoming relatively stable. The vegetation, with the exception of some marginal areas appeared healthy and was 1-foot or greater in thickness in most areas of the marsh. There is a potential risk for future flooding events to scour and erode relatively thicker historically deposited tailings in the buried delta-like feature at the up-stream end of the Upper Marsh; however, the thick vegetation would likely minimize the erosion and scouring of these sediments.

6.1.4 Groundwater

6.1.4.1 Contaminant Distribution

In general, both the October 2007 and July 2008 groundwater samples from the Mike Horse Creek and Beartrap Creek areas contained higher concentrations and more frequent exceedances of DEQ-7 groundwater standards (DEQ 2010) for the analyzed metals than did samples from wells further downstream. Groundwater standards for cadmium, copper, lead, and zinc were exceeded in samples from the Mike Horse and Carbonate areas. In samples from downstream wells, the DEQ-7 standards for cadmium, lead and zinc were also exceeded, but only rarely. Iron and manganese concentrations were often elevated in groundwater.

Groundwater – Surface Water Interconnection

Groundwater in the alluvial aquifer and surface water in the Blackfoot River valley and larger tributaries are intimately related, with the streams losing surface water to the alluvial aquifer system in some reaches and gaining water from it in other reaches. An assessment of the significance of this interchange was made by comparing surface water and groundwater quality at locations where both were monitored and also by comparing the loading rates for metals in surface water and groundwater at the two locations where alluvial aquifer hydraulic properties were known. Water quality comparisons were made at five locations, in order from upstream to downstream:

- Upper Mike Horse Creek between surface water stations BRSW-4 and BRSW-4A and groundwater monitoring wells UMHMW-1S/D and UMHMW-2S/D;
- Lower Beartrap Creek between surface water station BRSW-39A and groundwater monitoring well BCMW-10;
- Near the Mary P Mine between surface water station BRSW-109 and groundwater wells MPP-4 and BRGW-110;
- Near the head of the Upper Marsh between surface water station BRSW-12 and groundwater monitoring wells EDMW-2, EDP-2 and EDGW-105; and
- Near the downstream end of the Upper Marsh between surface water station BRSW-13 and groundwater monitoring wells LCMW-1 and BRGW-101.
- October 2007 data were available for all five locations, and June-July 2008 data were available for the first and last locations.

At all five locations, and for both sampling events, field measurements showed higher pH and dissolved oxygen concentrations in the surface water samples. Total dissolved solids and sulfate concentrations were nearly always higher in the groundwater sample, in the few cases where this was not true, differences in concentrations were very small.

In the upper Mike Horse Creek area and in Beartrap Creek, where the stream gains flow from groundwater, high metals concentrations in the shallow alluvial groundwater are an important source for the metal loads in the surface water.

At the next two locations downstream, near the Mary P Mine and the upper end of the Upper Marsh, the Blackfoot River loses water to the shallow alluvial groundwater system. It appears that the Blackfoot River is a source creating metals concentrations in the groundwater in these reaches.

At the most downstream locations, near the lower end of the Upper Marsh, the relative concentrations between groundwater and surface water change as flow conditions change. During October, with low stream-flow, surface water metal concentrations were higher than in the alluvial and bedrock groundwater. Lower metals concentrations in the surface water during the June high stream-flow reversed that trend. This stream reach gains flow from the groundwater system, so during low stream-flow periods the groundwater contribution would lead to lower contaminant concentrations in the surface water. No definitive conclusion can be made regarding the balance of contaminant transfer during high streamflow periods.

Alluvial Aquifer and Surface Water Metals Loads

Groundwater and surface water quality and flow data were used to calculate metal loading rates in the alluvial aquifer and the Blackfoot River. The results show that the metal loads transported

through both areas by surface water in the Blackfoot River are much larger than the loads transported by groundwater in the alluvial aquifer.

6.1.4.2 Potential Exposure Pathways for Groundwater

Potential exposure pathways for groundwater include contact with and ingestion of water from springs and seeps discharging contaminated groundwater to the surface, discharge of contaminated groundwater to surface water during periods of low surface water flow, wells producing contaminated groundwater, and encountering contaminated groundwater during construction activities. Springs and seeps occur in the upper Mike Horse Creek area, in the vicinity of the Mike Horse Tailings Impoundment, and from mine adits in the UBMC. Discharge of contaminated groundwater to surface water occurs along many reaches of the Blackfoot River and its tributaries in the UBMC, as described in the previous sections.

Seventeen water supply wells were identified in the vicinity of the UBMC facility. Three domestic wells downstream of the Upper Marsh complex, close to the Facility boundary and in immediate proximity of the Blackfoot River, have been sampled by DEQ twice per year since March 2009. Sampling of these wells is anticipated to continue through completion of construction activities. Metals concentrations in these three domestic wells are all below their respective DEQ-7 standards. Total metals arsenic and mercury have been below their respective laboratory detection limits for the period of record. Existing data suggest that domestic wells downstream of the Upper Marsh are not impacted by historic mining activities.

It is unclear whether several domestic wells located closer to the Upper Marsh complex in the vicinity of Surveyors Gulch are hydraulically connected to the Blackfoot River valley fill deposits. Although these closer wells are not known to be impacted by historic mining activity, it is possible that these wells could produce impacted groundwater. The lack of sampling of the wells near Surveyors Gulch is identified as a data gap and sampling is recommended.

6.1.5 Mine Inventory

A total of 269 mining related features were identified during the 2007/2008 mine feature inventory. Nineteen of these pose possible environmental or human health risks due to their environmental/geochemical characteristics or associated physical hazards. These features are listed in **Table 14** along with a description of the hazard(s) specific to each. This table also provides the footprint of each area in acres, a volume of materials estimate, and the distance to nearest surface water.

Some features identified could potentially impact surface water during times of high-run off, precipitation or snow-melt due to proximity or contact of these features with surface water channels. Dry conditions encountered during the mine inventory resulted in no observable transport of acidic or metal rich leachate, run-off, or sediments from mine wastes into nearby streams. Similarly, a few waste rock piles were located in run-off channels that were dry during 2008 mine inventory monitoring activities. It is possible that impacts could occur in these areas during higher flow/infiltration events.

Streams within the Facility have been adversely impacted by mining activities. Analytical results from mine inventory sampling indicate impacts to surface water and sediment in most of the drainages sampled. Mine wastes were identified as potential sources of contamination in several drainages. Some mine wastes were in contact with surface water and others were close enough to surface water such that precipitation runoff with metal leachate could flow to and impact surface water.

In conclusion, water quality in the most of the creeks surveyed during mine inventory activities at the UBMC were generally of near neutral pH and only occasional exceeded aquatic life

standards and human health standards for one to a few metals. Exceptions to this were limited to Stevens Gulch and Paymaster Creek. Paymaster Creek appears to have been impacted by both mining related disturbances and acid rock drainage that may be naturally occurring. Stevens Gulch appears to have been impacted along its length by dispersed mining related disturbances, which have caused decreased pH and elevated concentrations of some metals.

6.1.6 Mine Waste

6.1.7 Mine Waste Volumes

The following sections provide a summary and conclusion for each of the mine waste areas. In addition, Tetra Tech obtained the approximate area of mine waste impacts through the 2007 and 2008 sample and GIS, and used this information to calculate approximate waste volumes. With the exception of the three unreclaimed areas in the Anaconda Mine area and the waste pile at the Mary P mine area, the grade of each waste area was either relatively flush with the surrounding ground surface or, in some cases, slightly concave to the surrounding ground surface. Because of this, Tetra Tech estimated that mine wastes affect soil up to 2 feet bgs and/or that, if the area were to be amended, that amendments (cover soil, tilling, etc.) would only affect up to 2 feet of soil.

The exception is the Anaconda Mine waste areas which has three unreclaimed areas within its bounds. Because there has been no known removal of waste material from the three unreclaimed Anaconda waste areas, Tetra Tech assumed that mine waste/impacted soil may extent up to 3 feet below ground surface. The calculated volumes for each waste area are presented in the following table.

Also of exception are the wastes at the Mary P Mine waste area. The volume of the waste pile and estimated dimensions of the surrounding impacted soil were used in the calculations. The waste pile and dimensions were not measured in the field, and no GPS coordinates were recorded for sample locations. Therefore, the volume estimate is strictly based on observations and estimated dimensions.

The following tables present the volume estimates for each mine waste area.

Mine Waste/Impacted Soil Volume Estimates			
Mine Waste Impact Boundary Type	**Estimated Depth of Mine Waste/Soil Impacts**	**Estimated Area**	**Estimated In-Place Volume of Mine Waste/Impacted Soil**
Upper Anaconda Mine Waste Area			
Total Area of Mine Waste Impacts	2 ft	317,988 ft^2 (7.3 acres)	635,976 ft^3 (23,555 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	248,292 ft^2 (5.7 ac)	496,584 ft^3 (27,588 yd^3)
Capital Mine Waste Area			
Total Area of Mine Waste Impacts	2 ft	14,374 ft^2 (0.33 acres)	28,748 ft^3 (1,065 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	14,374 ft^2 (0.33 acres)	28,748 ft^3 (1,065 yd^3)
Carbonate Mine Waste Area			
Total Area of Mine Waste Impacts	2 ft	117,612 ft^2 (2.7 acres)	176,418 ft^3 (6,534 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	30,928 ft^2 (0.71 acres)	61,856 ft^3 (2,291 yd^3)
Consolation Mine Waste Area			
Total Area of Mine Waste Impacts	2 ft	75,359 ft^2 (1.73 acres)	150,717 ft^3 (5,582 yd^3)

Mine Waste/Impacted Soil Volume Estimates			
Mine Waste Impact Boundary Type	**Estimated Depth of Mine Waste/Soil Impacts**	**Estimated Area**	**Estimated In-Place Volume of Mine Waste/Impacted Soil**
Area Exceeding AAL/RSL/BTVs	2 ft	56,628 ft^2 (1.3 acres)	113,256 ft^3 (4,195 yd^3)
Edith Mine Waste Area			
Total Area of Mine Waste Impacts	2 ft	138,956 ft^2 (3.19 acres)	277,912 ft^3 (7,720 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	2,744 ft^2 (0.063 acres)	5,489 ft^3 (203 yd^3)
No. 3 Tunnel Mine Waste Area			
Total Area of Mine Waste Impacts	2 ft	117,612 ft^2 (2.7 acres)	235,224 ft^3 (8,712 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	28,314 ft^2 (0.65 acres)	56,628 ft^3 (2,097 yd^3)
Paymaster Mine Waste Area			
PMWA1			
Total Area of Mine Waste Impacts	2 ft	4,356 ft^2 (0.10 acre)	8,712 ft^3 (323 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	2,178 ft^2 (0.05 acres)	4,356ft^3 (161 yd^3)
PMWA2			
Total Area of Mine Waste Impacts	2 ft	5,663 ft^2 (0.13 acre)	11,325 ft^3 (429 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	2,178 ft^2 (0.05 acres)	4,356ft^3 (161 yd^3)
Upper Mike Horse Mine Waste Area			
UMH1			
Total Area of Mine Waste Impacts	2 ft	77,101 ft^2 (1.77 acre)	154,202 ft^3 (5,711 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	21,780 ft^2 (0.5 acres)	43,560 ft^3 (1,613 yd^3)
UMH2			
Total Area of Mine Waste Impacts	2 ft	77,101 ft^2 (1.77 acre)	154,202 ft^3 (5,711 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	65,340 ft^2 (1.5 acres)	130,680 ft^3 (4,840 yd^3)
UMH3			
Total Area of Mine Waste Impacts	2 ft	89,734 ft^2 (2.06 acre)	179,467 ft^3 (6,647 yd^3)
Area Exceeding AAL/RSL/BTVs	2 ft	74,052 ft^2 (1.7 acres)	148,104 ft^3 (5,485 yd^3)

ft – feet
ft^2 – square feet
ft^3 – cubic feet
yd^3 – cubic yards
Total Area of Mine Waste Impacts – mine waste boundary delineated based on 2007/2008 field XRF results
Area Exceeding AAL/RSL/BTVs – based on isopleth concentration analysis

Mary P Mine Waste Pile Volume Estimate of Mine Waste/Impacted Soil					
Waste Pile Volume					
Mine Waste Pile Height	Diameter of Top of Waste Pile	Diameter of Bottom of Waste Pile	Estimated In-Place Volume of Mine Waste/Impacted Soil		
7 ft	20 ft	40 ft	2,800 cf (103 yd^3)		
Estimated Volume of Soil Impacts Beneath and Surrounding the Pile					
Estimated Depth of Mine Waste Impacts Beneath Pile and to Surrounding Soil		Estimated Width East to West	Estimated Width North to South	Estimated Area	Estimated Volume of Impacts
3 ft		120 ft	60 ft	7,200 ft^2	21,600 ft^3 (800 yd^3)

ft – feet
ft^2 – square feet
ft^3 – cubic feet
yd^3 – cubic yards

Volume waste pile: $V = \frac{\pi}{12} h \left(D^2 + Dd + d^2\right)$
D – diameter of base of pile, *d* – diameter at top of pile

6.1.7.1 Upper Anaconda Waste Area Summary and Conclusions

Results of historical, 2007 and 2008 field investigations indicated the presence of five discrete mining related features within the Upper Anaconda Waste Area. The extent of impacted soils encompasses a large area that contains all five identified mine waste features, and areas adjacent to these features at both up, down, and cross-slope locations. Much of the Upper Anaconda Waste Area shows signs of impacts through the visual presence of mine wastes, staining/oxidation, stressed vegetation, or lack of vegetation.

The results of these investigations also indicate that surface soils associated with mine waste removal areas and in-situ mine waste in the Upper Anaconda exhibit metals concentrations above their respective screening levels. The boundary of impacted soils adjacent to UAW5 appears to be limited on the west side by an intermittent stream and a talus pile resulting from outcrops present on the west side of the stream. The extent of impacted soils for the Upper Anaconda Waste Area, in general, is limited to the south by the new water treatment plant.

ABA results indicated soil/mine waste in the Upper Anaconda Area ranges from uncertain acid generating potential to potentially acid generating. Results of SPLP testing indicated several metals do have the potential to leach from soil/mine waste. Therefore, metals in soil/mine waste for this area may migrate to the surrounding environment, including soil and water. Portions of the Upper Anaconda mine wastes are well above the valley floor, with UAW4 located approximately 1,200 feet from the Blackfoot River. Metals that may leach and migrate from the upper waste areas likely do not have the ability to reach surface water. The western lower boundary adjoins a possible ephemeral stream, near the rock outcrop, and the lower boundary adjoins the new water treatment plant on the hillside above the Blackfoot River. In this area, some migration of metals may be possible during wetter times of the year. Metal mobility to groundwater may be possible through fractured bedrock.

6.1.7.2 Capital Mine Waste Area Summary and Conclusions

Results of historical, 2007 and 2008 field investigations indicated the presence of one reclaimed/removal feature associated with the Capital Mine Waste Area. The extent of impacted soils encompasses a relatively small area that is adjacent to the removal feature at up, down and cross-slope locations, spanning both sides of Stevens Creek. A potential waste pile was identified during the 2008 investigation at the northern terminus of the removal area; however, field XRF results for a sample screened from this pile indicate concentrations and exceedances of screening levels is consistent with samples collected from the main waste area.

The results of these investigations also indicated that surface soils associated with mine waste removal areas exhibit metals at concentrations above their respective soil screening levels. ABA results vary widely from unlikely to generate acid to potentially acid generating. SPLP results indicate that some metals do have the potential to leach from soil/mine waste. Mobility of metals from soil/mine waste may be enhanced if the remaining mine waste are creating acid drainage. Stevens Creek cuts through the waste area and metals could migrate easily to this stream or into groundwater that may be present in the bedrock system or shallow groundwater.

6.1.7.3 Carbonate Mine Waste Area Summary and Conclusions

Results of historical, 2007 and 2008 field investigations indicated that soils *beneath the cover soil* associated with the mine waste removal area exhibited metals concentrations above their respective soil screening levels. The extent of impacted soils is limited to two areas, one along the Carbonate Mine access road and the other in the north-eastern portion of the reclaimed area.

ABA results identified soils adjacent to the removal area as having uncertain acid generating potential. However, SPLP testing indicated the potential for some metals to leach from the mine waste to surrounding soil and groundwater. Groundwater results from the Carbonate mine area exhibit concentrations of several metals above DEQ-7 groundwater standards. It may be possible that some metals leach from the soil and contribute to metal concentrations observed in the groundwater samples. However, the unusually high metals concentrations in the groundwater suggest that there may be an additional source such as the Carbonate mine workings. Additional evaluation is needed to confirm the source of metals.

6.1.7.4 Consolation Mine Waste Area Summary and Conclusions

Results indicate that surface soils associated with the mine waste removal area exhibited metals concentrations above their respective soil screening levels. The extent of impacted soils encompasses a large area that extends both sides of the Consolation Mine access road. The boundary of impacted soils is limited along the western perimeter by Shave Creek and an intermittent stream adjoining Shave Gulch. A waste pile is present at the southeastern most perimeter extent of the reclaimed area. Impacted soil distribution extends laterally from up to down-slope locations and extends across and below the access road.

ABA results identified soils adjacent to the removal area as having uncertain acid generating potential. However, SPLP results indicate that a few metals have the potential to leach from the soil/mine waste and migrate to surface water or groundwater. Much of the area within and adjacent to the Consolation Mine Waste Area shows visual signs of mine waste impacts through staining/oxidation, stressed vegetation, or the lack of vegetation.

6.1.7.5 Edith Mine Waste Area Summary and Conclusions

The Edith Mine Waste Area includes three previous mine waste removal areas. Mike Horse Road borders the waste areas on the north and the Upper Marsh on the west. The areas within and adjacent to the mine waste removal area were moderately vegetated in 2007 during the RI.

A waste pile is present at the southeastern most perimeter extent of the reclaimed area. The results of these investigations indicate that surface soils associated with the mine waste removal areas exhibited some metals concentrations above their respective soil screening levels. ABA results indicate an unlikely potential to generate acid and SPLP results support this data.

6.1.7.6 Mary P Mine Waste Area Summary and Conclusions

The Mary P Waste Area is bound within a narrow strip of land between Mike Horse Road and adjoining hillside. The mine waste appeared to impact adjoining soil at the time of the RI field work. Soil samples collected from the mine waste pile and surrounding soil indicate that some metals are present above their respective soil screening levels. The ABA result identified soils/mine waste as having uncertain acid generating potential. The SPLP results indicate that it is unlikely that metals will leach from the soil/residual mine waste and into surrounding soil and/or water.

6.1.7.7 No. 3 Tunnel Mine Waste Area Summary and Conclusions

The No. 3 Tunnel results indicate that surface soils associated with the previous mine waste removal exhibited metals concentrations above their respective soil screening levels. Samples collected from three mine features just outside the reclaimed waste area also had one or more metals that exceeded their respective soil screening levels. The highest concentrations of metals appeared to be in the north-central and southeast portions of the waste area. Additional metals delineation may be needed below the road and to the east and southeast of the reclaimed area. ABA results indicate an uncertain potential to generate acid, while The SPLP results indicate that it is unlikely that metals will leach from the soil/residual mine waste and into surrounding soil and/or water.

6.1.7.8 2007 Paymaster Mine Waste Area Summary and Conclusions

Results of historical, 2007 and 2008 field investigations indicated the presence of two previous removal/reclaimed areas within the Paymaster Mine Waste Area. Portions of the Paymaster Mine waste removal areas show visual signs of impacts through the presence of staining/oxidation, stressed vegetation, and/or the lack of vegetation.

Samples collected from these areas indicate that surface soils exhibit some metals concentrations above their respective soil screening levels. ABA results indicate that the soils identified within both removal areas are of uncertain acid generating potential, but SPLP results indicate that some metals have the potential to leach into surrounding soil and water.

6.1.7.9 Mike Horse Mine Waste Area Summary and Conclusions

The 2007 and 2008 field investigations indicated the presence of five previous removal/reclaimed areas within the Upper Mike Horse Mine Waste Area. Three of these areas, designated as UMH1, UMH2 and UMH3, were sampled during the 2007 and 2008 investigations. The other two areas had mine waste removed and were reclaimed and re-seeded by ASARCO in 2007.

Surface soil/mine waste associated with mine waste removal areas exhibit metals concentrations above their respective soil screening levels. In addition, the access road into the Upper Mike Horse area appears to contain metals, based on field XRF data, above their respective screening levels. Mike Horse Creek runs through the approximate center of this delineated area, and is likely being impacted by residual mine waste in the area.

ABA results indicate that these removal areas are of uncertain acid generating potential. SPLP results indicate that some metals have the potential to leach to adjoining soil and water. Areas

within Upper Mike Horse Mine Waste areas show visual signs of impacts through the presence of staining/oxidation, stressed vegetation, and/or the lack of vegetation.

6.1.8 Paymaster Constructed Wetlands Summary and Conclusions

Additional groundwater and surface water including, studies involving Cell A treatment, would be needed to further evaluate and understand subsurface geochemical conditions and reactions in this area. This data would be needed to evaluate what affect removal of the constructed wetland may have on the current and future surface and subsurface conditions of the area.

As part of the 2008 remedial investigation, Tetra Tech excavated four test pits in Cell B of the Paymaster Constructed Wetlands to evaluate the effectiveness of the removal of mine waste in 1996. Metal concentrations in underlying soil indicated that concentrations remained relatively constant over the depths sampled. Underlying soil results indicated that arsenic (181 – 1370 mg/kg) and iron (45,900 – 218,000 mg/kg) continue to exceed their respective soil screening levels, while the other metals exhibited similar concentrations below their respective screening levels.

In some locations, high iron concentrations, low pH and ferricrete deposits may be naturally occurring in Paymaster Gulch. The high iron concentrations and the compact and almost cemented nature of some of the native material encountered in the test pits during the 2008 investigation may be due to naturally occurring iron-oxide precipitation.

Arsenic concentrations in the native soil horizon sampled in 2008 ranged from 181 to 1,370 mg/kg, and remained relatively constant over the 0- to 24-inch depth interval. These concentrations range from 4 to 34 times greater than the DEQ action level. The concentrations are less than the concentration (2,505 mg/kg) exhibited by the single underlying soil horizon sample collected in 1996.

Results for groundwater samples collected in 2007 and 2008 from the Paymaster constructed wetlands downgradient monitoring wells indicated no detection of arsenic concentrations at or above the laboratory PQL. These data suggest that although the native soil horizon is enriched in arsenic (and potentially other trace metals), arsenic and other metals have likely adsorbed to or co-precipitated with iron-complexes and may also be bound with organics within the soil. Reducing conditions present in the groundwater system likely minimize mobility of many metals thereby reducing impacts to groundwater. Maintaining the current subsurface geochemical/oxidation state conditions in the vicinity of the Paymaster Constructed Wetland system is likely essential to limiting widespread deposition of ferrous iron (as ferric-hydroxide precipitates and the formation of ferricrete deposits) and increased metal mobility of at least arsenic and possibly other metals.

6.1.9 Reclamation Cover

Vegetative ground cover at the Paymaster Repository, Capital Mine waste areas, Carbonate Repository and Upper Anaconda waste areas was well established with respect to cover, and plant diversity appears to be improving with time. For example, conifer tree species are beginning to volunteer onto these sites.

Soil erosion was seldom noted in revegetated areas despite some relatively low vegetated cover values. High litter levels add to the soil stability, but of greater importance was the pervasive occurrence of soil fungi and moss. Soil fungi play an important ecological roll related to water dynamics, nutrient cycling, and noxious weed suppression. Moss provides valuable soil cover and creates micro-sites for seed germination helping reduce soil erosion from reclaimed sites.

Elsewhere, vegetation at the Consolation, Paymaster and Upper Mike Horse waste areas and the Mike Horse townsite has not reestablished itself as well as expected, and this is attributed to a combination of factors. These factors include:

- Low levels of organic matter (e.g. litter) were observed at both the Consolation and Upper Mike Horse areas; organic matter is important in soil texture formation and nutrient availability.
- Soil samples at all three waste areas had pH values below 5.0, potentially impacting vegetation establishment and growth. Low pH soils commonly have elevated metal concentration that can lead to phytoxicity.
- While plant species can establish and grow in acidic conditions, their growth form and productivity are affected. Metals in the soil may also affect plant growth and establishment.
- A number of the sample sites in these areas exhibited metal concentrations for arsenic, cadmium, copper, iron, lead, manganese, mercury, and zinc above one or more soil screening level. High levels of metal uptake in plants can result in phytotoxicity and eventual death. The ecological risk assessment will further evaluate potential phytotoxicity.
- The Mike Horse waste areas are very rocky. High surface rock fragment content may contribute to soil stability and erosion control on site.

Several of the reclamation areas sampled at the UBMC, while not infested, have established noxious species such as spotted knapweed, Canada thistle and yellow toadflax. These areas have been identified in the detailed discussion in the Reclamation Cover sub-section of Section 4. In order to be effective, these areas should be chemically treated in the spring before plants develop seed. Many of the plants observed were adjacent to travel corridors, likely introduced from recreation and work vehicles. Weed monitoring and management should be considered as remediation work continues in the area.

6.1.10 Floodplain Sediments

Floodplain sediment sampling performed during 2007 and 2008 allowed Tetra Tech to evaluate the extent of tailings impacts along Beartrap Creek and Blackfoot River resulting principally from the 1975 breaching of the Mike Horse tailing impoundment. The results indicate that streamside impacts from metals extend over the entire floodplain of Mike Horse Creek, Beartrap Creek, and Blackfoot River. The impacts extend across the entire floodplain of each drainage, from the toe of the slopes of the adjoining mountains. ABA results indicate floodplain sediments along the Blackfoot River have primarily an uncertain acid generating potential while floodplain sediments along Beartrap Creek have a potentially acid generating potential. SPLP testing indicated that most metals in the floodplain sediments along both streams have the potential to leach from the sediments and migrate to adjoining soil and water, including groundwater. SPLP testing from mine wastes within the Upper Mike Horse area that adjoin Mike Horse Creek indicate that floodplain sediments also have the potential to leach from the floodplain sediments.

Tetra Tech prepared preliminary estimates of the volume of tailings present within each of these two drainages. The volumes were calculated by obtaining an approximate area via GIS based on the 2007 and 2008 sampling and concentration isopleth results and also from data collected in 2000 and 2001 by ASARCO that evaluate the distribution and thickness of concentrated and dispersed tailings within the floodplains of Beartrap Creek, Blackfoot River, Mike Horse Creek. The estimated volume of impacted floodplain sediments for these drainage systems is presented in the following table.

Estimated Volume of Mine Waste Impacted Floodplain Sediments			
Stream	**Estimated Area**	***Average Thickness of Mine Wastes / Intermixed Mine Wastes (ft)**	**Estimated Volume of Impacted Alluvium/Soil**
Mike Horse Creek	45,738 ft^2 (1.1 ac)	3	137,214 ft^3 (5,082 yd^3)
Beartrap Creek	323,498 ft^2 (7.4 ac)	4	1,293,992 ft^3 (47,925 yd^3)
Blackfoot River	2,089,381 ft^2 (48 (ac)	4	8,357,524 ft^3 (309,538 yd^3)

* Average thickness based on historic and 2007 dispersed tailings, and 2007 edge of tailings data
ft^2 – square feet
ft – feet
yd^3 –cubic yards

6.1.11 Discrete Streamside Mine Waste Deposits

Historic results and results for the 2007-2008 remedial investigation indicate that concentrated streamside mine wastes (tailings inter-layered with alluvium and soil) in the Beartrap Creek and Blackfoot River floodplains exhibit metal concentrations above multiple soil screening levels. Analytical results indicate that the streamside mine waste and underlying alluvium or soils sampled during 2007 directly impact, or indirectly impact through leaching of metals, the alluvium and underlying native soil along the Blackfoot River. Results indicate that several metals in the streamside mine waste impact alluvium/soil up to 5 feet bgs.

The concentrated tailings and discrete streamside mine waste deposits exhibit paste pHs ranging from approximately 1.9 to 7.1. ABA test results of these tailings indicate that these deposits are potentially acid generating. SPLP testing indicated metals in the mine waste have the potential to leach from the mine waste to adjoining soil and water. Many of these areas show visual signs of impacts as evidenced by iron-oxide staining, the presences of precipitated metal salts, and a lack of vegetation.

Tetra Tech used the data obtained from the historic concentrated and dispersed tailings, the 2007-2008 dispersed tailings, and edge of streamside tailings/over bank deposits to estimate the volume of impacted materials in the Beartrap Creek and Blackfoot River floodplains. Section 6.1.9, above, presents the volume estimates.

6.1.12 Ecological Risk Sampling Summary and Conclusions

Metal concentrations in the ecological receptors of vegetation, small mammals, and invertebrates were determined through laboratory analysis across three transects (high risk, moderate to low risk, and a reference area) in both terrestrial and marsh habitats. Metal concentrations in collocated soil samples were also analyzed to allow direct correlation among soil and biological receptors in terms of assimilating COPCs. For some metals, concentration levels were not detected above the laboratory method minimum detection limit. Most notably, mercury was not detected above the laboratory detection limit in any receptor in any location. Cadmium was not measured above the detection limit in any small mammal sample in the terrestrial habitat and arsenic was not detected in any small mammal or vegetation sample in the marsh habitat.

For those metals that were detected, concentrations in each receptor were generally highest in the high risk transects, were at intermediate levels in the moderate to low risk transects, and were lowest in the reference transects in both terrestrial and marsh habitats. Overall,

concentrations of each metal in the ecological receptors of vegetation, small mammals, and invertebrates were less than the concentration of that metal in the soil. This suggest that bio-concentration of the metals analyzed has not occurred. A more detailed analysis of assimilation of the metals from the soil to the ecological receptors will be conducted during the ERA.

Soil metal concentrations were compared with ORNL and EPA Eco-SSLs to determine which COPCs and/or areas warrant further evaluation in the Baseline ERA to determine risk to the ecological receptor. Potential risks of aluminum, arsenic, copper, lead, manganese, and zinc to plant receptors should be considered in the high and the moderate to low risk transects in both the terrestrial and marsh habitat. Soil cadmium concentrations were below the plant screening values across the board and therefore could be potentially dropped from further analysis in assessing risk to plant receptors. No plant screening values were available for comparison for iron.

Potential risks of arsenic, cadmium, copper, and lead to mammal receptors should be further considered in the high and moderate to low risk transects in both the terrestrial and marsh transects. Cadmium and lead should be considered in both the terrestrial and marsh reference transect. No mammal Eco-SSLs values were available for aluminum, iron, manganese, mercury, or zinc.

Potential risks of arsenic, copper, lead, and zinc to invertebrate receptors should be further considered in the high and moderate to low risk transects in both the terrestrial and marsh habitats. Zinc should be considered in the reference area of the marsh habitat. Soil cadmium concentrations were below the invertebrate Eco-SSL across the board and therefore could be potentially dropped from further analysis in assessing risk to invertebrate receptors. No invertebrate Eco-SSL values were available for aluminum, iron, and manganese.

Analysis of soil samples in the marsh habitat indicate that there is potential for sulfide minerals in the dispersed tailings near UMT1 to generate acid and mobilize metals and potentially impact water quality and the ecosystem in the marsh habitat. A complete and detailed evaluation of COPC contamination and risks to ecological receptors at the study area will be completed during the ERA.

6.1.13 Aquatic Biota Sampling

Macroinvertebrate taxonomic community analysis from the fall 2007 to spring 2008 investigations indicated that sampling locations with drastic changes in macroinvertebrate abundance from the two sampling periods included BRSW-101, BRSW-106 and BRSW-16. Despite the change in abundance, the calculated metric scores remained similar. At sites where abundance numbers remained relatively similar, calculated metric scores were also similar, except for the diversity index score at BRSW-17 which dropped 0.6 points from 1.26 to 0.6. For the MMI scores, the biggest overall change was seen at BRSW-108, where the impairment determination shifted from unimpaired to impaired from the fall of 2007 to the spring of 2008. A large shift was also seen at the reference site (BRSW-06) where the numerical score went from 71.6 in the fall of 2007 to 92.2 in the spring of 2008.

Primary productivity dropped for all sampling locations sampled in the spring of 2008 when compared to fall 2007 measurements. This is most likely due to a difference in seasonality rather than a degradation of conditions at all sampling locations. This is further highlighted by the relatively small changes seen in other aquatic biota components measured as part of the sampling regime.

There were only two 2008 locations for which total abundance were sufficient to calculate a MMI impairment rating. The overall change between the 2007 and 2008 MMI scores at locations BRSW-06 and BRSW-17 are based in part on the percent of Ephemeroptera and Plecoptera

taxa (EPT). At the reference location, percent EPT increased from 45 to 73 percent and at BRSW-17 a decrease from 55 to 22 percent was seen. Ephemeroptera and Plecoptera taxa are generally sensitive to environmental contamination such as reduced dissolved oxygen, unstable substrates, and contamination due to heavy metals and other toxicants.

A decline in abundance of these taxa indicates a degradation of environmental conditions. A decline in the Percent EPT metric also indicates environmental contamination; sensitive and specialist individuals of the mayfly, stonefly, and caddisfly insect orders will emigrate or perish as conditions worsen. An abundance of Ephemeroptera, Plecoptera, and Trichoptera (EPT) indicate good water quality conditions, as the three taxa are sensitive to pollution.

Because the minimum target of 300 as required for the MMI calculation was only reached at some of the locations, there is some uncertainty in drawing conclusions based on indices calculated for locations for which less than 300 individuals were collected. The data collected as part of the 2007 and 2008 sampling periods suggest, but do not empirically support, that metals contamination as it is related to concentration and seasonal flow variances is driving the quality and abundance of the aquatic biota community.

6.1.14 Marsh Sediment Bioassay

The results of the bioassays support that the most toxic sediments exist at the upgradient end of the marsh where the Blackfoot River enters the marsh. This would be expected since tailings sediment from the breached impoundment settles rapidly as it entered a standing body of water in the marsh. Sediments are less toxic toward the margins and down-gradient end of the marsh. No toxicity was observed in sediment collected from the lower marsh. There is also a small area where metal concentrations are elevated and sediment is toxic in the vicinity of where Swamp Gulch formerly entered the marsh.

6.1.15 Data Provided for Risk Assessment and Remedial Alternative Evaluation

Based on the RI evaluation of the nature and extent of contamination and the distribution of contaminated media, the following information necessary to conduct the risk assessment and evaluation of alternatives has been provided by this RI Report:

- Location, area (footprint), and volume of mine waste, soil, and transported sediment that contains concentrations of contaminants of concern above literature-based screening levels;
- Background soil, sediment, surface water, and groundwater samples;
- Metal values, ABA data and SPLP data of mine waste, soil, and transported sediment that contains concentrations of contaminants of concern above literature-based screening levels;
- Source data for surface water contamination; location, metal concentrations above literature-based screening levels and state and federal water quality standards, metal loading data, and flow volumes;
- Where available, defined groundwater flow paths for source control and remediation of groundwater containing contaminants of concern above literature defined screening levels and state and federal water quality standards;
- Groundwater direction and rates of flow in alluvial, and bedrock aquifers; and exceedences of water quality standards.
- Understanding of the interconnection between groundwater and surface water.

6.2 Recommendations/Data Gaps

Based on the preliminary evaluation of contaminated media and likely remedial alternatives, the following additional information is considered necessary to conduct the evaluation of remedial alternatives for the UBMC:

- Human Health and Environmental Risk Assessment, including Fate & Transport analysis;
- Verified list of COCs,
- Risk-based site-specific clean-up levels
- Site-specific cleanup requirements for all affected media;
- Residential Well Sampling at Surveyors Gulch - It is unclear whether several domestic wells located closer to the Upper Marsh complex in the vicinity of Surveyors Gulch are hydraulically connected to the Blackfoot River valley fill deposits. Although these closer wells are not known to be impacted by historic mining activity, it is possible that these wells could produce impacted groundwater;
- Carbonate Mine groundwater chemistry – The source of elevated metals concentrations in groundwater is unknown. Additional investigation may be required to determine whether the metals are natural or mine induced;
- Marsh Sediment Geochemistry – Additional analyses may be required (pending 2012 results of the Floodplain investigation) to further evaluate the geochemical conditions within the marsh;
- Mining Inventory Features – Assess mine inventory features (**Table 14**) that are identified as targets for potential remedial actions or further study.
- Water Treatment Plant Cell 4 Seeps – Identify the nature and extent of the seeps emanating from the toe of Cell 4 at the WTP.

6.3 Human Health and Environmental Risk Analysis

After the completion of this RI Report for the UBMC, DEQ will conduct baseline (qualitative and quantitative) human health and ecological risk assessments using data compiled from the report. The risk assessments will assess threats to human health and the environment associated with exposure to mining related impacts within the UBMC. Risks will be evaluated under existing site conditions - using site-specific chemical concentration data, applicable exposure scenarios, and pertinent risk-based cleanup guidelines or other ecological criteria. A site-specific fate and transport evaluation of contaminants of concern will also be undertaken as part of this process.

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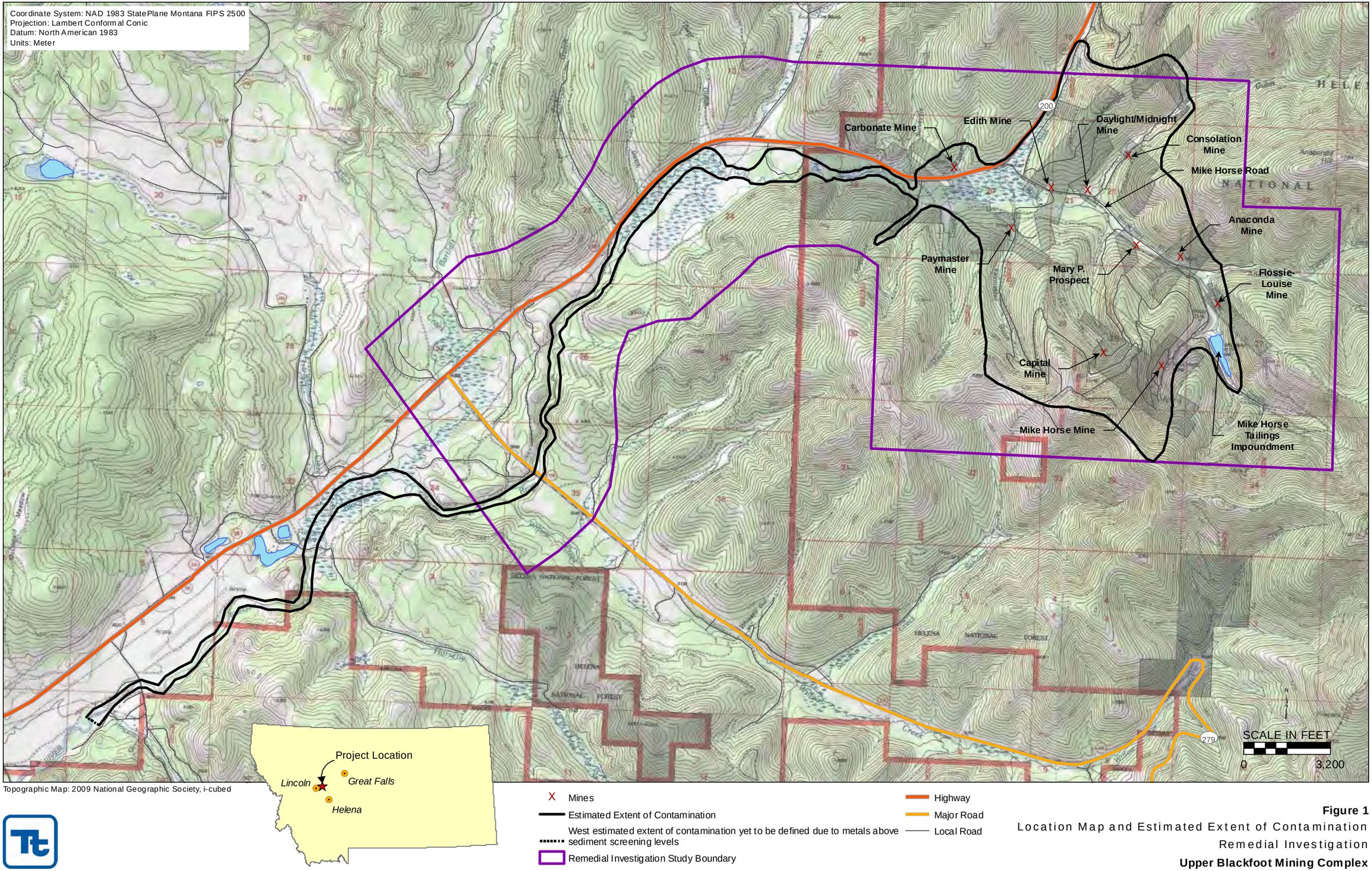
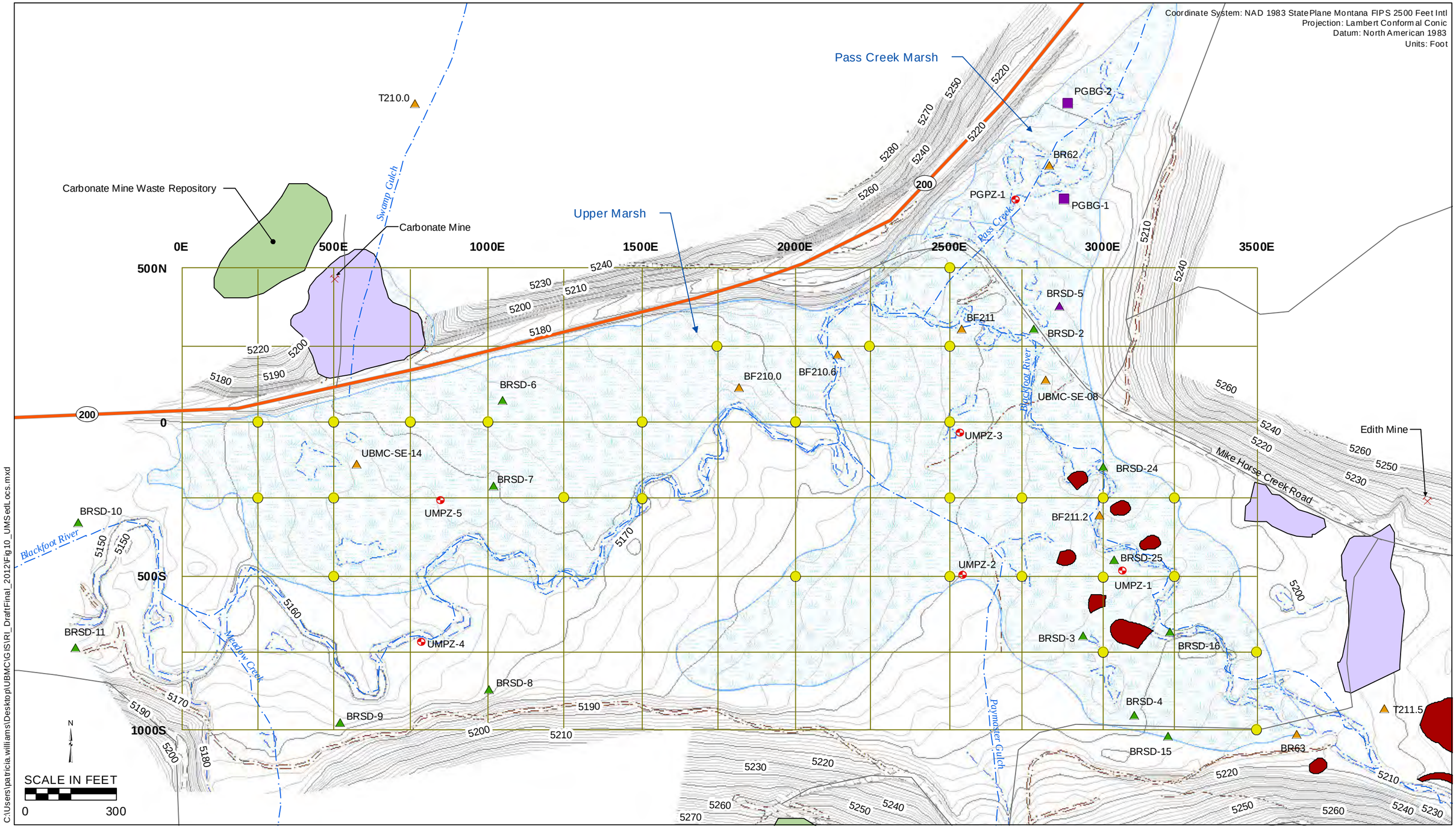


Topographic Map: 2009 National Geographic Society, i-cubed

Figure 1
Location Map and Estimated Extent of Contamination
Remedial Investigation
Upper Blackfoot Mining Complex



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- Mines
- Area of Dispersed Sandy (Fine) Tailings
- Estimated Extent of Mine Areas (Sampled 2007/2008)
- Mine Waste Repository
- 2008 Piezometers
- 2007 Upper Marsh Sediment Sample Location
- 2007 Background Sediment Sample Location
- 2008 Background Sediment Re-sample Location
- Historic Sediment Sample Location
- Historic Sediment Sample Location (sampled 2008)
- Grid Lines
- Marshes
- Local Roads
- State Highway
- Gravel Road
- Topographic Contours
- Interior Contours
- Trail
- Streams

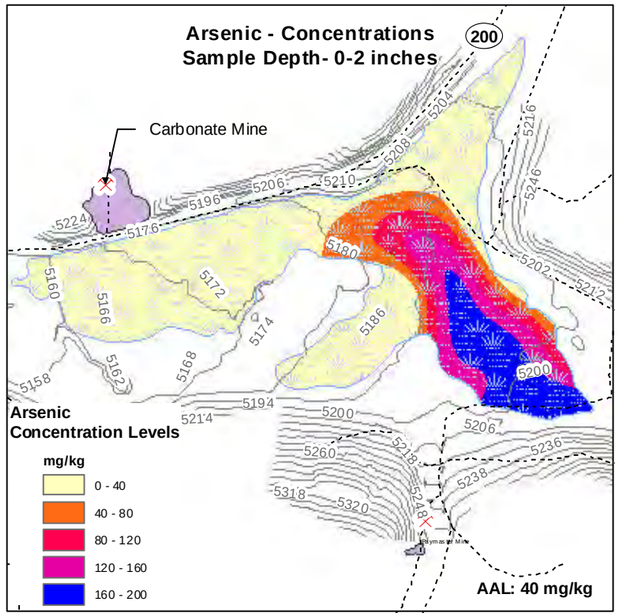
January 2013

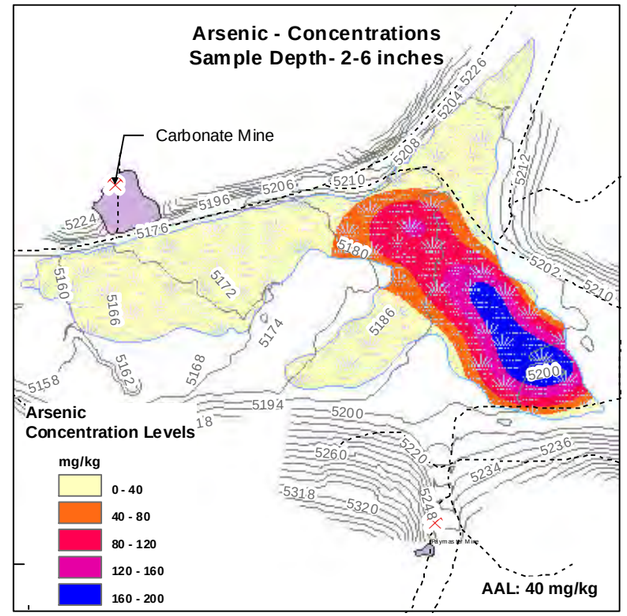
Figure 10

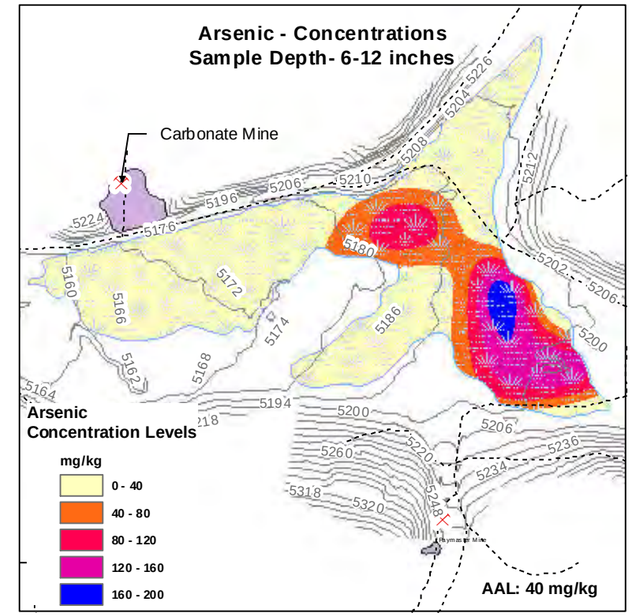
Upper Marsh Sediment Sampling Locations

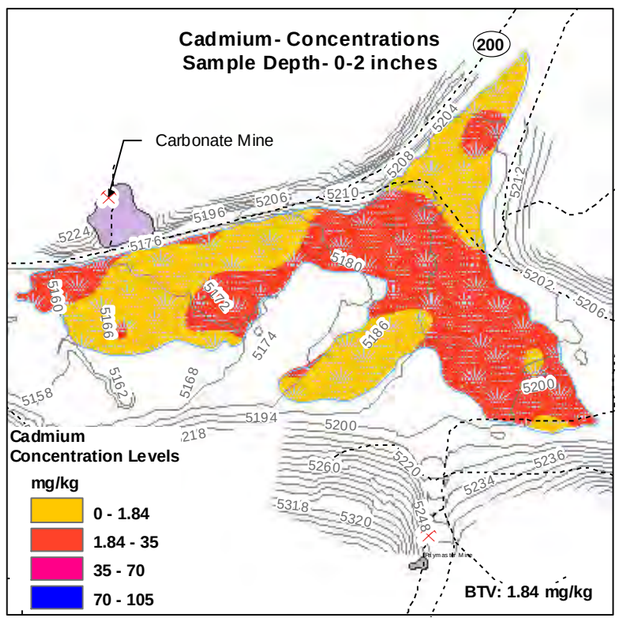
Remedial Investigation

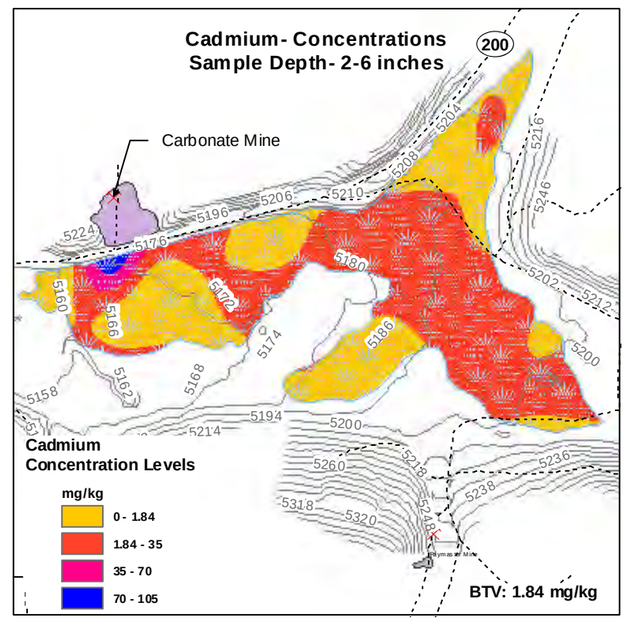
Upper Blackfoot Mining Complex

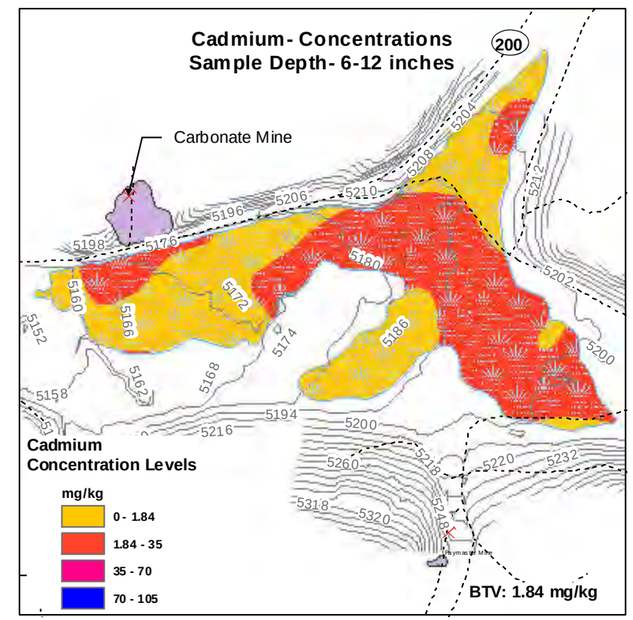












N

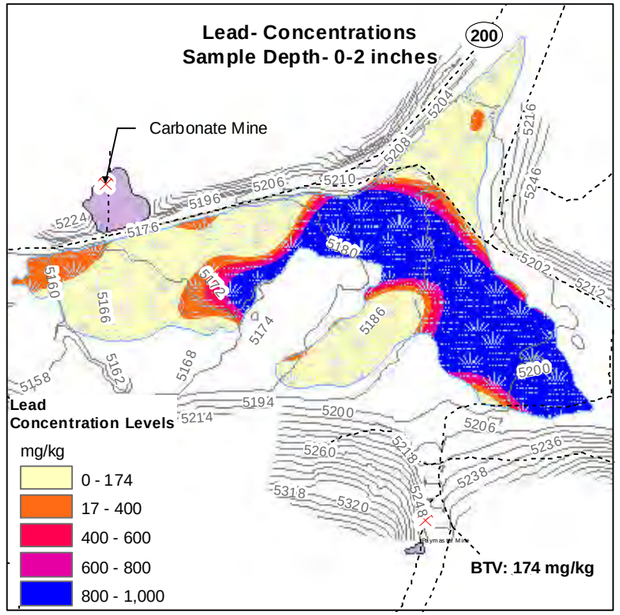
SCALE IN FEET
0 1,000

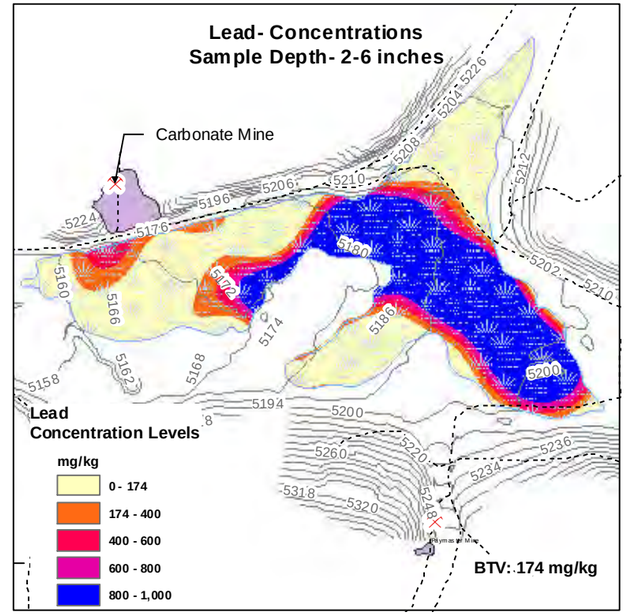
AAL - Montana DEQ Arsenic Action Level
BTV - Background Threshold Value

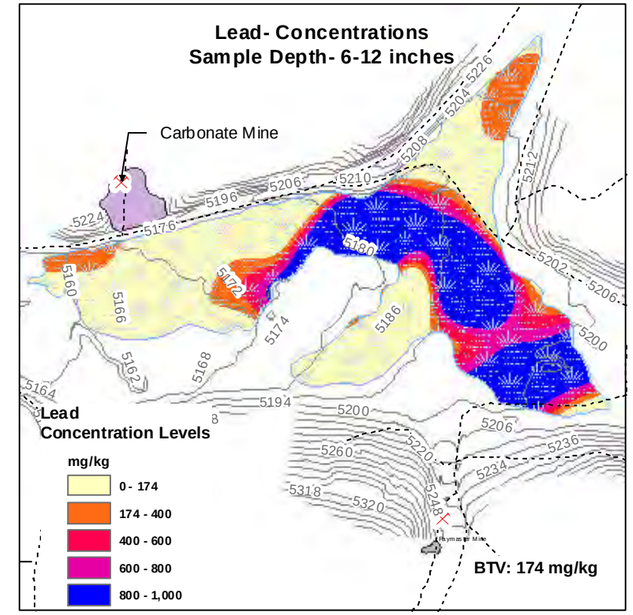
Note: XRF data was used to perform the evaluation

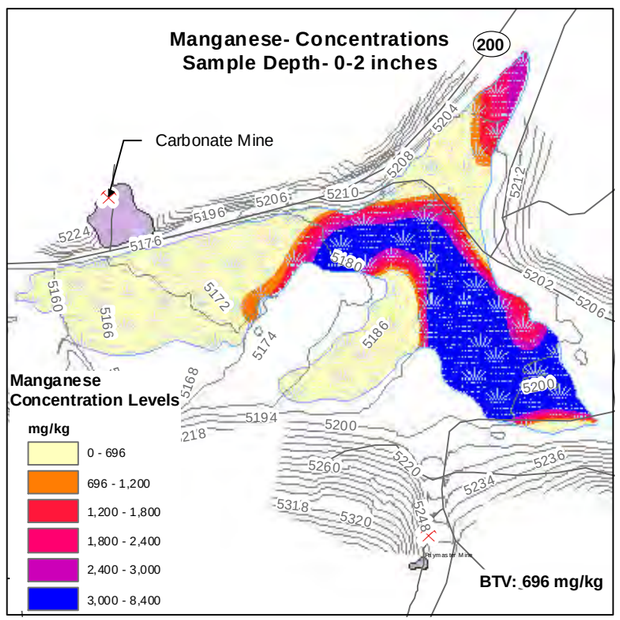
Mines
Roads
Estimated Extent of Mine Area (sampled 2007/2008)
Marsh
Topographic Contours

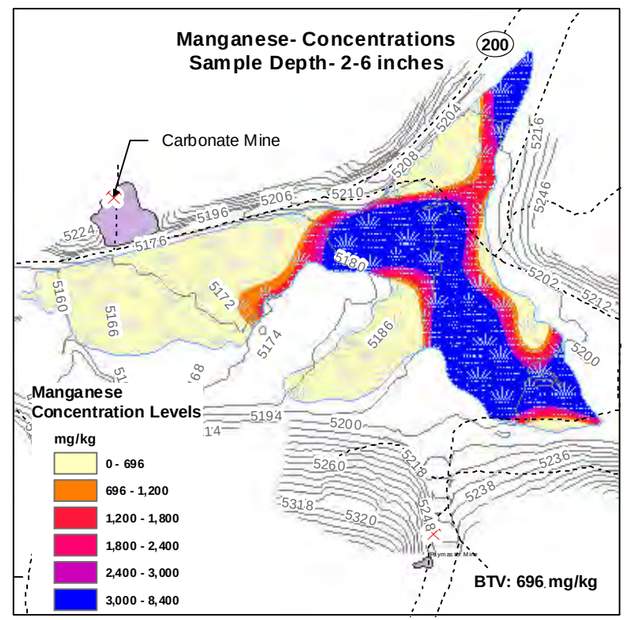
January 2013
Figure 11a
Comparison of Site Concentrations at Various Sample Depths
for Arsenic and Cadmium
Upper Marsh
Remedial Investigation
Upper Blackfoot Mining Complex

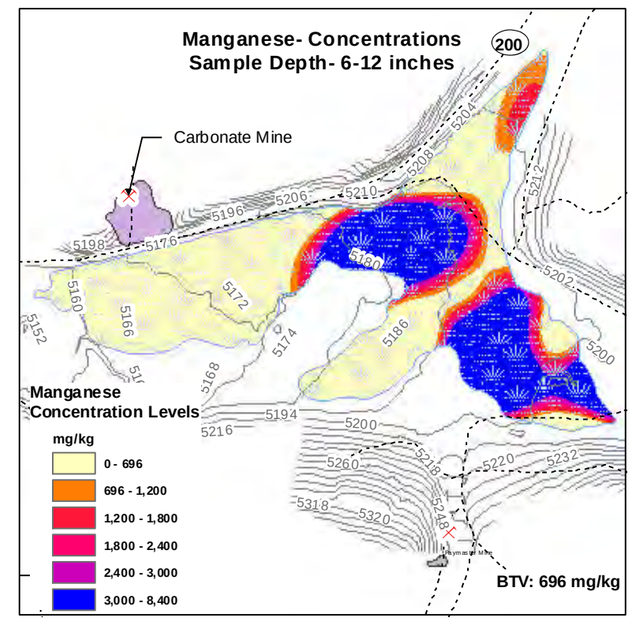












N

SCALE IN FEET

0 1,000

BTV - Background Threshold Value

Note: XRF data was used to perform the evaluation

Mines
Roads
Estimated Extent of Mine Area (sampled 2007/2008)
Marsh
Topographic Contours

January 2013

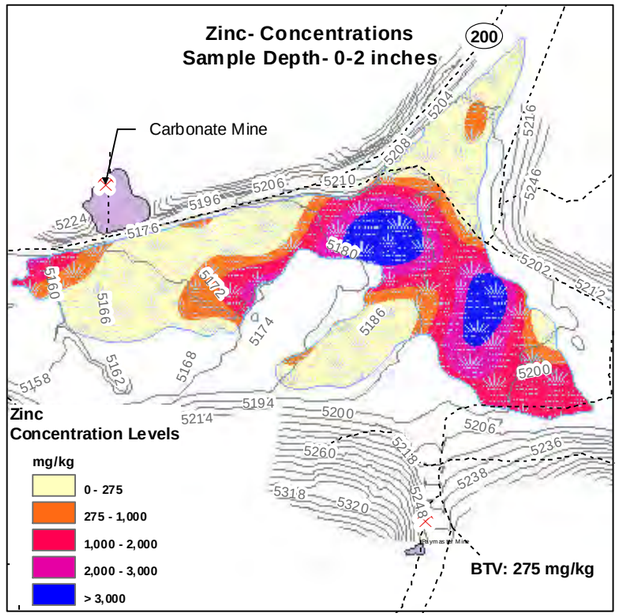
Figure 11b

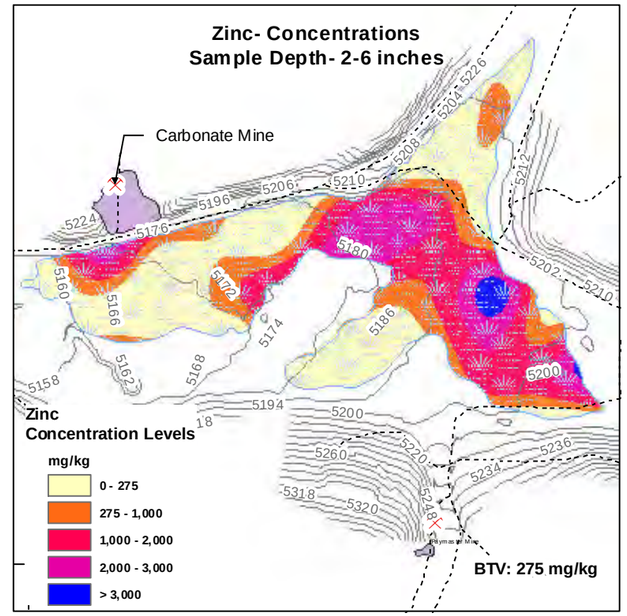
Comparison of Site Concentrations at Various Sample Depths for Lead and Manganese

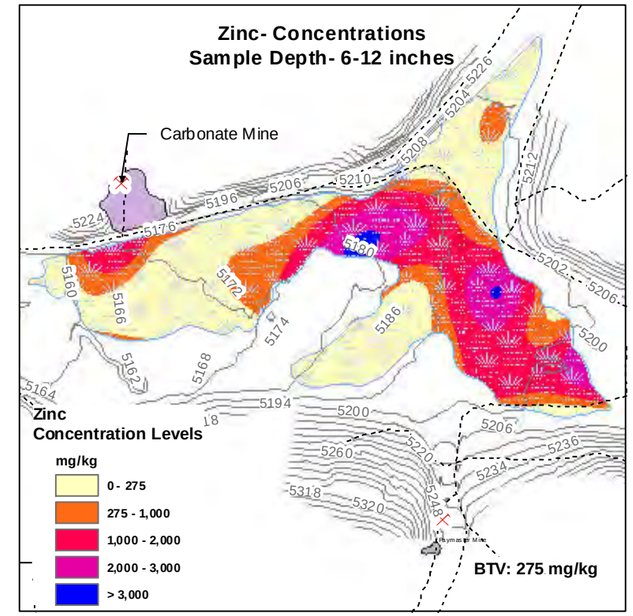
Upper Marsh

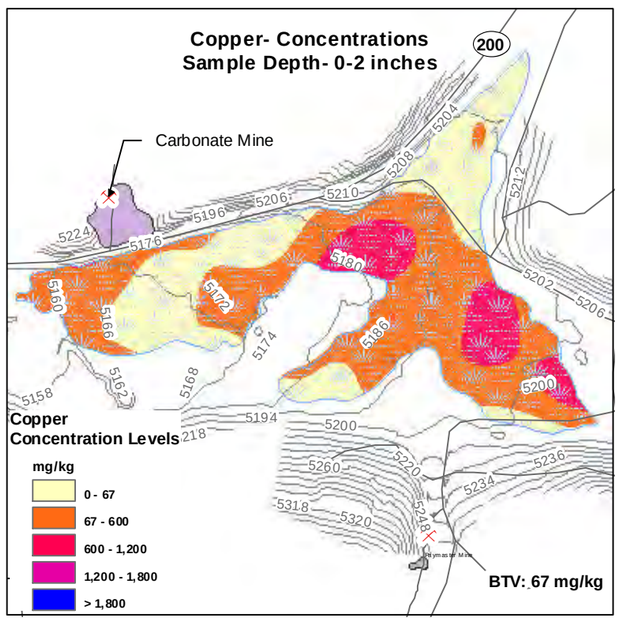
Remedial Investigation

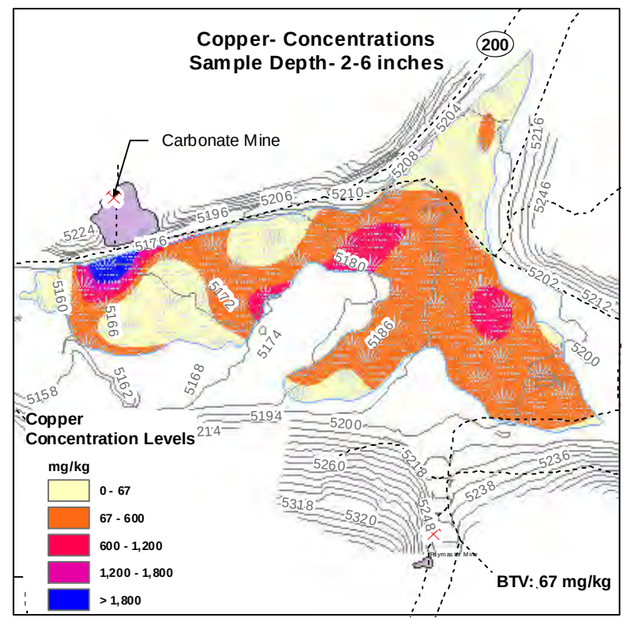
Upper Blackfoot Mining Complex

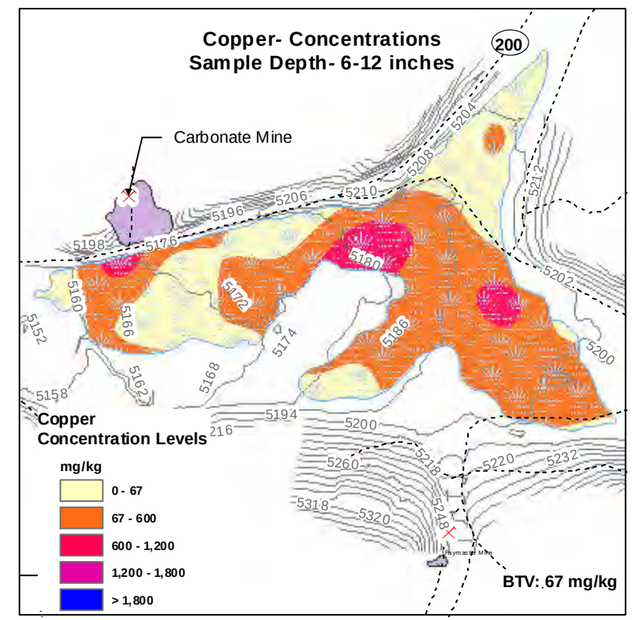












N

SCALE IN FEET

0 1,000

BTV - Background Threshold Value

Note: XRF data was used to perform the evaluation

Mines
Roads
Estimated Extent of Mine Area (sampled 2007/2008)
Marsh
Topographic Contours

January 2013

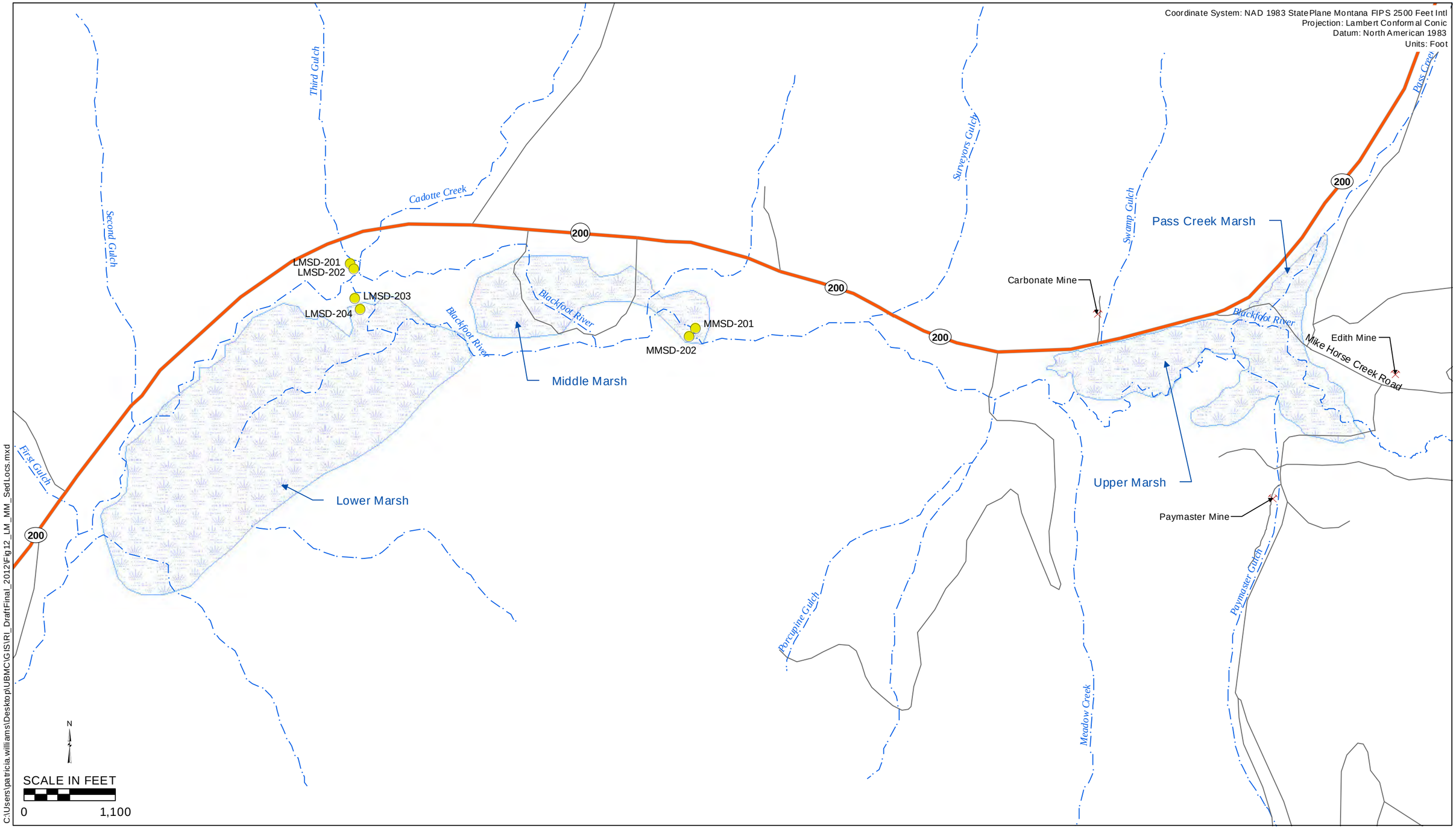
Figure 11c

Comparison of Site Concentrations at Various Sample Depths for Zinc and Copper

Upper Marsh

Remedial Investigation

Upper Blackfoot Mining Complex



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Mines
2011 Marsh Sediment Sample Location
Local Roads
State Highway
Marshes

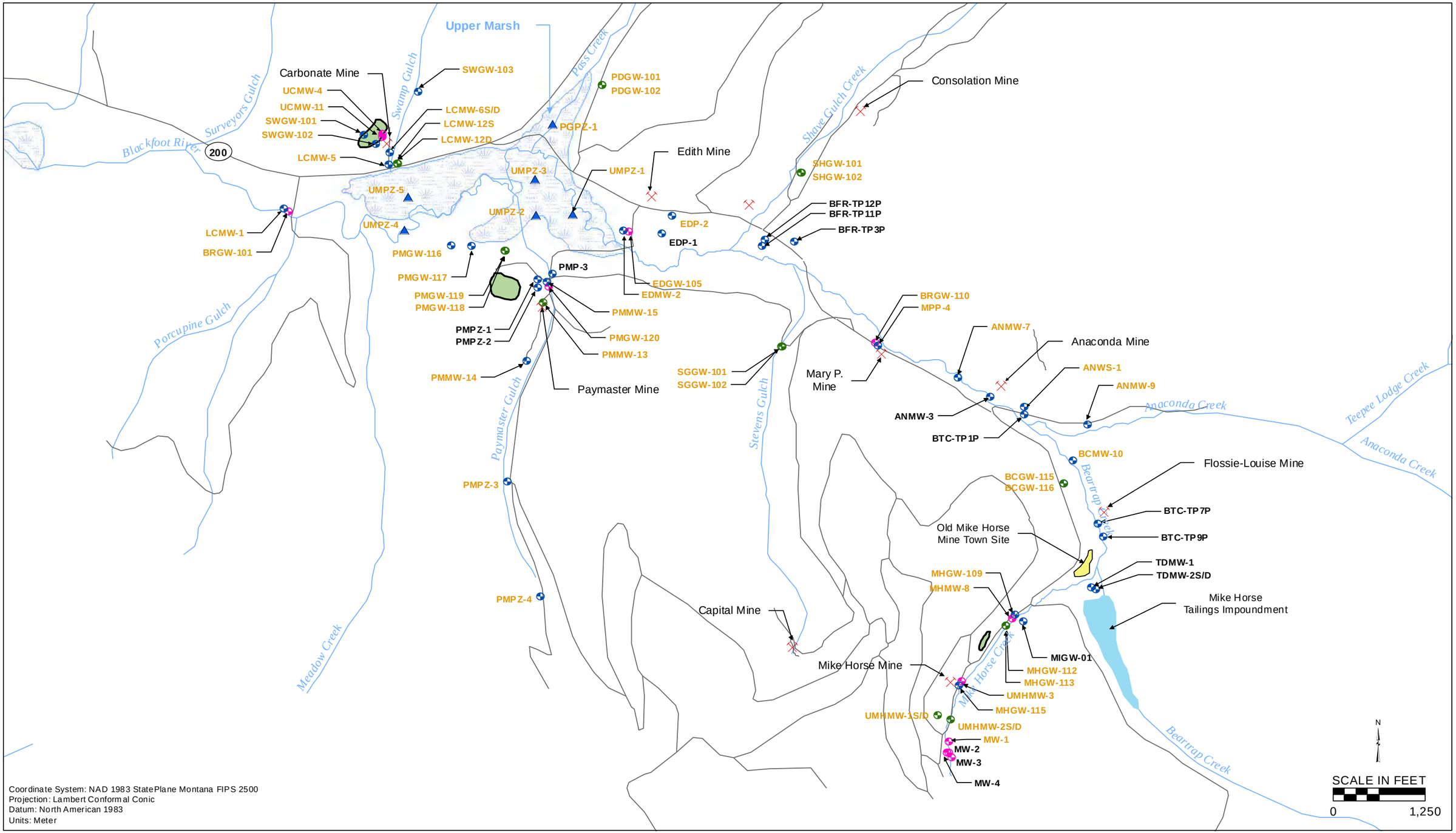
January 2013

Figure 12

Middle and Lower Marsh Sediment Sampling Locations

Remedial Investigation

Upper Blackfoot Mining Complex

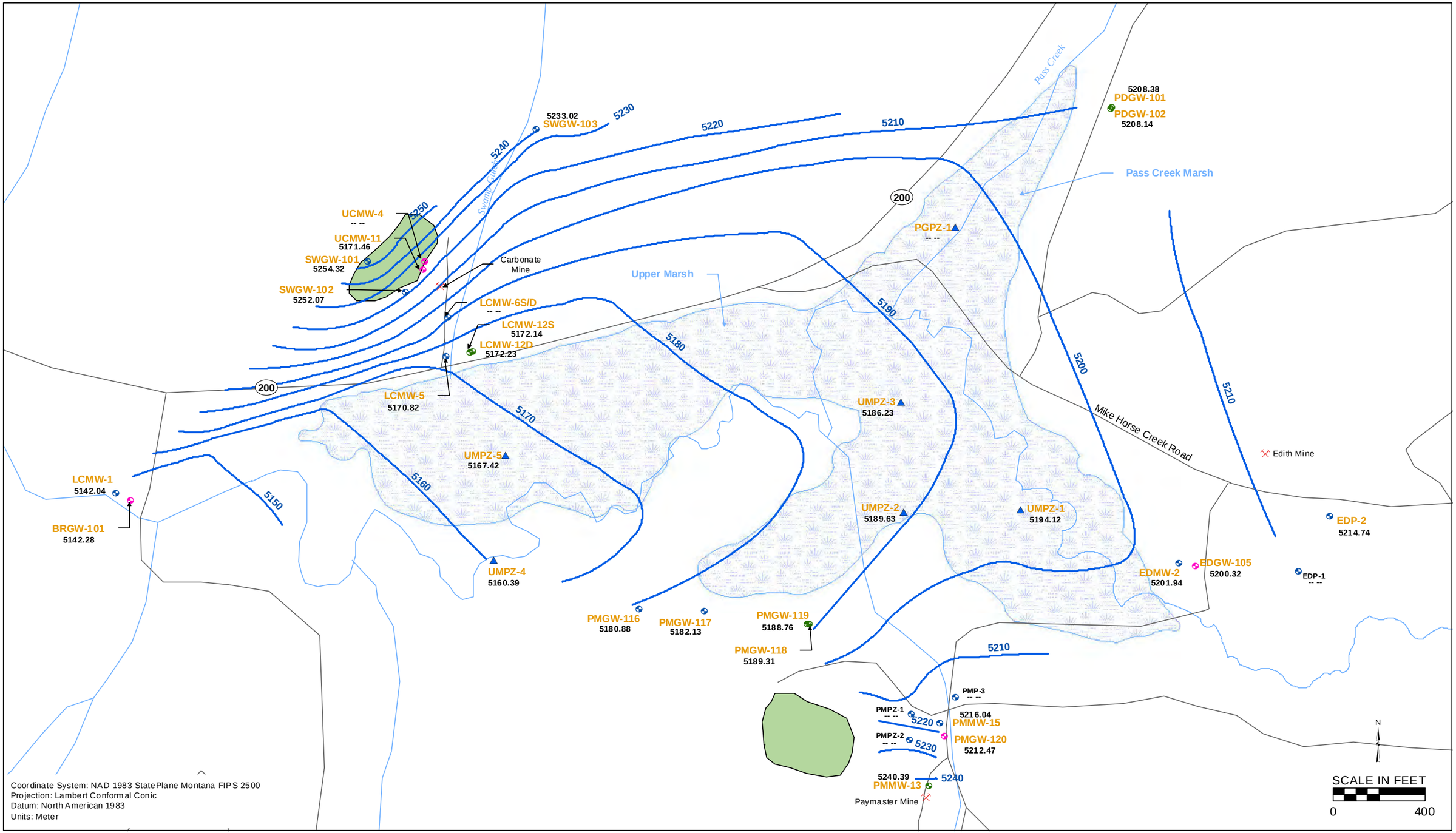


Mines
Streams
Marshes
Roads
2008 Alluvial Piezometers
Existing Groundwater Sample Location - Alluvial/Bedrock Pair
Existing Groundwater Sample Location - Alluvial
Existing Groundwater Sample Location - Bedrock
Mine Waste Repository
Old Mike Horse Mine Town Site
Mike Horse Tailings Impoundment
SGGW-101 Designates sampled in 2007, 2008 and/or 2011
PMPZ-1 Designates not sampled during Remedial Investigation

January 2013

Figure 13a

Groundwater Sampling Locations
Remedial Investigation
Upper Blackfoot Mining Complex

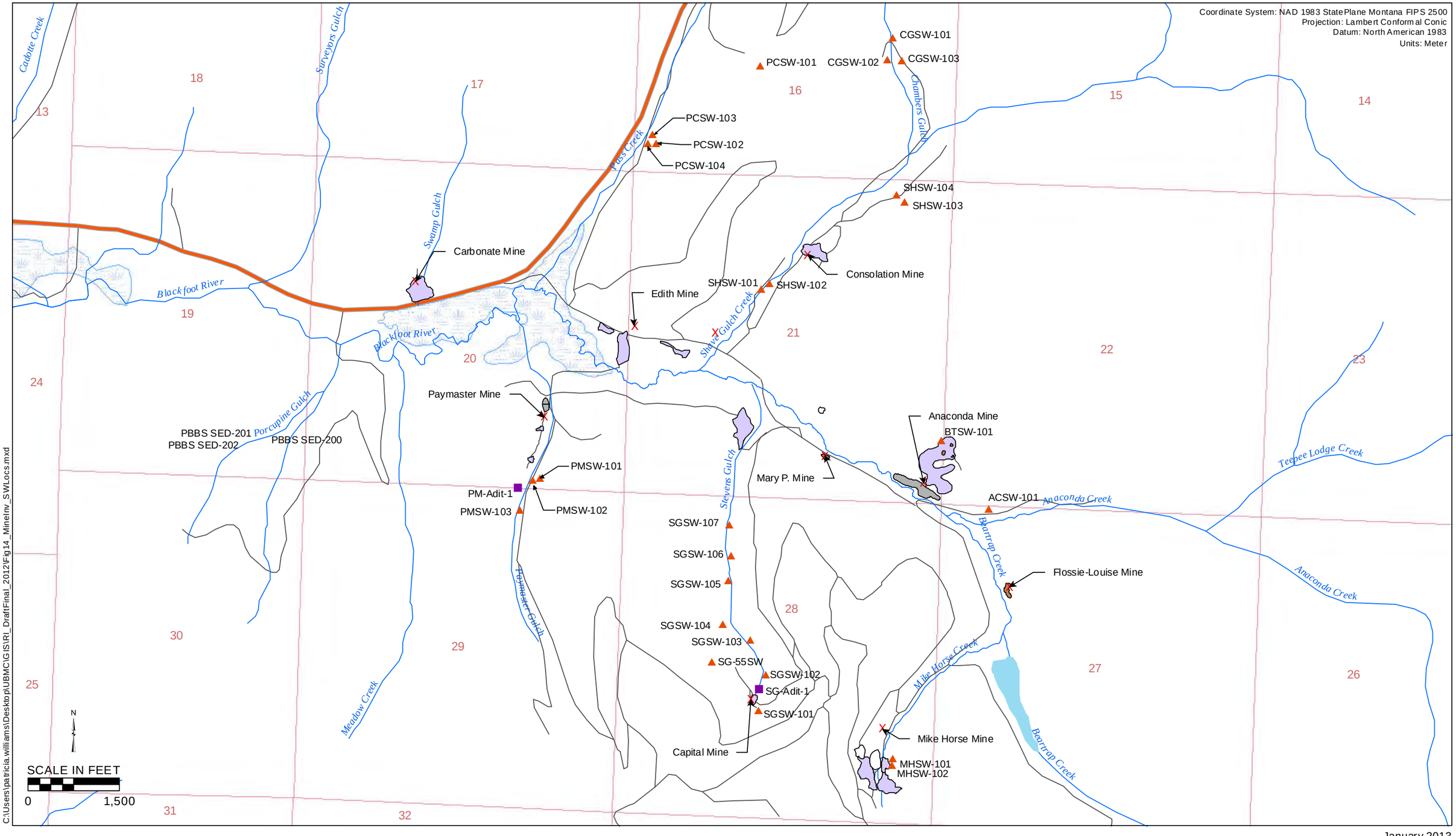


Mines
Streams
Roads
2008 Alluvial Piezometers
Existing Groundwater Sample Location - Alluvial/Bedrock Pair
Existing Groundwater Sample Location - Alluvial
Existing Groundwater Sample Location - Bedrock
Approximate Potentiometric Surface (elevation in feet)
5240.39 Groundwater Elevation (feet)
-- -- No data available
Mine Waste Repository
Marshes
SGGW-101 Designates sampled in 2007, 2008 and/or 2011
PMPZ-1 Designates not sampled during remedial investigation

July 2008

Figure 13B

Groundwater Potentiometric Map
Remedial Investigation
Upper Blackfoot Mining Complex



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January 2013

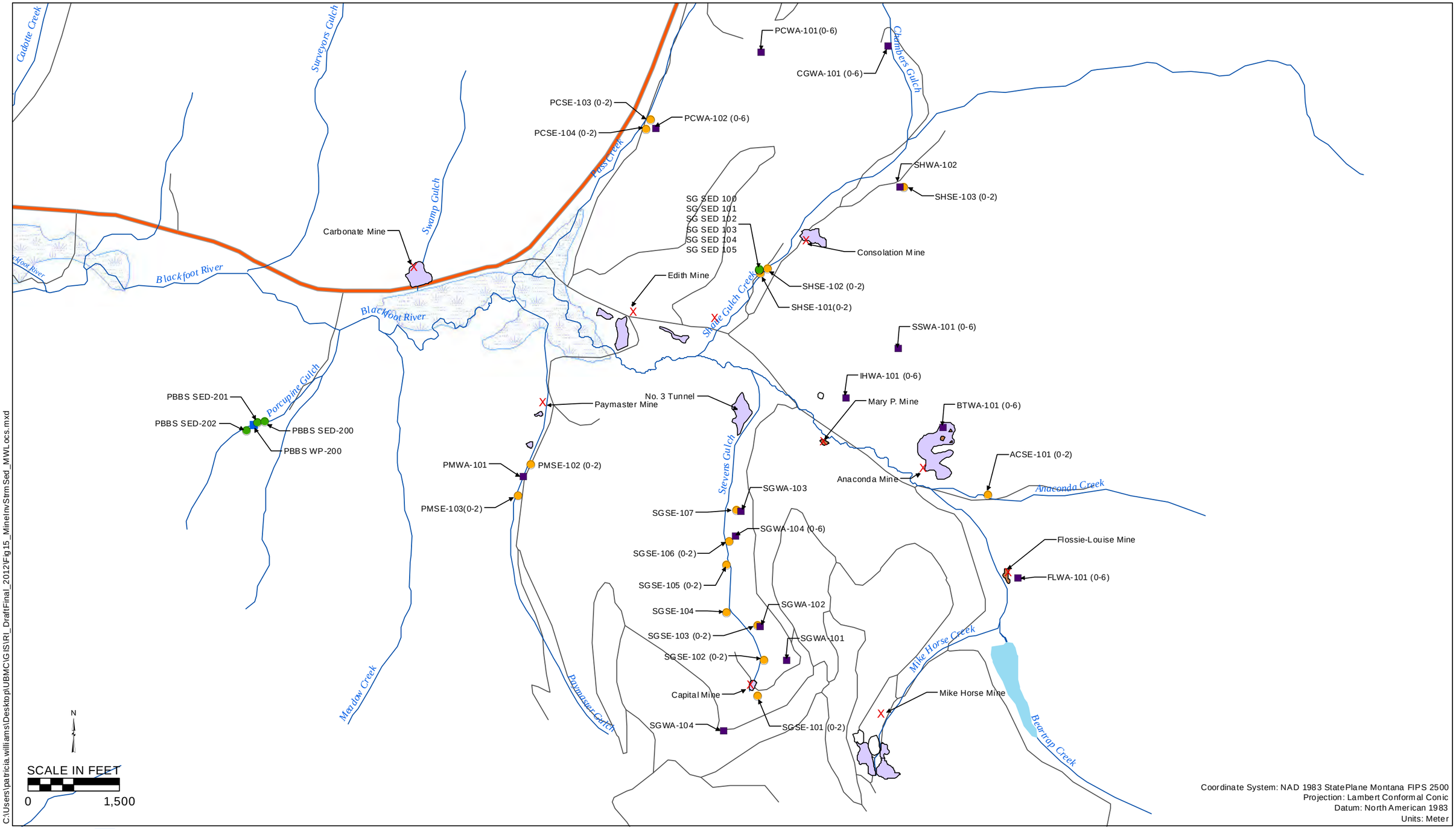
Figure 14

Mine Inventory Surface Water Locations

Remedial Investigation

Upper Blackfoot Mining Complex

X Mines
Adit Locations
Surface Water Sample Locations
Streams
Sections
Estimated Extent of Mine Areas (Sampled 2007/2008)
Former Wetland Treatment Cells
Mine Waste Areas (Not Sampled)
Unreclaimed Mine Waste Areas (Sampled 2007/2008)
Highway
Local Road
Marsh Area
Mike Horse Tailings Impoundment



Coordinate System: NAD 1983 StatePlane Montana FIPS 2500
Projection: Lambert Conformal Conic
Datum: North American 1983
Units: Meter

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Marsh Area
Estimated Extent of Mine Areas (Sampled 2007/2008)
Mine Waste Areas (Not Sampled)
Unreclaimed Mine Waste Areas (Sampled 2007/2008)

X Mines
2008 Mine Inventory Sediment Sample Locations
2008 Mine Inventory Mine Waste Sample Locations
2011 Mine Inventory Sediment Sample Locations
2011 Mine Inventory Mine Waste Sample Locations

Streams
Highway
Local Road

Notes:
SGWA-101 is referenced as SSWA-101 on Mine Inventory table.
PCWA-101 is referenced as PCMW-101 on Mine Inventory table.

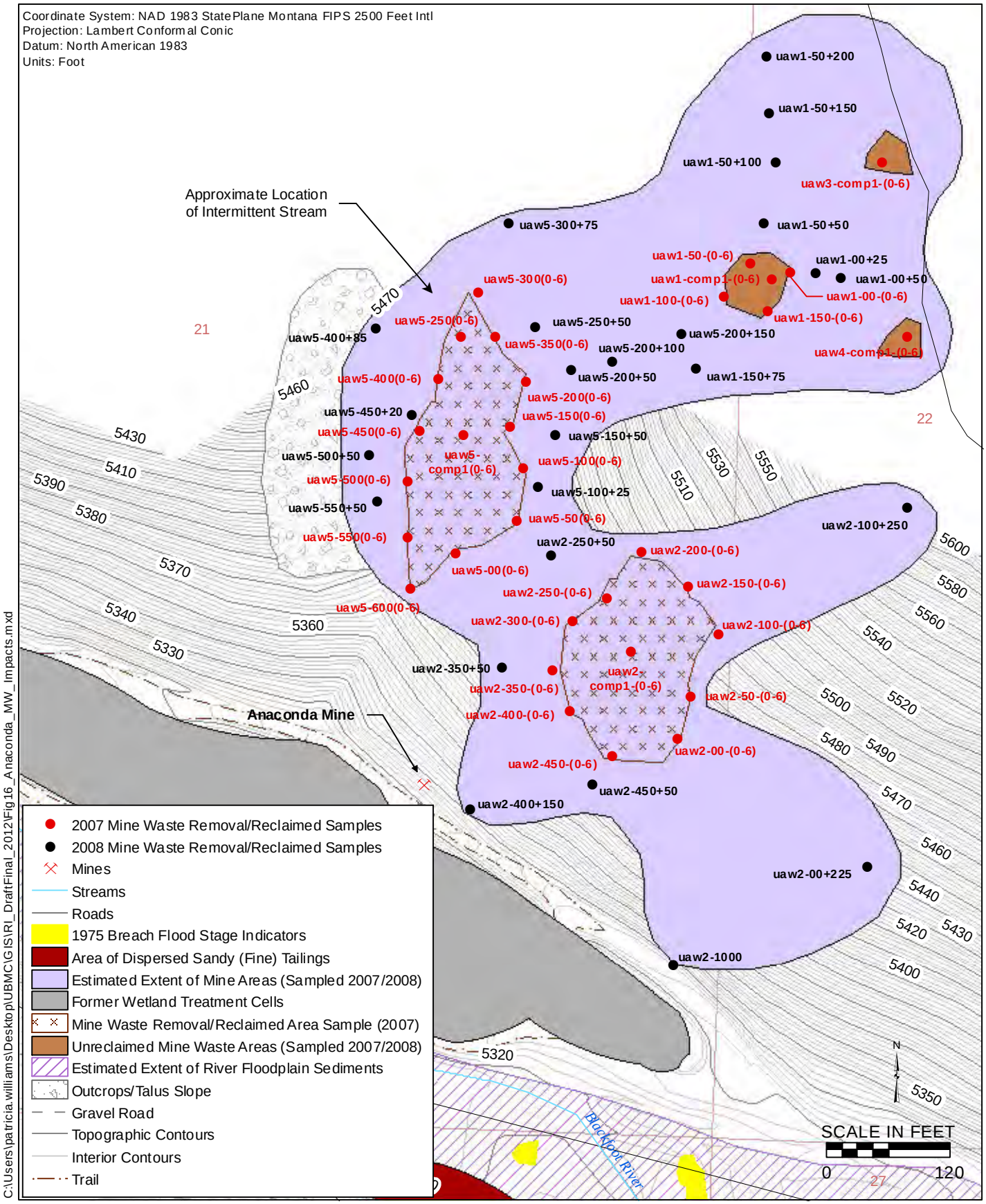
January 2013

Figure 15

Mine Inventory Streambed Sediment and Mine Waste Locations

Remedial Investigation

Upper Blackfoot Mining Complex



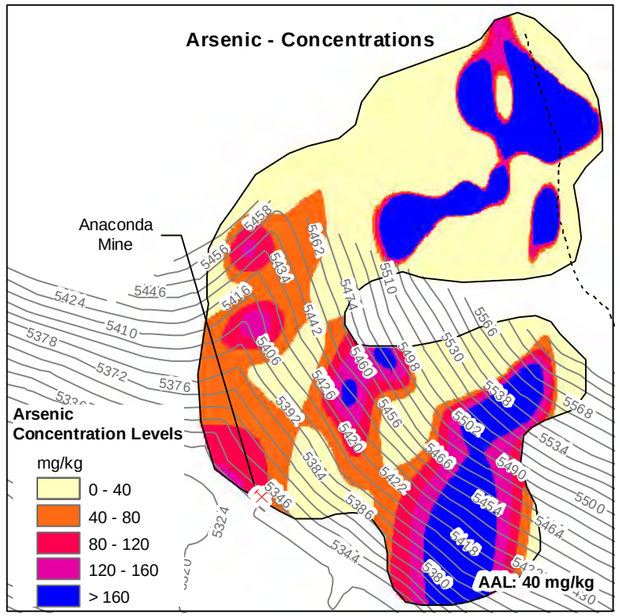
January 2013

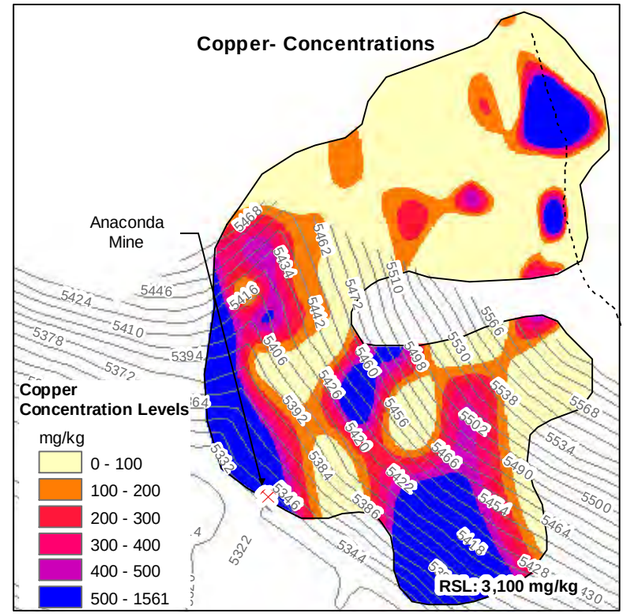
Figure 16

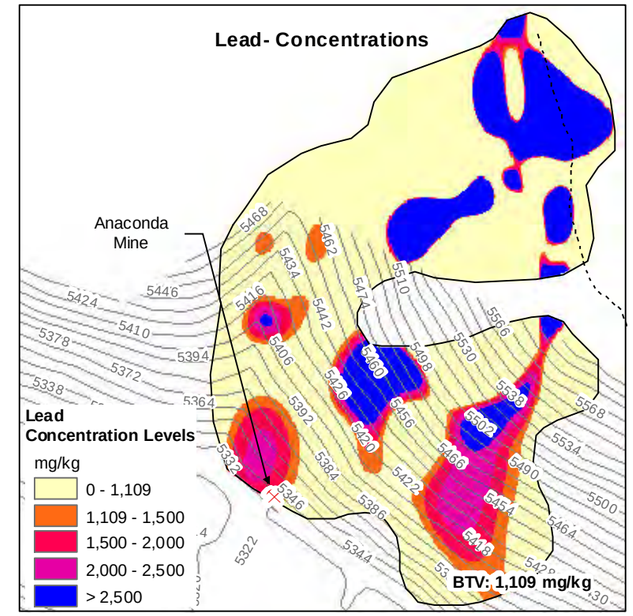
Anaconda Area - Mine Waste Impacts

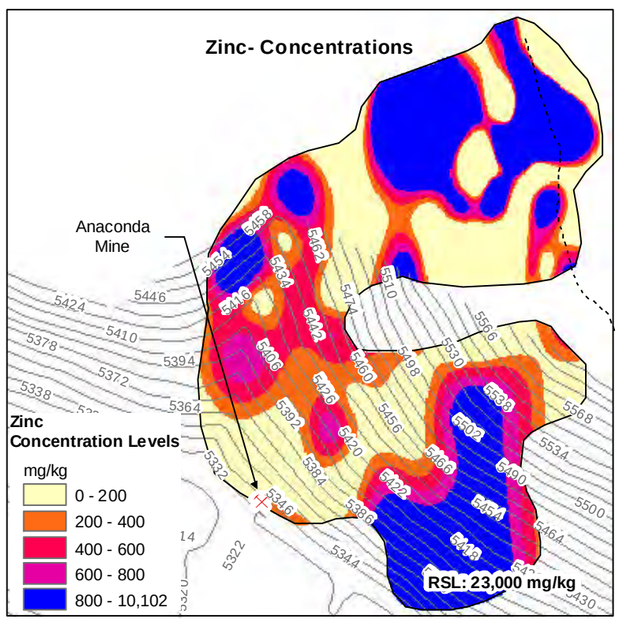
Remedial Investigation

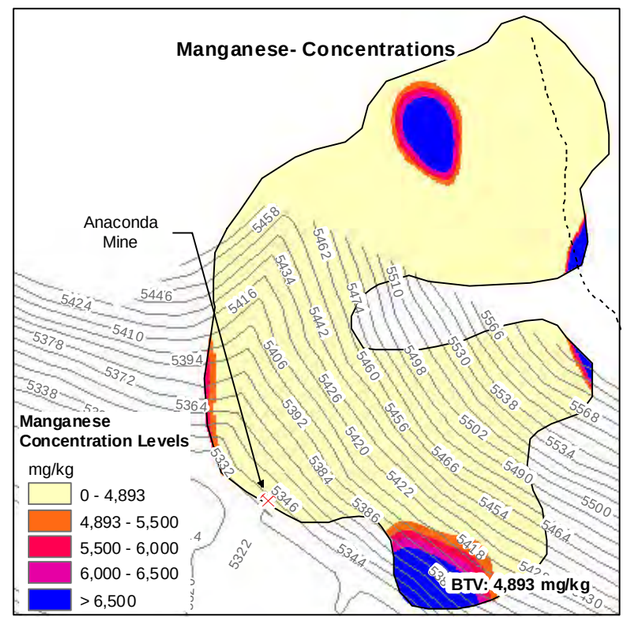
Upper Blackfoot Mining Complex

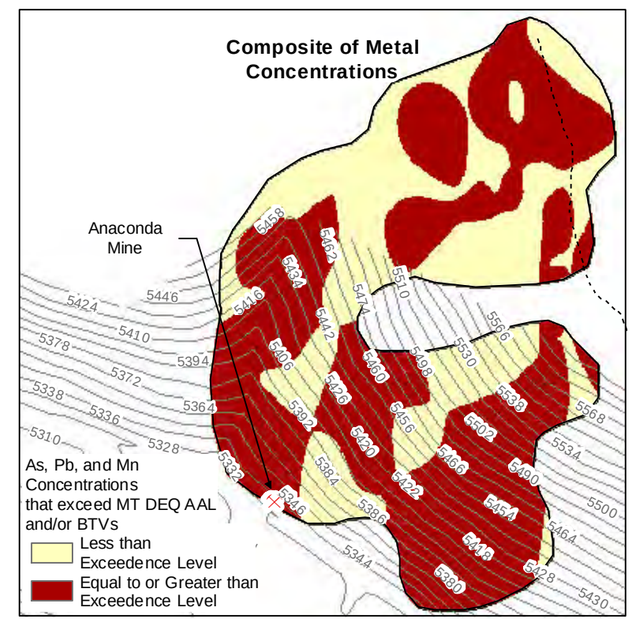












N

SCALE IN FEET
0 258

AAL - Montana DEQ Arsenic Action Level
BTV - Background Threshold Value
RSL - EPA Regional Screening Level

Note: XRF data was used to perform the evaluation

Mines
Roads
Estimated Extent of Mine Area (sampled 2007/2008)
Topographic Contours

January 2013

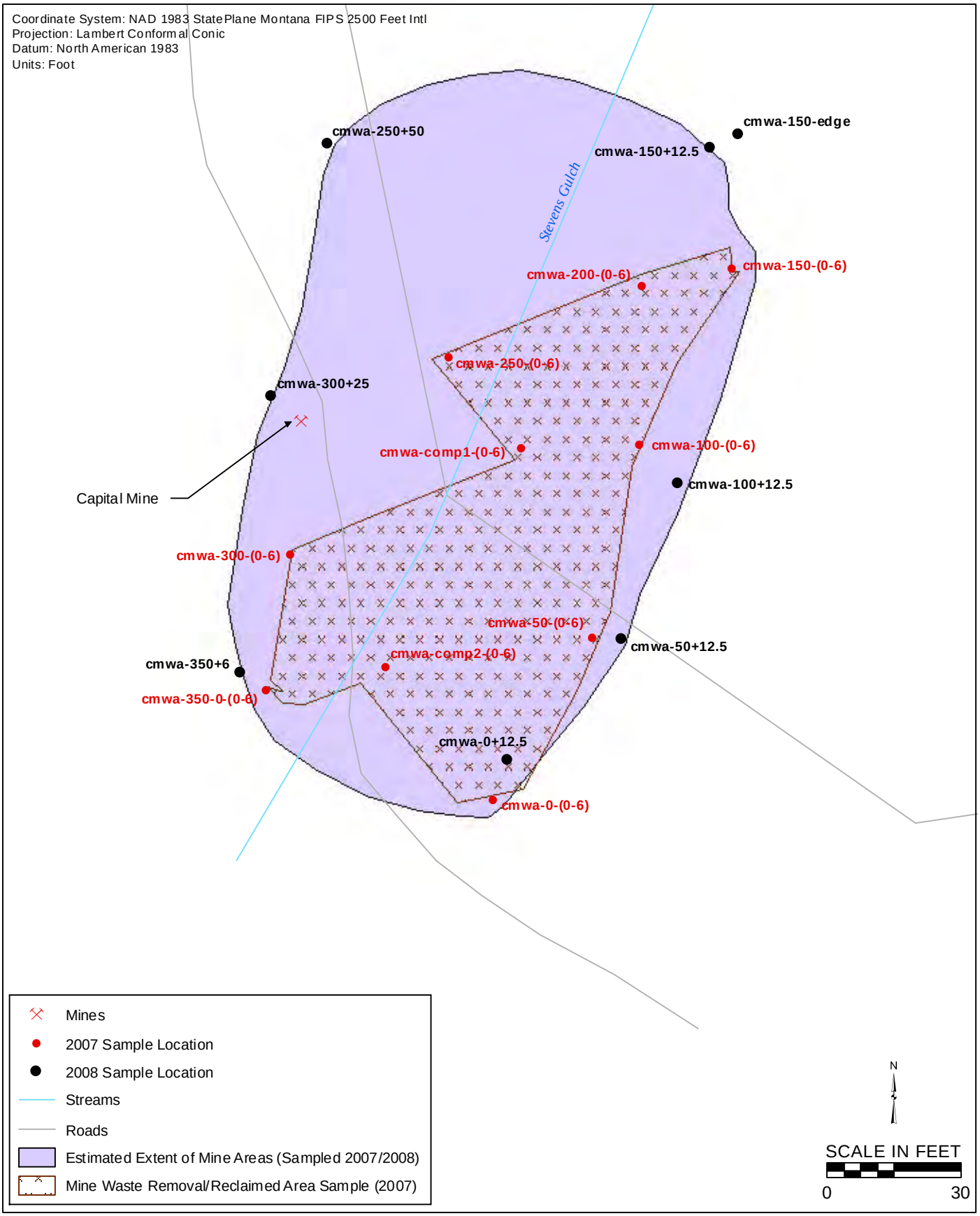
Figure 17

Comparison of Site Concentrations for Arsenic, Copper, Lead, Zinc, and Manganese

Anaconda Mine Waste Area

Remedial Investigation

Upper Blackfoot Mining Complex



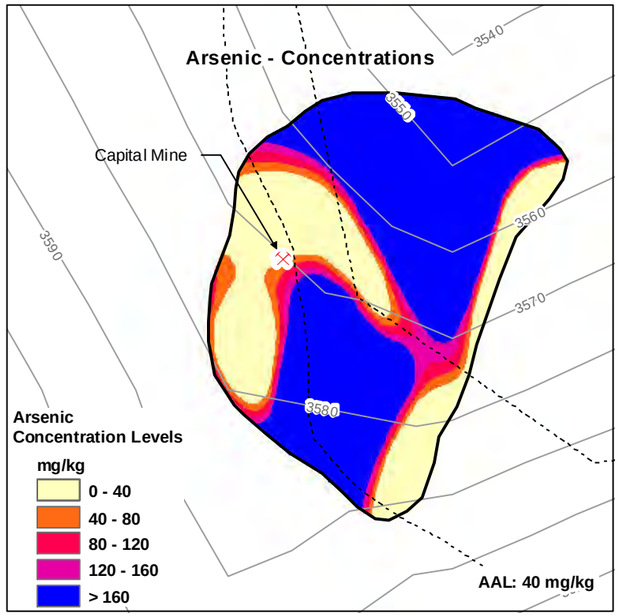
January 2013

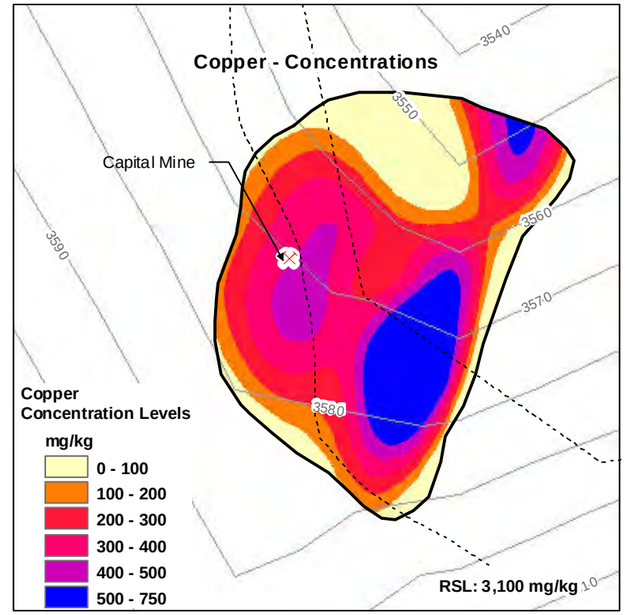
Figure 18

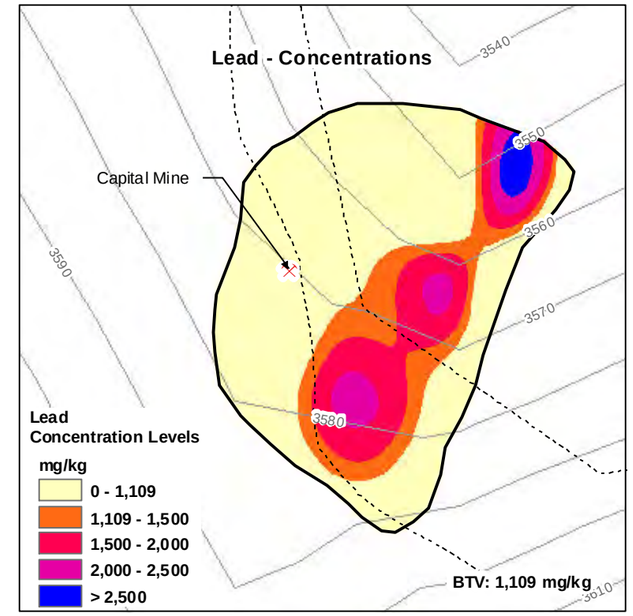
Capital Area - Mine Waste Impacts

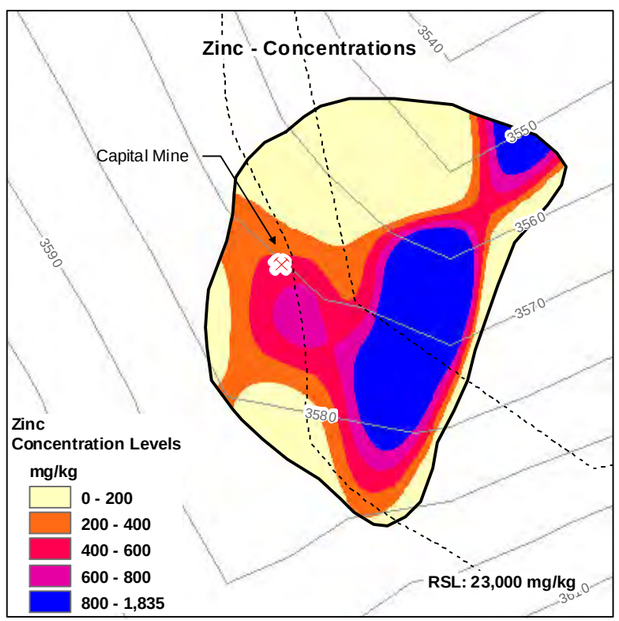
Remedial Investigation

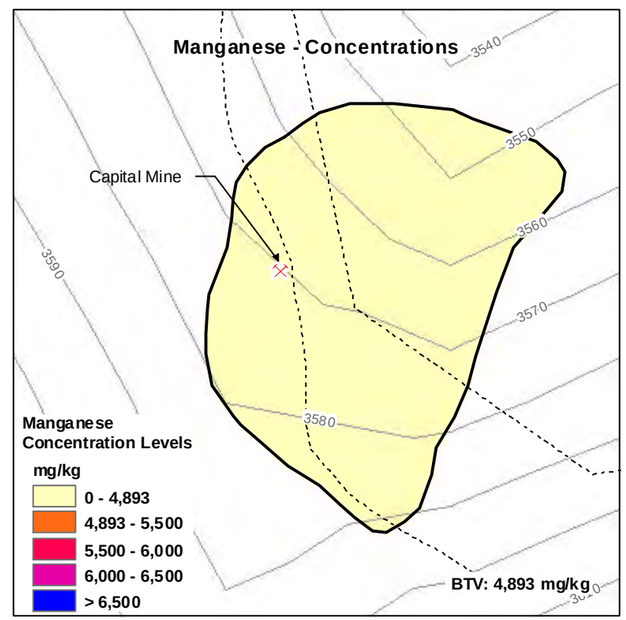
Upper Blackfoot Mining Complex

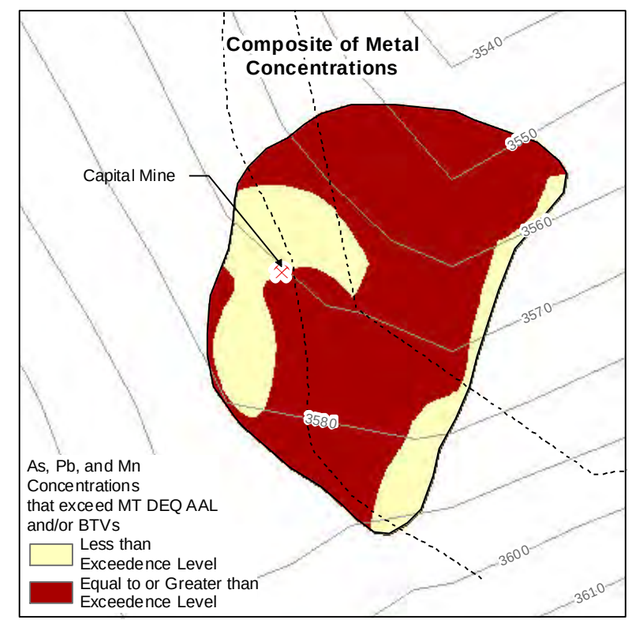












N

SCALE IN FEET

0 67

AAL - Montana DEQ Arsenic Action Level
BTV - Background Threshold Value
RSL - EPA Regional Screening Level

Note: XRF data was used to perform the evaluation

Mines
Roads
Estimated Extent of Mine Area (sampled 2007/2008)
Topographic Contours

January 2013

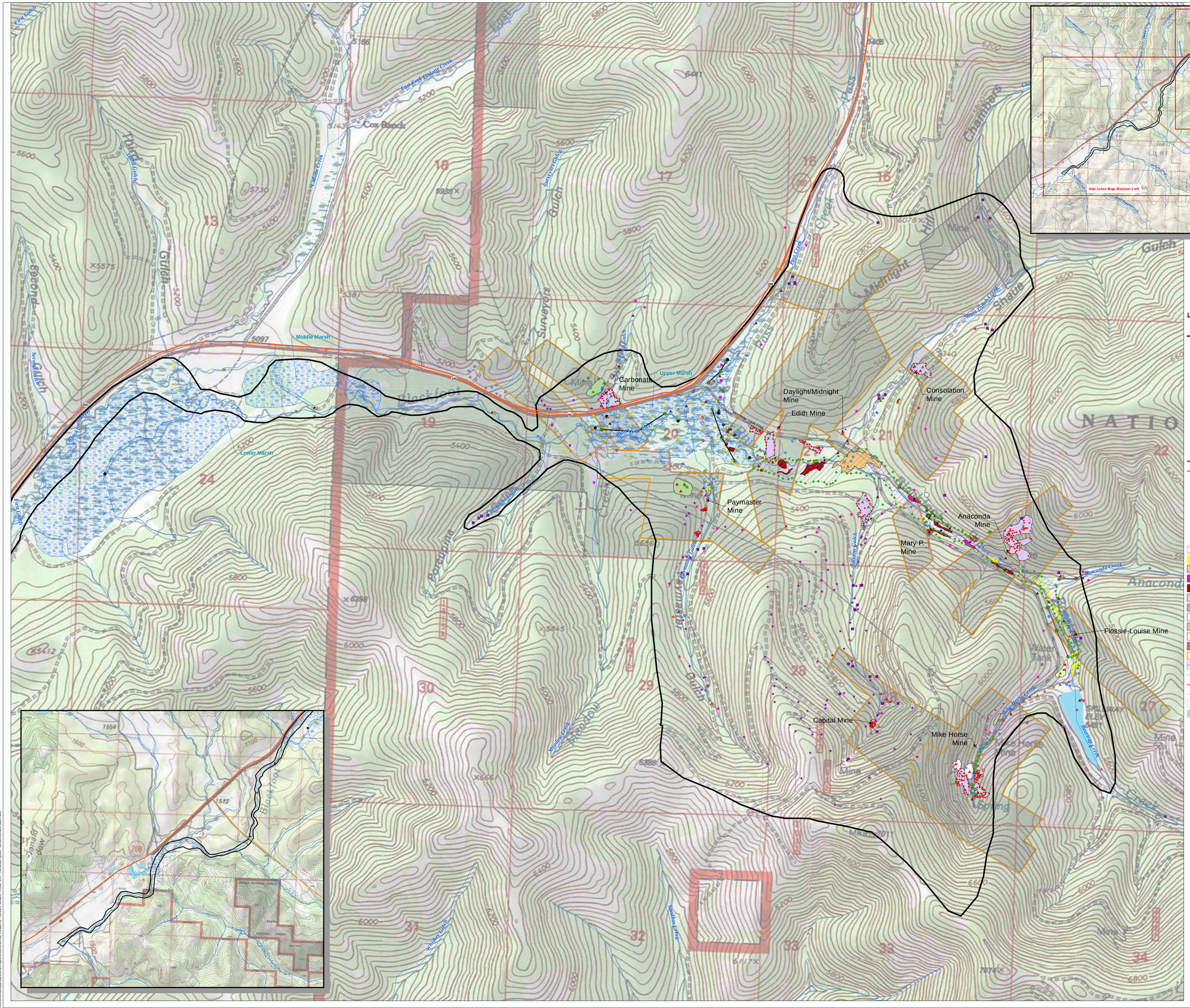
Figure 19

Comparison of Site Concentrations for Arsenic, Copper, Lead, Zinc, and Manganese

Capital Mine Waste Area

Remedial Investigation

Upper Blackfoot Mining Complex



LEGEND

- Estimated River Floodplain Sediment Sample
- UBMC Estimated Extent of Contamination (dashed where inferred)
- Mine Waste Removal/Reclaimed Samples
- Bioassay Reference Sample
- Benthic/Macroinvertebrate Sampling Locations
- Upper Blackfoot Test Pit Locations
- Historic Surface Water Sampling Locations
- RI Surface Water Sampling Locations
- Background Soil Samples
- Historic Sediment Sample Location
- Streambed Sediment Sampling Location
- Marsh Sediment Sample Location
- Marsh Background Sediment Sample Location
- Eco-Risk Sample Location
- Marsh Surface Transect
- Terrestrial Receptor Transects
- Paymaster Underlying Soil Sample
- Mine Inventory Mine Waste, Surface Water or Stream Sediment Sample Location
- Piezometers
- Groundwater Monitoring Well
- Cover Soil Transect
- Reclamation Soil Sample
- Mine Inventory Feature
- Estimated Extent of Impacted Floodplain Sediments
- 1975 Breach Flood Stage Indicators
- Area of Concentrated Tailings/Mine Waste
- Area of Dispersed Coarse-Grained Tailings
- Area of Dispersed Sandy (Fine) Tailings
- Estimated Extent of Mine Areas (Sampled 2007/2008)
- Former Wetland Treatment Cells
- Mine Waste Areas (Not Sampled)
- Mine Waste Repository
- Old Mike Horse Mine Townsite
- Unreclaimed Mine Waste Areas (Sampled 2007/2008)
- ASARCO Patented Mine Claims
- Marshes
- Local Roads
- State Highway
- Streams
- Sections
- Lakes

N

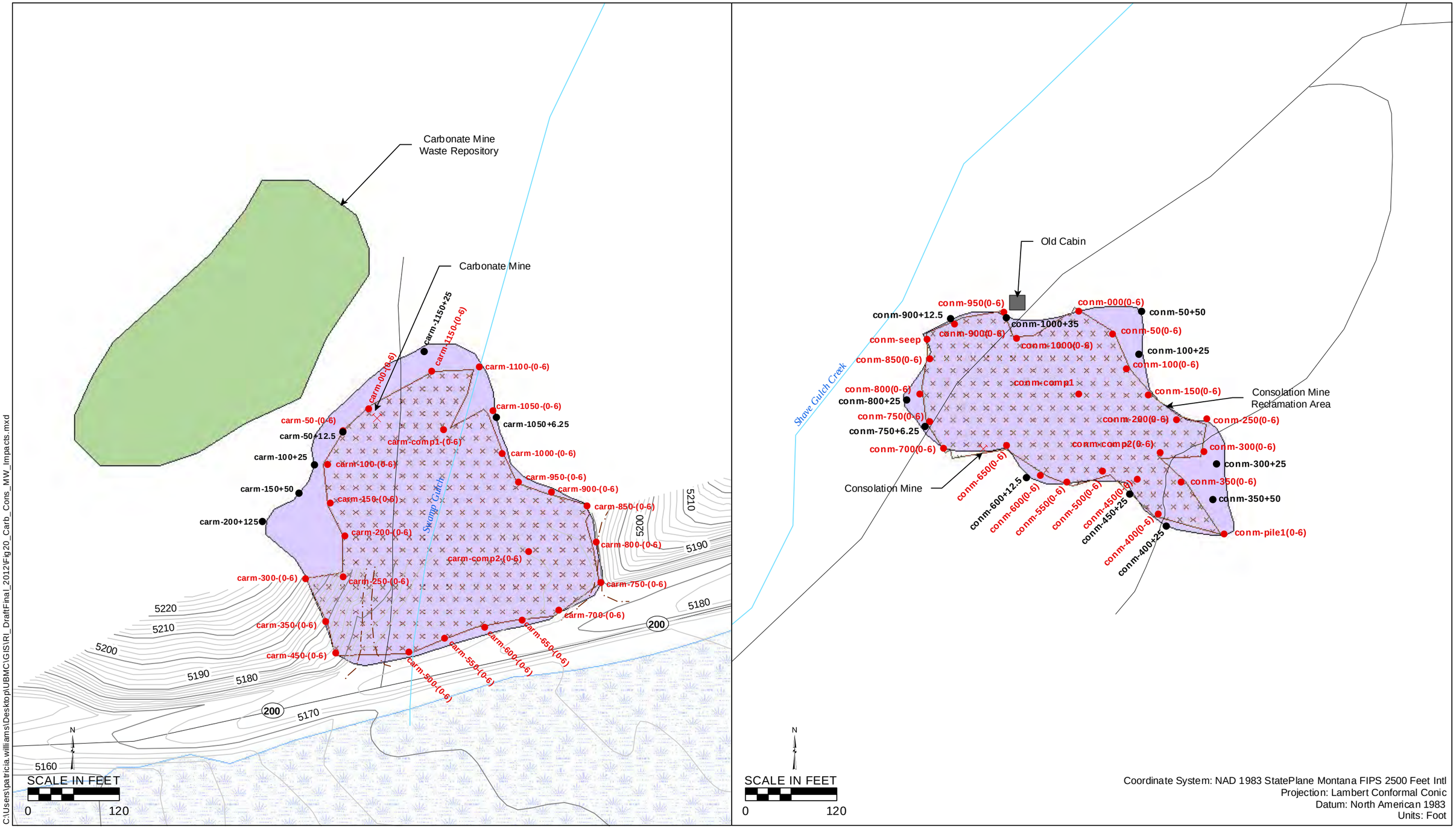
SCALE IN FEET
600 0 1,200

PROJECT NO:	1157561589
DATE:	JUNE 2012
DESIGNED BY:	PAW
DRAWN BY:	PAW
CHECKED BY:	NJM
APPROVED BY:	NJM

Existing Conditions
Remedial Investigation Report
Upper Blackfoot Mining Complex

PREPARED FOR:
Montana DEQ
Remediation Division

DRAWING NO:
FIG 2



C:\Users\patricia.williams\Desktop\UBMC\GIS\RI_DraftFinal_2012\Fig20_Carb_Cons_MW_Impacts.mxd

Mines
2007 Mine Waste Removal/Reclaimed Samples
2008 Mine Waste Removal/Reclaimed Samples
Marshes
Estimated Extent of Mine Areas (Sampled 2007/2008)
Mine Waste Removal/Reclaimed Area Sample (2007)
Mine Waste Repository
Streams
Gravel Road
Topographic Contours
Interior Contours
Trail

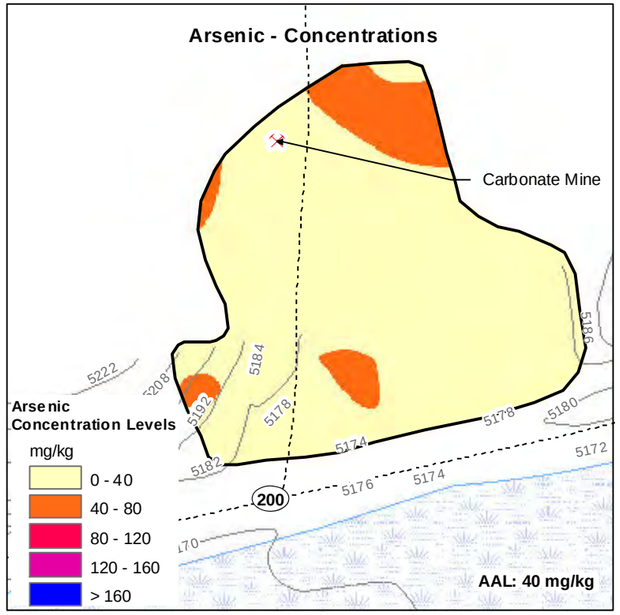
January 2013

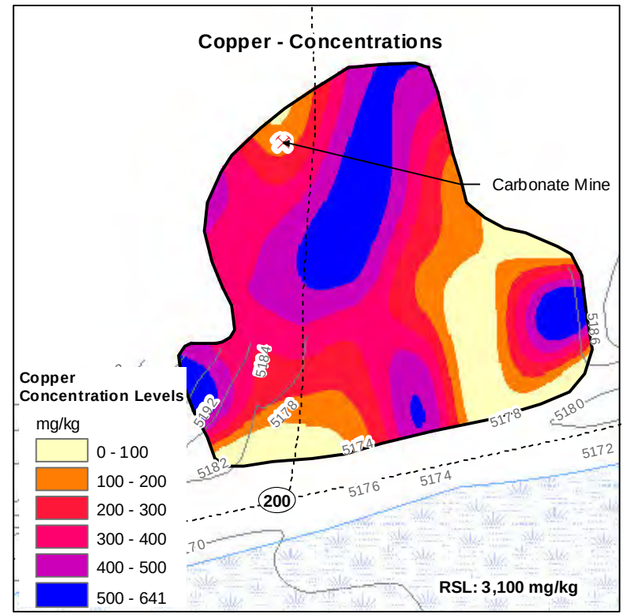
Figure 20

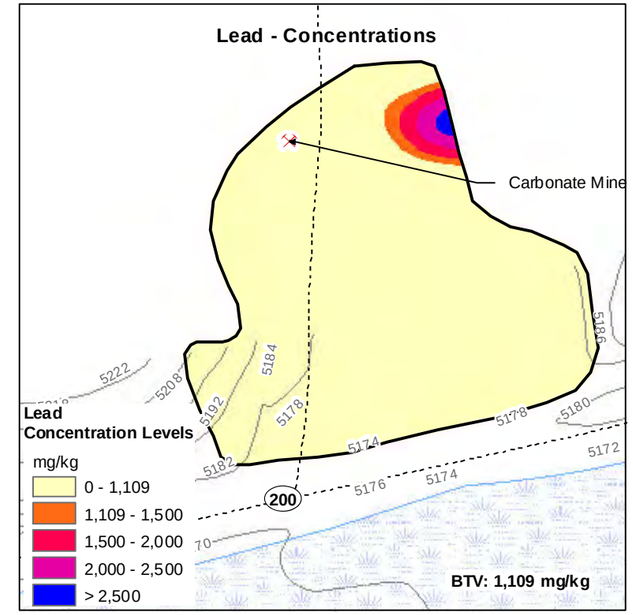
Carbonate & Consolation Areas - Mine Waste Impacts

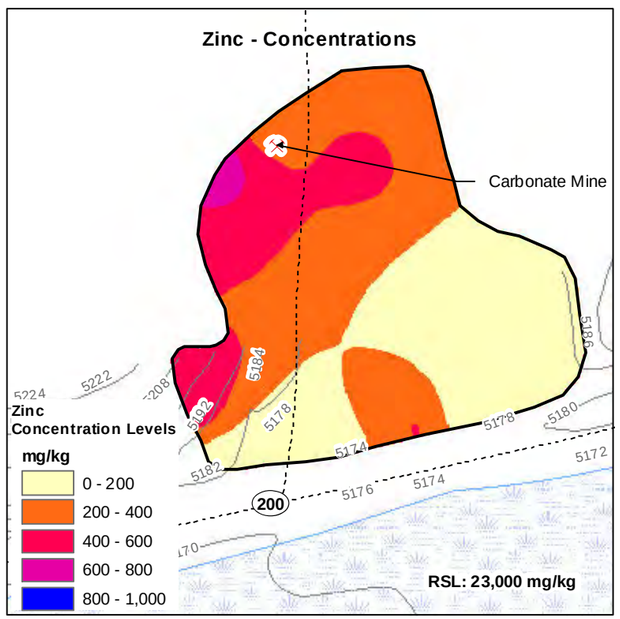
Remedial Investigation

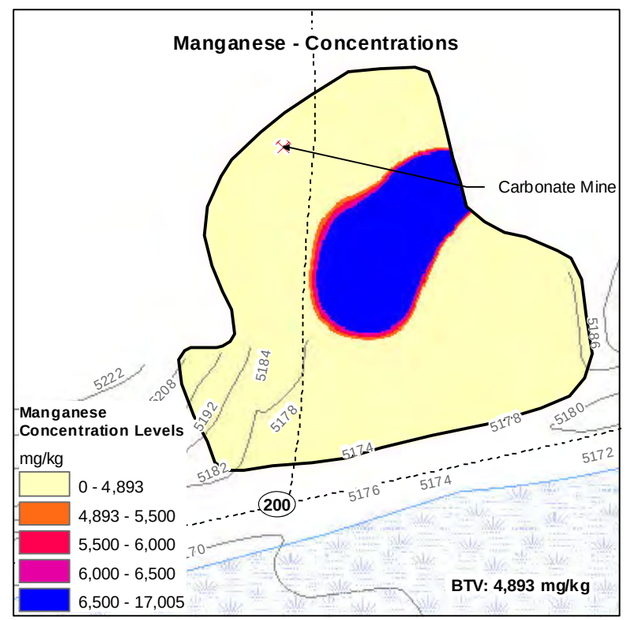
Upper Blackfoot Mining Complex

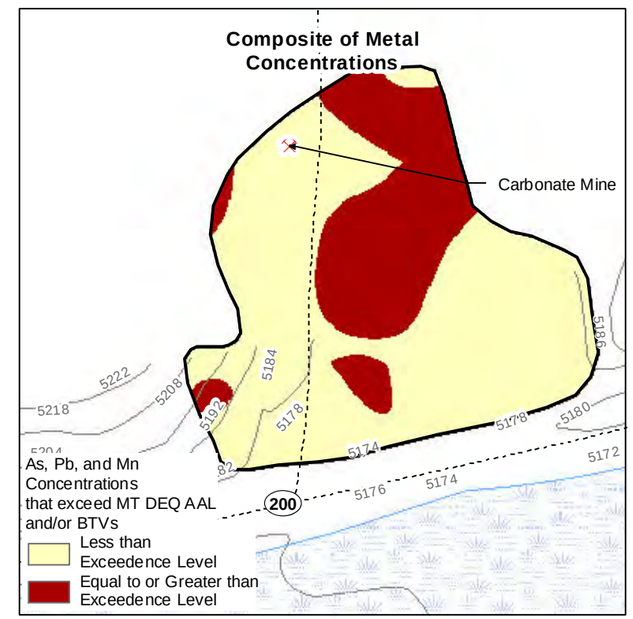












N

SCALE IN FEET
0 158

AAL - Montana DEQ Arsenic Action Level
BTV - Background Threshold Value
RSL - EPA Regional Screening Level

Note: XRF data was used to perform the evaluation

Mines
Roads
Estimated Extent of Mine Area (sampled 2007/2008)
Marsh
Topographic Contours

January 2013

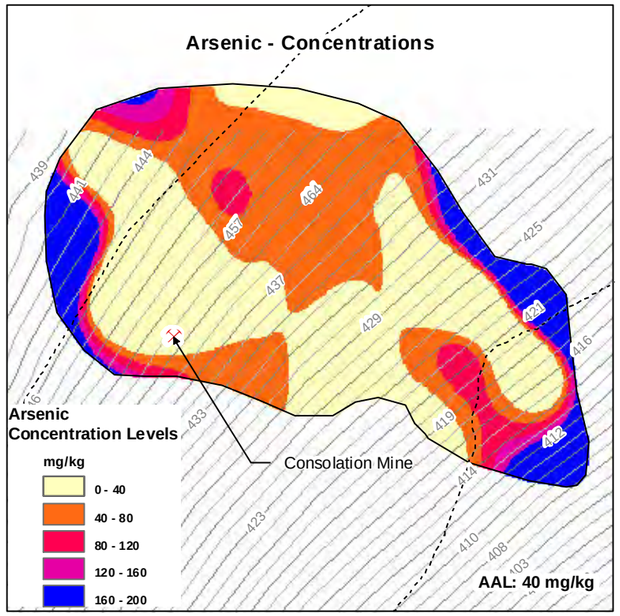
Figure 21

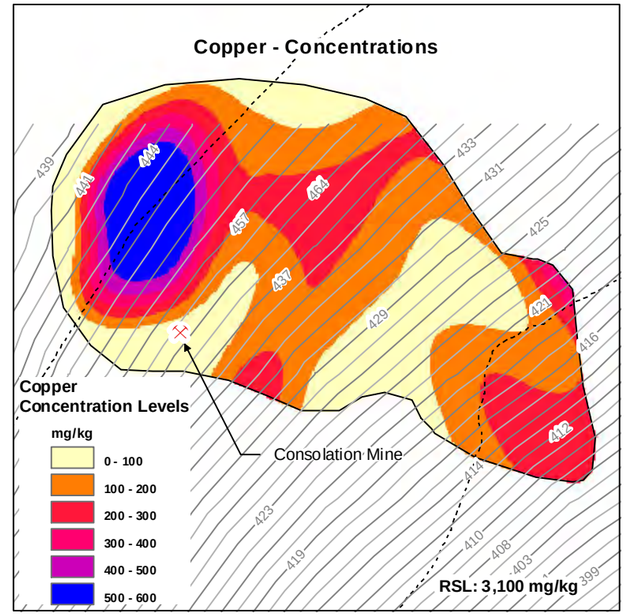
Comparison of Site Concentrations for Arsenic, Copper, Lead, Zinc, and Manganese

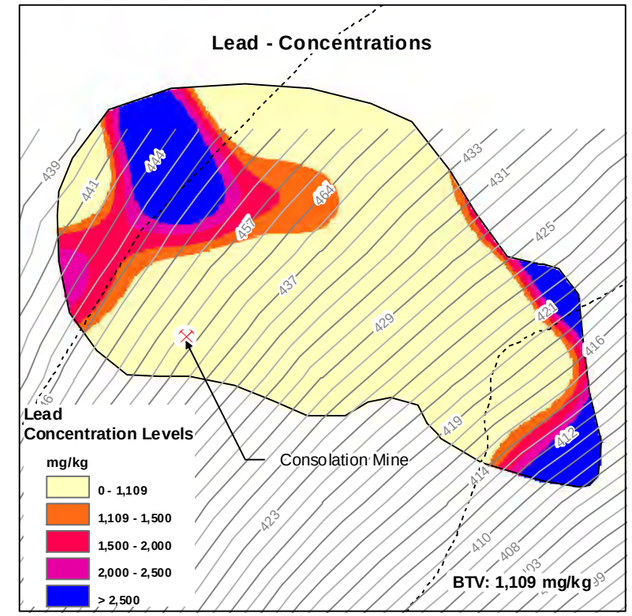
Carbonate Mine Waste Area

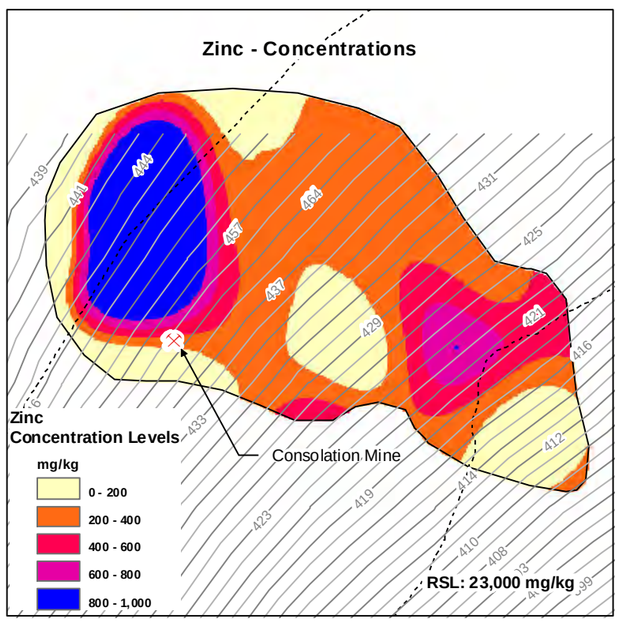
Remedial Investigation

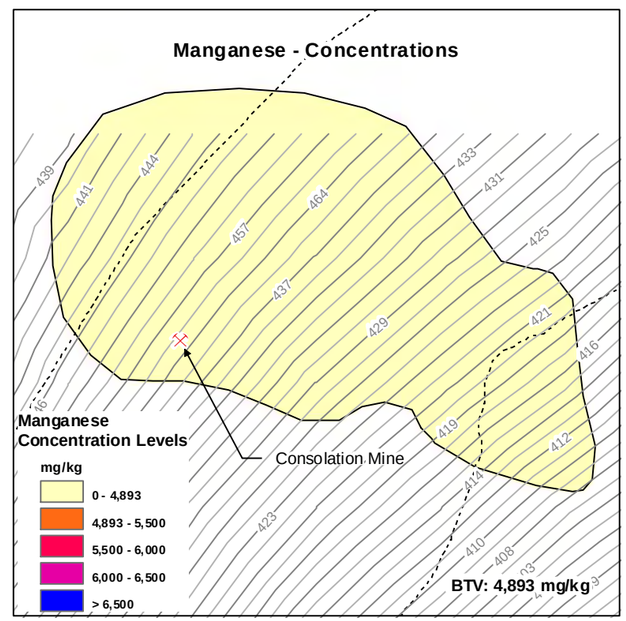
Upper Blackfoot Mining Complex

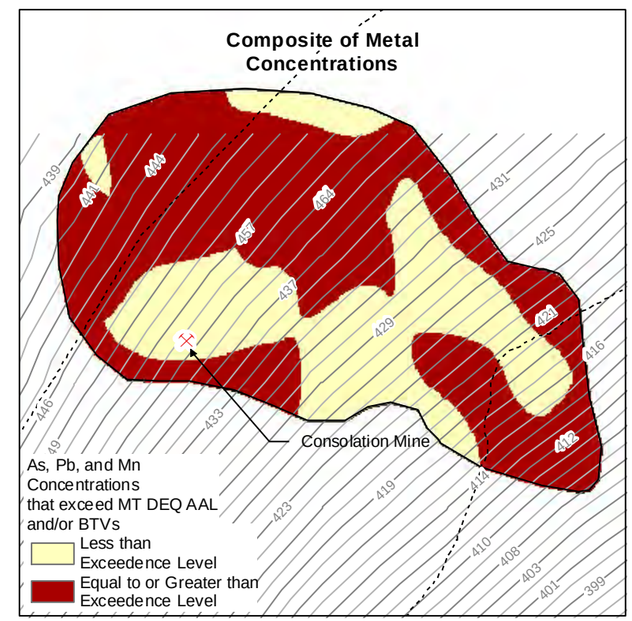












N

SCALE IN FEET
0 120

AAL - Montana DEQ Arsenic Action Level
BTV - Background Threshold Value
RSL - EPA Regional Screening Level

Note: XRF data was used to perform the evaluation

Mines
Roads
Estimated Extent of Mine Area (sampled 2007/2008)
Topographic Contours

January 2013

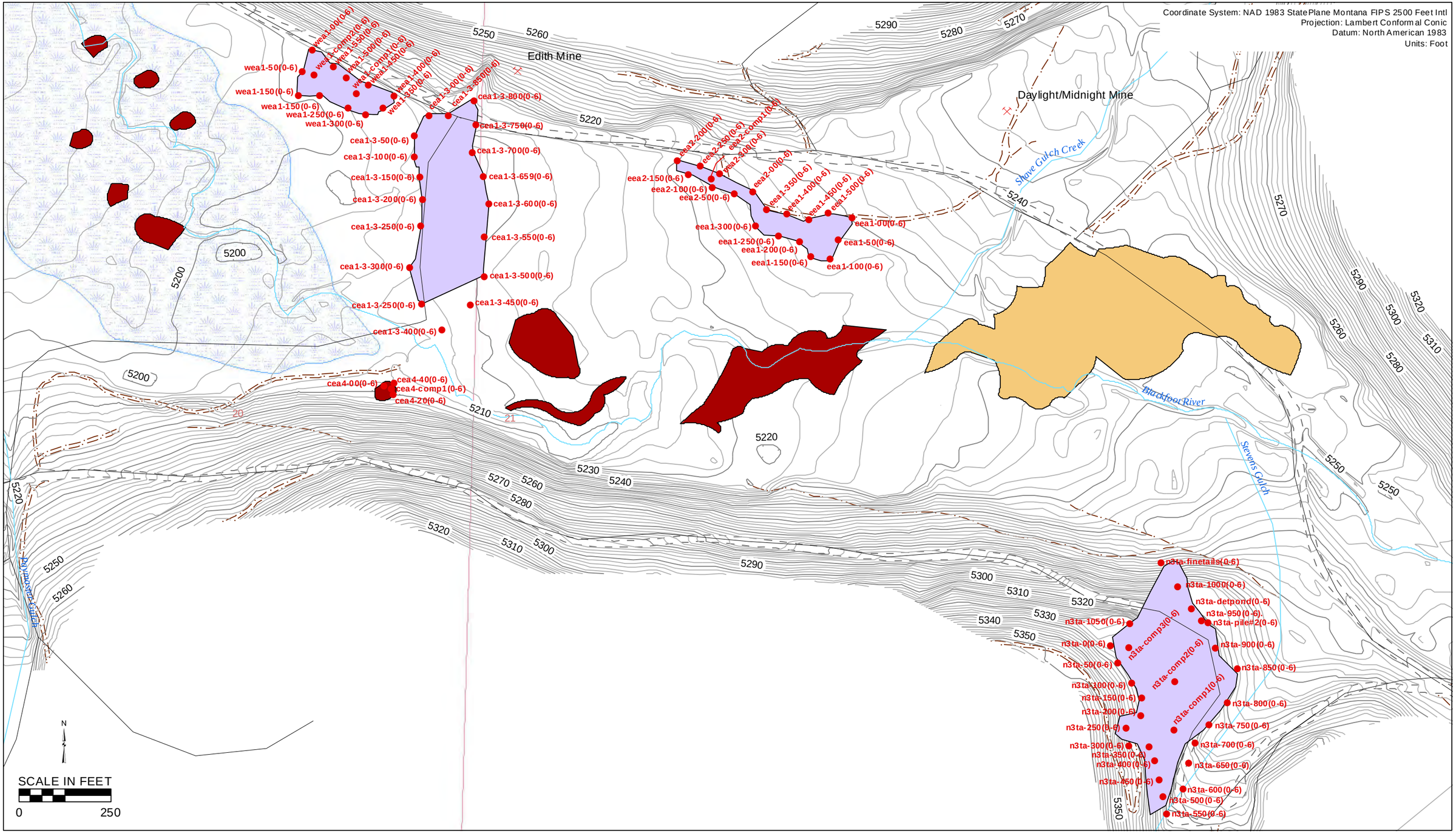
Figure 22

Comparison of Site Concentrations for Arsenic, Copper, Lead, Zinc, and Manganese

Consolation Mine Waste Area

Remedial Investigation

Upper Blackfoot Mining Complex



Mines
2007 Mine Waste Removal/Reclaimed Samples
Estimated Extent of River Floodplain Sediments
Sections
Estimated Extent of Mine Areas (Sampled 2007/2008)
Area of Concentrated Tailings/Mine Waste
Area of Dispersed Sandy (Fine) Tailings
Marshes
Gravel Road
Topographic Contours
Interior Contours
Trail
Streams

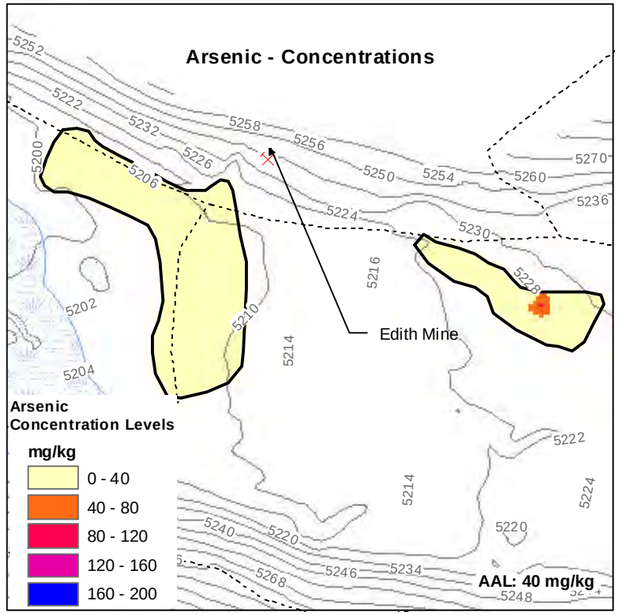
January 2013

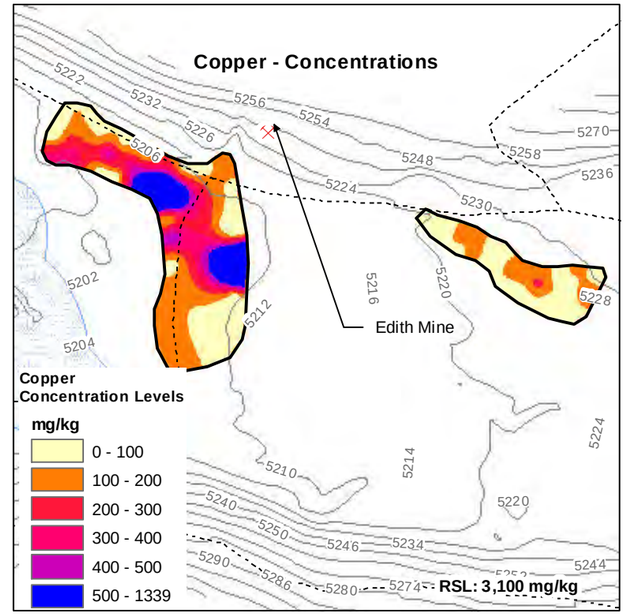
Figure 23

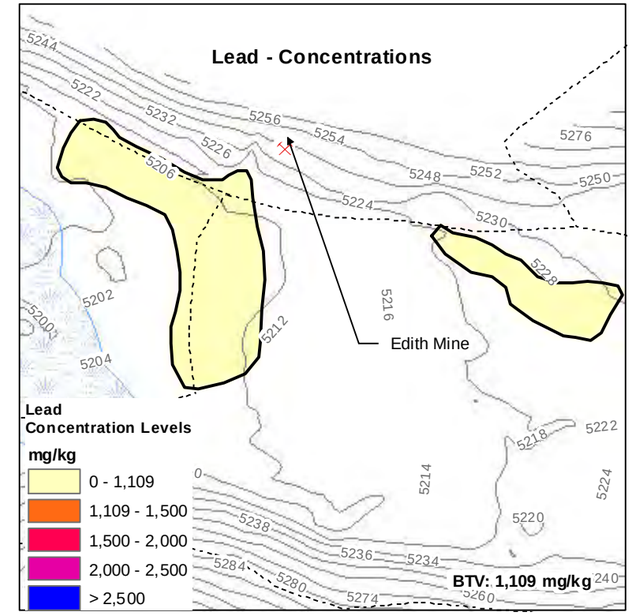
Edith Mine & No. 3 Tunnel Areas - Mine Waste Impacts

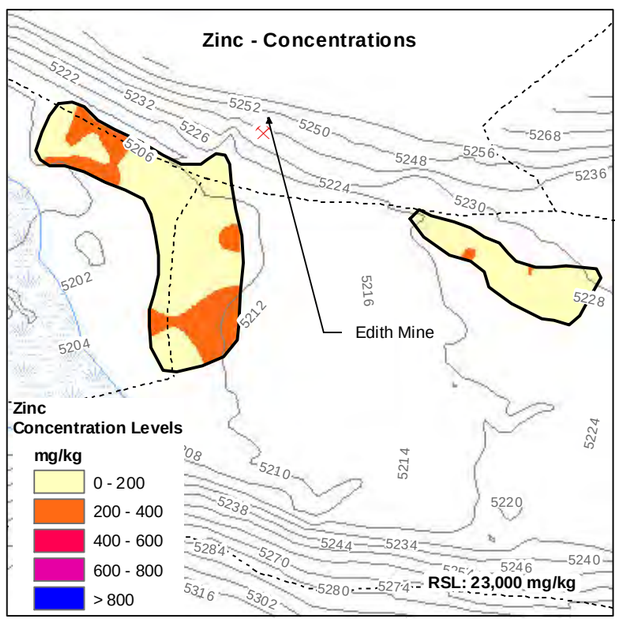
Remedial Investigation

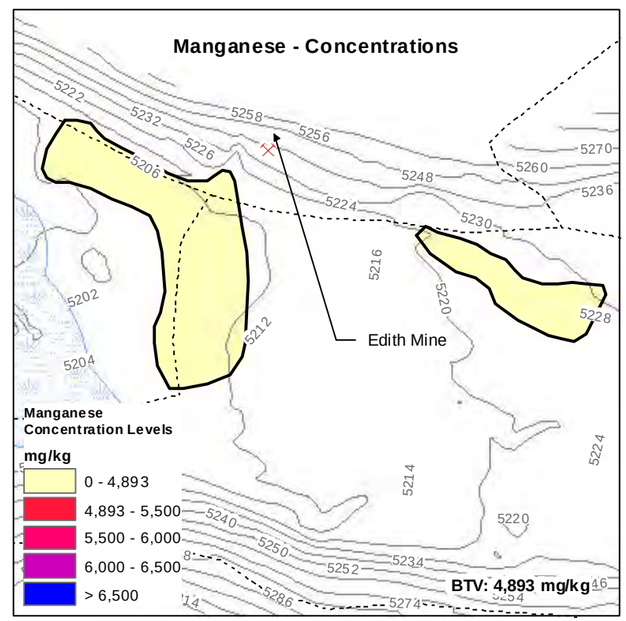
Upper Blackfoot Mining Complex

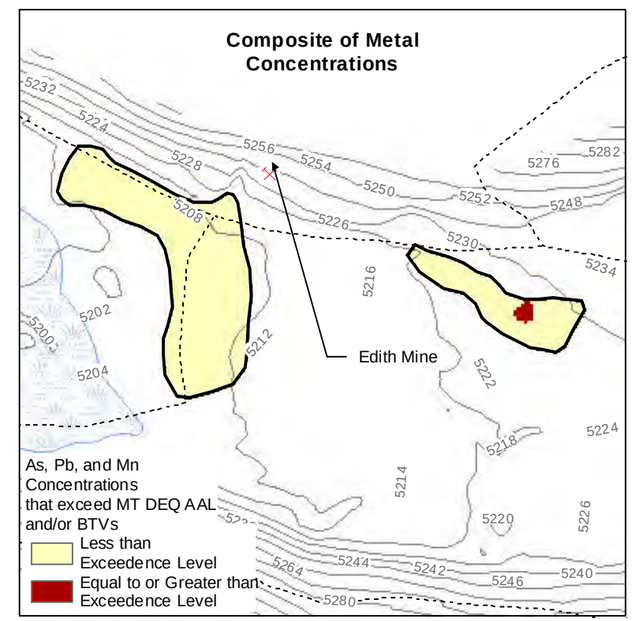












N

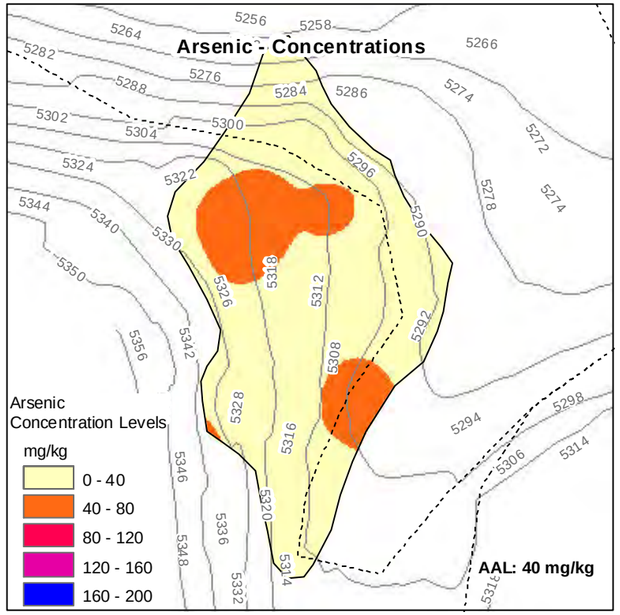
SCALE IN FEET
0 420

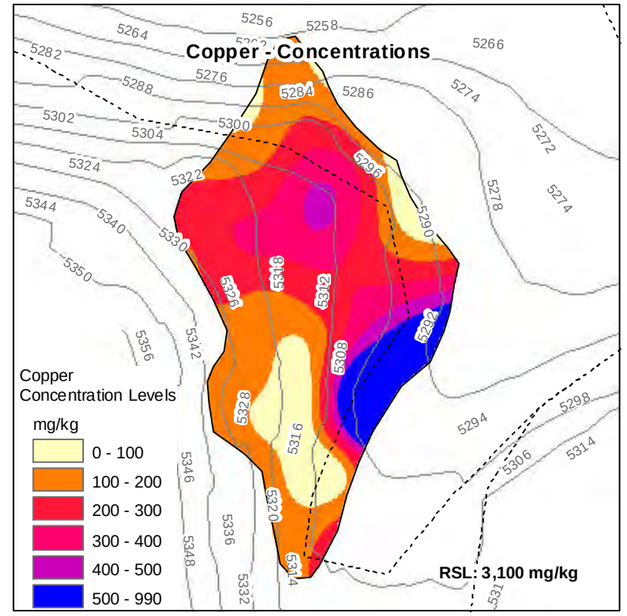
AAL - Montana DEQ Arsenic Action Level
BTV - Background Threshold Value
RSL - EPA Regional Screening Level

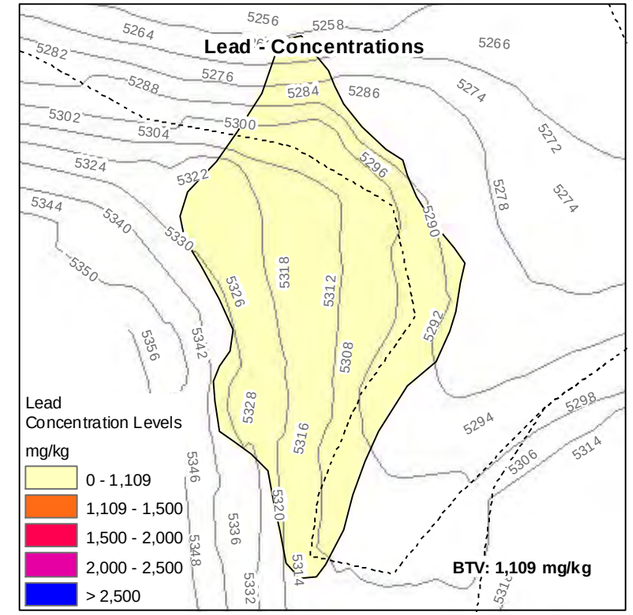
Note: XRF data was used to perform the evaluation

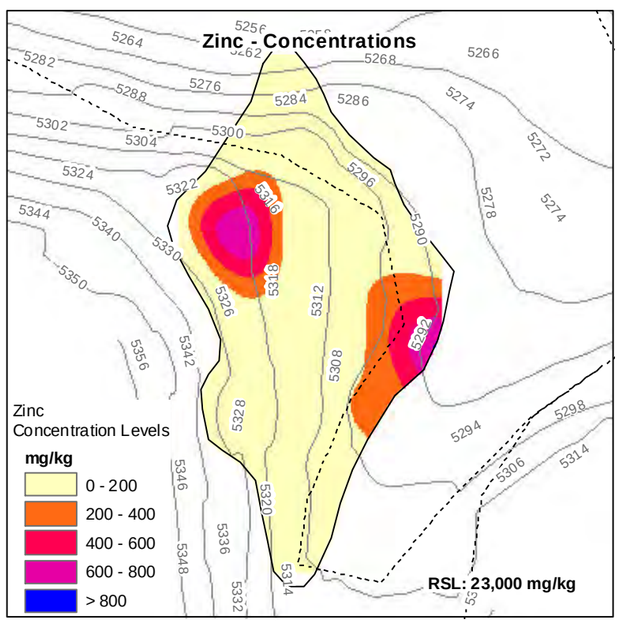
Mines
Roads
Estimated Extent of Mine Areas (Sampled 2007/2008)
Marsh
Topographic Contours

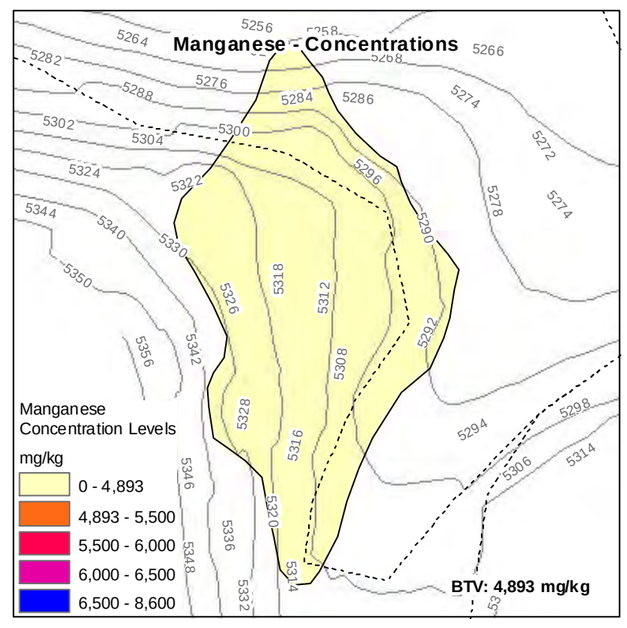
January 2013
Figure 24
Comparison of Site Concentrations for Arsenic, Copper, Lead, Zinc, and Manganese
Edith Mine Waste Area
Remedial Investigation
Upper Blackfoot Mining Complex

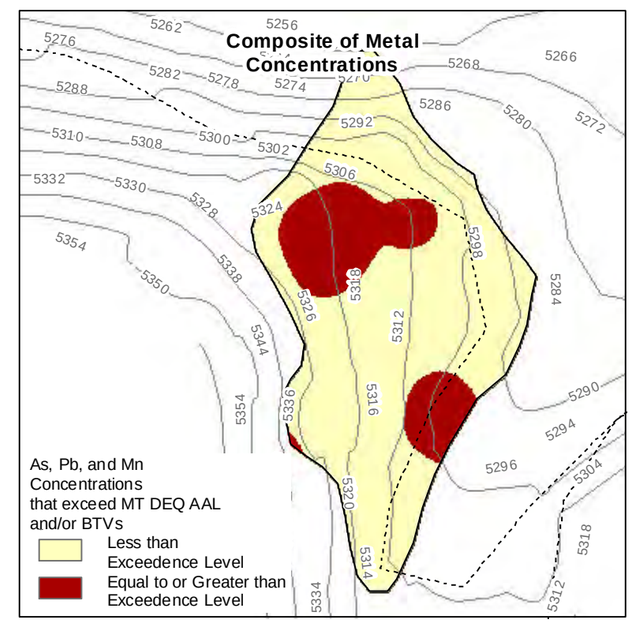












N

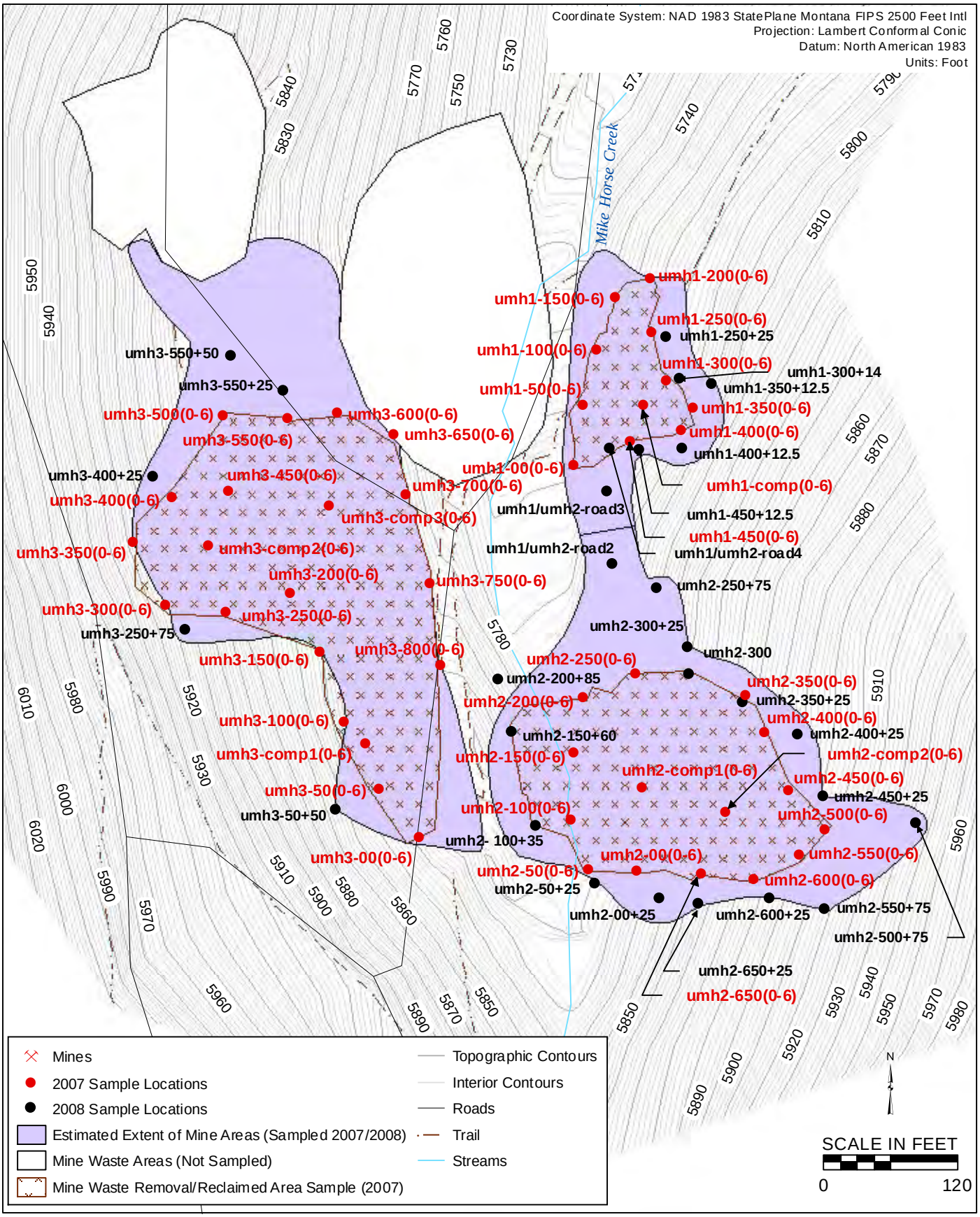
SCALE IN FEET
0 200

AAL - Montana DEQ Arsenic Action Level
BTV - Background Threshold Value
RSL - EPA Regional Screening Level

Note: XRF data was used to perform the evaluation

Mines
Roads
Estimated Extent of Mine Area (sampled 2007/2008)
Topographic Contours

January 2013
Figure 25
Comparison of Site Concentrations for Arsenic, Copper, Lead, Zinc, and Manganese
No. 3 Tunnel Waste Area
Remedial Investigation
Upper Blackfoot Mining Complex



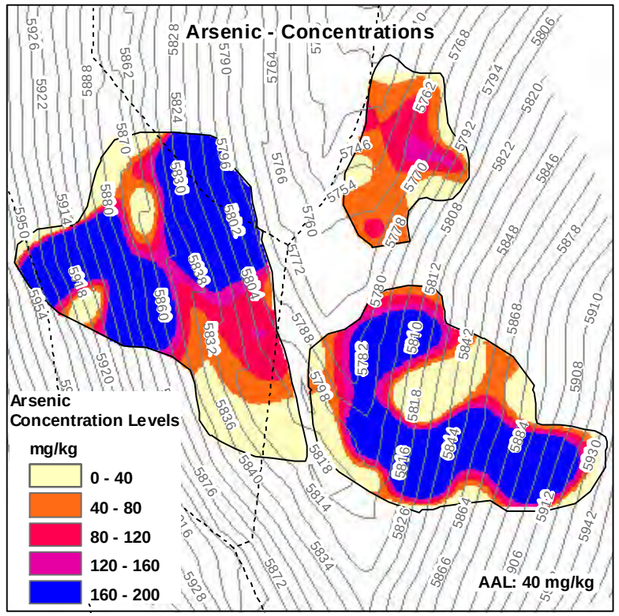
January 2013

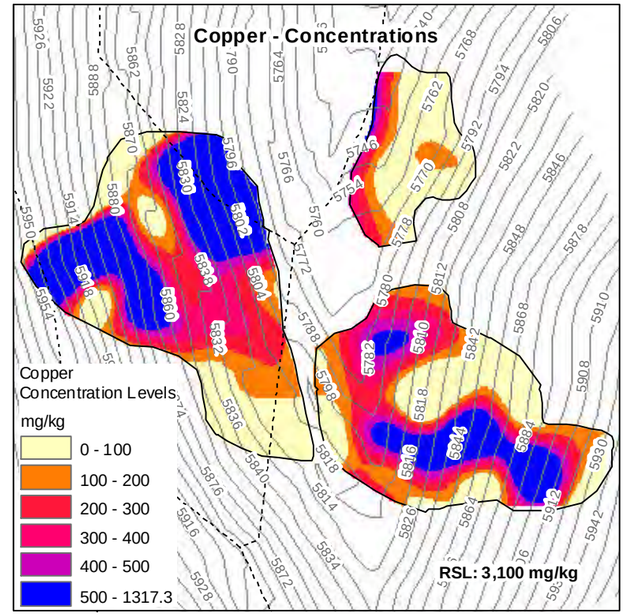
Figure 26

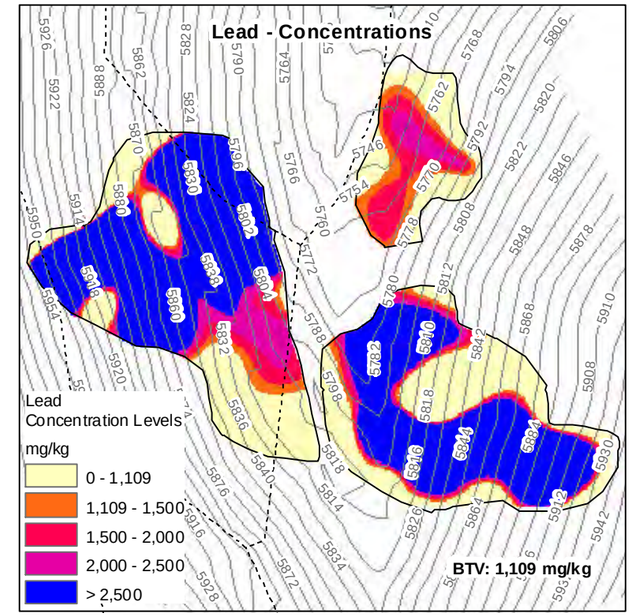
Mike Horse Areas - Mine Waste Impacts

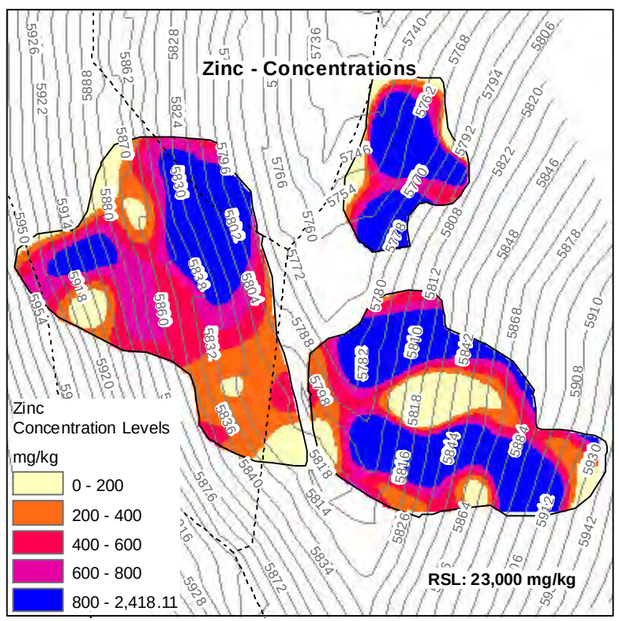
Remedial Investigation

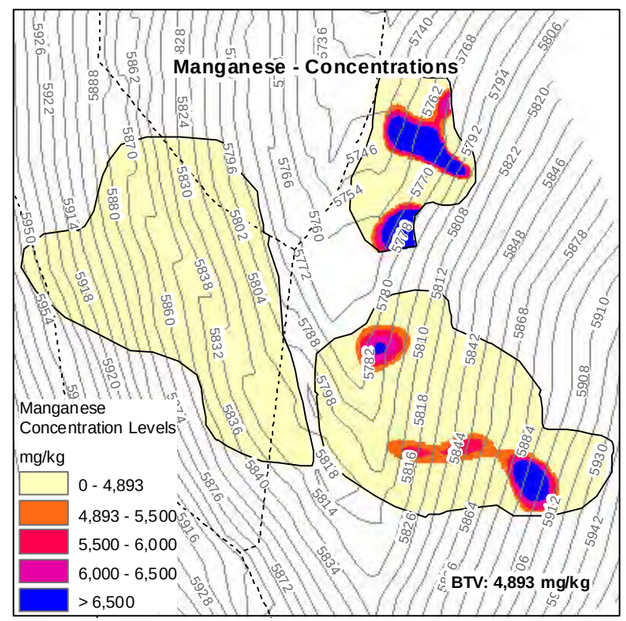
Upper Blackfoot Mining Complex

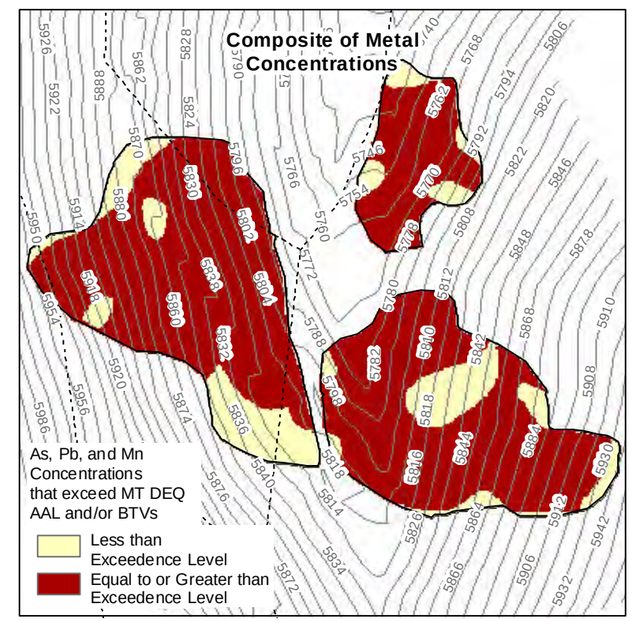












N

SCALE IN FEET
0 212

AAL - Montana DEQ Arsenic Action Level
BTV - Background Threshold Value
RSL - EPA Regional Screening Level

Note: XRF data was used to perform the evaluation

Mines
Roads
Estimated Extent of Mine Area (sampled 2007/2008)
Topographic Contours

January 2013

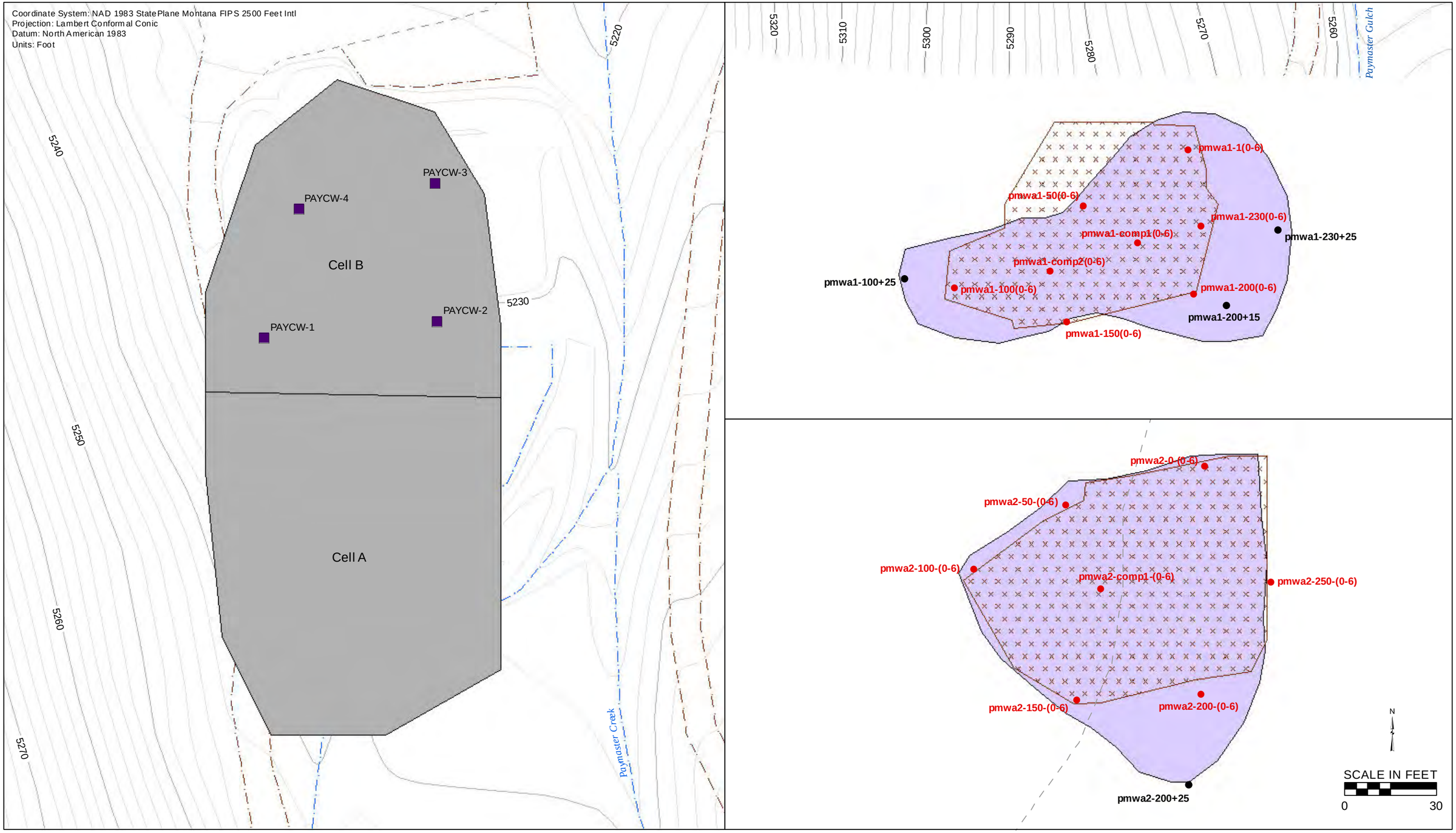
Figure 27

Comparison of Site Concentrations for Arsenic, Copper, Lead, Zinc, and Manganese

Upper Mike Horse Area

Remedial Investigation

Upper Blackfoot Mining Complex



Mines
2007 Mine Waste Removal/Reclaimed Samples
2008 Mine Waste Removal/Reclaimed Samples
Paymaster Underlying Soil Sample
Estimated Extent of Mine Areas (Sampled 2007/2008)
Former Wetland Treatment Cells
Mine Waste Removal/Reclaimed Area Sample (2007)
Gravel Road
Topographic Contours
Interior Contours
Trail
Stream

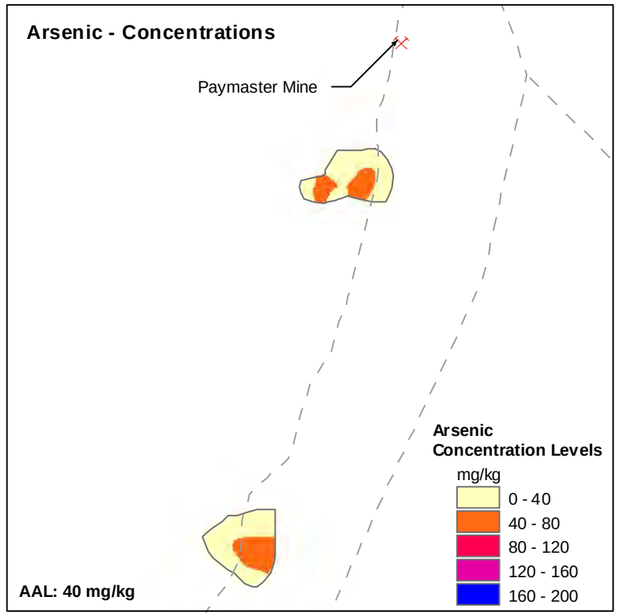
January 2013

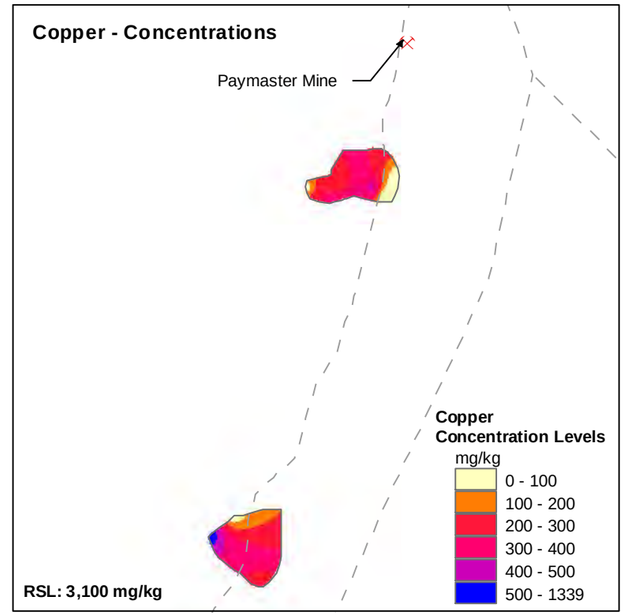
Figure 28

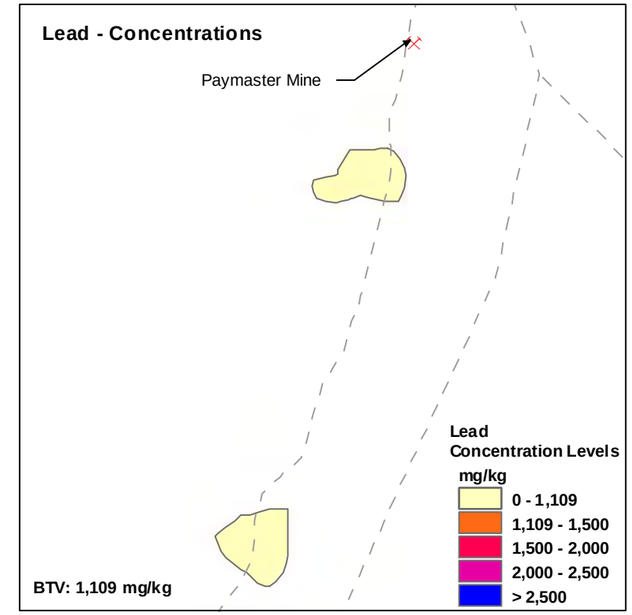
Paymaster Area - Mine Waste Impacts

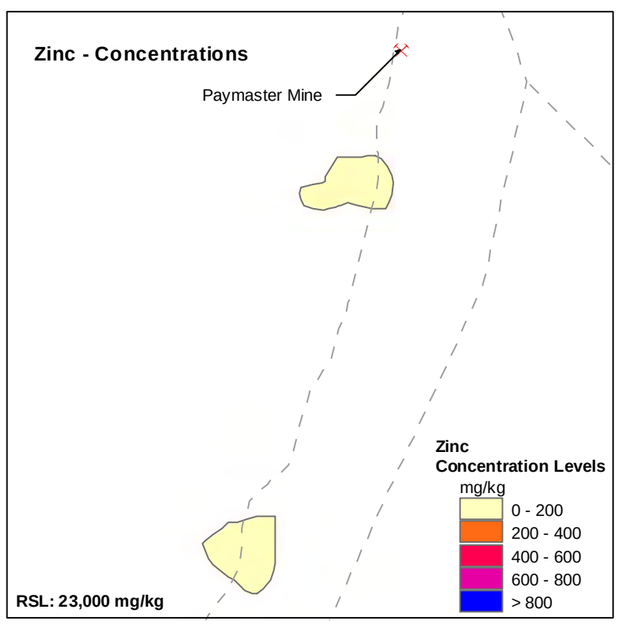
Remedial Investigation

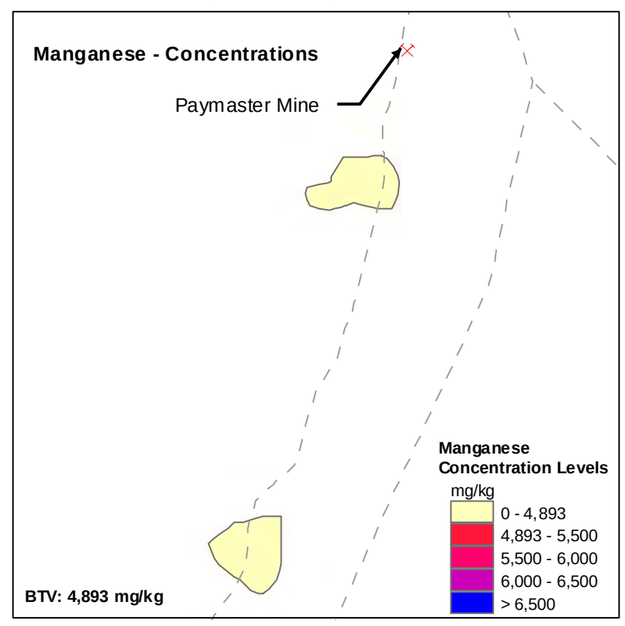
Upper Blackfoot Mining Complex

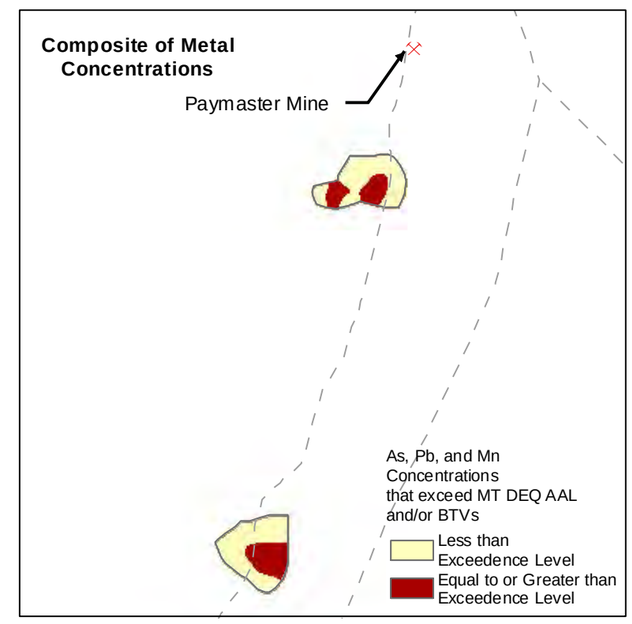












N

SCALE IN FEET

0 165

AAL - Montana DEQ Arsenic Action Level
BTV - Background Threshold Value
RSL - EPA Regional Screening Level

Note: XRF data was used to perform the evaluation

Mines
Roads
Estimated Extent of Mine Area (sampled 2007/2008)

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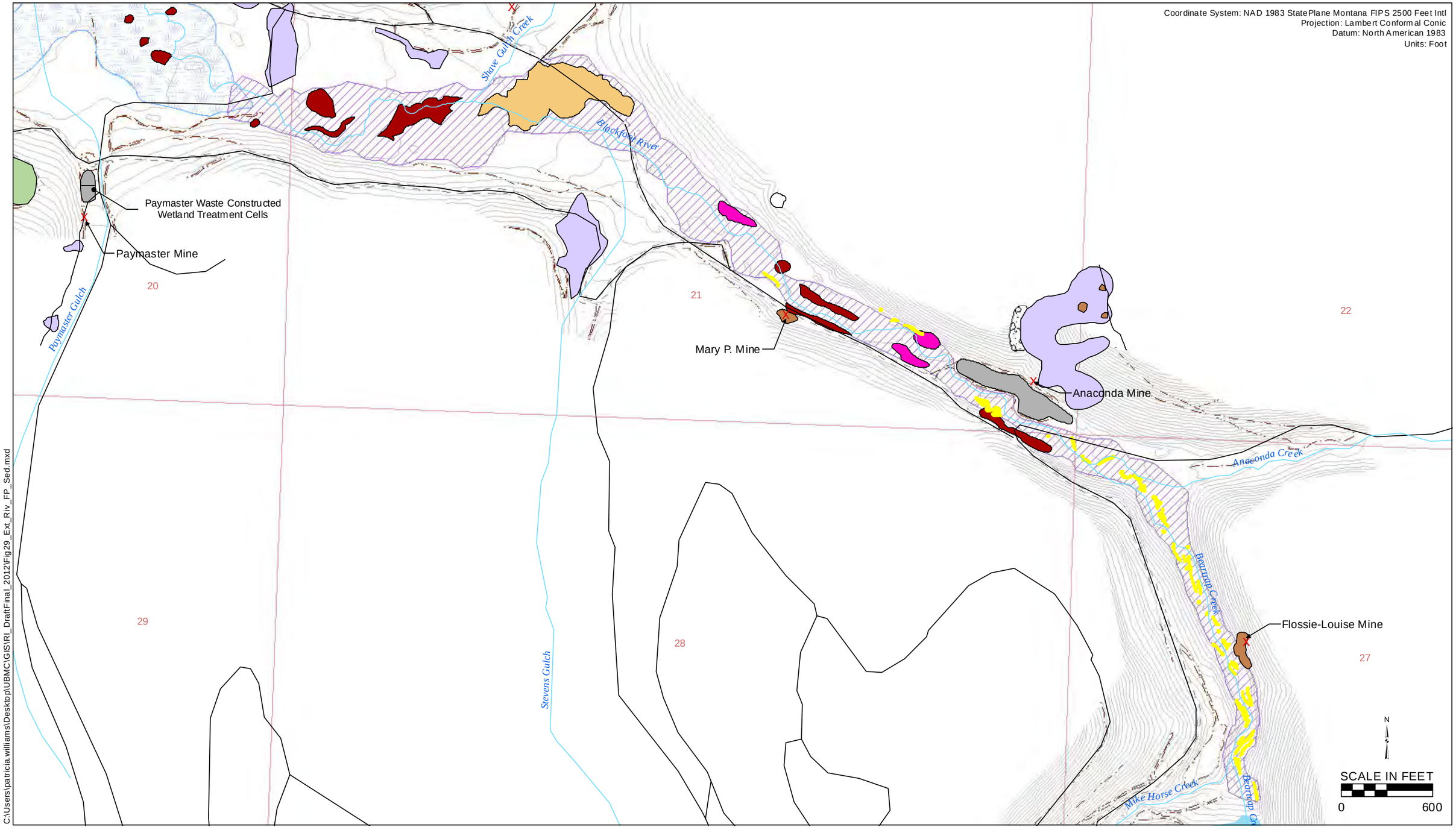
Figure 28a

Comparison of Site Concentrations for Arsenic, Copper, Lead, Zinc, and Manganese

Paymaster Mine Waste Area

Upper Blackfoot Mining Complex



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X Mines
Estimated Extent of River Floodplain Sediments
Outcrops/Talus Slope
Sections
1975 Breach Flood Stage Indicators
Area of Concentrated Tailings/Mine Waste
Area of Dispersed Coarse-Grained Tailings
Area of Dispersed Sandy (Fine) Tailings
Estimated Extent of Mine Areas (Sampled 2007/2008)
Former Wetland Treatment Cells
Mine Waste Areas (Not Sampled)
Mine Waste Repository
Unreclaimed Mine Waste Areas (Sampled 2007/2008)
Mike Horse Tailings Impoundment
Marshes
Topographical Contours
Gravel Road
Trail
Streams

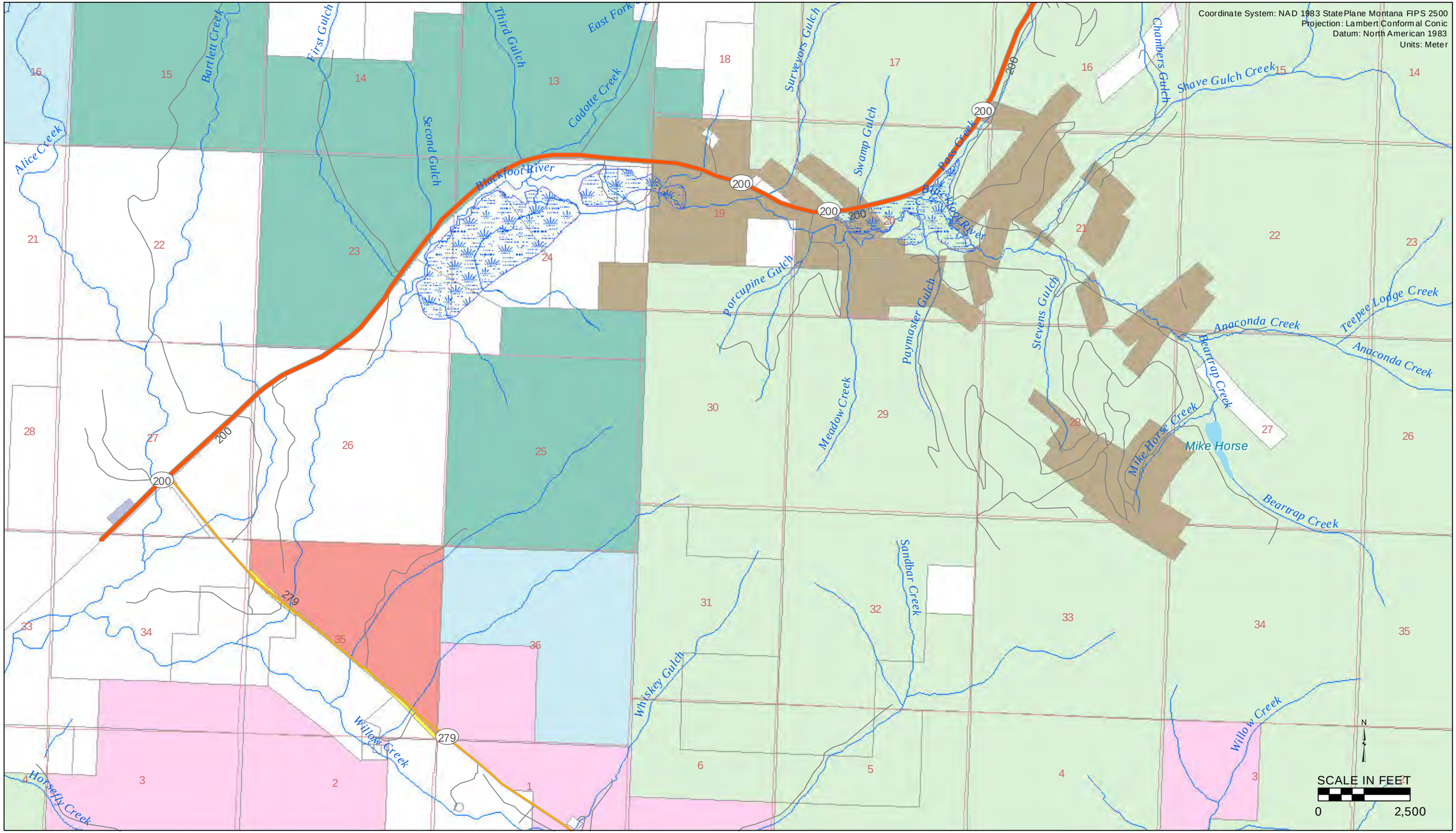
January 2013

Figure 29

Extent of River & Creek Floodplain Sediments

Remedial Investigation

Upper Blackfoot Mining Complex



Montana Department of Environmental Quality
Montana Department of Transportation
Montana Environmental Trust Group
Other Private
State of Montana
Stimson Lumber Company
United States of America
USDA Forest Service
Unknown Road Right of Way
Highway
Major Road
Local Road
Streams
Lake
Marshes
Section Lines

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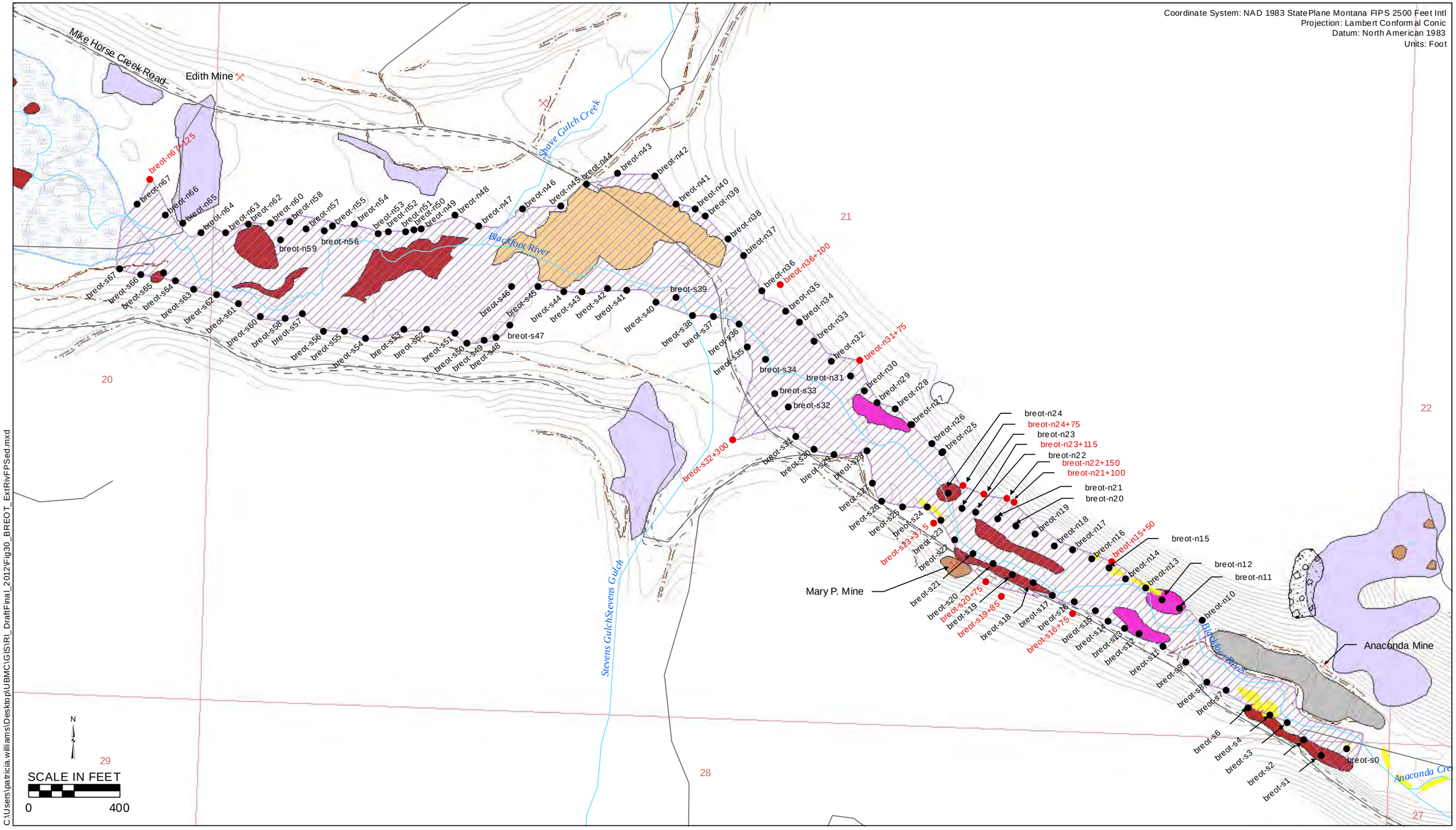
Figure 3

Land Ownership Map

Lincoln, Montana

Upper Blackfoot Mining Complex



Mines
Estimated River Floodplain Sediment Sample (2007)
Estimated River Floodplain Sediment Sample (2008)
Outcrops/Talus Slope
Estimated Extent of River Floodplain Sediments
1975 Breach Flood Stage Indicators
Area of Concentrated Tailings/Mine Waste
Area of Dispersed Coarse-Grained Tailings
Area of Dispersed Sandy (Fine) Tailings
Estimated Extent of Mine Areas (Sampled 2007/2008)
Former Wetland Treatment Cells
Mine Waste Areas (Not Sampled)
Mine Waste Repository
Unreclaimed Mine Waste Areas (Sampled 2007/2008)
Sections
Gravel Road
Topographic Contours
Trail
Roads
Streams

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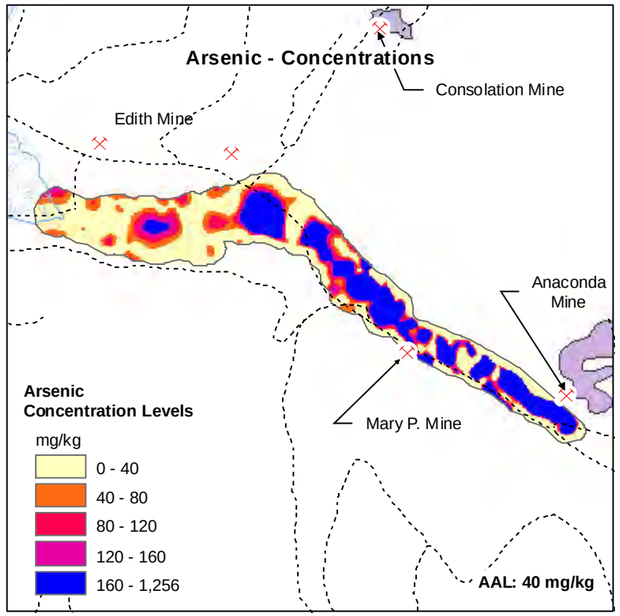
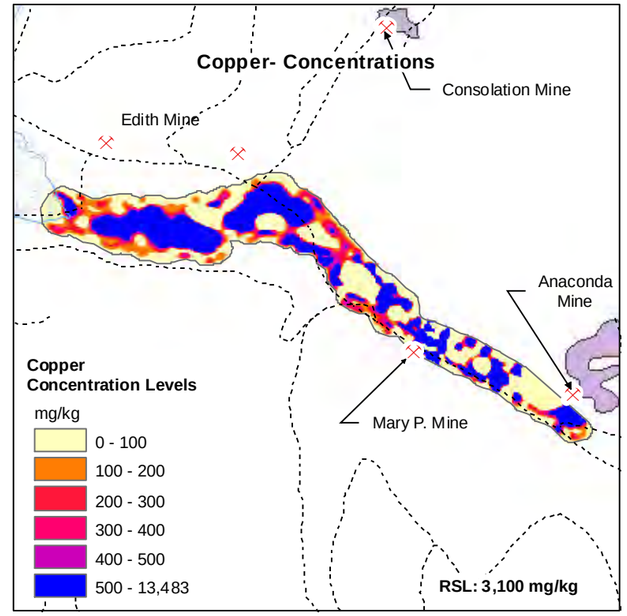
Figure 30

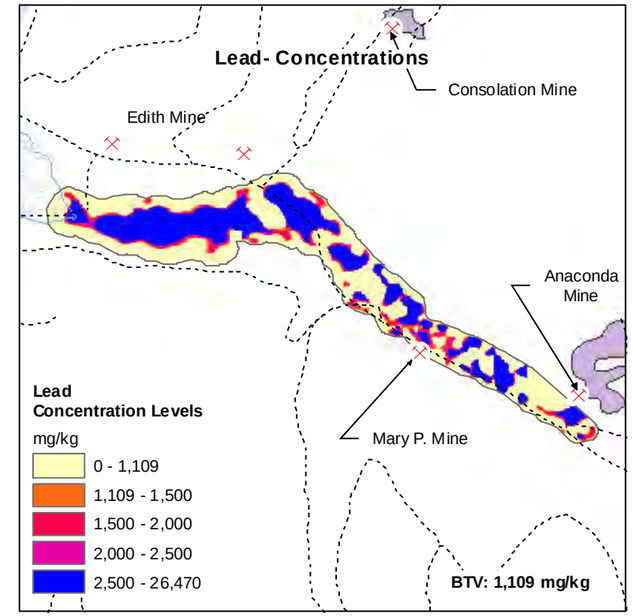
Blackfoot River Extent of River Floodplain Sediments

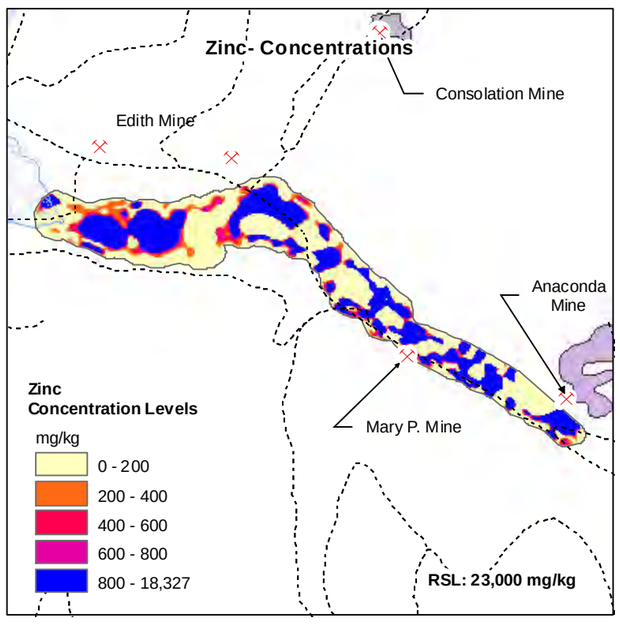
Remedial Investigation

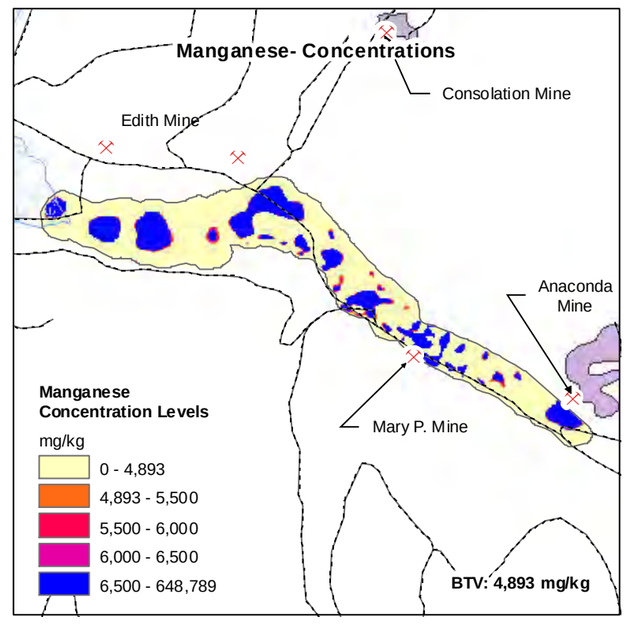
Upper Blackfoot Mining Complex

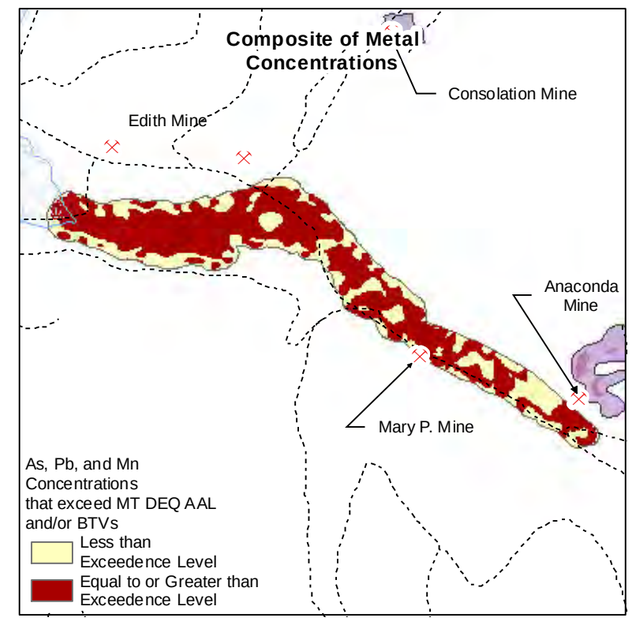












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SCALE IN FEET
0 1,545

AAL - Montana DEQ Arsenic Action Level
BTV - Background Threshold Value
RSL - EPA Regional Screening Level

Note: XRF data was used to perform the evaluation

Mines
Roads
Estimated Extent of Mine Area (sampled 2007/2008)
Marsh
Blackfoot River Boundary

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Figure 31

Comparison of Site Concentrations for Arsenic, Copper, Lead, Zinc, and Manganese

Blackfoot River

Remedial Investigation

Upper Blackfoot Mining Complex

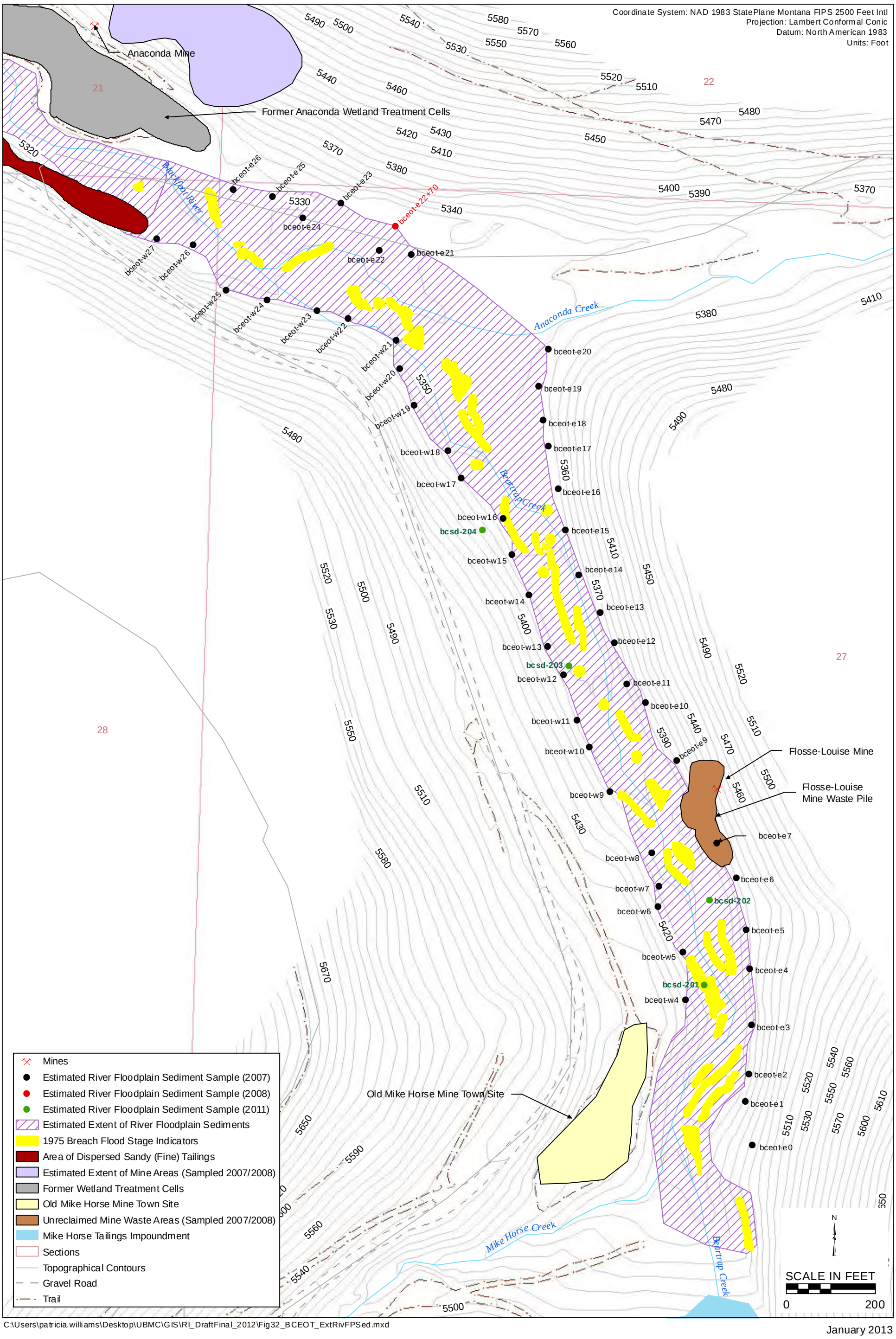

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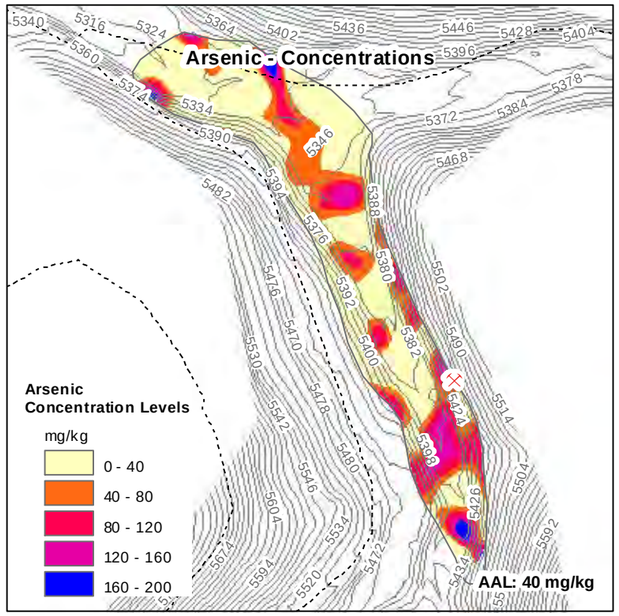
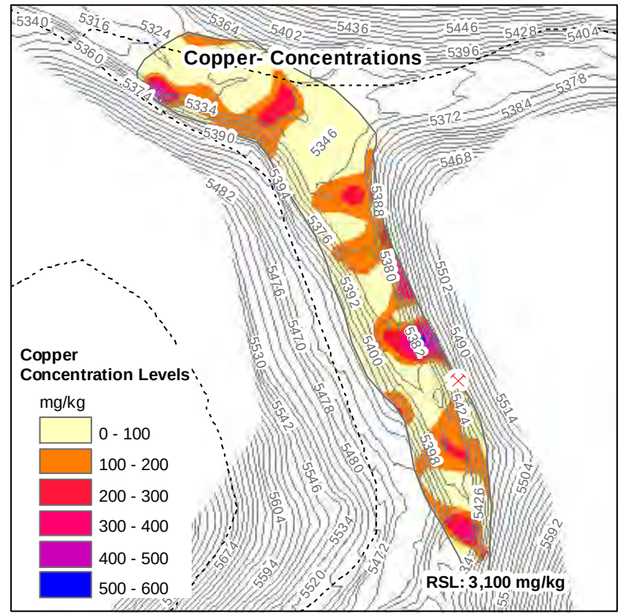
Figure 32

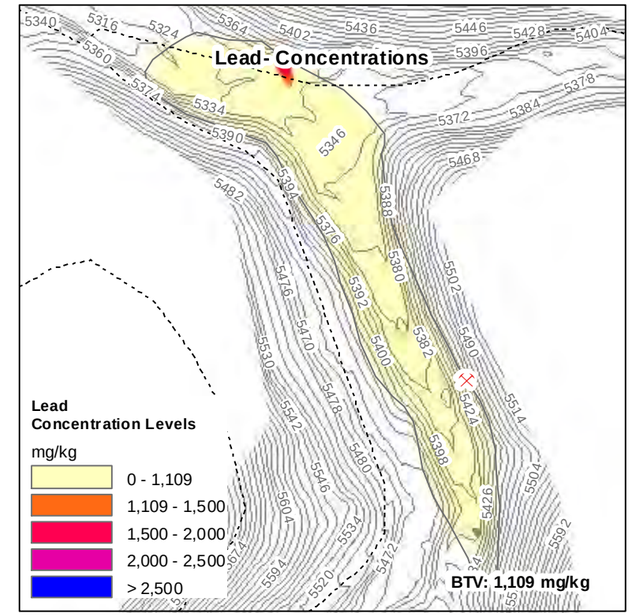
Beartrap Creek Extent of River Floodplain Sediments

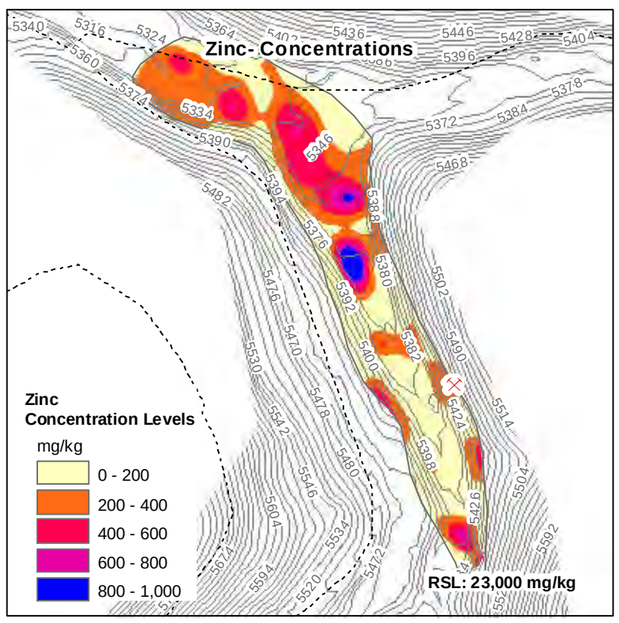
Remedial Investigation

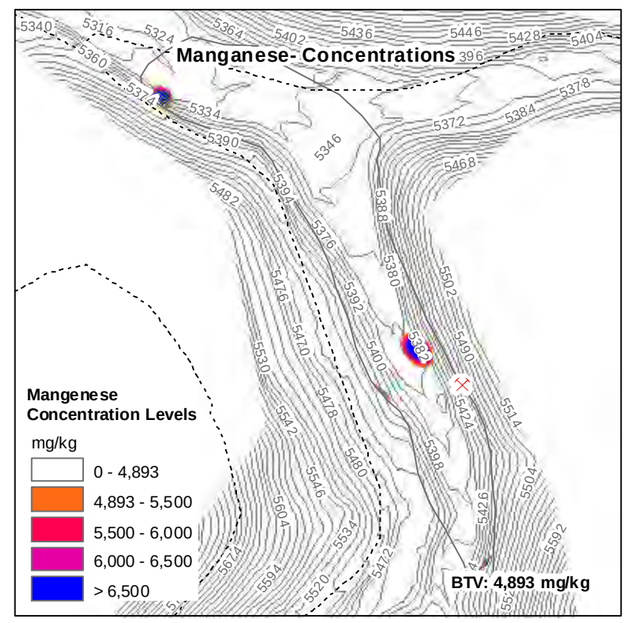
Upper Blackfoot Mining Complex

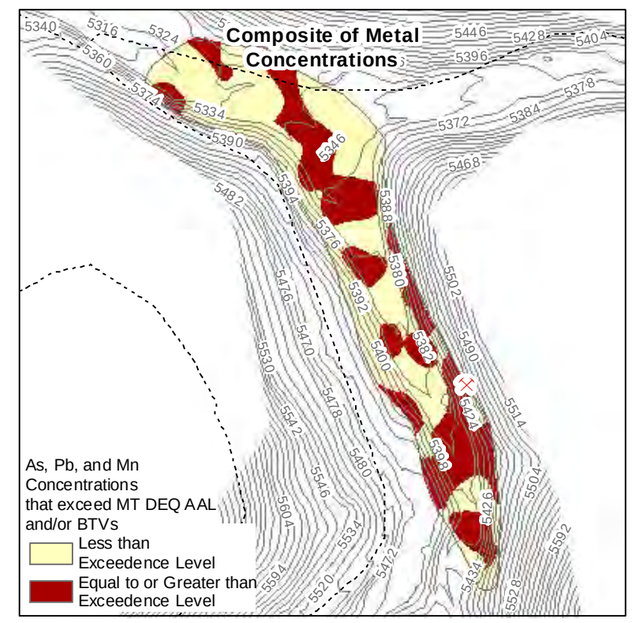












N

SCALE IN FEET
0 615

AAL - Montana DEQ Arsenic Action Level
BTV - Background Threshold Value
RSL - EPA Regional Screening Level

Note: XRF data was used to perform the evaluation

Mines
Roads
Estimated Extent of Mine Area (sampled 2007/2008)
Marsh
Topographic Contours
Bear Creek Boundary

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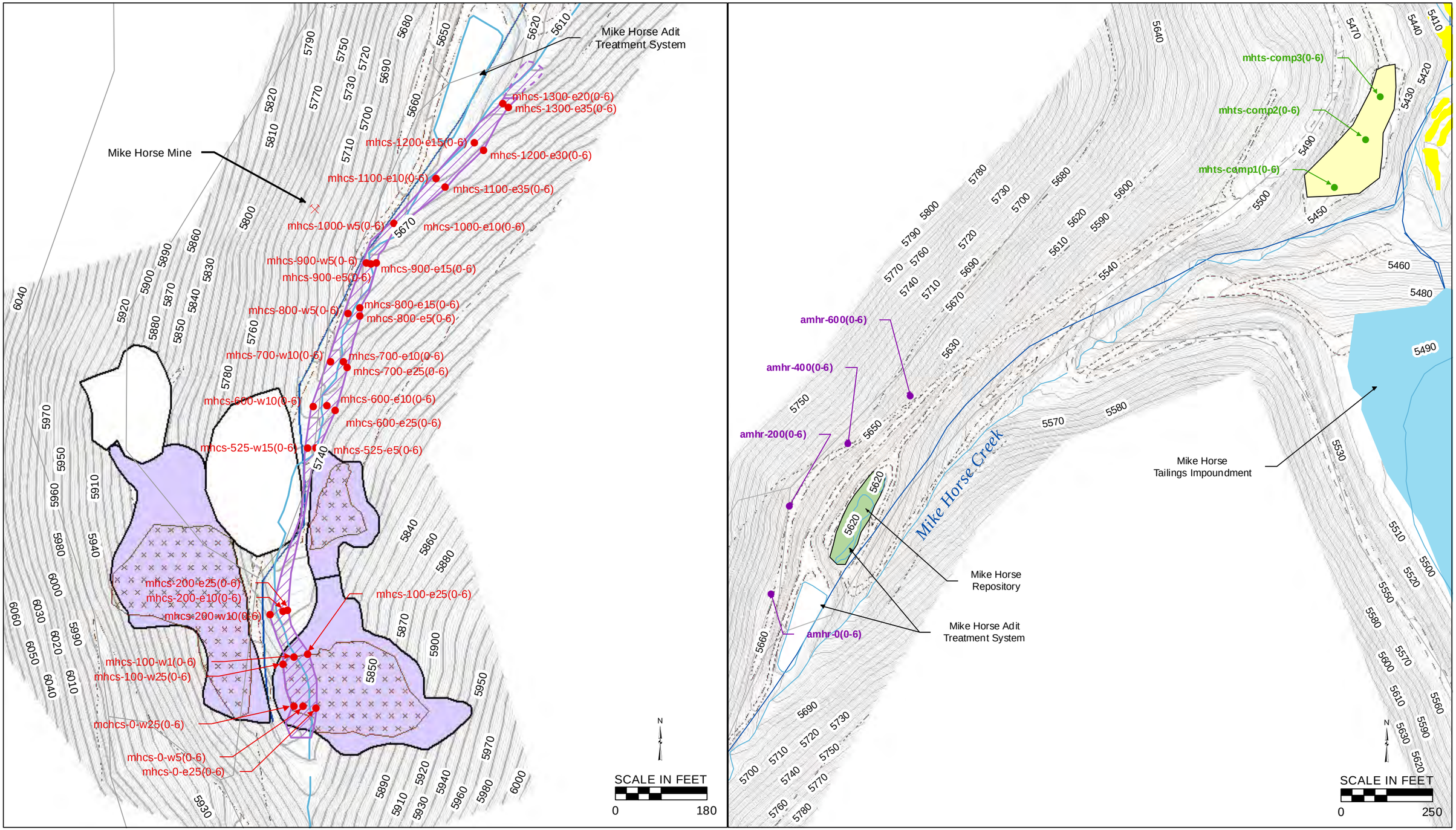
Figure 33

Comparison of Site Concentrations for Arsenic, Copper, Lead, Zinc, and Manganese

Beartrap Creek

Remedial Investigation

Upper Blackfoot Mining Complex



Mines
2007 Estimated Creek Floodplain Sediments
Mike Horse Townsite Sample - Post Reclamation
Hillside Sample Above Mike Horse Repository
Estimated Extend of River/Creek Floodplain Sediments (Dashed where inferred)
1975 Breach Flood Stage Indicators
Estimated Extent of Mine Areas (Sampled 2007/2008)
Mine Waste Areas (Not Sampled)
Mine Waste Removal/Reclaimed Area Sample (2007)
Mine Waste Repository
Old Mike Horse Mine Townsite
Unreclaimed Mine Waste Areas (Sampled 2007/2008)
Lakes
County Road
Other Gravel Roads/Trails
Topographic Contours
Interior Contours
Stream

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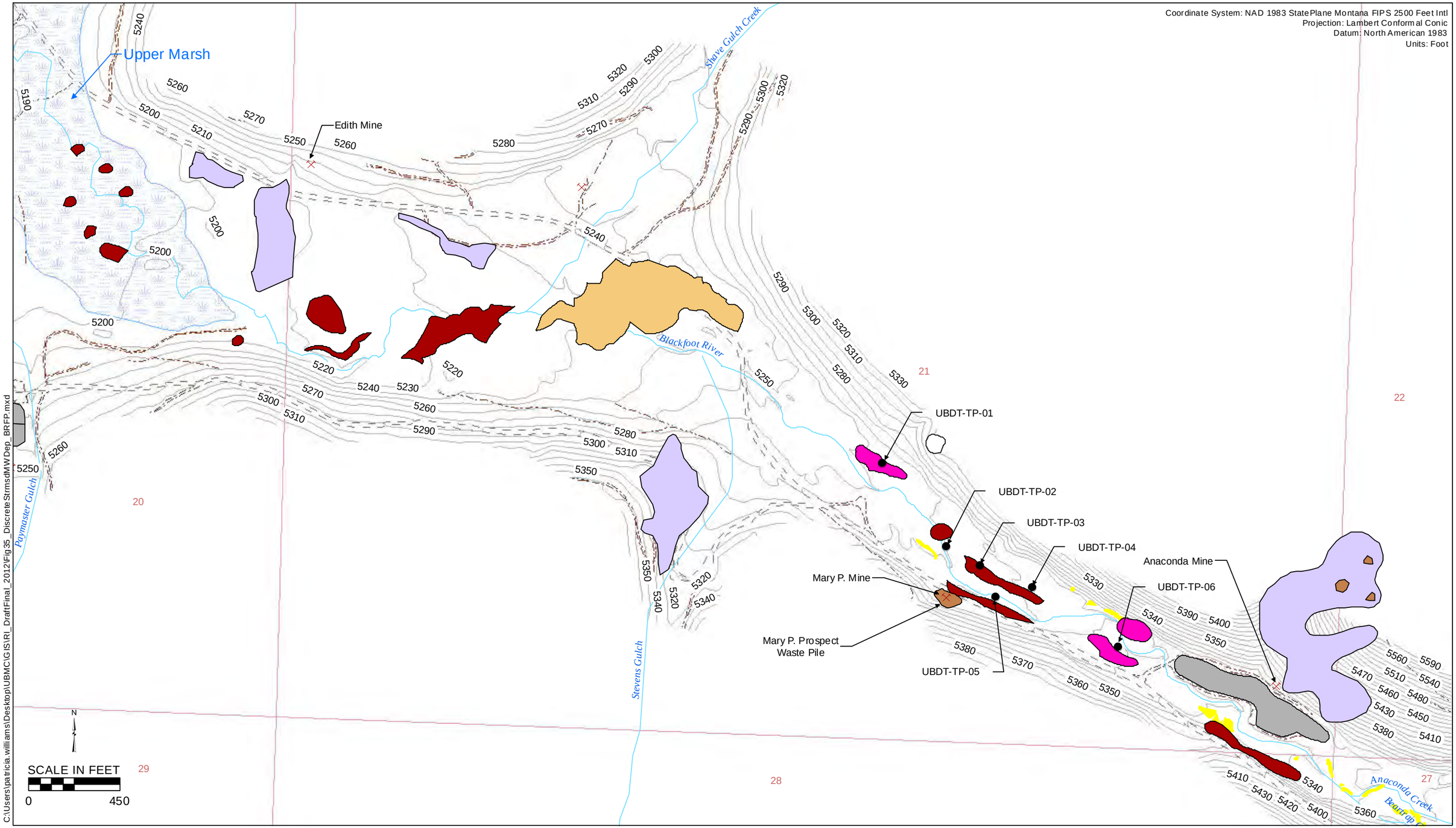
Figure 34

Mike Horse Creek & Mike Horse Townsite Sample Locations

Remedial Investigation

Upper Blackfoot Mining Complex



Mines
Upper Blackfoot Test Pit Locations within Discrete Streamside Mine Waste Deposits
Streams
Estimated Extent of River Floodplain Sediments
1975 Breach Flood Stage Indicators
Area of Concentrated Tailings/Mine Waste
Area of Dispersed Coarse-Grained Tailings
Area of Dispersed Sandy (Fine) Tailings
Estimated Extent of Mine Areas (Sampled 2007/2008)
Former Wetland Treatment Cells
Mine Waste Areas (Not Sampled)
Unreclaimed Mine Waste Areas (Sampled 2007/2008)
Topographical Contours
Gravel Road
Trail
Marshes

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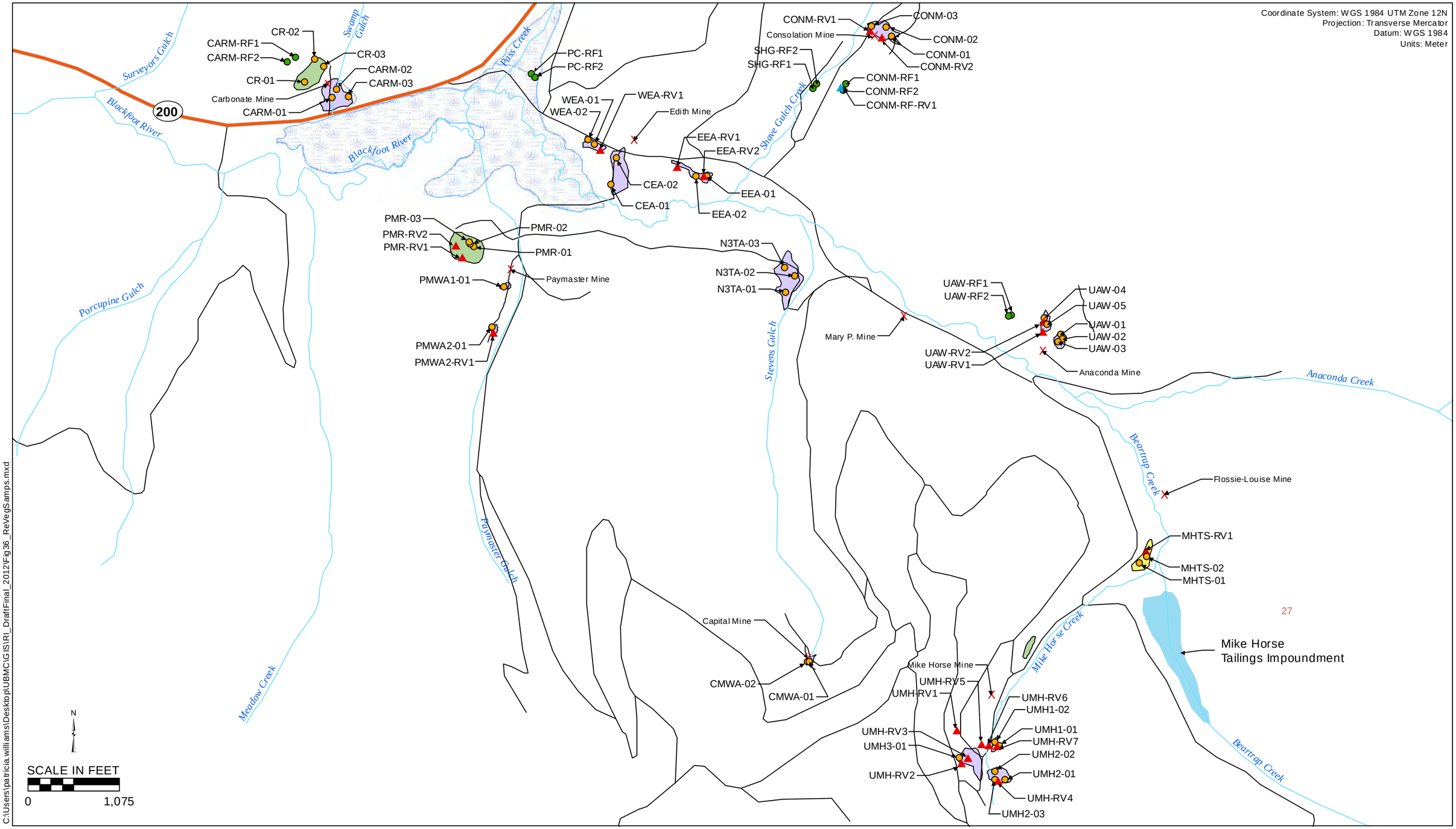
Figure 35

Discrete Streamside Mine Waste Deposits - Blackfoot River Floodplain

Remedial Investigation

Upper Blackfoot Mining Complex



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2008 Reclamation Cover Soil Investigation Locations

- Cover Transect
- Cover Reference Transect
- Reclamation Soil Sample
- Reclamation Reference Soil Sample
- Mines
- Streams
- Marshes
- Mike Horse Tailings Impoundment
- Mine Waste Removal/Reclaimed Area Sample (2007)
- Mine Waste Repository
- Old Mike Horse Mine Town Site

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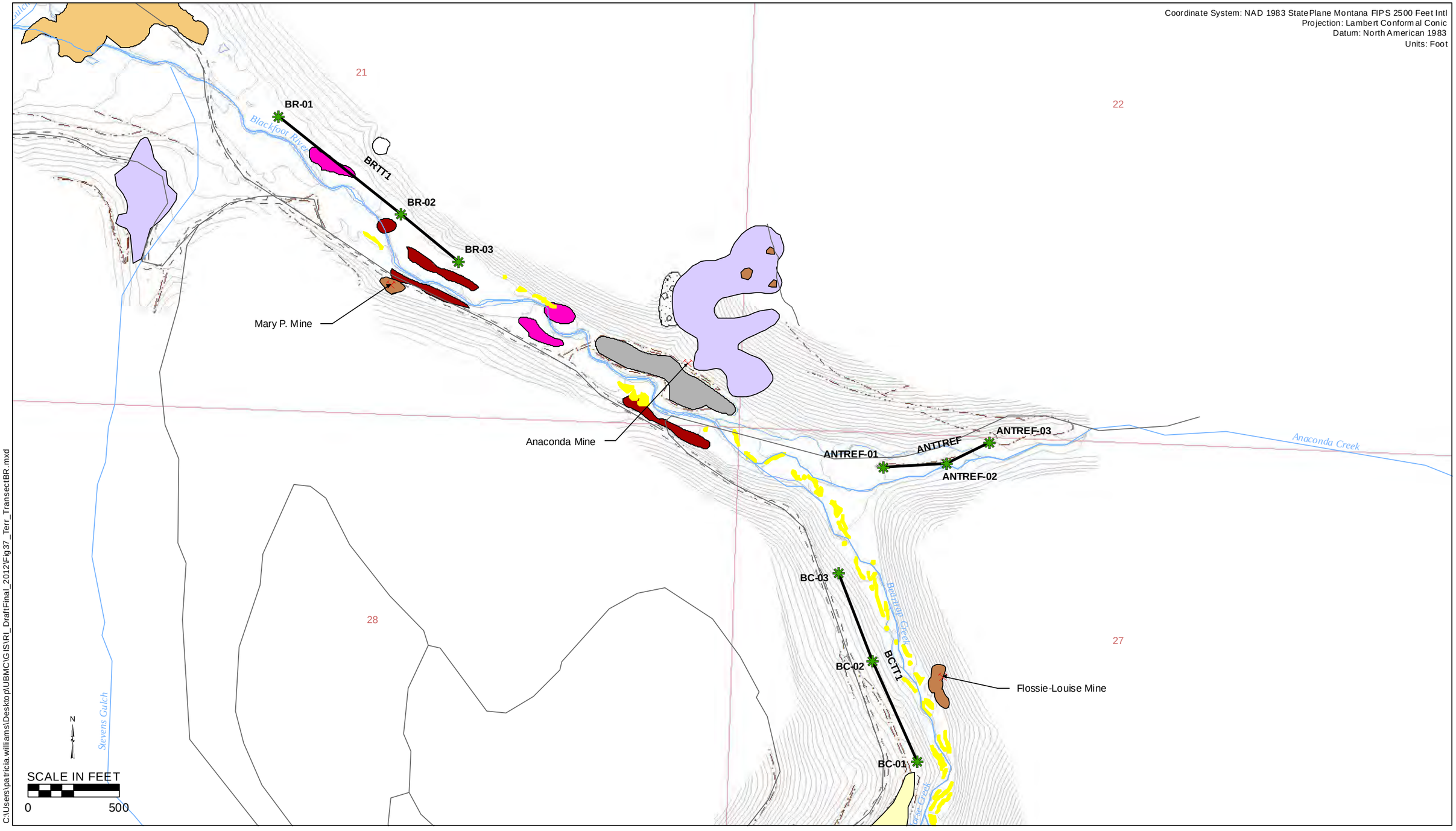
Figure 36

Revegetation Sample Points

Remedial Investigation

Upper Blackfoot Mining Complex



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Mines
2008 Terrestrial Sampling Locations
Terrestrial Receptor Transects
Estimated Extent of Streamside Impacts Soil Sampling
Outcrops/Talus Slope
1975 Breach Flood Stage Indicators
Area of Concentrated Tailings/Mine Waste
Area of Dispersed Coarse-Grained Tailings
Area of Dispersed Sandy (Fine) Tailings
Estimated Extent of Mine Areas (Sampled 2007/2008)
Former Wetland Treatment Cells
Mine Waste Areas (Not Sampled)
Old Mike Horse Mine Townsite
Unreclaimed Mine Waste Areas (Sampled 2007/2008)
Sections
Roads
Gravel Road
Topographic Contours
Trail
Streams

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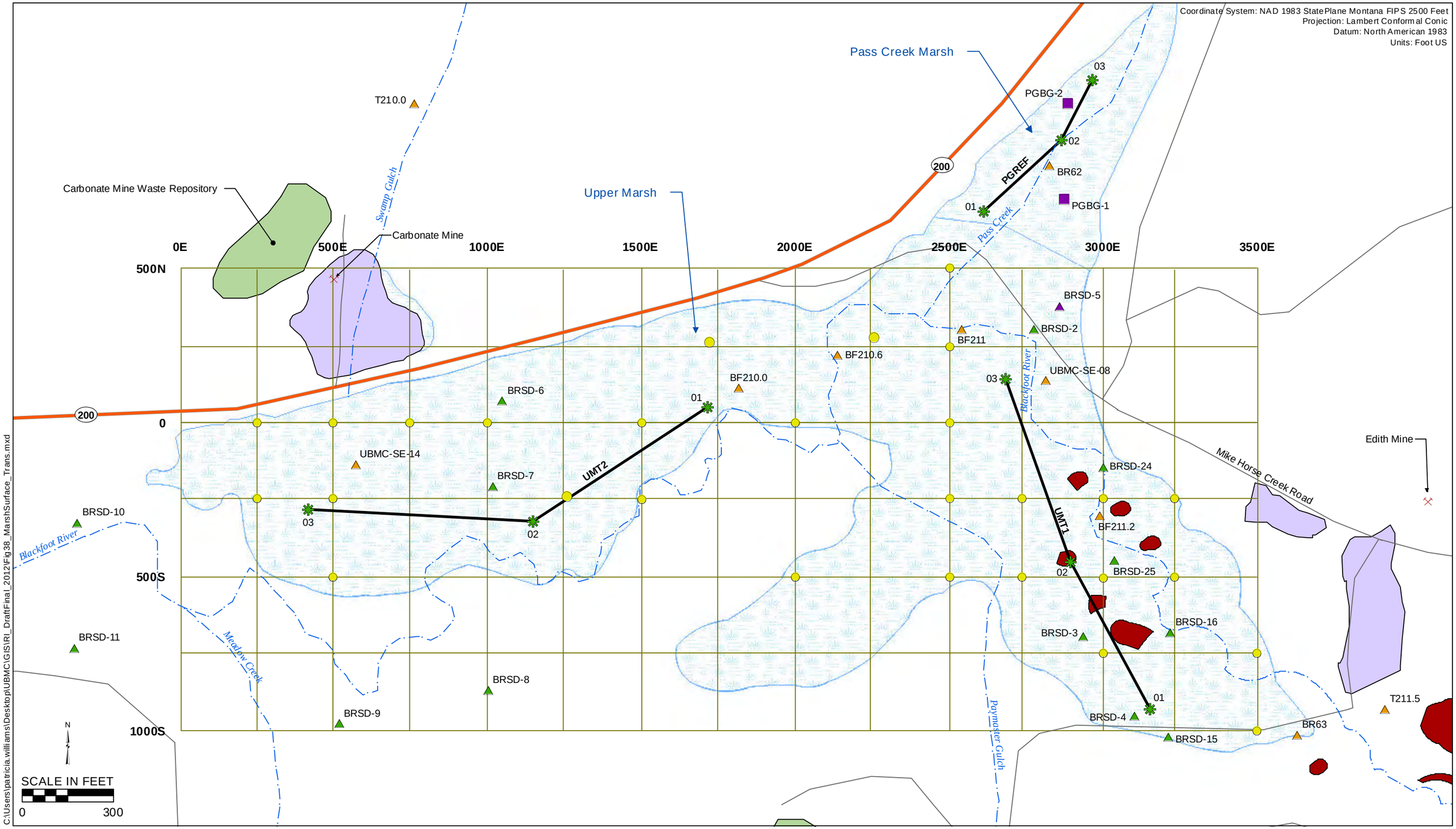
Figure 37

Terrestrial Transect Map

Remedial Investigation

Upper Blackfoot Mining Complex



Mines
Area of Dispersed Sandy (Fine) Tailings
Estimated Extent of Mine Areas (Sampled 2007/2008)
Mine Waste Repository
2008 Marsh Sampling Location
2007/2008 Upper Marsh Sediment Sample Location
2007 Background Sediment Sample Location
2008 Background Sediment Re-sample Location
Historic Sediment Sample Location
Historic Sediment Sample Location (sampled 2008)
Marsh Surface Transect
Estimated Extent of River Floodplain Sediments
Grid Lines
Marshes
Local Roads
State Highway
Gravel Road
Topographic Contours
Interior Contours
Trail
Streams

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Figure 38

Marsh Surface Transect Map

Remedial Investigation

Upper Blackfoot Mining Complex

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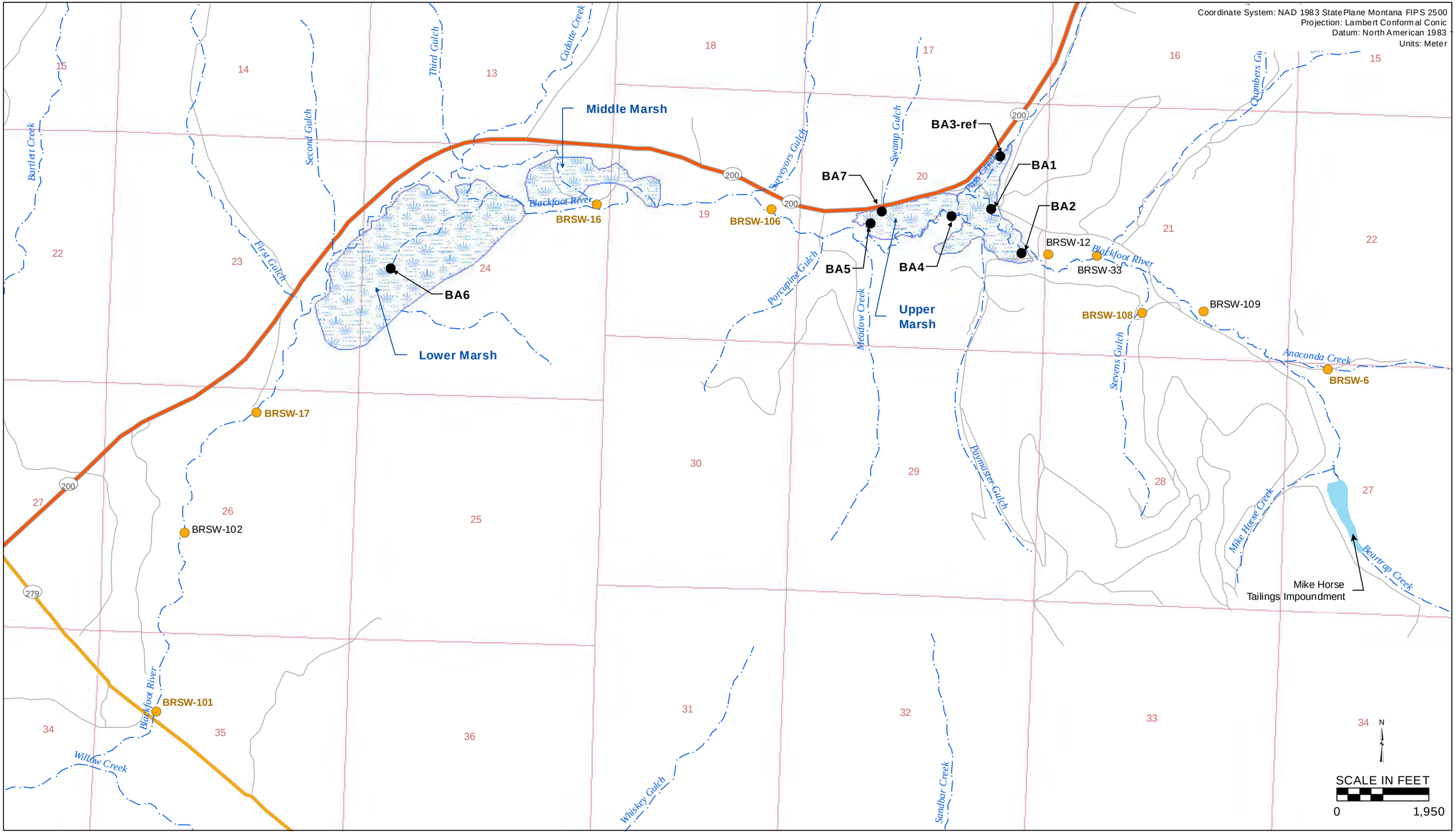


Bioassay Reference Sample

2007/2008 Benthic/Macroinvertebrate Sampling Locations

BRSW-16 Designates 2008 Sample Locations

Marshes

Mike Horse Tailings Impoundment

Sections

Streams

Highway

Major Road

Local Road

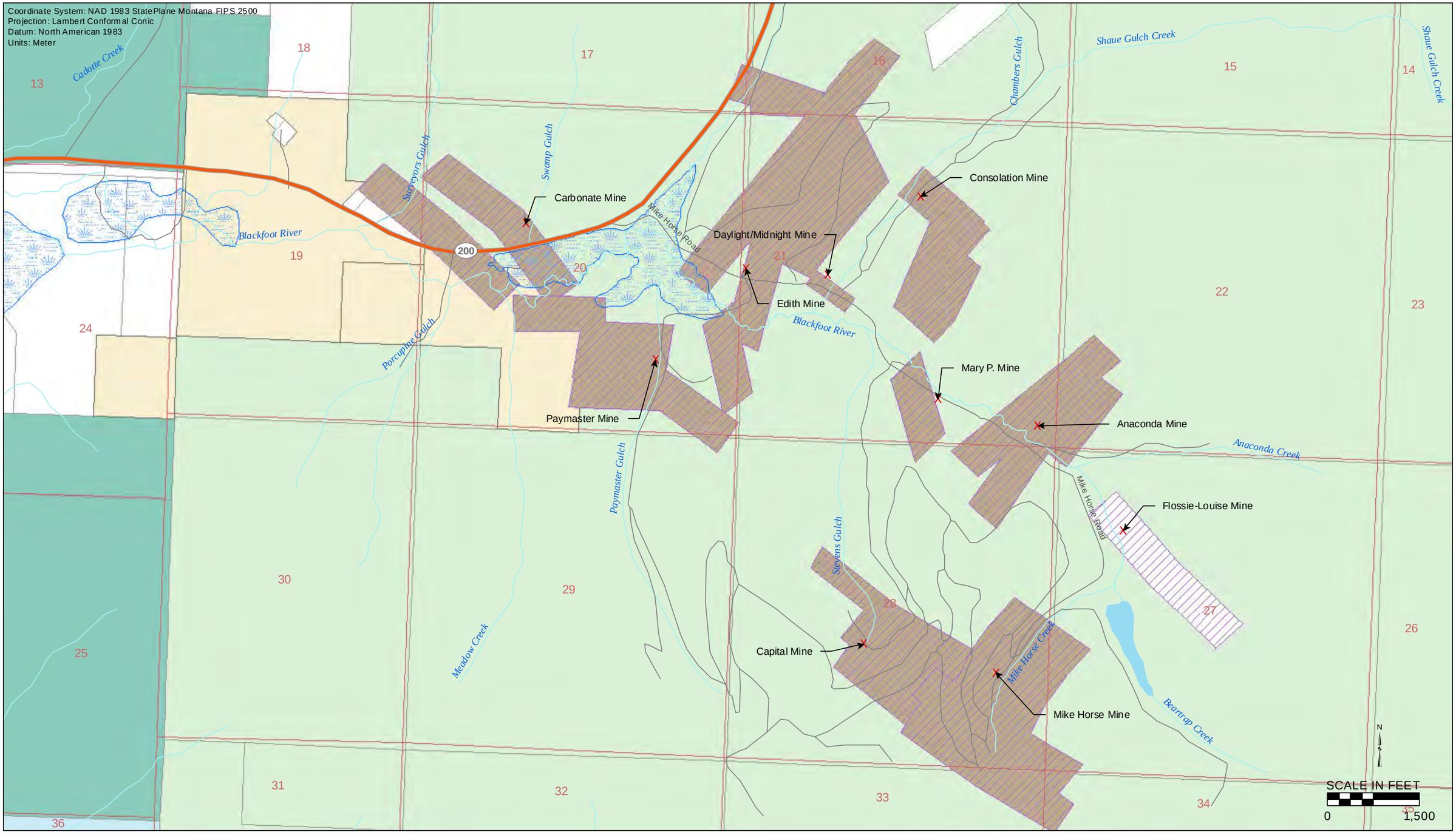
January 2013

Figure 39

Benthic/Macroinvertebrate Sampling Locations

Remedial Investigation

Upper Blackfoot Mining Complex



X Mines
Patented Mine Claims
Former Asarco Fee Land owned by METG
Marsh Area
Montana Environmental Trust Group
Other Private
State of Montana
United States of America
USDA Forest Service
Mike Horse Tailings Impoundment
Stream
Highway
Local Road
Sections

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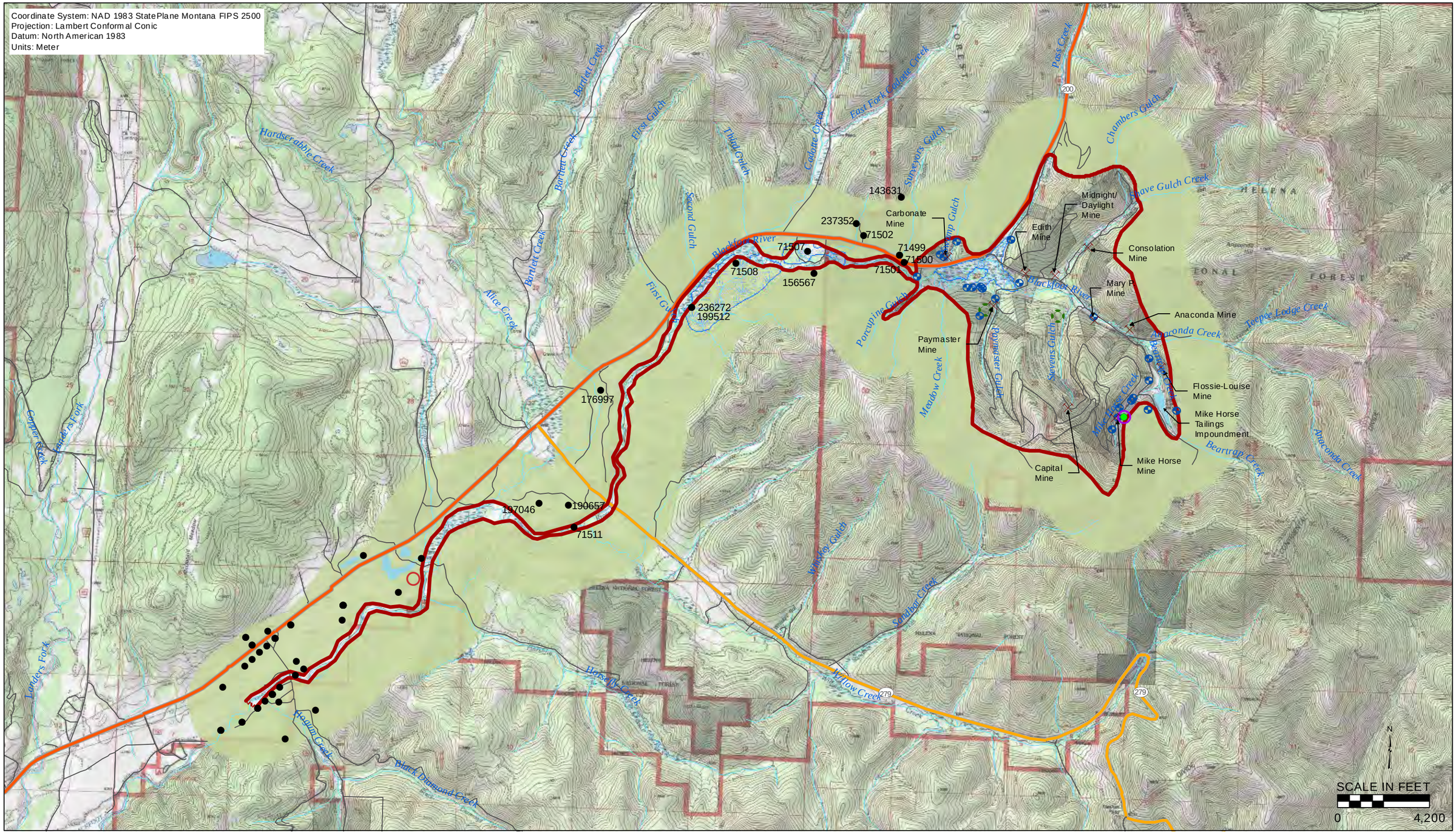
Figure 4

Historic Mining Features

Remedial Investigation

Upper Blackfoot Mining Complex



Mines
West estimated extent of contamination yet to be defined due to metals above sediment screening levels
Estimated Extent of Contamination
Half Mile Radius

Comprehensive Environmental Cleanup and Responsibility Act (CECRA)
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
Voluntary Cleanup & Redevelopment Act (VCRA) (UBMC)
EPA Toxic Release

Monitoring Well
Supply Well
Streams
Marshes
Highway
Major Road
Local Road

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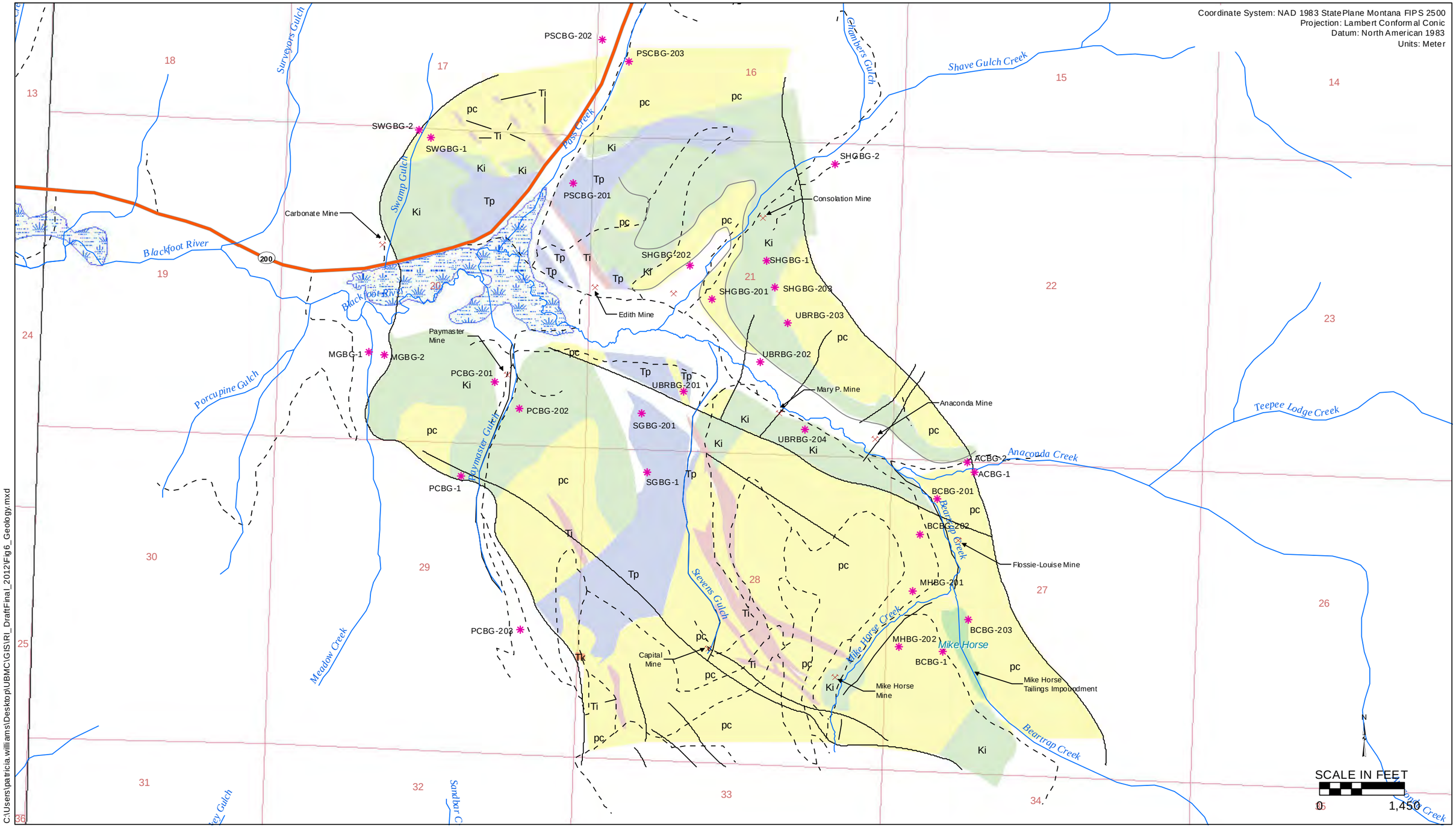
Figure 5

Regulated Facilities

Remedial Investigation

Upper Blackfoot Mining Complex



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- Background Soil Samples
- Mines
- Faults
- Local Roads
- State Highway
- Section Lines
- Marshes
- Lakes

- Ki — Diorite (gabbfro) sill
- Ti — Quartz monzonite porphyry dikes
- Tk — Kleinschmidt breccia pipe
- Tp — Quartz monzonite porphyry and quartz porphyry intrusives
- pc — Spokane Shale (Belt Supergroup)

Note:
Geologic unit boundaries are estimated.
White areas within UBMC assumed to be alluvial deposits.

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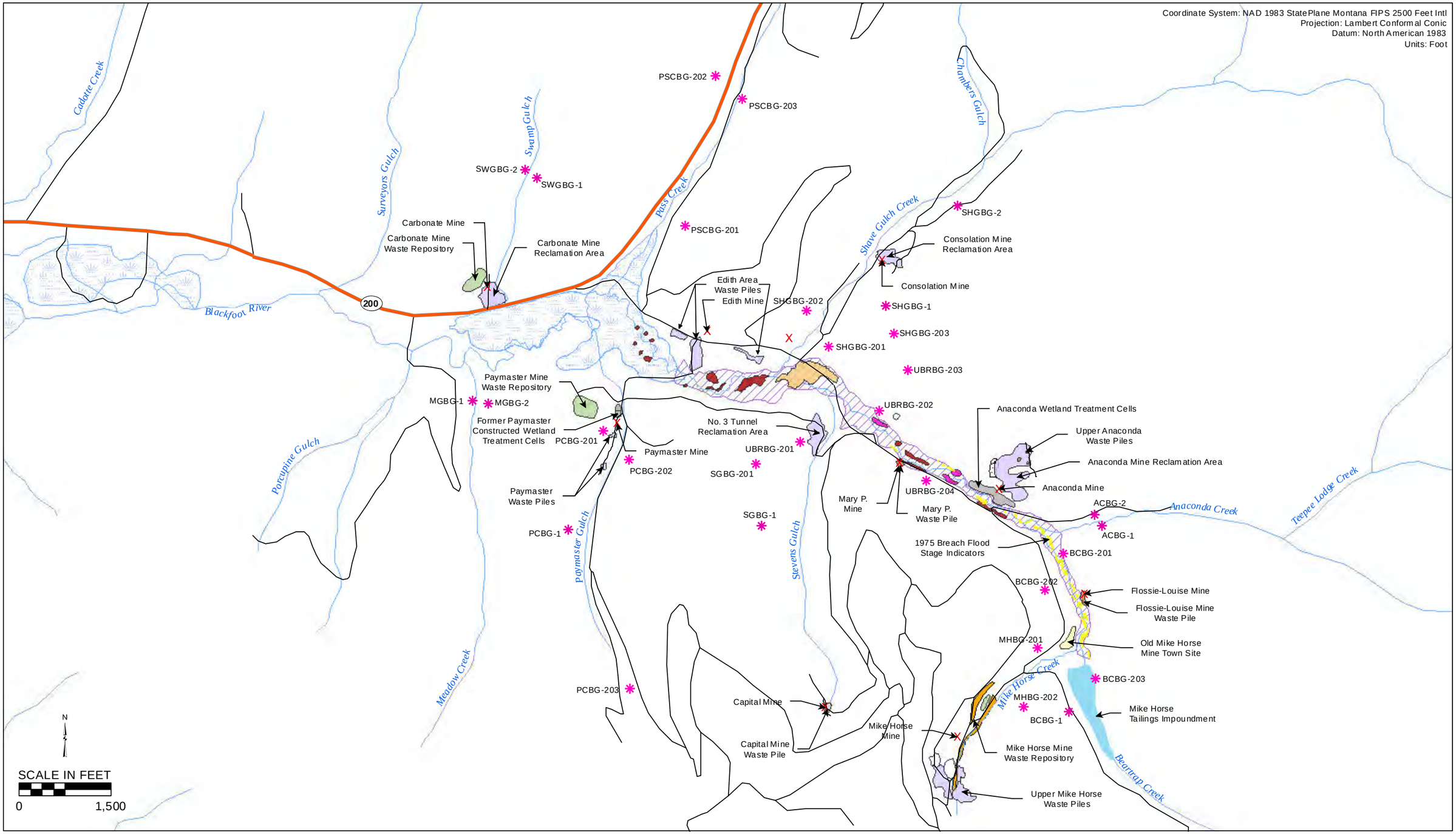
Figure 6

Geologic Map of the UBMC Area

Remedial Investigation

Upper Blackfoot Mining Complex



X Mines
Background Soil Samples
Estimated Extent of Streamside Impacts Soil Sampling
Mike Horse Creek and Repository Area Sampling
1975 Breach Flood Stage Indicators
Area of Concentrated Tailings/Mine Waste
Area of Dispersed Coarse-Grained Tailings
Area of Dispersed Sandy (Fine) Tailings
Estimated Extent of Mine Areas (Sampled 2007/2008)
Former Wetland Treatment Cells
Mine Waste Areas (Not Sampled)
Mine Waste Repository
Old Mike Horse Mine Townsite
Unreclaimed Mine Waste Areas (Sampled 2007/2008)
Marsh/Wetlands Area (Submerged)
Outcrop/Talus Slope
Mike Horse Tailings Impoundment
Streams
Local Roads
State Highway

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Figure 7

Overview of Mine Waste Areas

Remedial Investigation

Upper Blackfoot Mining Complex

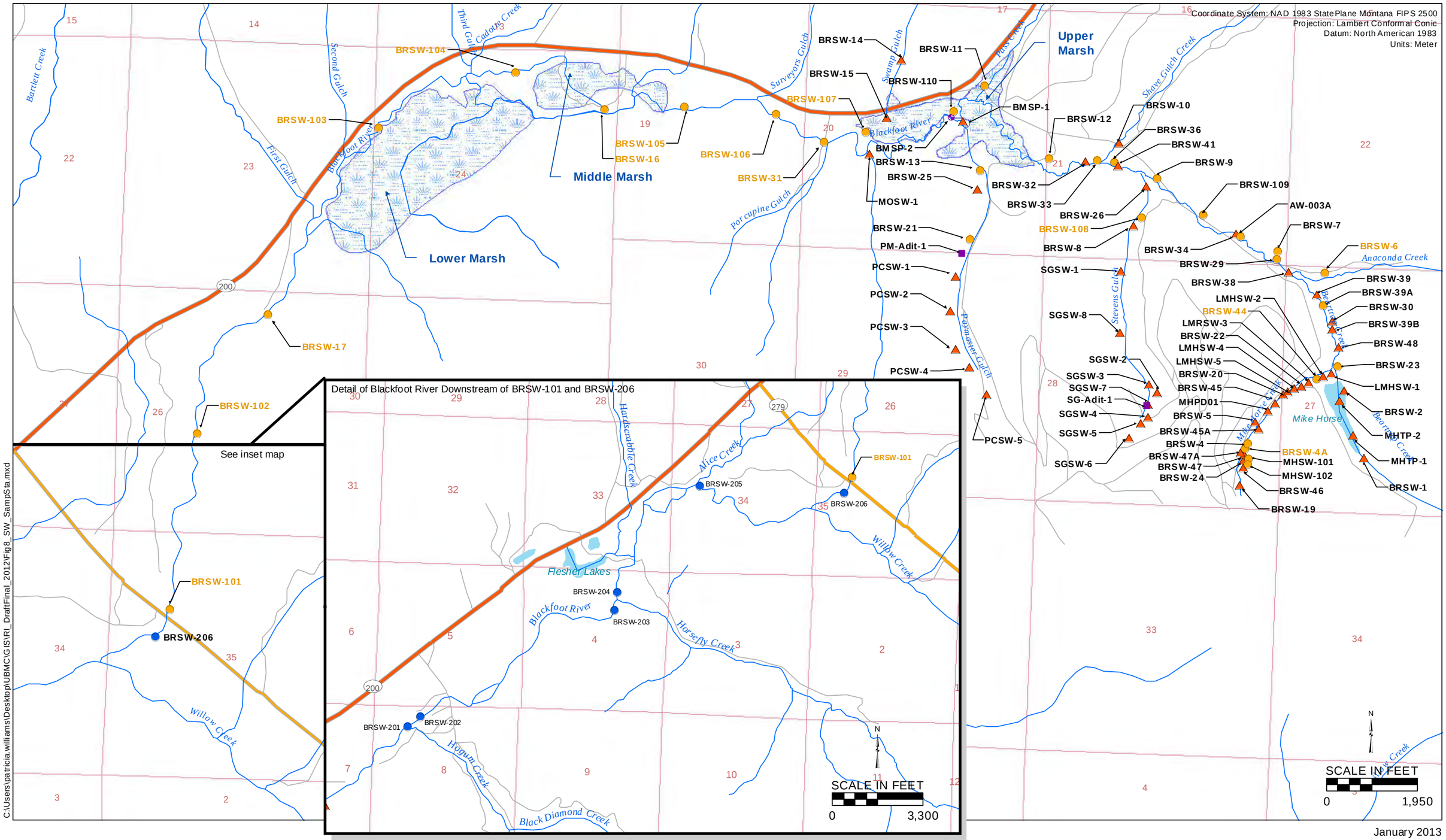

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Figure 8

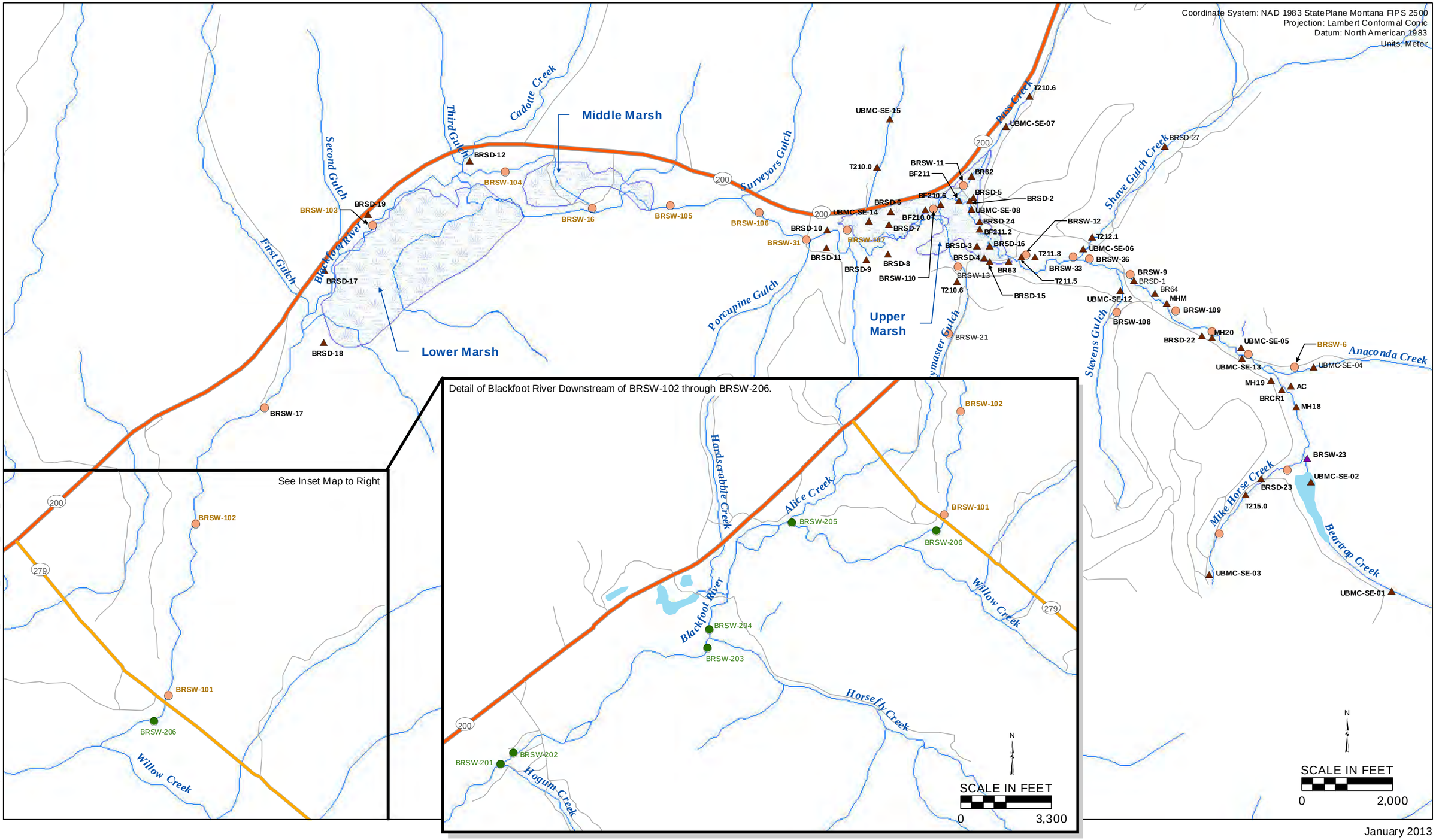
Surface Water Sampling Stations

Remedial Investigation

Upper Blackfoot Mining Complex

BRSW-101 Sampled in 2008

- Adit Locations
- Historic Surface Water Sampling Locations
- 2007 and/or 2008 Surface Water Sampling Locations
- 2011 Surface Water Sampling Locations
- Flowing Well Proposed Sample (abandoned)
- Mike Horse Tailings Impoundment
- Marshes
- Streams
- Highway
- Major Road
- Local Road



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▲	Historic Sediment Sampling Location	Highway	Streams
BRSW-101	2007 Streambed Sediment Sampling Location	Major Road	Mike Horse Tailings Impoundment
BRSW-101	2007/2008 Streambed Sediment Sampling Location	Local Road	Marshes
BRSW-101	2011 Streambed Sediment Sampling Location		

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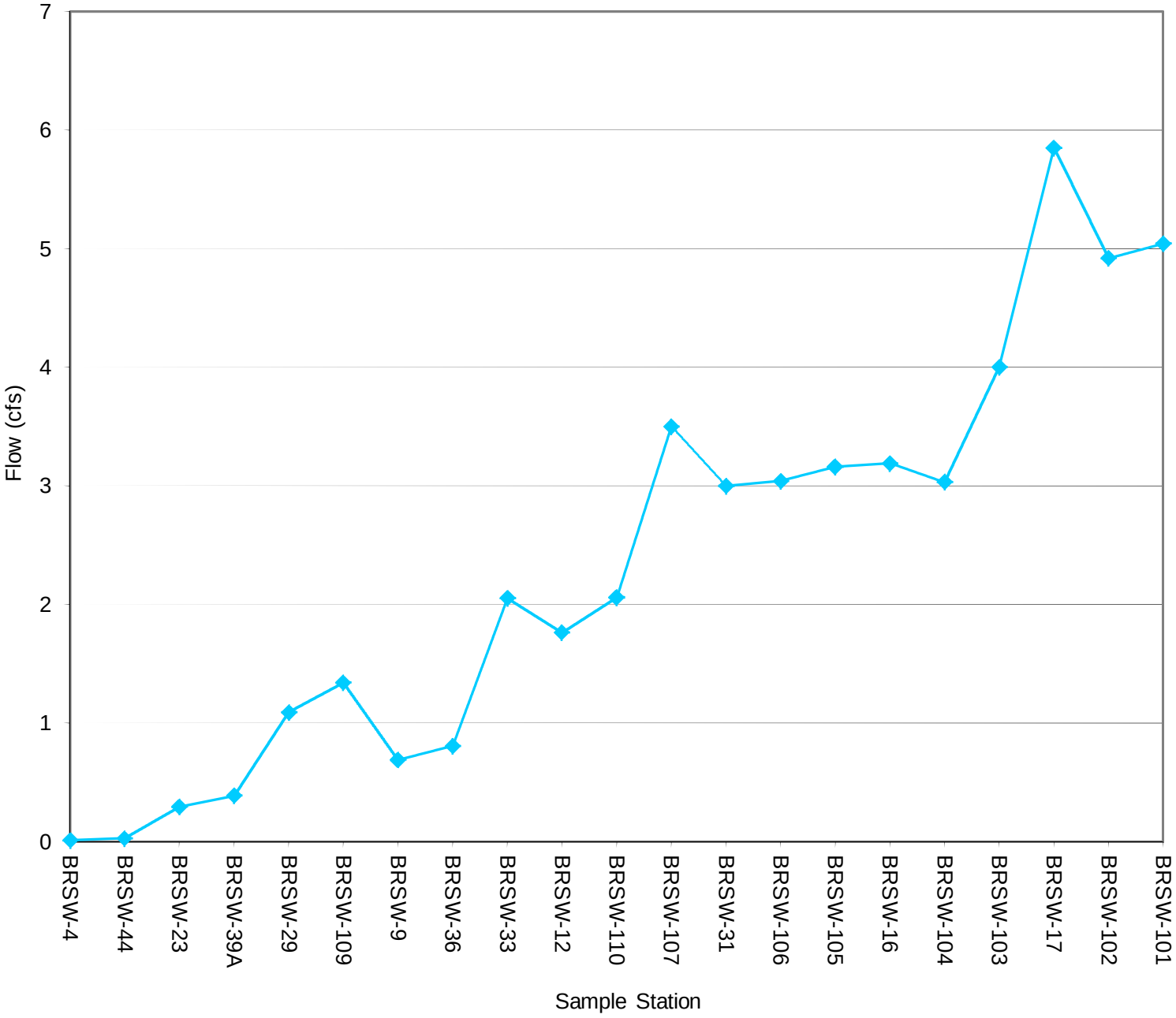
Figure 9

Streambed Sediment Sampling Stations

Remedial Investigation

Upper Blackfoot Mining Complex

Figure 40 Surface Water Flow - October 2007



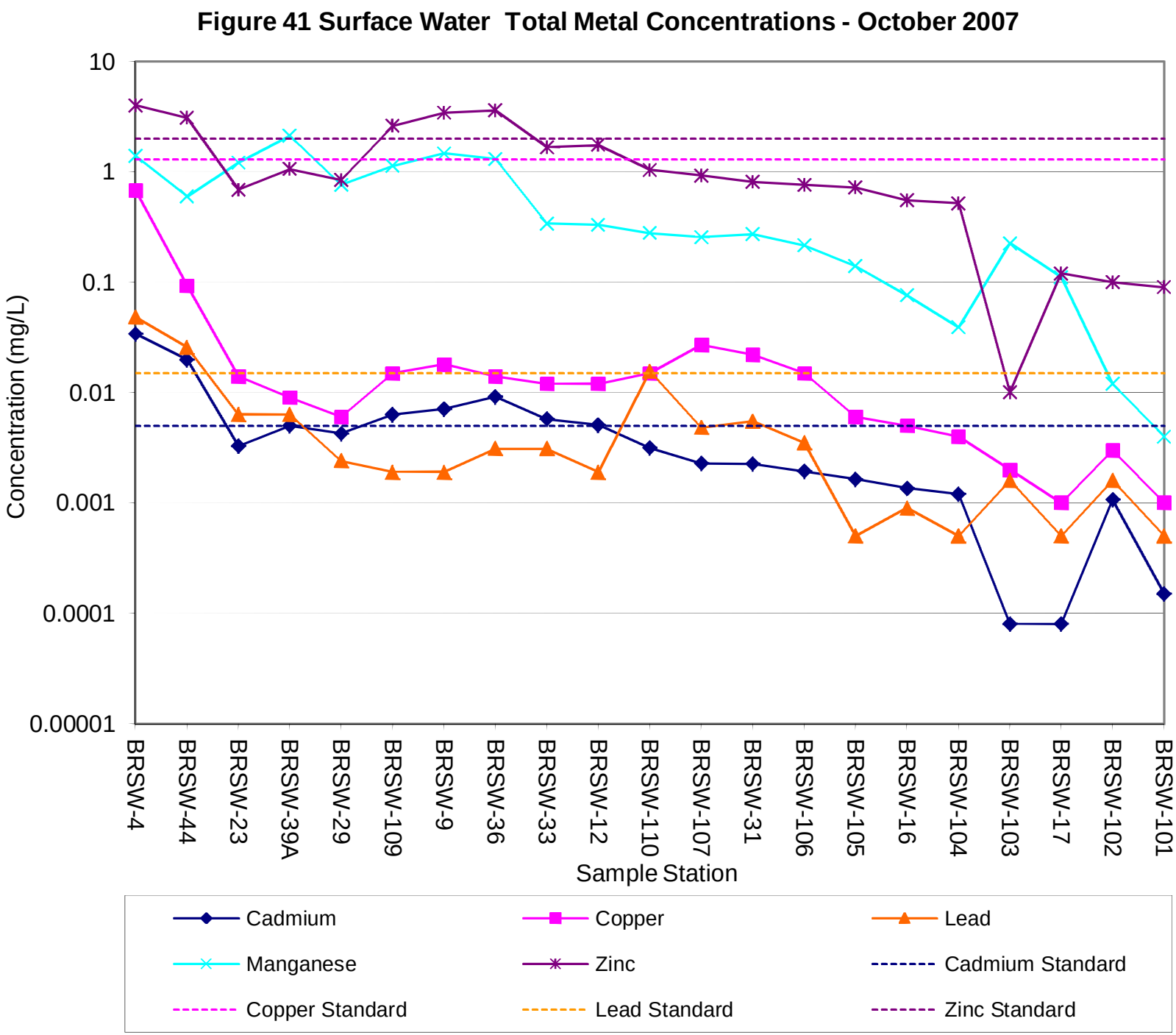


Figure 41 Surface Water Total Metal Concentrations - October 2007
Concentration (mg/L)
10
1
0.1
0.01
0.001
0.0001
0.00001
BRSW-4
BRSW-44
BRSW-23
BRSW-39A
BRSW-29
BRSW-109
BRSW-9
BRSW-36
BRSW-33
BRSW-12
BRSW-110
BRSW-107
BRSW-31
BRSW-106
BRSW-105
BRSW-16
BRSW-104
BRSW-103
BRSW-17
BRSW-102
BRSW-101
Sample Station
Cadmium
Copper
Lead
Manganese
Zinc
Cadmium Standard
Copper Standard
Lead Standard
Zinc Standard

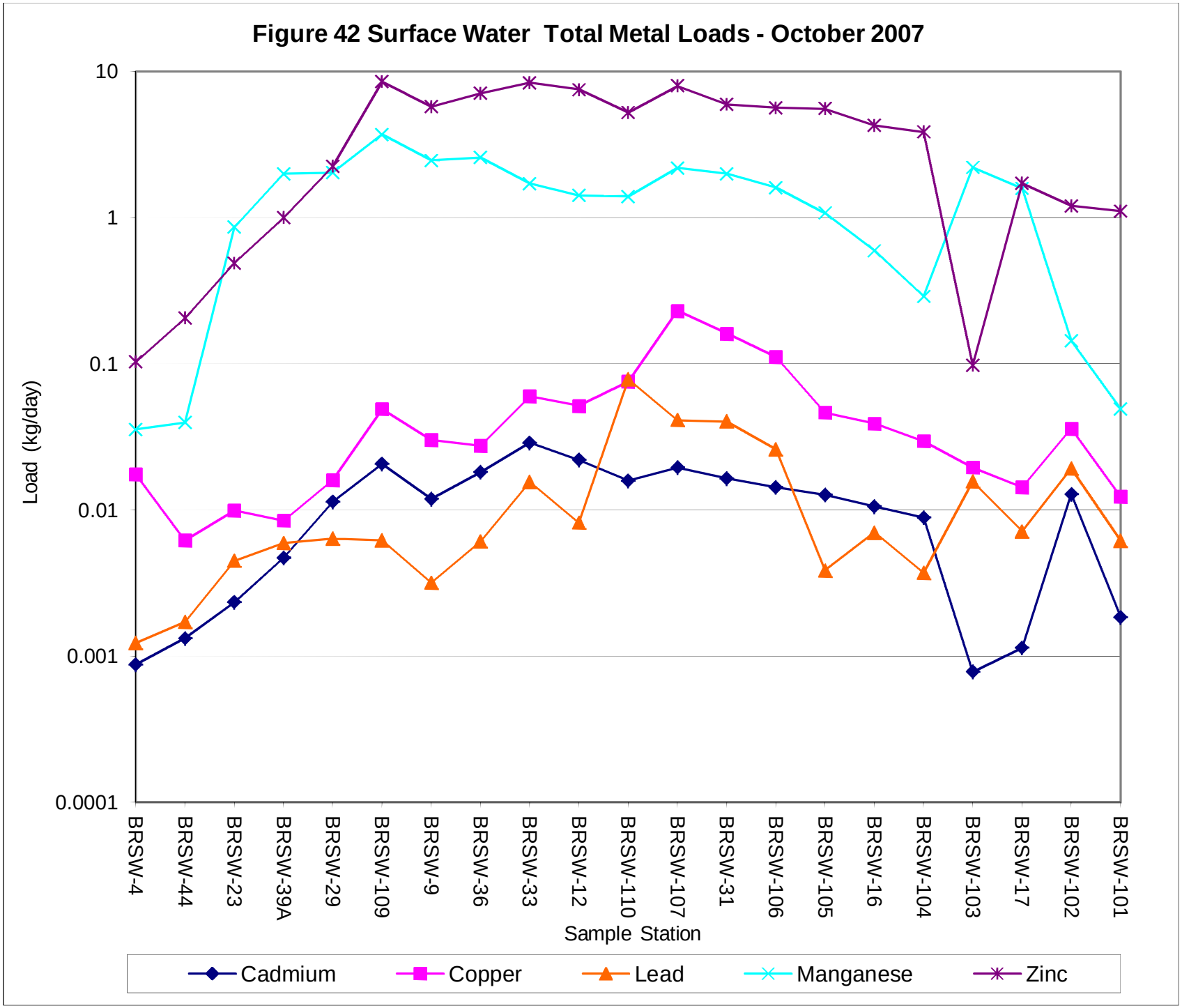


Figure 42 Surface Water Total Metal Loads - October 2007
10
1
0.1
0.01
0.001
0.0001
Load (kg/day)
BRSW-4
BRSW-44
BRSW-23
BRSW-39A
BRSW-29
BRSW-109
BRSW-9
BRSW-36
BRSW-33
BRSW-12
BRSW-110
BRSW-107
BRSW-31
BRSW-106
BRSW-105
BRSW-16
BRSW-104
BRSW-103
BRSW-17
BRSW-102
BRSW-101
Sample Station
Cadmium
Copper
Lead
Manganese
Zinc

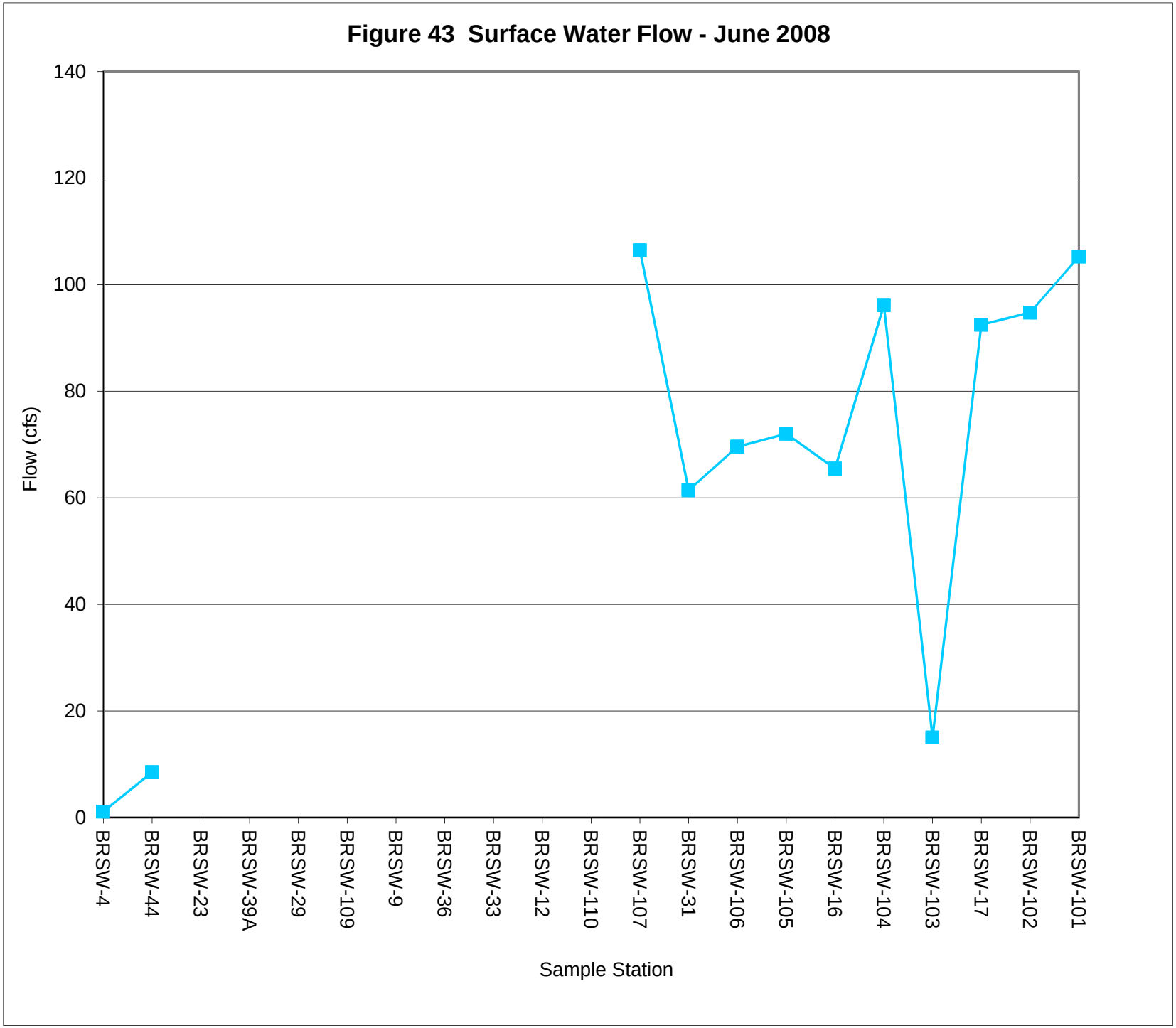


Figure 43 Surface Water Flow - June 2008
Flow (cfs)
140
120
100
80
60
40
20
0
BRSW-4
BRSW-44
BRSW-23
BRSW-39A
BRSW-29
BRSW-109
BRSW-9
BRSW-36
BRSW-33
BRSW-12
BRSW-110
BRSW-107
BRSW-31
BRSW-106
BRSW-105
BRSW-16
BRSW-104
BRSW-103
BRSW-17
BRSW-102
BRSW-101
Sample Station

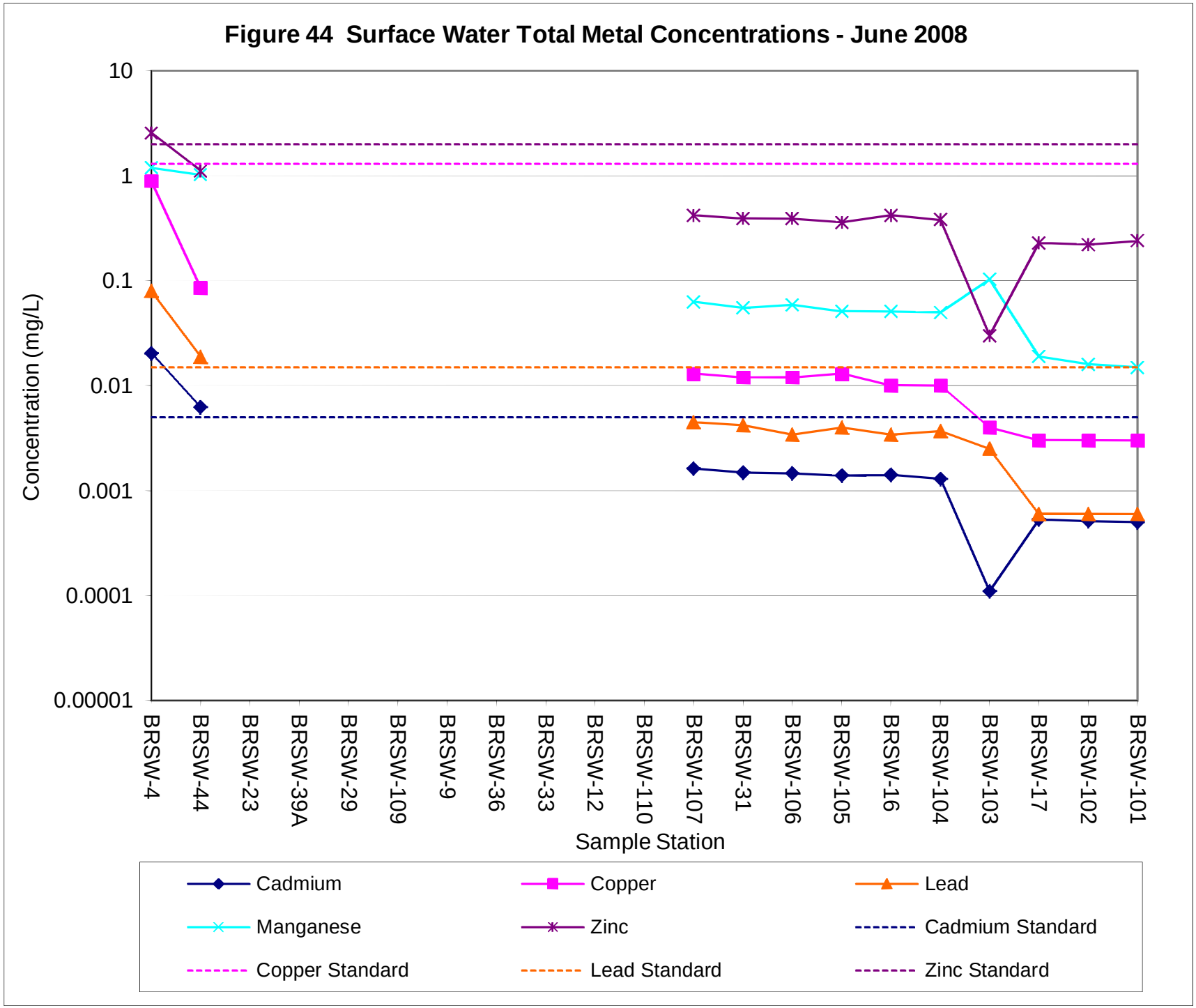


Figure 44 Surface Water Total Metal Concentrations - June 2008
10
1
0.1
0.01
0.001
0.0001
0.00001
Concentration (mg/L)
BRSW-4
BRSW-44
BRSW-23
BRSW-39A
BRSW-29
BRSW-109
BRSW-9
BRSW-36
BRSW-33
BRSW-12
BRSW-110
BRSW-107
BRSW-31
BRSW-106
BRSW-105
BRSW-16
BRSW-104
BRSW-103
BRSW-17
BRSW-102
BRSW-101
Sample Station
Cadmium
Copper
Lead
Manganese
Zinc
Cadmium Standard
Copper Standard
Lead Standard
Zinc Standard

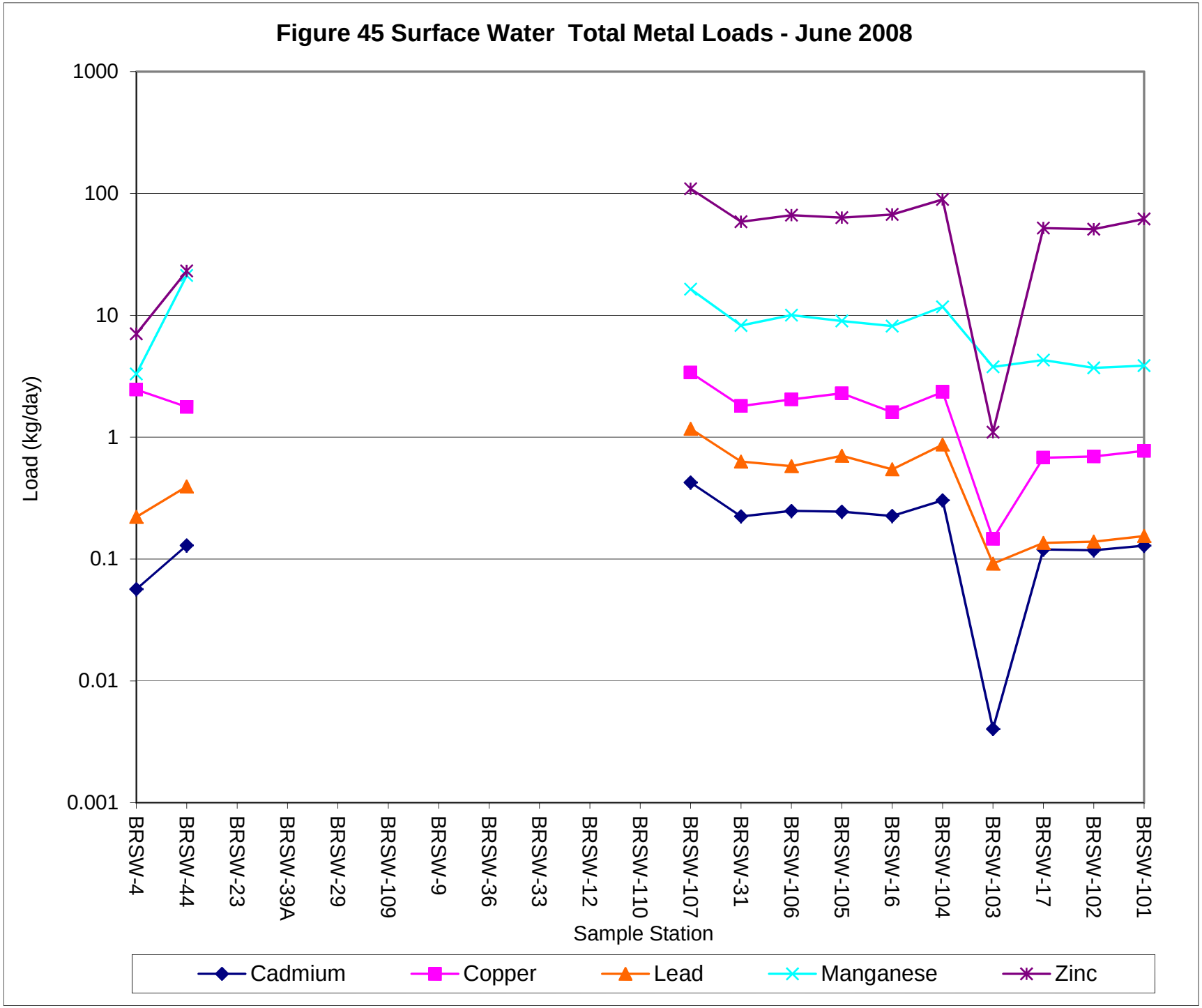


Figure 45 Surface Water Total Metal Loads - June 2008
1000
100
10
1
0.1
0.01
0.001
Load (kg/day)
BRSW-4
BRSW-44
BRSW-23
BRSW-39A
BRSW-29
BRSW-109
BRSW-9
BRSW-36
BRSW-33
BRSW-12
BRSW-110
BRSW-107
BRSW-31
BRSW-106
BRSW-105
BRSW-16
BRSW-104
BRSW-103
BRSW-17
BRSW-102
BRSW-101
Sample Station
Cadmium
Copper
Lead
Manganese
Zinc

FIGURE 46
Blackfoot River Streambed Sediment Concentrations in 0 ot 2-inch Depth Increment
(Arsenic and Cadmium)

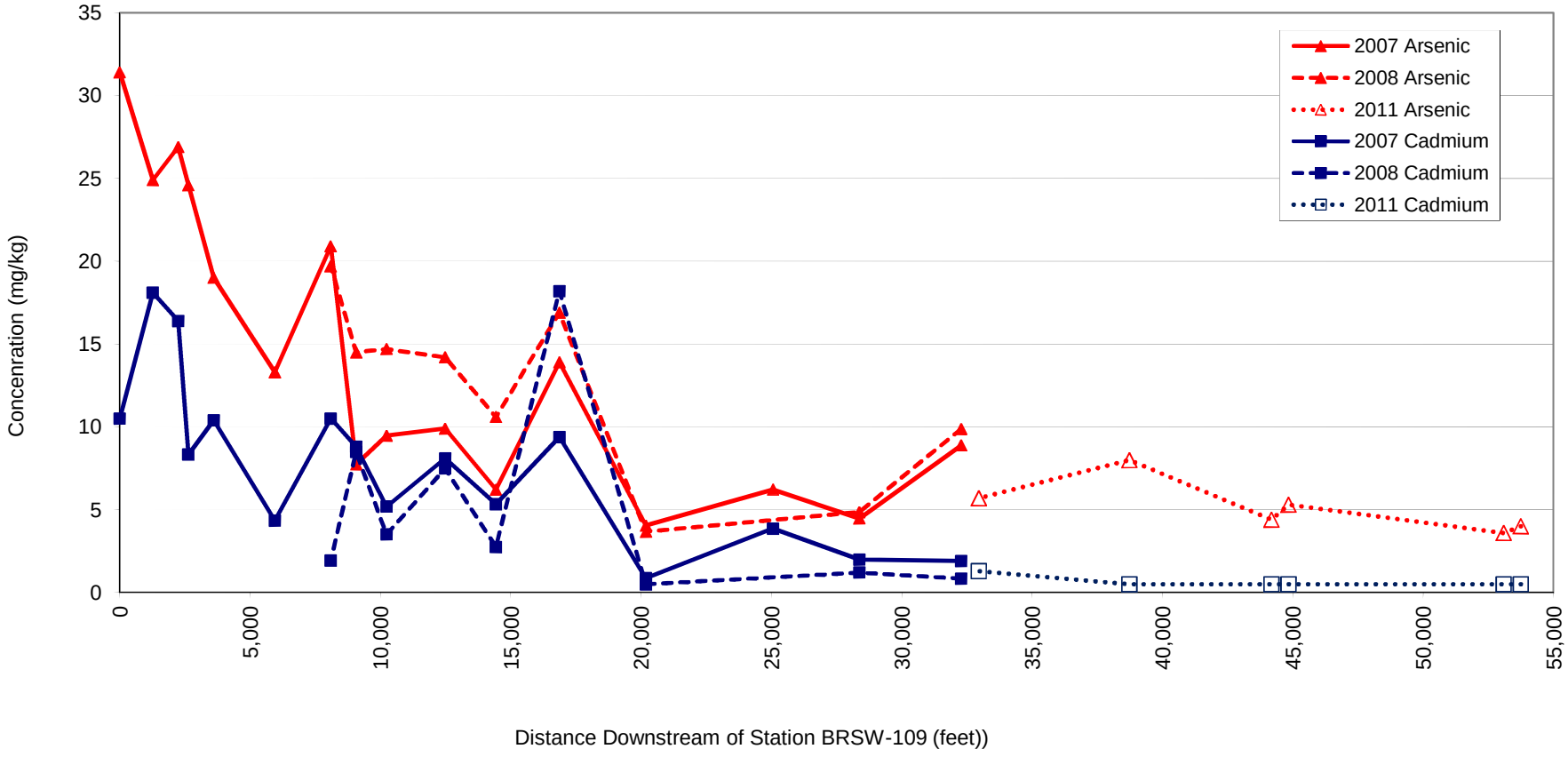


FIGURE 47
Blackfoot River Streambed Sediment Concentrations in 0 to 2-inch Depth Increment
(Lead, Manganese, and Zinc)

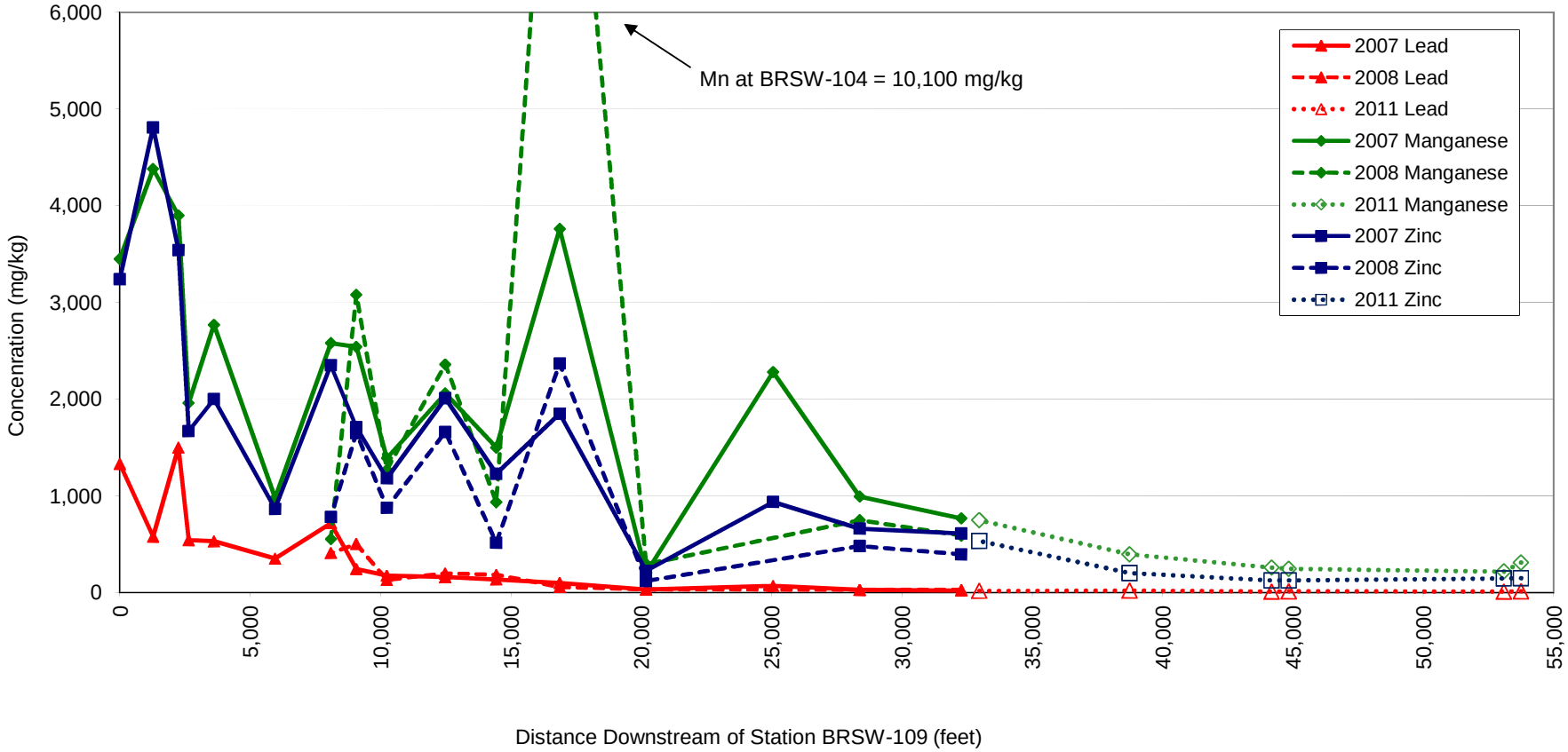
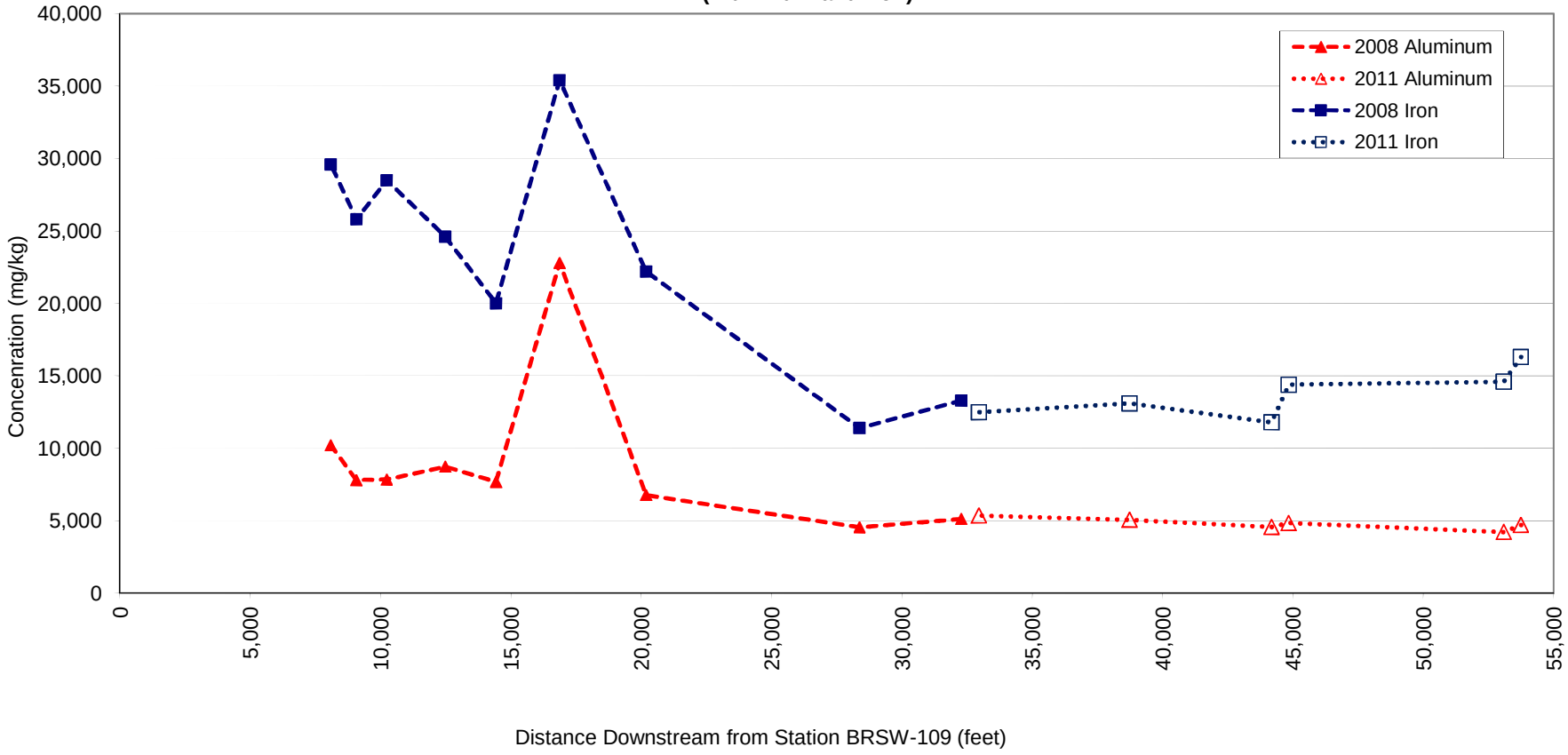


FIGURE 48
Blackfoot River Streambed Sediment Concentrations in 0 to 2-inch Depth Increment (Aluminum and Iron)



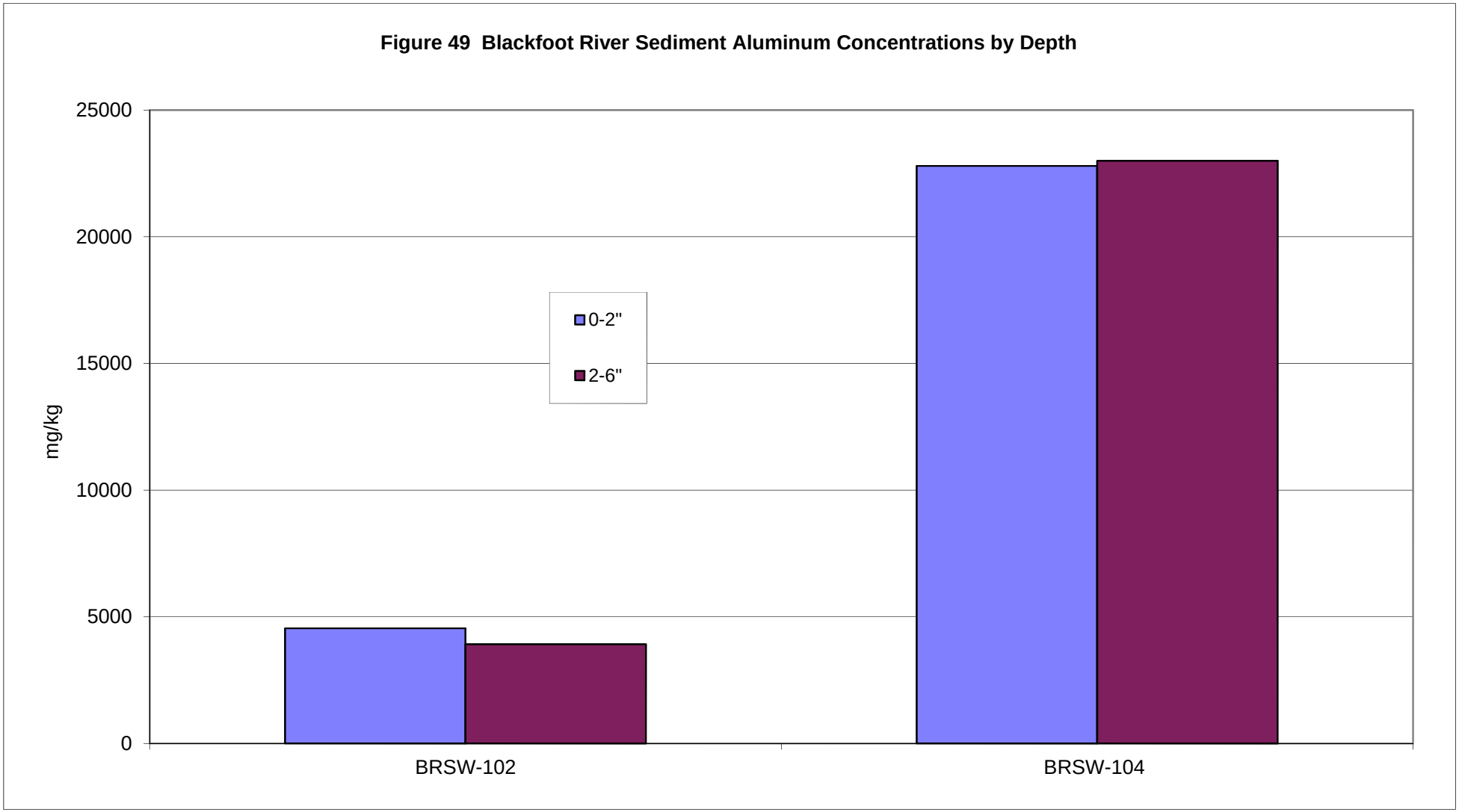


Figure 49 Blackfoot River Sediment Aluminum Concentrations by Depth
25000
20000
15000
10000
5000
0
mg/kg
0-2"
2-6"
BRSW-102
BRSW-104

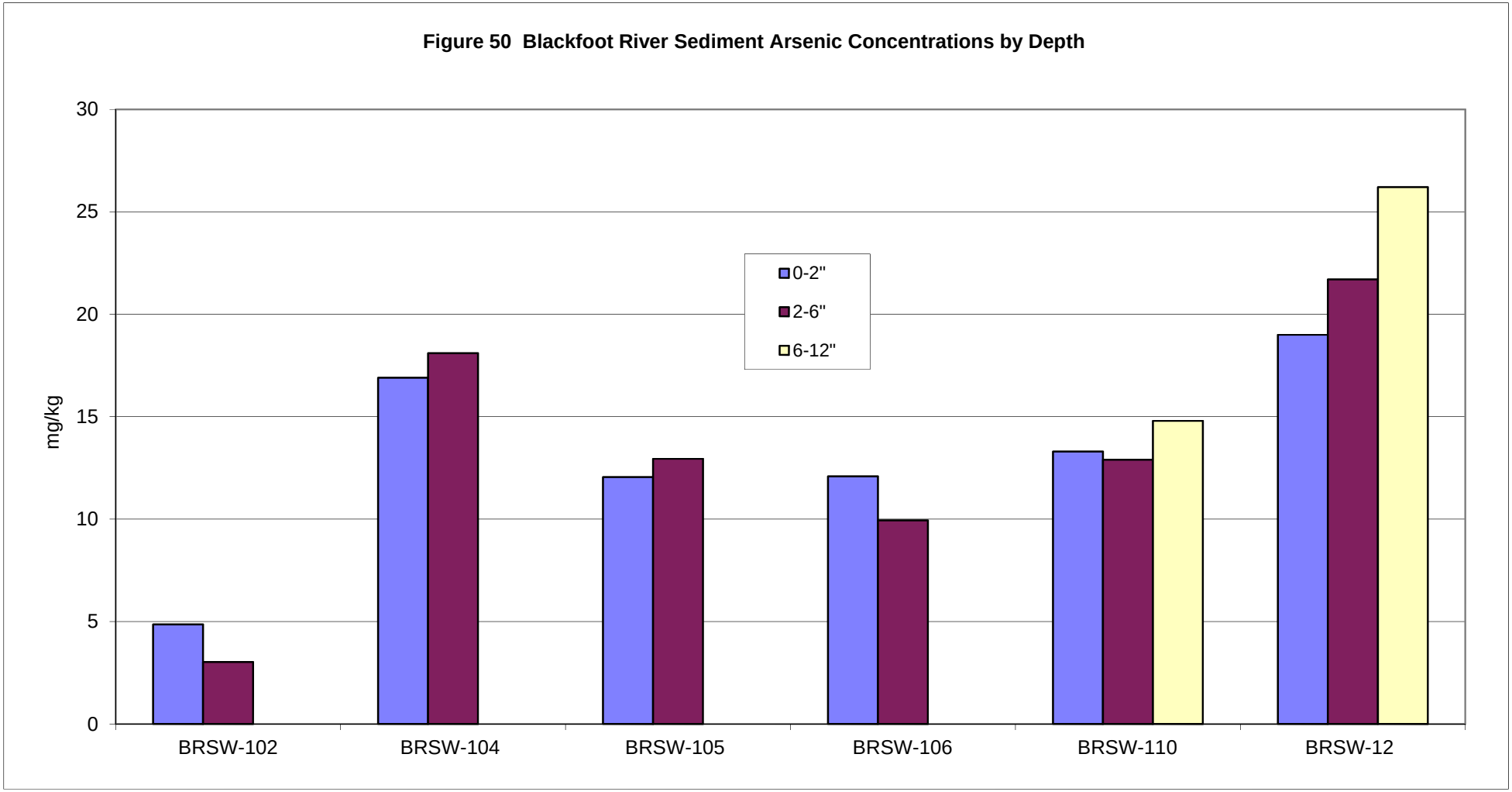


Figure 50 Blackfoot River Sediment Arsenic Concentrations by Depth
mg/kg
30
25
20
15
10
5
0
0-2"
2-6"
6-12"
BRSW-102
BRSW-104
BRSW-105
BRSW-106
BRSW-110
BRSW-12

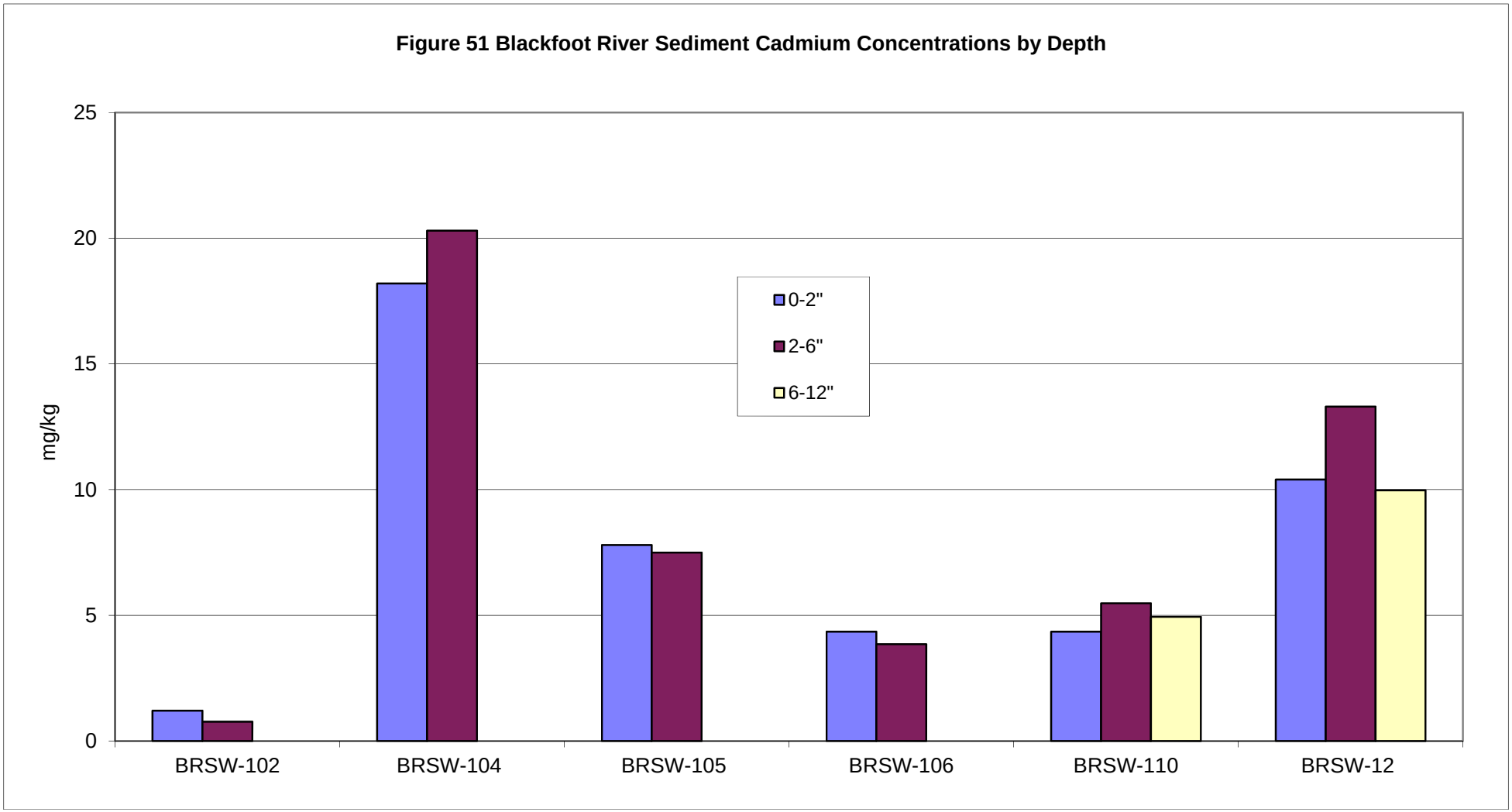


Figure 51 Blackfoot River Sediment Cadmium Concentrations by Depth
mg/kg
25
20
15
10
5
0
0-2"
2-6"
6-12"
BRSW-102
BRSW-104
BRSW-105
BRSW-106
BRSW-110
BRSW-12

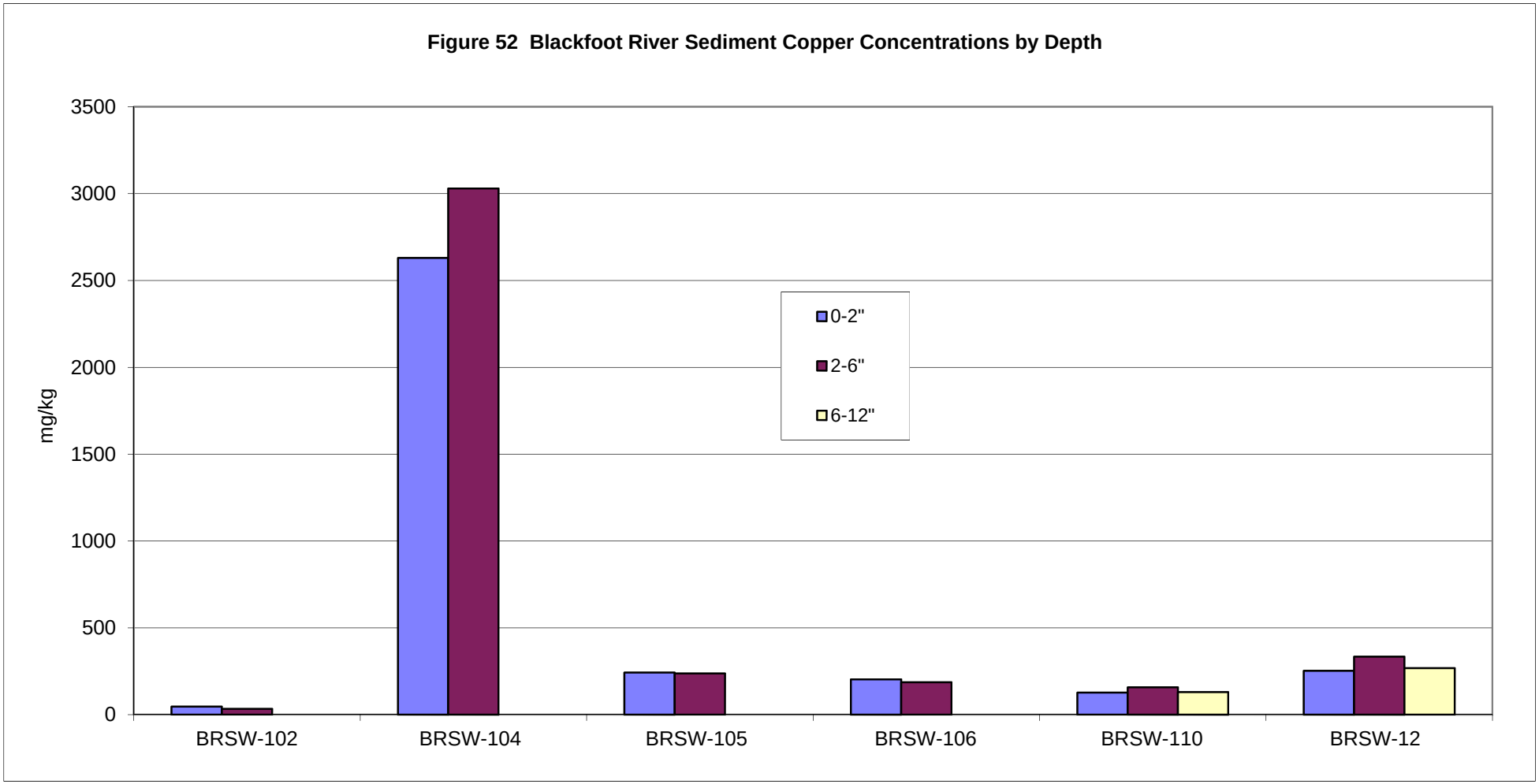
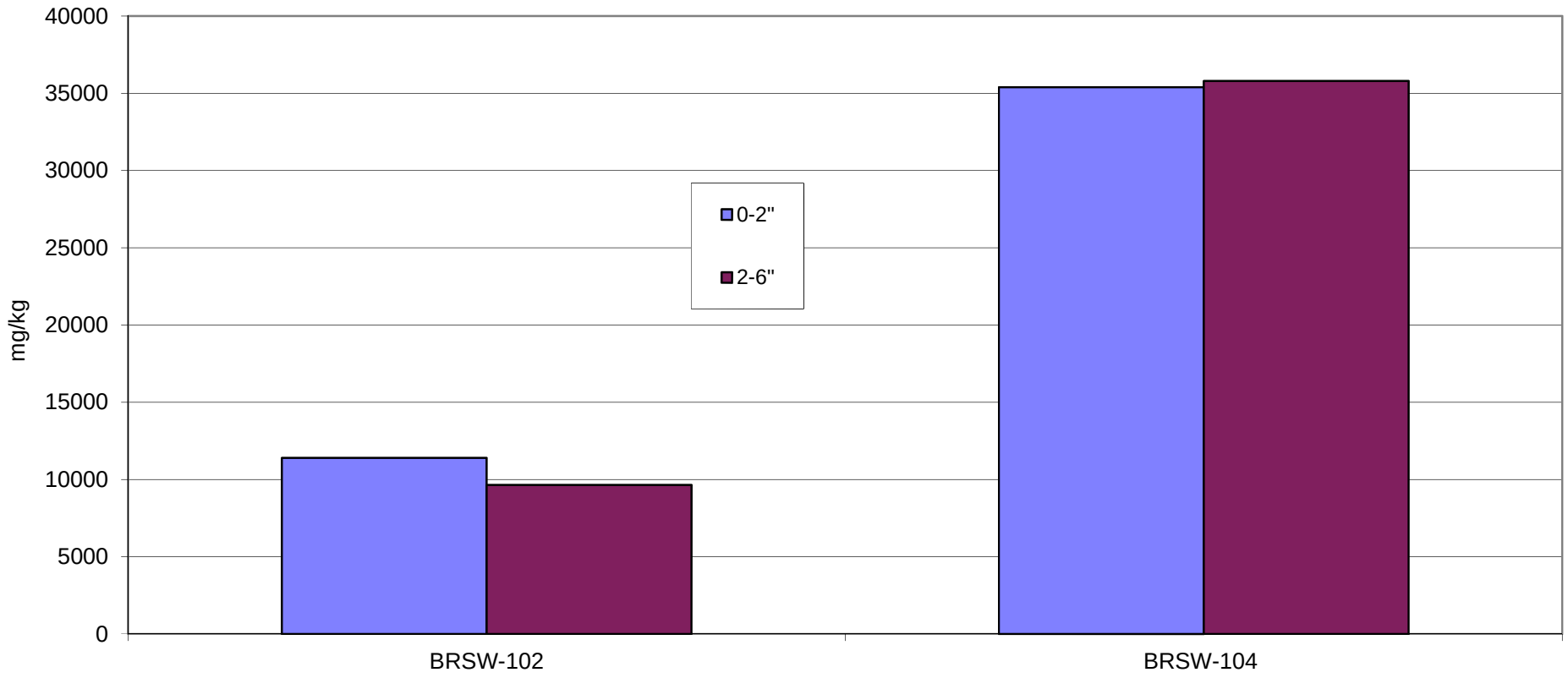


Figure 52 Blackfoot River Sediment Copper Concentrations by Depth
3500
3000
2500
2000
1500
1000
500
0
mg/kg
0-2"
2-6"
6-12"
BRSW-102
BRSW-104
BRSW-105
BRSW-106
BRSW-110
BRSW-12

Figure 53 Blackfoot River Sediment Iron Concentrations by Depth



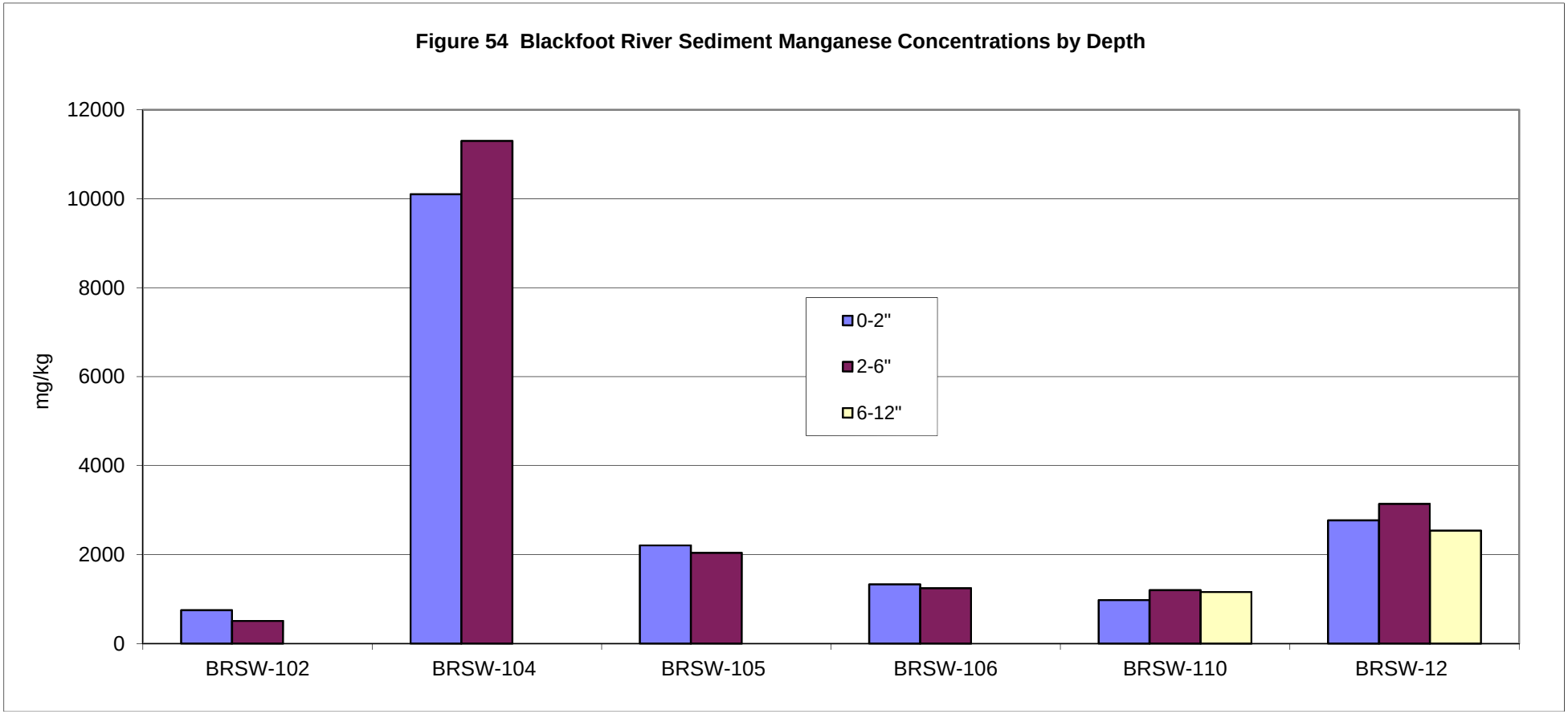
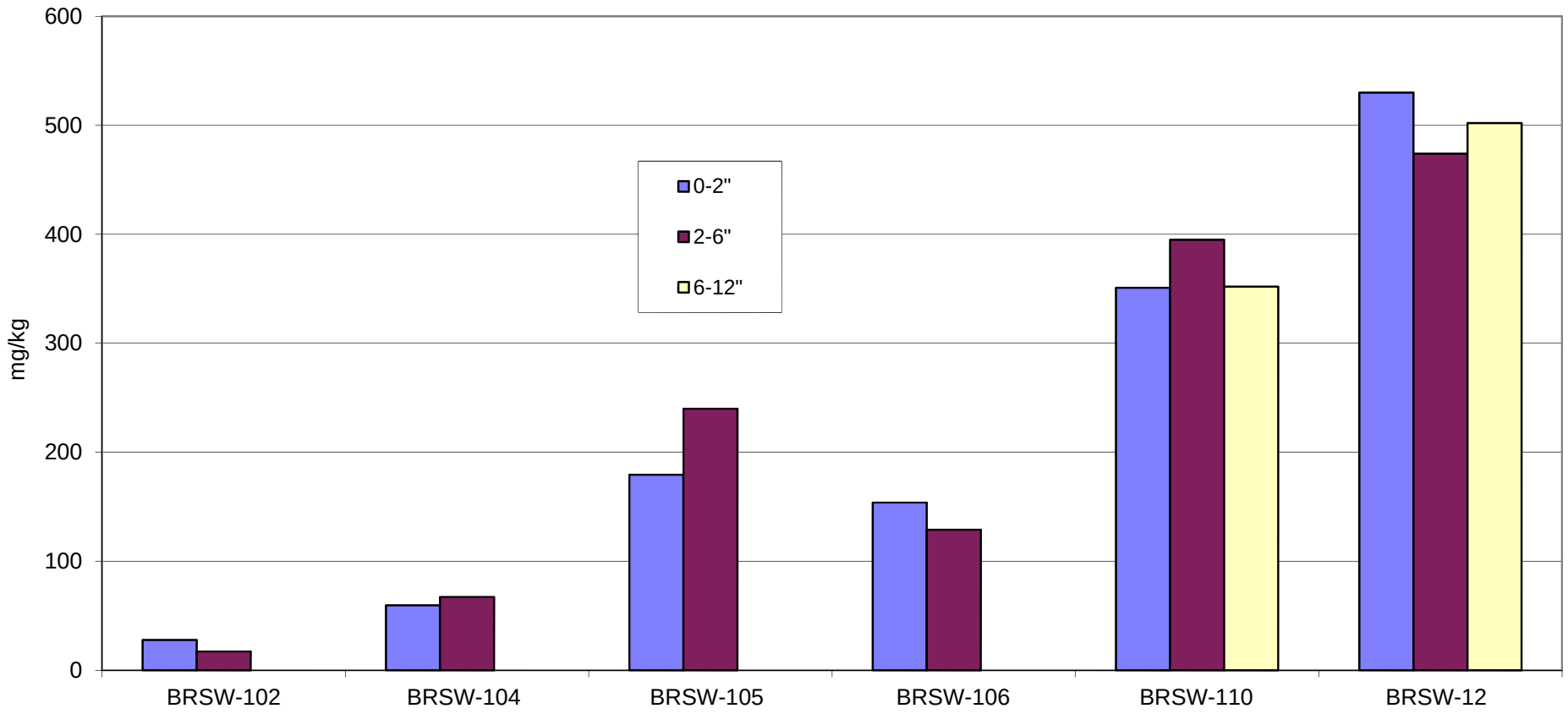


Figure 54 Blackfoot River Sediment Manganese Concentrations by Depth
12000
10000
8000
6000
4000
2000
0
mg/kg
0-2"
2-6"
6-12"
BRSW-102
BRSW-104
BRSW-105
BRSW-106
BRSW-110
BRSW-12

Figure 55 Blackfoot River Sediment Lead Concentrations by Depth



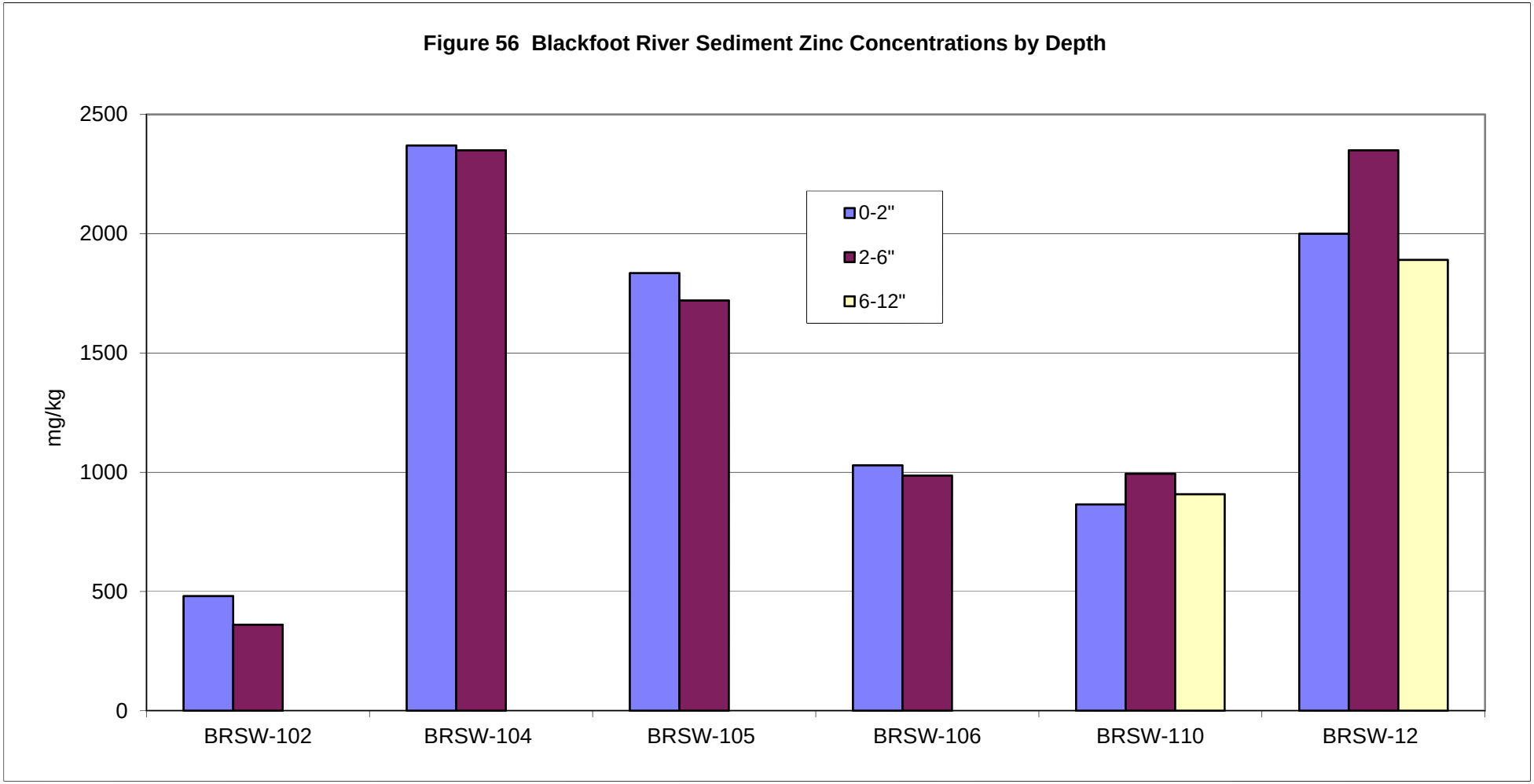
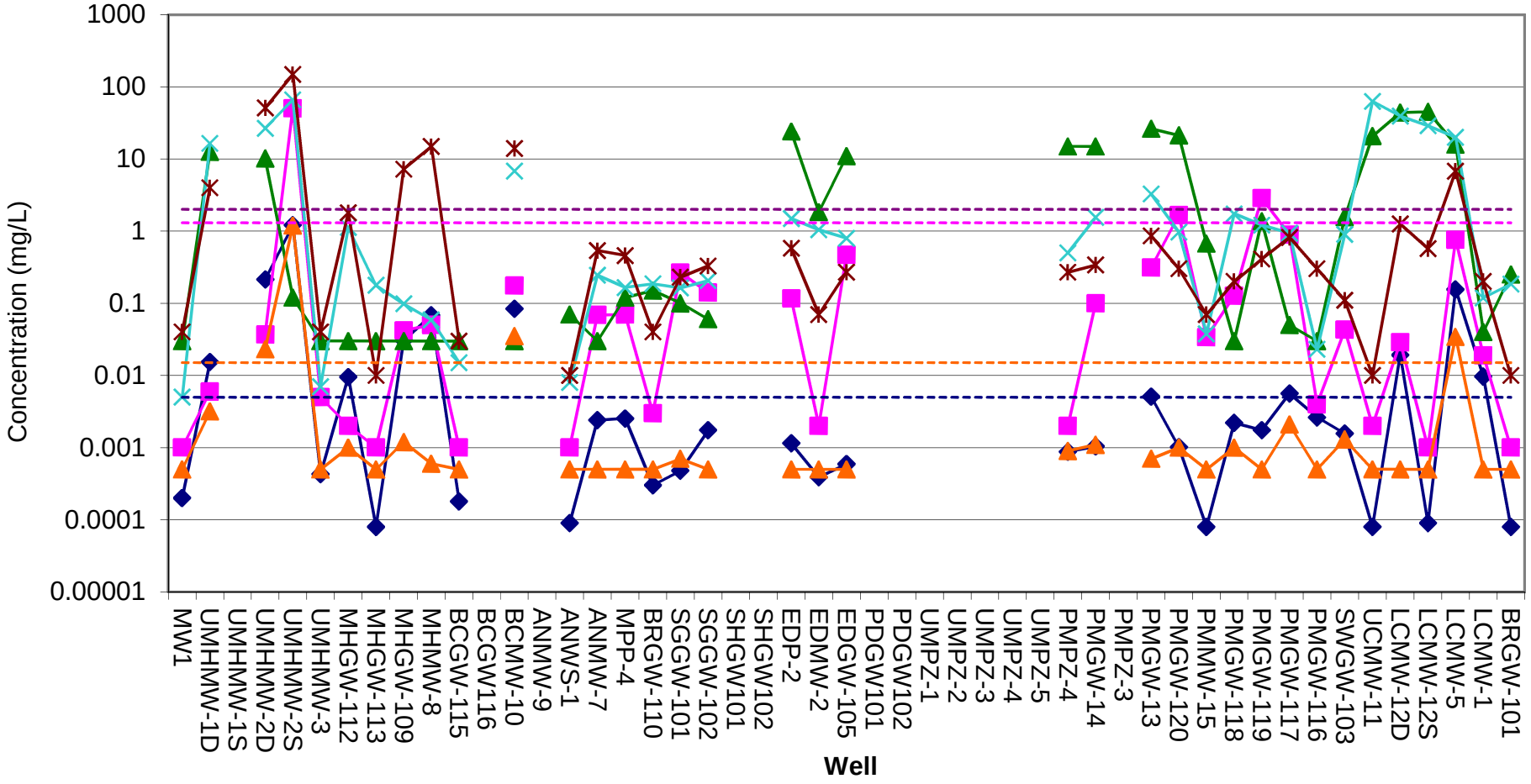


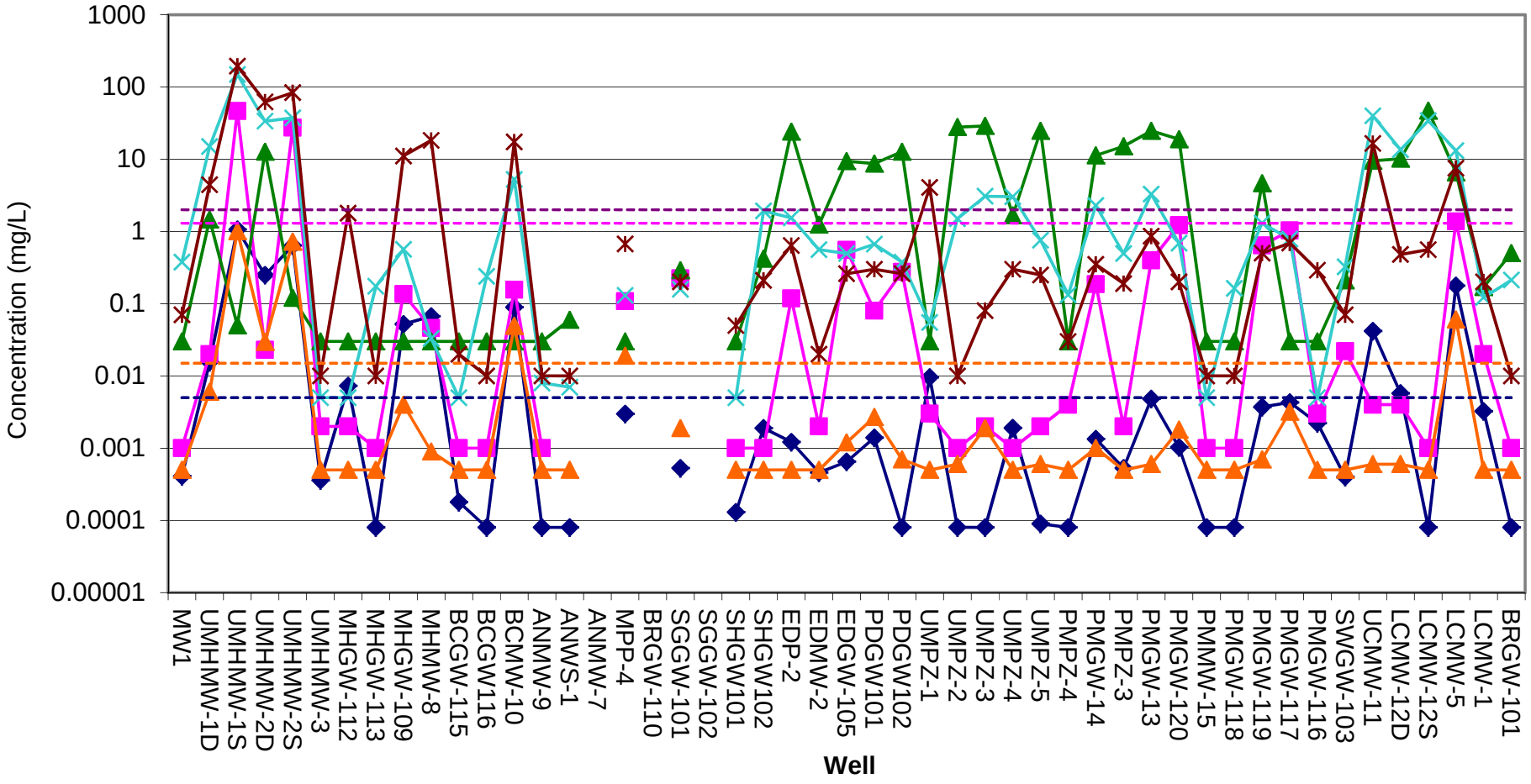
Figure 56 Blackfoot River Sediment Zinc Concentrations by Depth
2500
2000
1500
1000
500
0
mg/kg
0-2"
2-6"
6-12"
BRSW-102
BRSW-104
BRSW-105
BRSW-106
BRSW-110
BRSW-12

Figure 57 Dissolved Metals in Groundwater - October 2007



Cadmium
Copper
Iron
Lead
Manganese
Zinc
Cadmium Standard
Copper Standard
Lead Standard
Zinc Standard

Figure 58 Dissolved Metals in Groundwater - July 2008

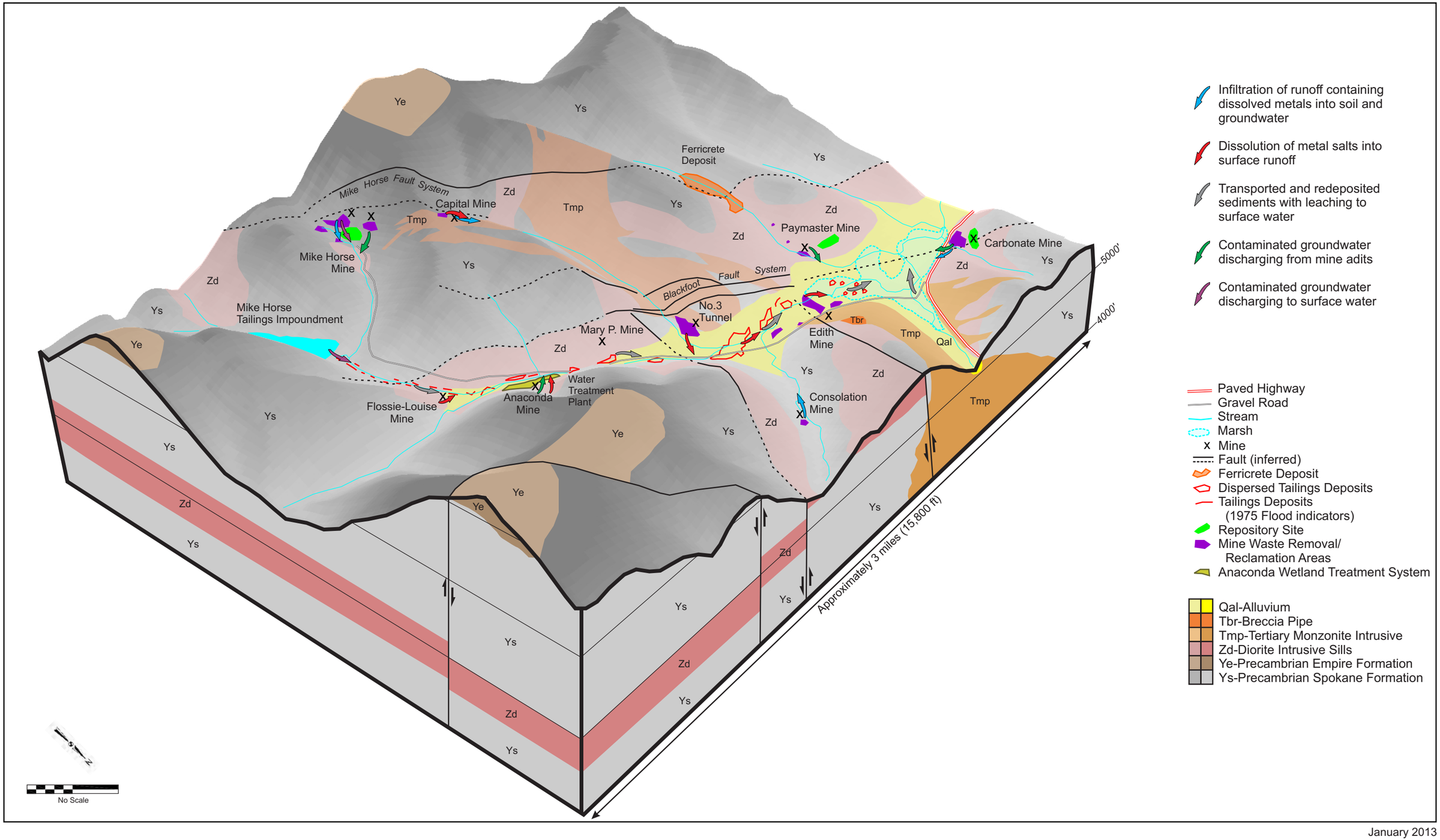


PRIMARY SOURCE	PRIMARY RELEASE MECHANISM	SECONDARY SOURCE	SECONDARY RELEASE MECHANISM	TERTIARY SOURCE	TERTIARY RELEASE MECHANISM	QUATERNARY SOURCE	EXPOSURE ROUTE	POTENTIAL RECEPTORS: Human: Current and Future Recreational User (1)	Human: Current and Future Construction Worker	Human: Current and Future Industrial Worker	Human: Current and Future Resident	Ecological: Terrestrial	Ecological: Aquatic
Mine Waste: Waste Piles, Tailings, Mining Disturbed Areas							Ingestion	●	●	●	●	A	--
							Dermal Contact	●	●	●	●	A	--
							Plant Uptake	○	○	○	○	A	--
	Wind Suspension & Vehicle Traffic	Outdoor Air (Particulates)					Inhalation	●	●	●	●	B	--
	Infiltration and Percolation	Groundwater					Ingestion	○ (5)	~ (5)	● (5)	● (5)	--	--
							Dermal Contact	○ (5)	● (5)	● (5)	● (5)	--	--
Untreated Mine Adit Water													
	Surface Runoff and Flood (Particulate and Dissolved)	Surface Water					Ingestion	● (5)	~ (5)	~ (5)	● (5)	A	A
							Dermal Contact	● (5)	~ (5)	~ (5)	● (5)	A	A
							Plant Uptake	○ (5)	○ (5)	○ (5)	○ (5)	--	A
		Sediment (2) (Resuspension)					Ingestion	●	~	~	●	A	A
							Dermal Contact	●	~	~	●	A	A
							Plant Uptake	○	○	○	○	A	A
			Wind Suspension of Floodplain Sediments/Soils	Outdoor Air (Particulates)			Inhalation	●	~	~	●	B	--
			Biota (Plant/Animal) Uptake	Food Chain			Ingestion	● (3)	○	○	○	A (4)	A (4)
							Dermal Contact	○	○	○	○	--	--
	Infiltration and Mixing	Soil					Ingestion	●	●	●	●	A	--
							Dermal Contact	●	●	●	●	A	--
							Plant Uptake	○	○	○	○	A	--
			Wind Suspension & Vehicle Traffic	Outdoor Air (Particulates)			Inhalation	●	●	●	●	B	--
			Infiltration and Percolation	Groundwater			Ingestion	○ (5)	~ (5)	● (5)	● (5)	--	--
							Dermal Contact	○ (5)	● (5)	● (5)	● (5)	--	--
			Surface Runoff and Flood (Particulate and Dissolved)	Surface Water			Ingestion	● (5)	~ (5)	~ (5)	● (5)	A	A
							Dermal Contact	● (5)	~ (5)	~ (5)	● (5)	A	A
							Plant Uptake	○ (5)	○ (5)	○ (5)	○ (5)	A	A
				Sediment (2) (Resuspension)			Ingestion	●	~	~	●	A	A
							Dermal Contact	●	~	~	●	A	A
							Plant Uptake	○	○	○	○	A	A
					Wind Suspension of Floodplain Sediments/Soils	Outdoor Air (Particulates)	Inhalation	●	~	~	●	B	--
					Biota (Plant/Animal) Uptake	Food Chain	Ingestion	● (3)	○	○	○	A (4)	A (4)
							Dermal Contact	○	○	○	○	--	--
			Biota (Plant/Animal) Uptake	Food Chain			Ingestion	● (3)	○	○	○	A (4)	--
							Dermal Contact	○	○	○	○	--	--

LEGEND

- ● Complete exposure pathway; will be quantitatively evaluated
- ~ Complete exposure pathway; will be qualitatively evaluated
- ○ Not applicable; incomplete exposure pathway
- (1) Four categories of recreational users will be evaluated: fisherman, hunter, gold panner/rock hound, and all-terrain vehicle and motorcycle rider
- (2) Includes pore water for ecological exposure
- (3) For human receptors (recreational fisherman and hunters), the food chain pathway includes ingestion of fish and terrestrial wildlife
- (4) For ecological receptors, the food chain pathway includes ingestion of plants, invertebrates, fish, and terrestrial wildlife
- (5) Groundwater and Surface Water will be compared to DEQ-7 water quality

Figure 59
Preliminary Conceptual Site Exposure Model
Upper Blackfoot Mining Complex



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January 2013

Figure 60
Graphical-Conceptual Model
Remedial Investigation
Upper Blackfoot Mining Complex

TABLE 1
UBMC PROPERTY OWNERSHIP

Legal Name	Parcel Owner	Property Description	Total Area (Acres)
ASARCO MINE CLAIMS			
Mike Horse Mine Claims	MT Environmental Trust Group, LLC	Mine Claims	*138.85*
MS# 10371 Mike Horse Mine Area Black Ore, Detroit, Hog All, Little Nell, Mike Horse, Pine Hill, Sterling			
Capital Mine Claims	MT Environmental Trust Group, LLC	Mine Claims	66.17
MS# 7351, 7352, 7354 Denver Lode2, Snowdrift, Capital, Copper Wreath			
Midnight Mine Claims	MT Environmental Trust Group, LLC	Mine Claim	190.18
MS # 9806, 7356, 7353, 10105 Daylight, Copper Gate, Midnight, Sunlight, Sunset, Yellowstone, Helena, Edith, Tunnel Site Area, Eureka, Summit, Tunnel site MS # 10106 Midnight Millsite			
Carbonate Mine Claims	MT Environmental Trust Group, LLC	Mine Claim	80.23
MS# 10557 (39.4 acres) Carbonate No. 1, Carbonate No. 2 *MS# 10556 (40.83 acres)* Carbonate Mine Area, Carbonate No. 3, Carbonate No. 5			
Anaconda Mine Claims	MT Environmental Trust Group, LLC	Mine Claim	81.66
MS #9286 Anaconda Mine Area, Anaconda, Big Dick, Blue Cristle, Copper Bell, Little Joe			
Paymaster Mine Claims	MT Environmental Trust Group, LLC	Mine Claim	84.75
MS #9287 Paymaster Mine Area, Black Diamond, Bonanza, Cicero, Jumbo, Paymaster			
Consolation Mine Claims	MT Environmental Trust Group, LLC	Mine Claim	55.05
MS# 10502 Consolation Mine Area, Blackfoot Belle, Consolation, Golden Eagle			
Mary P mine Claims			
MS 9286 Mary P	MT Environmental Trust Group, LLC	Mine Claim	18.92
FORMER ASARCO FEE LAND			
Gov't Lt 5; Lt 9; Lts 15-16	MT Environmental Trust Group, LLC	Agricultural Land	78.68
Gov't Lts 1-3 & 6	MT Environmental Trust Group, LLC	Agricultural Land	243.98

TABLE 1
UBMC PROPERTY OWNERSHIP

Legal Name	Parcel Owner	Property Description	Total Area (Acres)
PRIVATE OWNERSHIP			
TR IN SENE 2.67 AC	Bordeleau, Denis B. & Linda M.	Residential Rural	2.67
TR IN SENE 2.77 AC	Bordeleau, Linda & Denis	Residential Rural	2.77
E2E2 SWSE	Cox, Esther M.	Agricultural Land	200
Govt. LTS 1-3 NE4NE4 W2NE4	Trustee for Lowell D. Cox Cox, Esther M.	Cadotte Cr. Farmstead	239.45
W2SE4	Cox, Lucia L 1/2 Interest	Unknown	80
NESE	Johnson, Ernest W.	Agricultural Land	40
SENE	Johnson, Ernest W.	Agricultural Land	40
Rtc Sportal 17.82 Ac	Lewin-Opitz, Susan	Agricultural Land	58.13
Ms# 10465 Flosse & Louise	Lovely, Mitchell A & Joaquina P	Mine Claim	41.26
Govt Lot 4	USA	Unknown	39.87
Minor Sub #19 Lt 1	Zuelke, Robert Emil & Kathleen	Primary Site	1.6
TR in NWNE 2 AC	Shaw, M. Douglas & Diane R	Residential Rural	2
Govt LTS All Less Mines	USDA Forest Service	Forest Service	542.62
TR in NWNE .943 AC 1/2 Mile	Zuelke, Robert E. & Kathleen J.	Residential Rural	0.943
NESE	Robbins, Brian	--	40

TABLE 10
UPPER BLACKFOOT MINING COMPLEX SAMPLING SUMMARY
SURFACE WATER, SEDIMENT & MACROINVERTEBRATE SAMPLING LOCATIONS

Location Information						Investigation Type						Surface Water Analyses			Sediment An	Aquatics Analyses		
Line Entry	Surface Water Body	Location Type (s)	Station Number	Media Type	Sediment Sample Depth Intervals	Proposed Sample ID	Source	Nature and Extent	Risk	RD	Stream Gage (General Location)	Field[1]	Common Anions & Cations[2]	Metals[3]	Metals[4]	Taxonomy	Metals	Rationale / Comments
1	MH	SW	BRSW-4	SW	--	--	X	X		X	above anticipated seepage area, at station location, below anticipated seepage area but above confluence with Beartrap Creek/tailings outfall	X	X	X	--	--	--	Evaluate potential loading from seeps and waste removal areas.
2	MH	SW	BRSW-44	SW	--	--	X	X		X	above anticipated seepage area, at station location, below anticipated seepage area but above confluence with Beartrap Creek/tailings outfall	X	X	X	--	--	--	Evaluate loading from tailings deposits and tailings dam seeps.
3	BC	SW	BRSW-23	SW	--	--	X	X		X	above waste piles, at sample location, below waste piles	X	X	X	--	--	--	Evaluate potential metals loading from tailings and mine waste deposits.
4	BC	SW	BRSW-39A	SW	--	--	X	X		X	at station location	X	X	X	--	--	--	Evaluate loading from tailings and mine waste deposits.
5	AC	SW, SE, AQ	BRSW-6	SW, SE, AQ		--	X	X		X	at station location	X	X	X	X	X	X	Good water quality stream. Evaluate stream as possible background or reference stream for water, sediment, and aquatic organisms.
6	BR	SW	BRSW-29	SW	--	--	X	X		X	at station location	X	X	X	--	--	--	Evaluate potential metals loading and possible change in concentration following confluence of Anaconda Creek.
7	BR	SW	AW-003	SW	--	--	X	X		X	at station location	X	X	X	--	--	--	Evaluate metals load from constructed wetlands outflow.
8	BR	SW, SE, AQ	BRSW-109	SW, SE, AQ	0-2"	BRSW-109	X	X		X	at station location	X	X	X	X	X	X	Evalute metals in water and sediment from potential loading from tailings/mine waste. Evaluate affects on aquatics
9	BR	SW, SE	BRSW-9	SW, SE	0-2"	--	X	X		X	at station location	X	X	X	X	--	--	Evaluate metal load in water and sediment on Blackfoot River above confluence with Stevens Creek
10	BR	SW, SE, AQ	BRSW-108	SW, SE, AQ	0-2"	BRSW-108	X	X		X	at location and on Stevens Creek	X	X	X	X	X	X	Evalaute metal in water and sediment following Blackfoot River below confluence with Stevens Creek. Evaluate affect on aquatics
11	BR	SW, SE	BRSW-36	SW, SE	0-2"	--	X	X		X	at station location	X	X	X	X	X	X	Evaluate metal load in water and sediment above Shave Creek. Evaluate affects on aquatics
12	BR	SW, SE, AQ	BRSW-33	SW, SE, AQ	0-2"	--	X	X		X	at station location	X	X	X	X	X	X	Evaluate metal load to water and sediment below Shave Creek. Evaluate affects on aquatics.
13	BR	SW, SE, AQ	BRSW-12	SW, SE, AQ	0-2"	--	X	X		X	at station location	X	X	X	X	X	X	Evalaute metal load in water and sediment prior to entering marsh. Evaluate affects on aquatics.

TABLE 10
UPPER BLACKFOOT MINING COMPLEX SAMPLING SUMMARY
SURFACE WATER, SEDIMENT & MACROINVERTEBRATE SAMPLING LOCATIONS

Location Information						Investigation Type						Surface Water Analyses			Sediment An	Aquatics Analyses		
Line Entry	Surface Water Body	Location Type (s)	Station Number	Media Type	Sediment Sample Depth Intervals	Proposed Sample ID	Source	Nature and Extent	Risk	RD	Stream Gage (General Location)	Field[1]	Common Anions & Cations[2]	Metals[3]	Metals[4]	Taxonomy	Metals	Rationale / Comments
14	PD	SW, SE, AQ	BRSW-11	SW, SE, AQ	0-2"	--	X	X		X	at station location	X	X	X	X	X	X	Evaluate possible background metals concentrations in water and sediment from Pass Creek. Evaluate health of aquatics.
15	PM	SW, SE, AQ	BRSW-21	SW, SE, AQ	0-2"	--	X	X		X	at station location	X	X	X	X	X	X	Evaluate metal load in water and sediment from Paymaster Creek. Evaluate affect on aquatics.
16	PM	SW, SE, AQ	BRSW-13	SW, SE, AQ	0-2"	--	X	X		X	at station location	X	X	X	X	X	X	Evaluate metal load in water and sediment from Paymaster Creek. Evaluate affect on aquatics.
17	BR	FW	BMSP-2	FW	--	--	X	X		X	at station location	X	X	X	--	--	--	Possible abandoned flowing exploration well in marsh. Sample if flowing, note if abandonned.
18	BR	SW, SE, AQ	BRSW-110	SW, SE, AQ	--	BRSW-110	X	--		X	at station location	X	X	X	X	X	X	Evaluate chemistry of surface water & sediment in marsh near BMSP-2. Evaluate aquatic organisms
19	BR	SW, SE, AQ	BRSW-107	SW, SE, AQ	0-2"	BRSW-107	X	X		X	at station location	X	X	X	X	X	X	Evaluate metal load in water and sediment in Upper Marsh. Evaluate affects on aquatics.
20	BR	SW, SE	BRSW-31	SW, SE	0-2"	--	X	X		X	at station location	X	X	X	X	--	--	Evaluate metals in water and sediment below the confluence with Swamp Creek, Meadow Creek, and Porcupine Creek
21	BR	SW, SE, AQ	BRSW-106	SW, SE, AQ	0-2"	BRSW-106	X	X		X	at station location	X	X	X	X	X	X	Evaluate metal load in water and sediment above confluence with Surveyor Gulch. Evaluate aquatic organisms.
22	BR	SW, SE	BRSW-105	SW, SE	0-2"	BRSW-105	X	X		X	at station location	X	X	X	X	--	--	Evaluate metal load in water and sediment above Middle Marsh.
23	BR	SW, SE, AQ	BRSW-16	SW, SE, AQ	0-2"	--	X	X		X	at station location	X	X	X	X	X	X	Evaluate metal load in water and sediment within central portion of Middle Marsh. Evaluate affects on aquatics.
24	BR	SW, SE, AQ	BRSW-104	SW, SE, AQ	0-2"	BRSW-104	X	X		X	at station location	X	X	X	X	X	X	Evaluate metal load in water and sediment between Middle March and Lower Marsh. Evaluate aquatic organisms.
25	BR	SW, SE, AQ	BRSW-103	SW, SE, AQ	0-2"	BRSW-103	X	X		X	at station location	X	X	X	X	X	X	Evaluate metal load in water and sediment within central portion of Lower Marsh. Evaluate affects on aquatics.
26	BR	SW, SE, AQ	BRSW-17	SW, SE, AQ	0-2"	--	X	X		X	at station location	X	X	X	X	X	X	Evaluate metal load in water and sediment below Lower Marsh. Evaluate affects on aquatics.
27	BR	SW, SE, AQ	BRSW-102	SW, SE, AQ	0-2"	BRSW-102	X	X		X	at station location	X	X	X	X	X	X	Evaluate metal load in water and sediment approximately mid-way between Lower Marsh and Highway 279. Evaluate affects on aquatics.
28	BR	SW, SE, AQ	BRSW-101	SW, SE, AQ	0-2"	BRSW-101	X	X		X	at station location	X	X	X	X	X	X	Evaluate metal load in water and sediment upstream of Highway 279 bridge. Evaluate affects on aquatics.
29	BR	SW, SE	BRSW-201	SW, SE	0-2"	BRSW-201	X	X		X	at station location	X	X	X	X	X	X	Evaluate metal load in water and sediment at furthest downstream location

TABLE 10
UPPER BLACKFOOT MINING COMPLEX SAMPLING SUMMARY
SURFACE WATER, SEDIMENT & MACROINVERTEBRATE SAMPLING LOCATIONS

Location Information						Investigation Type						Surface Water Analyses			Sediment An	Aquatics Analyses		
Line Entry	Surface Water Body	Location Type (s)	Station Number	Media Type	Sediment Sample Depth Intervals	Proposed Sample ID	Source	Nature and Extent	Risk	RD	Stream Gage (General Location)	Field[1]	Common Anions & Cations[2]	Metals[3]	Metals[4]	Taxonomy	Metals	Rationale / Comments
30	BR	SW, SE	BRSW-202	SW, SE	0-2"	BRSW-202	X	X		X	at station location	X	X	X	X	X	X	Evaluate metal load in water and sediment downstream of Hwy 279, eval. Western boundary
31	BR	SW, SE	BRSW-203	SW, SE	0-2"	BRSW-203	X	X		X	at station location	X	X	X	X	X	X	Evaluate metal load in water and sediment downstream of Hwy 279, eval. Western boundary
32	BR	SW, SE	BRSW-204	SW, SE	0-2"	BRSW-204	X	X		X	at station location	X	X	X	X	X	X	Evaluate metal load in water and sediment downstream of Hwy 279, eval. Western boundary
33	BR	SW, SE	BRSW-205	SW, SE	0-2"	BRSW-205	X	X		X	at station location	X	X	X	X	X	X	Evaluate metal load in water and sediment downstream of Hwy 279, eval. Western boundary
34	BR	SW, SE	BRSW-206	SW, SE	0-2"	BRSW-206	X	X		X	at station location	X	X	X	X	X	X	Evaluate metal load in water and sediment downstream of Hwy 279, evaluate western boundary'

NOTES:

Drainage Basin
BR-Blackfoot River
BC-Beartrap Creek
MH-Mike Horse Creek
PD-Pass Creek Meadow
AC - Anaconda Creek

MEDIA
SE - Sediment
SW - Surface Water
AQ - Aquatics (macroinvertebrates, periphyton, etc.)
FW - Flowing Well

1 - Field parameters include: dissolved oxygen, temperature, pH, specific conductance, and flow gagaing
2 - Anions & Common cations include: sulfate, bicarbonate, carbonate, chloride, calcium, magnesium, potassium, sodium
3 - Metals (surface water) include: alumium, arsenic, cadmium, copper, iron, lead, manganese, zinc
4 - Metals (Sediment and Aquatics) - arsenic, cadmium, copper, lead, manganese, mercury, zinc

Table 11
Summary of Monitoring Well and Piezometer Inventory

								Investigation Type[1]					Proposed Analyses					
Line Entry	**General Location**	**Drainage Basin**	**Station Number**	**Media Type**	**Alluvial**	**Bedrock**	**Soil Sample Depth Intervals**	**Proposed Sample ID**	**Source**	**Nature and Extent**	**Risk**	**RD**	**Field**	**Standard Analyte Suite**	**Metals**	**Water Levels**	**Rationale / Comments**	**Total Depth ft bgs (Est.)**
1	At mouth of Porcupine Gulch / road to Meadow Creek	BR	LCMW-1	GW	X	--	--	LCMW-1	--	X	X	--	X	X	X	X	Evaluate alluvial groundwater exiting UBMC	27
2	At mouth of Porcupine Gulch paired w/ LCMW-1	BR	BRGW-101	GW	--	X	--	BRGW-101	--	X	X	--	X	X	X	X	Evaluate bedrock groundwater exiting UBMC	85
3	Along Blackfoot River at Mary P Prospect	BR	MPP-4	GW	X	--	--	MPP-4	X	X	X	--	X	X	X	X	Evaluate alluvial groundwater near Mary P Prospect paired w/ BRGW-110	29
4	Along Blackfoot River at Mary P Prospect paired w/ MPP-4	BR	BRGW-110	GW	--	X	--	BRGW-110	--	X	X	--	X	X	X	X	Evaluate bedrock groundwater near Mary P Prospect paired w/ MPP-4	41
5	At down stream end of Anaconda Mine constructed wetlands	BR	ANMW-7	GW	X	--	--	ANMW-7	X	X	X	--	X	X	X	X	Evaluate alluvial groundwater exiting the Anaconda Mine area and shallow Blackfoot River	21
6	Upper Marsh	BR	PGPZ-1	GW	X	--	--	PGPZ-1	X	X	--	--	X	X	X	X	Evaluate source of water to marsh	6.5
7	Upper Marsh	BR	UMPZ-1	GW	X	--	--	UMPZ-1	X	X	--	--	X	X	X	X	Evaluate source of water to marsh	3.5
8	Upper Marsh	BR	UMPZ-2	GW	X	--	--	UMPZ-2	X	X	--	--	X	X	X	X	Evaluate source of water to marsh	9
9	Upper Marsh	BR	UMPZ-3	GW	X	--	--	UMPZ-3	X	X	--	--	X	X	X	X	Evaluate source of water to marsh	14
10	Upper Marsh	BR	UMPZ-4	GW	X	--	--	UMPZ-4	X	X	--	--	X	X	X	X	Evaluate source of water to marsh	7.5
11	Upper Marsh	BR	UMPZ-5	GW	X	--	--	UMPZ-5	X	X	--	--	X	X	X	X	Evaluate source of water to marsh	8.5
12	Mouth of drainage near Highway 200	SW	LCMW-5	GW	X	--	--	LCMW-5	X	X	X	--	X	X	X	X	Evaluate alluvial groundwater exiting Carbonate Mine area	19
13	Downgradient of Carbonate Mine seep	SW	LCMW-6S	GW	X	---	---	LCMW-6S	X	X	---	---	X	X	X	X	Evaluate source of elevated metals in Carbonate Mine area	10.5
14	Downgradient of Carbonate Mine seep	SW	LCMW-6D	GW	---	X	---	LCMW-6D	X	X	---	---	X	X	X	X	Evaluate source of elevated metals in Carbonate Mine area	17
15	Mouth of drainage near Highway 200	SW	LCMW-12D	GW	X	--	--	LCMW-12D	X	X	X	--	X	X	X	X	Evaluate alluvial groundwater exiting Carbonate Mine area	27
16	Mouth of drainage near Highway 200	SW	LCMW-12S	GW	X	--	--	LCMW-12S	X	X	X	--	X	X	X	X	Evaluate alluvial groundwater exiting Carbonate Mine area	18
17	At top of Carbonate Mine repository	SW	SWGW-101	GW	X	--	--	SWGW-101	X	X	--	--	X	X	X	X	Alluvial well for repository monitoring	7
	At bottom of Carbonate Mine repository paired w/ UCMW-11	SW	SWGW-102	GW	X	--	--	SWGW-102	X	X	X	--	X	X	X	X	Alluvial well for repository monitoring	23
18	Drainage bottom upstream of reclaimed area	SW	SWGW-103	GW	X	--	--	SWGW-103	--	X	--	--	X	X	X	X	Background well for mine reclamation area	20
19	At base of repository	SW	UCMW-4	GW	---	X	---	UCMW-4	X	X	---	---	X	X	X	X	Evaluate source of elevated metals in Carbonate Mine area	---
20	At base of repository	SW	UCMW-11	GW	--	X	--	UCMW-11	X	X	--	--	X	X	X	X	Evaluate repository and bedrock groundwater	84
21	Mouth of Pass Creek	PD	PDGW-101	GW	X	--	--	PDGW-101	--	X	--	--	X	X	X	X	Evaluate alluvial groundwater leaving Pass Creek drainage	20
22	Mouth of Pass Creek	PD	PDGW-102	GW	--	X	--	PDGW-102	--	X	--	--	X	X	X	X	Evaluate bedrock groundwater leaving Pass Creek drainage	67
23	Paymaster mine	PM	PMMW-13	GW	X	X	--	PMMW-13	X	X	--	--	X	X	X	X	Alluvial bedrock interface with historic data in vicinity of mine site	18
24	Downstream of Mike Horse fault crossing in vicinity of veins	PM	PMMW-14	GW	X	--	--	PMMW-14	--	X	--	--	X	X	X	X	Alluvial well in vicinity of fault vein crossing drainage	24
25	Paymaster Mine	PM	PMMW-15	GW	X	--	--	PMMW-15	X	X	X	--	X	X	X	X	Alluvial well downstream of impacts	12
26	Downgradient of Paymaster repository	PM	PMGW-116	GW	X	--	--	PMGW-116	--	X	--	--	X	X	X	X	Monitor downgradient of proposed repository expansion area	18

Table 11
Summary of Monitoring Well and Piezometer Inventory

								Investigation Type[1]					Proposed Analyses					
Line Entry	General Location	Drainage Basin	Station Number	Media Type	Alluvial	Bedrock	Soil Sample Depth Intervals	Proposed Sample ID	Source	Nature and Extent	Risk	RD	Field	Standard Analyte Suite	Metals	Water Levels	Rationale / Comments	Total Depth ft bgs (Est.)
27	Downgradient of Paymaster repository	PM	PMGW-117	GW	X	--	--	PMGW-117	--	X	--	--	X	X	X	X	Monitor downgradient of proposed repository expansion area	25
28	Downstream of mine along edge of marsh paired w/ PMMW-119	PM	PMGW-118	GW	X	--	--	PMGW-118	--	X	--	--	X	X	X	X	Evaluate shallow groundwater downgradient of mine along edge of marsh system	28
29	Downstream of mine along edge of marsh paired w/ PMMW-118	PM	PMGW-119	GW	--	X	--	PMGW-119	--	X	--	--	X	X	X	X	Evaluate bedrock groundwater downgradient of mine along edge of marsh system	81
30	Paymaster mine near PMMW-15	PM	PMGW-120	GW	--	X	--	PMGW-120	X	X	X	--	X	X	X	X	Evaluate bedrock groundwater, in vicinity of gaining reach	59
31	Headwater reach within ferricrete below historic cabins	PM	PMPZ-3	GW	X	--	--	PMPZ-3	--	X	--	--	X	X	X	X	Alluvial well to evaluate Mike Horse fault	8
32	Headwater reach above ferricrete by historic cabins	PM	PMPZ-4	GW	X	--	--	PMPZ-4	--	X	--	--	X	X	X	X	Alluvial well in headwaters to evaluate upstream of Mike Horse fault	8
33	Adjacent to county road in wet area	ED	EDP-2	GW	X	--	--	EDP-2	X	X	--	--	X	X	X	X	Evaluate shallow alluvial groundwater in vicinity of mining activities	28
34	West of Edith Mine waste rock piles	ED	EDMW-2	GW	X	--	--	EDMW-2	X	X	--	--	X	X	X	X	Evaluate shallow alluvial groundwater in vicinity of mining activities	28
35	Edith Mine paired with EDMW-2	ED	EDGW-105	GW	--	X	--	EDGW-105	X	X	--	--	X	X	X	X	Evaluate bedrock groundwater in vicinity of mining activities	90
36	Mouth of Shave Gulch	SH	SHGW-101	GW	X	--	--	SHGW-101	--	X	--	--	X	X	X	X	Evaluate alluvial groundwater leaving Shave Gulch drainage	20
37	Mouth of Shave Gulch	SH	SHGW-102	GW	--	X	--	SHGW-102	--	X	--	--	X	X	X	X	Evaluate bedrock groundwater leaving Shave Gulch drainage	72
38	Lower Stevens Gulch at switchback paired w/ SGGW-102	SG	SGGW-101	GW	X	--	--	SGGW-101	--	X	--	--	X	X	X	X	Evaluate bedrock groundwater at mouth of drainage	70
39	Lower Stevens Gulch at switchback paired w/ SGGW-101	SG	SGGW-102	GW	--	X	--	SGGW-102	--	X	--	--	X	X	X	X	Evaluate alluvial groundwater at mouth of drainage	30
40	Upstream end of Anaconda Mine reclamation area	AN	ANWS-1	GW	X	--	--	ANWS-1	--	X	--	--	X	X	X	X	Evaluate alluvial groundwater entering the Anaconda Mine area	15
41	Mouth of Anaconda Creek	AN	ANMW-9	GW	X	--	--	ANMW-9	--	X	--	--	X	X	X	X	Evaluate alluvial groundwater leaving Anaconda Creek drainage	13
42	~1500 feet upstream of Anaconda Mine	BC	BCMW-10	GW	X	--	--	BCMW-10	--	X	--	--	X	X	X	X	Evaluate alluvial groundwater in vicinity of projected Blackfoot Fault crossing	16
43	~1500 feet downstream of Dam along main road	BC	BCGW-115	GW	X	--	--	BCGW-115	--	X	--	--	X	X	X	X	Alluvial well in vicinity of Blackfoot Fault crossing of channel, evaluate gaining/loosing reach	85
44	~1500 feet downstream of Dam along main road	BC	BCGW-116	GW	--	X	--	BCGW-116	--	X	--	--	X	X	X	X	Evaluate Blackfoot Fault crossing of channel, evaluate gaining/loosing reach	129
45	At switchback in access road to Dam	MH	MHMW-8	GW	--	X	--	MHMW-8	--	X	X	--	X	X	X	X	Evaluate shallow bedrock near mouth of Mike Horse Creek	26
46	At switchback in access road to Dam paired w/MHMW-8	MH	MHGW-109	GW	X	--	--	MHGW-109	--	X	X	--	X	X	X	X	Evaluate alluvial groundwater leaving Mike Horse Creek drainage	12
47	~500 feet upstream of MHMW-8 at toe of repository near seep area. Paired w/ MHGW-113	MH	MHGW-112	GW	X	--	--	MHGW-112	X	X	X	--	X	X	X	X	Alluvial well to monitor repository	10

Table 11
Summary of Monitoring Well and Piezometer Inventory

								Investigation Type[1]					Proposed Analyses					
Line Entry	**General Location**	**Drainage Basin**	**Station Number**	**Media Type**	**Alluvial**	**Bedrock**	**Soil Sample Depth Intervals**	**Proposed Sample ID**	**Source**	**Nature and Extent**	**Risk**	**R D**	**Field**	**Standard Analyte Suite**	**Metals**	**Water Levels**	**Rationale / Comments**	**Total Depth ft bgs (Est.)**
48	~500 feet upstream of MHMW-8 at toe of repository near seep area. Paired with MHGW-112	MH	MHGW-113	GW	--	X	--	MHGW-113	X	X	X	--	X	X	X	X	Bedrock well to monitor repository	38
49	Mike Horse Mine site above water treatment	MH	UMHMW-3	GW	--	X	--	UMHMW-3	X	X	--	--	X	X	X	X	Evaluate upstream end of gaining reach above water treatment facility	18
50	Mike Horse Mine site above water treatment paired w/UMHMW-3	MH	MHGW-115	GW	--	X	--	MHGW-115	X	X	--	--	X	X	X	X	Evaluate alluvial groundwater quality from mine waste rock seepage entering repository area	7
51	Upslope of Mike Horse Mine seepage area	MH	UMHMW-1D	GW	--	X	--	UMHMW-1D	X	X	--	--	X	X	X	X	Evaluate groundwater quality from mine tailings seepage	44
52	Upslope of Mike Horse Mine seepage area	MH	UMHMW-1S	GW	X	--	--	UMHMW-1S	X	X	--	--	X	X	X	X	Evaluate groundwater quality from mine tailings seepage	17
53	Upslope of Mike Horse Mine seepage area	MH	UMHMW-2D	GW	--	X	--	UMHMW-2D	X	X	--	--	X	X	X	X	Evaluate groundwater quality from mine tailings seepage	21
54	Upslope of Mike Horse Mine seepage area	MH	UMHMW-2S	GW	X	--	--	UMHMW-2S	X	X	--	--	X	X	X	X	Evaluate groundwater quality from mine tailings seepage	13
55	Upstream of Mike Horse Mine adits near spring	MH	MW-1	GW	--	X	--	MW-1	X	X	--	--	X	X	X	X	Evaluate bedrock groundwater Mike Horse fault contributions to creek	124

NOTES:
Drainage Basin
PM-Paymaster Gulch
PD-Pass Creek
SG-Stevens Gulch
SW-Swamp Gulch

BR-Blackfoot River
ED-Edith Mine
BC-Beartrap Creek
AN-Anaconda Creek
MH-Mike Horse Creek
SH-Shave Gulch

MEDIA
GW - Groundwater
SE - Sediment
SS - Surface Soil
SW - Surface Water
SB - Subsurface Soil

-- Not Applicable
Field = specific conductance, pH, temperature, oxidation-reduction potential, dissolved oxygen
Metals=aluminum, arsenic, cadmium, copper, iron, manganese, mercury, zinc
Standard Analyte Suite = Common Cations (calcium, magnesium, potassium, sodium) and Common Anions (carbonate, bicarbonate, sulfate, chloride)

1. Some samples satisfy multiple investigation objectives.

Table 12
Mine Inventory Data

Site/Map ID Number	Field Book ID	Year Inventoried	Photo Number	Drainage	Associated Mine Claim	Associated Mine or Mine Feature[1]	Site Type	Adit Entrance Observed in Field	Site Location		Elev. (feet AMSL)	Estimated Disturbance for Exploratory Pads and Adits (sf) and Exploratory Pits and Trenches (cy)[2]	Waste Rock Pile Estimated Volume (cy)	Surface Water/ Seep Observed in Field	Distance to Nearest Observed Surface Water Feature (feet)	Comments/Notes	Sampled in 2008	
									Latitude	Longitude							Waste or Sediment Sample ID	Surface Water Sample ID
AC-1	613	2008	--	Anaconda Creek	--	--	Adit		47.03485418	-112.35615028	5367	--	--		0	Caved or reclaimed adit on road cut-slope. Waste (if present) is incorporated into road fill slope, the toe of slope contacts Anaconda Ck.	ACSE-101 (0-2)	ACSW-101
BC-01	622	2008	100 – 2791 through 2793	Beartrap Creek	Non-Asarco	--	Adit and waste rock pile		47.03113278	-112.35475813	5410	--	1,100	X	50	Collapsed adit leaks about 1 GPM (visual est) and has iron oxide staining.	FLWA-101 (0-6)	--
BR-01	001- Belle of the Hill	2007	BR-01-001 to 002	Blackfoot River	Belle of the Hill	Belle of the hill	Adit		47.03769313	-112.3658488	5,312	6300 sf	700	X	200	Intermittent spring (150 square feet) at toe of slope where adit was likely located. Large floodplain bench which is possible tailings.	--	--
BR-02	002- Belle of the Hill	2007	BR-02-003	Blackfoot River	Belle of the Hill	--	Exploratory dig out		47.03810234	-112.3655688	5,371	11 cy	33		--	No tailings evident.	--	--
BR-03	520	2008	--	Blackfoot River	Edith	--	Drill pad		47.04304590	-112.37990342	5295	--	--		--	Drill pad with possible second pad about 75 feet downhill of first. Twelve foot wide non-vegetated strip of ground stretching between the two pads.	--	--
BR-04	527	2008	--	Blackfoot River	Yellowstone	--	Drill pad		47.04474893	-112.38001834	5361	--	--		--	Impacted vegetation downgradient	--	--
BR-05	528	2008	--	Blackfoot River	Yellowstone	--	Drill pad		47.04390890	-112.38037960	5374	--	--		--	Impacted vegetation downgradient	--	--
BR-06	529	2008	--	Blackfoot River	Sunlight	--	Drill pad		47.04380111	-112.37961240	5374	--	--		--	Impacted vegetation downgradient	--	--

Table 12
Mine Inventory Data

Site/Map ID Number	Field Book ID	Year Inventoried	Photo Number	Drainage	Associated Mine Claim	Associated Mine or Mine Feature[1]	Site Type	Adit Entrance Observed in Field	Site Location		Elev. (feet AMSL)	Estimated Disturbance for Exploratory Pads and Adits (sf) and Exploratory Pits and Trenches (cy)[2]	Waste Rock Pile Estimated Volume (cy)	Surface Water/ Seep Observed in Field	Distance to Nearest Observed Surface Water Feature (feet)	Comments/Notes	Sampled in 2008	
									Latitude	Longitude							Waste or Sediment Sample ID	Surface Water Sample ID
BR-07	530	2008	--	Blackfoot River	Sunlight	--	Adit		47.04346994	-112.37810802	5354	300 sf	90		--	Portal location obscured by tree fall. Area is well vegetated. Waste pile difficult to delineate due to road building disturbances.	--	--
BR-08	531	2008	--	Blackfoot River	Daylight	--	Drill pad		47.04303777	-112.37710269	5344	--	--		--	Impacted vegetation downgradient	--	--
BR-09	532	2008	--	Blackfoot River	Edith	--	Drill pad		47.04250082	-112.37835411	5341	--	--		--	Impacted vegetation downgradient	--	--
BR-10	536	2008	--	Blackfoot River	Sunset	--	Pipe		47.04468657	-112.37920923	5446	--	--		--	Pipe in ground. Not a well. Possible anchor point.	--	--
BR-11	537	2008	--	Blackfoot River	Sunset	--	Drill pad		47.04526803	-112.37947494	5502	--	50		--	No apparent mine workings but rock pile is present and incorporated into road fill.	--	--
BR-12	540	2008	--	Blackfoot River	Sunlight	--	Drill pad		47.04538168	-112.37740486	5551	--	--		--	Impacted vegetation downgradient	--	--
BR-14	567	2008	100 – 2756 through 2758	Blackfoot River	Black Foot Belle	--	Adit and waste rock pile		47.04193178	-112.36843337	5590	2,500 sf	2,000	X	--	Collapsed adit with leaking water that is pooled near entrance supporting vegetation. Collapsed tipple and woody debris is present. Waste rock difficult to distinguish from road fill slope and has been graded for structure footings.	--	--
BR-15	568	2008	100 – 2759, 2760	Blackfoot River	Skyscraper	--	Exploratory pits		47.04112971	-112.36236152	5627	110 cy	--		--	Two large prospect pits	--	--

Table 12
Mine Inventory Data

Site/Map ID Number	Field Book ID	Year Inventoried	Photo Number	Drainage	Associated Mine Claim	Associated Mine or Mine Feature[1]	Site Type	Adit Entrance Observed in Field	Site Location		Elev. (feet AMSL)	Estimated Disturbance for Exploratory Pads and Adits (sf) and Exploratory Pits and Trenches (cy)[2]	Waste Rock Pile Estimated Volume (cy)	Surface Water/ Seep Observed in Field	Distance to Nearest Observed Surface Water Feature (feet)	Comments/Notes	Sampled in 2008	
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BR-16	569	2008	100 – 2761, 2762	Blackfoot River	Skyscraper	--	Adit and waste rock pile		47.04124907	-112.36321421	5623	--	25		0	Caved adit with collapsed and rotted wooden shoring. Small vegetated waste rock pile in direct communication with seasonal run-off channel (dry at time of visit).	SSWA-101 (0-6)	--
BR-17	570	2008	--	Blackfoot River	Skyscraper	--	Adit and waste rock pile		47.04148913	-112.36255967	5797	--	7		--	Small waste rock pile and collapsed adit that is almost completely filled and nearly level with grade.	--	--
BR-18	571	2008	100 - 2763	Blackfoot River	--	--	Shaft		47.04354479	-112.36089142	6184	--	15		--	Possible caved shaft measuring 10 feet in diameter by 5 feet deep with log timbers partially buried in center.	--	--
BR-19	572	2008	100 - 2764	Blackfoot River	Skyscraper		Exploratory pit		47.04326953	-112.36246169	6056	6 cy	--		--	Prospect pit 1- foot diameter by 5 feet deep.	--	--
BR-20	590	2008	100 – 2772, 2773	Blackfoot River	Iron Hill	Iron Hill Mine	Adit and waste rock pile		47.03894069	-112.36694315	5535	--	2,100		400	Large waste dump and caved adit with railroad tracks leading out of it. Woody debris scattered about and impacted vegetation below waste dump.	IHWA-101 (0-6)	--
BR-21	591	2008	100 – 2776 through 2778	Blackfoot River	Iron Hill	--	Breached dam (water supply – not tailings)		47.03969289	-112.36659153	5387	--	--	X	0	Pipe buried in creek channel above breached dam. Water flows out of pipe but appears to be creek water (not groundwater).	--	--

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									Latitude	Longitude							Waste or Sediment Sample ID	Surface Water Sample ID
BR-22	592	2008	--	Blackfoot River	Iron Hill	--	Series of pits		Missing GPS Data	Missing GPS Data	--	--	20		--	Series of prospect pits and one caved shaft (10 feet in diameter by 5 feet deep).	--	--
BR-23	593	2008	--	Blackfoot River	Iron Hill	--	Adit and waste rock pile		47.03949390	-112.36747641	5525	400 sf	35		--	Collapsed adit portal and waste pile. Waste pile has been partially cleared by road building activity.	--	--
BR-24	594	2008	--	Blackfoot River	Iron Hill	Mary P Mine	Waste pile		47.03696894	-112.36682120	5338	--	2,020		--	Mary P waste pile.	--	--
BR-25	596	2008	--	Blackfoot River	Mary P.	--	Trash		47.03534494	-112.36797103	5948	--	--		--	Road bed with trash poly pipe, antique beer cans, cable, etc	--	--
BR-26	597	2008	--	Blackfoot River	Mary P.	--	Exploratory pit		47.03522198	-112.36726787	5604	2 cy	--		--	--	--	--
BR-27	598	2008	100 - 2779	Blackfoot River	Mary P.	--	Exploratory pits		47.03542734	-112.36667208	5535	--	--		--	Six prospect pits all less than 5 feet diameter	--	--
BR-28	599	2008	--	Blackfoot River	Mary P	Mary P Mine	Claim corner		47.03546556	-112.36611200	5571	--	--		--	#4 corner Mary P claim	--	--
BR-29	600	2008	--	Blackfoot River	Mary P	Mary P Mine	Adit and waste rock pile		47.03622814	-112.36768194	5561	--	280		0	Collapsed adit and waste pile located in center of gully that may be a seasonal drainage (dry at time of visit).	--	--
BR-30	601	2008	--	Blackfoot River	Mary P.	--	Exploratory pits		47.03647021	-112.36804781	5433	--	--		--	Three prospect pits all less than 5 feet diameter	--	--
BR-31	602	2008	--	Blackfoot River	Mary P.	--	Exploratory pit		47.03701797	-112.36823816	5318	--	--		--	--	--	--
BR-32	603	2008	100 - 2780	Blackfoot River	--	--	Adit and waste rock pile		47.03741468	-112.36389566	5420	--	160		--	Collapsed portal. Impacted vegetation below waste dump.	--	--
BR-33	604	2008	--	Blackfoot River	--	--	Exploratory pits		47.03806068	-112.36330641	5545	--	--		--	One of these two pits may be a natural depression.	--	--

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BR-34	605	2008	--	Blackfoot River	Big Dick/Anaconda	--	Adit		47.03802573	-112.35810259	5784	--	--		--	Collapsed adit. No waste rock is present other than what may be incorporated into roadbed/cut-fill slope.	--	--
BR-35	606	2008	--	Blackfoot River	Big Dick/Anaconda	--	Exploratory pit		47.03780000	-112.35791978	5771	3 cy	--		--	--	--	--
BR-36	607	2008	100 – 2781 through 2783 and 100 – 2786 through 2789	Blackfoot River	Big Dick/Anaconda	--	Adit and waste rock pile		47.03765768	-112.35853309	5722	--	270	X	--	Caved or reclaimed adit portal. Waste pile has been graded in roadbeds in some areas. Water seeping from portal area and infiltrates into waste bench.	2007 sample "UAW3 – Comp 1 (0-6)"	--
BR-37	608	2008	--	Blackfoot River	Big Dick/Anaconda	--	Waste rock pile		47.03717723	-112.35838347	5692	--	225		--	No signs of adit portal – may be on road cut slope and filled with erosion.	2007 sample "UAW 4-Comp 1 (0-6)"	--
BR-38	609	2008	--	Blackfoot River	Big Dick/Anaconda	--	Adit and waste rock pile		47.03731787	-112.35899049	5613	--	555		--	Caved or reclaimed adit and waste pile.	2007 sample "UAW 1-Comp 1 (0-6)" and "UAW 1 – 00 (0-6)"	--
BR-39	610	2008	--	Blackfoot River	Big Dick	--	Adit and waste rock pile		47.03781609	-112.36006195	5535	--	32		5	Caved adit and waste pile along edge of unnamed creek.	BTWA-101 (0-6)	BTSW-101
BR-40	611	2008	--	Blackfoot River	Big Dick/Anaconda	--	Waste rock		47.03709098	-112.35997930	5449	--	--		--	Reclaimed waste rock area above Anaconda Wetlands.	2007 sample "UAW 2 - 200 (0-6)"	--

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BR-41	612	2008	--	Blackfoot River	Little Joe/Anaconda	--	Waste rock		47.03633602	-112.35981175	5476	--	--		--	Reclaimed waste rock area above Anaconda Wetlands.	2007 sample "UAW 2 - 300 (0-6)"	--
BR-42	614	2008	--	Blackfoot River	Blue Cristle	--	Adit		47.03524947	-112.35837643	5482	--	--		--	Collapsed or reclaimed adit portal along creek. No wast is evident.	--	--
BR-43	615	2008	--	Blackfoot River	Anaconda	--	Shaft		47.03592019	-112.35962349	5394	--	--		--	12 foot diameter collapsed shaft above Anaconda adit.	--	--
BR-44	616	2008	--	Blackfoot River	Little Joe/Anaconda	--	Exploratory pits		47.03667247	-112.36107524	5390	--	--		--	Two prospect pits 6x3x1 feet.	--	--
CG-01	558	2008	--	Chambers Gulch	--	--	Adit		47.05577432	-112.36402114	5499	--	--		--	Collapsed adit with no waste rock pile evident.	--	--
CG-02	559	2008	100 – 2745 through 2749	Chambers Gulch	--	--	Adit and waste rock pile		47.05492322	-112.36394822	5554	--	19,000	X	15	Adit portal is not open but leaks water (1 GPM visual estimate). Collapsed tipple and other structure(s) present.	CGWA-101 (0-6)	CGSW-101, CGSW-102, CGSW-103
CG-03	560	2008	100 – 2750, 2751	Chambers Gulch	--	--	Adit and waste rock pile		47.05654001	-112.36245213	5633	--	1,554	X	--	Seeping water is impounded in 8-foot diameter pool/marsh that is heavily vegetated with sedges etc. Difficult to identify waste edge. Some regarding may have occurred.	--	--

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CG-04	561	2008	--	Chambers Gulch	--	--	Adit		47.05570425	-112.36314565	5512	--	--	X	--	Collapsed or reclaimed adit with pooled water nearby. Waste material(?) at foot of adit channel is very well vegetated and indistinguishable from surrounding ground.	--	--
CG-05	644	2008	--	Chambers Gulch	--	--	Claim corner		47.05596736	-112.36394143	5407	--	--		--	RTC-10907	--	--
PC-01	500	2008	100 – 2705	Pass Creek	Tunnel Site	--	Adit with Waste Rock Pile		47.051	-112.378	5280	--	133	X	20	Collapsed adit with timber and associated waste rock pile. A shallow, square, timber-framed "shaft" is nearby with dimensions 5x5x2 feet (possible drinking water well). Is filled with water.	PCSE-103(0-2) PCSE-104(0-2) PCWA-102(0-6)	PCSW-102 PCSW-103 PCSW-104
PC-02	501	2008	--	Pass Creek	Tunnel Site	--	Drill Pad					--	--		450	Located 400 ft uphill of feature 500.	--	--
PC-03	502	2008	100 - 2706	Pass Creek	Tunnel Site	--	Exploratory Pits		47.05033606	-112.37804901	5426	35 cy	--		--	One 15 ft diameter by 4 ft deep prospect pit and several smaller (3 to 5 ft diameter) in general area.	--	--
PC-04	503	2008	--	Pass Creek	Tunnel Site	--	Exploratory Pit		47.05024688	-112.37769269	5508	--	--		--	--	--	--
PC-05	504	2008	--	Pass Creek	Tunnel Site	--	Exploratory Pit		47.04986315	-112.37744367	5561	--	--		--	--	--	--
PC-06	505	2008	100 – 2707 through 2709	Pass Creek	Eureka	--	Collapsed Adit and Waste Rock Pile		47.04986952	-112.37589830	5699	--	1,700		--	Collapsed adit portal with large non-vegitated waste rock dump and scattered timbers and metal debris.	--	--

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PC-07	506	2008	--	Pass Creek	Eureka	--	Drill cuttings pile		47.05000414	-112.37510780	5745	--	--		--	--	--	--
PC-08	507	2008	--	Pass Creek	Eureka	--	Exploratory pits		47.05052968	-112.37483480	5800	--	--		--	Two small prospect pits near claim corner 10105 4TS.	--	--
PC-09	516	2008	--	Pass Creek	Summit Frac.	--	Exploratory pit		47.05197246	-112.37271862	5922	7 cy	--		--	--	--	--
PC-10	518	2008	100 – 2718 through 2720	Pass Creek	--	--	Adit		47.05379846	-112.37171506	5932	--	--	X	--	Very large disturbance. Multi-tiered basin with seep at head of disturbance. Possible caved adit portal.	--	--
PC-11	519	2008	--	Pass Creek	--	--	Adit		47.05439483	-112.37230464	5636	--	--		20	Possible caved adit at base of disturbance (feature 518). No visible adit flow but runoff channel passes near area. No waste pile is present – possibly reclaimed previously.	PCWA-101(0-6)	PCSW-101
PC-12	521	2008	--	Pass Creek	--	--	Drill pad and well		47.04461658	-112.38227986	5302	--	--		--	3 ½ inch steel well with cap inside 5 inch protector.	--	--
PC-13	522	2008	--	Pass Creek	Yellowstone		Drill pad		47.04504406	-112.38095971	5321	--	--		--	Impacted vegetation downgradient	--	--
PC-14	523	2008	--	Pass Creek	--	--	Drill pad		47.04568368	-112.38066726	5335	--	--		--	Impacted vegetation downgradient	--	--
PC-15	524	2008	--	Pass Creek	--	--	Drill pad		47.04679085	-112.38076516	5423	--	--		--	Impacted vegetation downgradient	--	--
PC-16	525	2008	--	Pass Creek	--	--	Drill pad		47.04698129	-112.37981315	5384	--	--		--	Impacted vegetation downgradient	--	--
PC-17	526	2008	--	Pass Creek	--	--	Drill pad		47.04612734	-112.38029519	5381	--	--		--	Impacted vegetation downgradient	--	--
PC-18	538	2008	--	Pass Creek	Sunset	--	Drill pad		47.04610462	-112.37918635	5482	--	--		--	Impacted vegetation downgradient	--	--

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PC-19	539	2008	--	Pass Creek	Sunset	--	Drill pad		47.04631610	-112.37846307	5485	--	--		--	Impacted vegetation downgradient underlain by yellow sandy/powdery soil that appears similar to tailings although no mine workings are apparent.	--	--
PC-20	552	2008	--	Pass Creek	Sunset	--	Drill pad		47.04780129	-112.37694285	5643	--	--		--	Impacted vegetation downgradient	--	--
PC-21	642	2008	--	Pass Creek	--	--	Adit	X	47.05747032	-112.37582940	5249	--	--		--	Open adit (3x3 foot) in sandstone face near highway. Evidence of animal use.	--	--
JM-01	020- Jumbo Mine	2007	JM-01-021 to 025	Paymaster Gulch	Jumbo	Jumbo mine	Adit		47.03679384	-112.3838562	5,629	56 cy	542		--	Adit trench and waste pile onsite.	--	--
JM-02	021- Jumbo Mine	2007	JM-02-024	Paymaster Gulch	Jumbo	Jumbo mine	Exploratory drill pad		47.03663969	-112.3824271	5,468	3200 sf	--		--	Appears tailings from Jumbo adit have been incorporated into fill material for drill pad (quantity unknown).	--	--
PM-01	440- Paymaster	2007	PM-01-046 to 047	Paymaster Gulch	Black Diamond	Paymaster	Exploratory pit		47.03748149	-112.3869125	5,364	50 cy	11		--	No tailings evident.	--	--
PM-02	442- Paymaster Tunnel 3	2007	PM-02-048 to 049	Paymaster Gulch	Paymaster	Paymaster Tunnel 3	Tunnel		47.03852545	-112.3855776	5,282	--	--		--	Revegetation in good condition.	--	--
PM-03	443- Paymaster	2007	PM-03-050	Paymaster Gulch	Paymaster	--	Trench		47.03807174	-112.3864707	5,348	56 cy	--		--	Four trenches east of Tunnel No. 3 200 feet.	--	--
PM-04	444- Paymaster	2007	PM-04-051 to 052	Paymaster Gulch	Paymaster	Diamond bit drill hole	Exploratory pit		47.03783378	-112.3871928	5,397	142 cy	106		--	Exploratory pit with possible tailings	--	--
PM-05	445- Paymaster	2007	PM-05-053	Paymaster Gulch	--	--	Trench		47.0375436	-112.3917602	5,446	27 cy	--		--	Two trenches located beyond Paymaster claim boundary.	--	--
PM-06	446- Paymaster	2007	PM-06-054 to 056	Paymaster Gulch	Black Diamond	--	Trench		47.03684857	-112.3872329	5,499	285 cy	423		--	Two trenches located digout. Possible tailings.	--	--
PM-07	447- Paymaster	2007	PM-07-057	Paymaster Gulch	Black Diamond	--	Exploratory dig out		47.0373302	-112.387098	5,479	3 cy	--		--	Small dig out. No tailings evident.	--	--

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PM-08	448-Paymaster Tunnel No. 2	2007	PM-08-059	Paymaster Gulch	Black Diamond	Paymaster Tunnel 2	Tunnel		47.03637407	-112.3859447	5,417	--	--		--	Revegetation in good condition.	--	--
PM-09	448-Paymaster Tunnel No. 2	2007	PM-09-058	Paymaster Gulch	Black Diamond	Paymaster Tunnel 2	Trench		47.03637407	-112.3859447	5,417	93 cy	--		--	Trench just upslope of revegetation. No tailings evident.	--	--
PM-10	448-Paymaster Tunnel No. 2	2007	--	Paymaster Gulch	Black Diamond	Paymaster Tunnel 2	Trench		47.03637407	-112.3859447	5,417	16 cy	--		--	No tailings evident.	--	--
PM-11	449-Paymaster	2007	PM-11-060 to 061	Paymaster Gulch	--	--	Trench		47.0349955	-112.3873019	5,502	67 cy	33		--	300 feet southeast of Paymaster Tunnel No. 2 above access road. Copper salts observed on surface rock.	--	--
PM-12	450-Paymaster	2007	PM-12-062 to065	Paymaster Gulch	--	--	Adit	X	47.03501662	-112.3869881	5,482	113 cy	1,288		--	Collapsed adit entrance and large waste rock pile within 5 feet of the creek.	--	--
PM-13	451-Paymaster	2007	PM-13-066 to 067	Paymaster Gulch	Black Diamond	DD hole	Ground disturbance		47.03680926	-112.3857658	5,217	336 cy	--		--	Possible DD hole along powerline route. Fill material brought in to widen the road. Possible tailings material.	--	--
PM-14	452-Paymaster Tunnel	2007	PM-14-068	Paymaster Gulch	Paymaster	Paymaster	Tunnel		47.03773152	-112.3855611	5,295	--	--		--	Seep adjacent to adit reclamation sampled in 2007. Revegetation in good condition.	--	--
PM-15	001-Paymaster	2007	PM-15-001 to 002	Paymaster Gulch	--	--	Trench		47.03409637	-112.3873469	5,434	--	6		--	Digout 10 feet upslope (1.8 cy). No tailings evident.	--	--
PM-16	002-Paymaster	2007	PM-16-003	Paymaster Gulch	--	--	Exploratory dig out		47.03185455	-112.3874718	5,601	1 cy	1		--	No tailings evident.	--	--
PM-17	003-Paymaster	2007	PM-17-004	Paymaster Gulch	--	--	Exploratory dig out		47.03138265	-112.3870724	5,566	1 cy	1		--	No tailings evident.	--	--
PM-18	004-Paymaster	2007	PM-18-005	Paymaster Gulch	--	--	Exploratory dig out		47.03090991	-112.386823	5,595	16 cy	--		--	No defined waste rock pile or tailings evident.	--	--

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PM-19	006-Paymaster	2007	PM-19-006 to 007	Paymaster Gulch	--	--	Exploratory dig out		47.02878443	-112.3863732	5,588	5 cy	6		--	No tailings evident.	--	--
PM-20	008-Paymaster	2007	--	Paymaster Gulch	--	--	Stream		47.02819342	-112.3850929	5,598	--	--		--	Stream becomes intermittent above this point. No iron staining. White milky standing water.	--	--
PM-21	009-Paymaster	2007	--	Paymaster Gulch	--	--	Cabins		47.02819895	-112.3850559	5,530	--	--		--	--	--	--
PM-22	010-Paymaster	2007	PM-22-009 to 011	Paymaster Gulch	--	--	Ground disturbance		47.02747358	-112.3853186	5,532	400 sf	--		--	Large V-shape channel running 100 feet to main stream channel. Uncertain if this is natural or man-made. White staining on rocks in channel bottom. Head of channel sloughing into channel.	--	--
PM-23	011-Paymaster	2007	--	Paymaster Gulch	--	--	Exploratory dig out		47.02747358	-112.3853186	5,532	25 sf	--		--	Three small dig outs (10 sf each). No tailings evident.	--	--
PM-24	012-Paymaster	2007	--	Paymaster Gulch	--	--	Road		47.02747358	-112.3853186	5,532	--	--		--	End of access road.	--	--
PM-25	014-Paymaster	2007	PM-25-012	Paymaster Gulch	--	--	Exploratory drill pad		47.02747358	-112.3853186	5,532	875 sf	--		--	Fill from road cut pushed into intermittent channel. No waste rock piles or tailings evident. Bucket, cable and wooden pole onsite. Wildlife wallow at upstream end of pad.	--	--
PM-26	015-Paymaster	2007	PM-26-013	Paymaster Gulch	--	--	Waste rock		47.02486865	-112.3816488	5,532	--	2,689		--	Large tailings pile with access road at its toe which bisects the intermittent Paymaster creek channel.	--	--

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									Latitude	Longitude							Waste or Sediment Sample ID	Surface Water Sample ID
PM-27	016-Paymaster	2007	PM-27-0014 to 0016	Paymaster Gulch	--	--	Adit		47.02666615	-112.374966	5,605	1950 sf	--		--	Small moss mat is located were the old adit entrance was located. No surface water was visible.	--	--
PM-28	017-Paymaster	2007	PM-28-017 to 019	Paymaster Gulch	--	--	Adit		47.02264359	-112.3767602	6,536	18 cy	167		--	Trench remaining from an old adit. Three lupine plants observed growing along the edge of the tailings pile.	--	--
PM-29	018-Paymaster	2007	PM-29-020	Paymaster Gulch	--	--	Exploratory dig out		47.02338472	-112.379635	6,058	1 cy	--		--	No tailings evident.	--	--
PM-30	019-Paymaster	2007	--	Paymaster Gulch	--	--	Exploratory dig out		47.02769486	-112.3848262	5,640	38 cy	--		--	Dig out on edge of access road. No waste rock or tailings evident.	--	--
PM-31	623	2008	--	Paymaster Gulch	--	--	Drill pad		47.02469339	-112.38165784	5830	--	--		0	Road cut material in contact with creek but no mining wastes present.	--	--
PM-32	624	2008	--	Paymaster Gulch	--	--	Claim corner		47.02659658	-112.38488252	5830	--	--		--	Claim corner CT4	--	--
PM-33	625	2008	--	Paymaster Gulch	--	--	Exploratory pit		47.02870555	-112.38648548	5817	3 cy	--		200	Waste pile is well vegetated	--	--
PM-34	626	2008	--	Paymaster Gulch	--	--	Exploratory pit		47.03095090	-112.38691421	5646	4 cy	--		50	--	--	--
PM-35	627	2008	--	Paymaster Gulch	--	--	Adit and waste pile		47.03491906	-112.38688756	5508	--	--		--	Inventoried in 2007	PMWA-101, PMSE-102 (0-2), PMSE-103(0-2)	PMSW-102, PMSW-103
PM-36	628	2008	--	Paymaster Gulch	--	--	Adit or large exploratory pit		47.02782998	-112.38483399	5784	--	--		--	No waste pile is visible and vegetation is very dense.	--	--

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PM-37	629	2008	--	Paymaster Gulch	--	--	Adit and waste rock pile		47.03549162	-112.38577855	5361	--	445		200	Adit is caved and on opposite side of road from waste rock pile. Seep present on top of waste.	PMWA-102	PMSW-101
SH-01	508	2008	100 - 2712, 2713	Shave Gulch	Eureka	--	Shaft and waste rock pile.		47.04943953	-112.37409250	5781	--	45		--	Caved shaft with associated waste rock pile and an estimated 20 prospect pits and channel cuts in vicinity.	--	--
SH-02	509	2008		Shave Gulch	Eureka	--	Drill pad		47.05030463	-112.37346126	5817	--	--		--	--	--	--
SH-03	510	2008	100 - 2714	Shave Gulch	Eureka	--	Channel cut		47.05090519	-112.37307862	5938	35 cy	--		--	Channel cut measuring 50x10x2 ft with associated rock piles. Possible infiltration basin for drilling activities.	--	--
SH-04	511	2008	--	Shave Gulch	Eureka	--	Channel cut		47.05082171	-112.37239751	5899	--	--		--	--	--	--
SH-05	512	2008	--	Shave Gulch	Summit Frac.	--	Bearing Tree		47.05106277	-112.37142311	5876	--	--		--	Bearing tree SE Corner #1.	--	--
SH-06	513	2008	100 - 2715	Shave Gulch	Calliope	--	Open Adit Portal	X	47.05030127	-112.37165605	5833	--	780		--	Open adit portal and associated waste rock pile. Waste is vegetated with evergreens with trunks measuring 1 to 3 inches in diameter.	--	--
SH-07	514	2008	100 - 2716	Shave Gulch	Calliope	--	Adit		47.04991722	-112.37146511	5755	--	590		--	Collapsed adit immediately downhill from feature 513	--	--
SH-08	515	2008	100 - 2717	Shave Gulch	Calliope	--	Trench cut		47.04937734	-112.37136654	5630	12,500 sf	--		--	Deep trench/road cut measuring 500 ft long x 25 ft wide x 12 ft deep.	--	--
SH-09	517	2008	--	Shave Gulch	Summit Frac.	--	Exploratory pit		47.05170658	-112.37222635	5942	18 cy	--		--	--	--	--

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SH-10	535	2008	--	Shave Gulch	Daylight	--	Drill pad		47.04371251	-112.37590869	5397	--	--		--	Large area of impacted vegetation (appx 500 ft x 25 ft).	--	--
SH-11	541	2008	--	Shave Gulch	Sunlight	--	Exploratory pit		47.04558654	-112.37638260	5574	2 cy	--		--	--	--	--
SH-12	543	2008	--	Shave Gulch	Sunlight	--	Claim post		47.04523291	-112.37423365	5522	--	--		--	Metal post # A 32452	--	--
SH-13	544	2008	100 – 2728 through 2730	Shave Gulch	Copper Gate	--	Adit		47.04527867	-112.37566218	5502	--	5,600		--	Little to no vegetation on waste or near toe. Faint sulfur smell was detected.	--	--
SH-14	545	2008	100 – 1731 through 1736	Shave Gulch	Midnight	--	Adits and waste rock pile		47.04766634	-112.37350250	5518	--	8,000		--	Very large waste dump and possibly 3 collapsed adits. Two collapsed wooden structure. Sulfur smell and impacted vegetation extending 75 ft below waste pile. Erosion channel cut into ground below waste pile but area is far from surface water.	--	--
SH-15	546	2008	--	Shave Gulch	Copper Gate	--	Exploratory trench		47.04627955	-112.37235216	5551	18 cy	--		--	--	--	--
SH-16	547	2008	--	Shave Gulch	Copper Gate	--	Exploratory pit		47.04586029	-112.37243330	5548	10 cy	--		--	--	--	--

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SH-17	548	2008	100 – 2737, 2738	Shave Gulch	--	--	Adit and waste rock pile		47.04482328	-112.37204287	5394	750 sf	9,200		75	Collapsed adit with waste rock pile.	SHSE-101 (0-2), SHSE-102 (0-2) SHWA-101 (0-6) *SG-SED-100 *SG-SED-101 *SG-SED-102 *SG-SED-103 *SG-SED-104 *SG-SED-105	SHSW-101, SHSW-102
SH-18	549	2008	--	Shave Gulch	Daylight	--	Drill pad		47.04440578	-112.37435242	5374	--	--		--	Impacted vegetation downgradient. Drill hole is visible and about 2 feet deep.	--	--
SH-19	550	2008	--	Shave Gulch	Daylight	--	Exploratory pit		47.04438365	-112.37448410	5423	5 cy	--		--	--	--	--
SH-20	551	2008	--	Shave Gulch	Sunlight	--	Drill pad		47.04605911	-112.37632594	5627	--	--		--	2-inch diameter steel well casing with no cap. No impacts to vegetation.	--	--
SH-21	553	2008	--	Shave Gulch	Eureka	--	Exploratory pit		47.04933593	-112.37433951	5751	50 sf	--		--	Prospect pit located on drill pad. No waste rock is visible. 6 to 8 inch diameter tree growing in middle of pit.	--	--
SH-22	554	2008	--	Shave Gulch	--	--	Water supply well		47.04244198	-112.37488283	5285	4 sf	--		--	Possible drinking water well near old cabin at Tt staging area (2-foot square)	--	--

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									Latitude	Longitude							Waste or Sediment Sample ID	Surface Water Sample ID
SH-23	555	2008	100 – 2742, 2743	Shave Gulch	--	--	Adit and waste rock pile		47.04251700	-112.37449617	5259	--	330		--	Collapsed adit portal and waste rock pile.	--	--
SH-24	556	2008	--	Shave Gulch	Calliope	Calliope Adit	Adit and waste rock pile		47.04820873	-112.36928640	5508	--	550		--	Collapsed adit portal and heavily vegetated waste rock pile.	--	--
SH-25	557	2008	100 - 2744	Shave Gulch	Calliope	Calliope Adit	Adit and waste rock pile		47.04763139	-112.36943459	5403	--	67		--	Collapsed adit with small waste pile about 300 feet southwest of feature 556.	--	--
SH-26	562	2008	--	Shave Gulch	--	--	USFS boundary sign		47.05078457	-112.36113542	5436	--	--		--	South Portal RTC Southwest #3 Corner	--	--
SH-27	563	2008	--	Shave Gulch	Consolation	Consolation Mine	Adit		47.04636019	-112.36833019	5367	--	--		--	Lower reclaimed Consolation Adit. Moss at foot of slope suggests seasonal adit seepage or overland flow.	--	--
SH-28	564	2008	--	Shave Gulch	Consolation	--	Exploratory cut		47.04626706	-112.36702572	5367	100 sf	--		--	--	--	--
SH-29	565	2008	100 – 2752 through 2754	Shave Gulch	Consolation	Consolation Mine	Adit and waste pile		47.04530398	-112.36779861	5463	--	125		--	Collapsed Upper Cconsolation adit. With up to 7 small prospect pits nearby.	2007 sample “Com-Pile #1 (0-6)”	--
SH-30	566	2008	100 - 2755	Shave Gulch	Black Foot Belle	--	Exploratory pit		47.04261658	-112.36794923	5636	30 cy	--		--	Size of pit suggests that it could be a caved shaft but waste volume appears to be just enough to fill currently visible depression. Area downgradient has been worked with heavy equipment.	--	--
SH-31	573	2008	--	Shave Gulch	Skyscraper	--	Exploratory trench		47.04334228	-112.36397563	5955	6 sf	--		--	Faint scar of trench. Well vegetated.	--	--

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SH-32	574	2008	--	Shave Gulch	--	--	Exploratory trenches		47.04323734	-112.36471659	5919	12 sf	--		--	Two faint scars of trenches. Well vegetated.	--	--
SH-33	575	2008	100 – 2765 through 2767	Shave Gulch	--	--	Adit		47.04344605	-112.36509050	5892	--	15		--	Small collapsed adit (or large prospect pit) near three other prospect pits. Bearing tree nearby S48W 16 ft T15N, R6W, S21 Corner SE#3 10502.	--	--
SH-34	576	2008	--	Shave Gulch	Consolation	--	Exploratory pit		47.04440955	-112.36451592	5843	--	--		--	--	--	--
SH-35	577	2008	--	Shave Gulch	--	--	Exploratory pit		47.04468381	-112.36425181	5843	--	--		--	--	--	--
SH-36	578	2008	--	Shave Gulch	--	--	Exploratory pits		47.04575200	-112.36418350	5735	--	--		--	Four prospect pits ranging in diameter from 6 to 8 feet and 3 to 4 feet deep. Very lush vegetation in area.	--	--
SH-37	579	2008	100 - 2768	Shave Gulch	--	--	Adit and waste rock pile		47.04572434	-112.36505136	5643	--	55		0	Waste pile located at head of seasonal drainage/run-off channel. Channel was dry at time of visit.	--	--
SH-38	580 and 581	2008	100 - 2769	Shave Gulch	Consolation	--	Adits		47.04515244 47.04530675	-112.36620932 -112.36624452	5650	--	32		--	Two small collapsed adits with waste pile. Small prospect pits below road.	--	--
SH-39	582	2008	--	Shave Gulch	Black Foot Belle/Consolation	--	Exploratory pit		47.04416815	-112.36697257	5689	--	--		--	--	--	--
SH-40	583	2008	--	Shave Gulch	Black Foot Belle	--	Exploratory pit		47.04386934	-112.36717869	5695	--	--		--	--	--	--
SH-41	584	2008	--	Shave Gulch	Black Foot Belle	--	Exploratory pit		47.04327045	-112.36726552	5712	--	--		--	--	--	--
SH-42	585	2008	--	Shave Gulch	Black Foot Belle	--	Road cut or trench sample location		47.04281582	-112.36759082	5699	--	--		--	--	--	--

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SH-43	586	2008	100 – 2770, 2771	Shave Gulch	--	--	Adit and waste rock pile		47.04860142	-112.36285798	5472	--	1,800	X	0	Collapsed and leaking adit (2 to 5 GPM estimate) with additional flow contributed by seeps between adit and waste rock pile. Stream flows along top of dump.	SHSE-103 (0-2), SHWA-102 (0-6)	SHSW-103, SHSW-104
SH-44	587	2008	--	Shave Gulch	--	--	Adits(?)		47.04832080	-112.36201569	5548	--	110		--	Series of caved adits and/or prospect pits and trenches.	--	--
SH-45	588	2008	--	Shave Gulch	Mazuma	--	Adit and waste rock pile		47.04835231	-112.36168385	5492	300 sf	30		--	Certificate of discovery found near caved adit portal.	--	--
SH-46	589	2008	--	Shave Gulch	--	--	Adit and waste rock pile		47.04853152	-112.36148821	5607	--	30		--	Caved adit. Prospect pit located 30 feet downhill of portal.	--	--
SG-01	003-Stevens Gulch	2007	SG-01-005	Stevens Gulch	--	--	Exploratory drill pad		47.03760412	-112.3742944	5,381	3825 sf	29		--	Open well casing (8 inches). Possible safety hazard.	--	--
SG-02	004-Stevens Gulch	2007	SG-02-006	Stevens Gulch	--	--	Exploratory drill pad		47.03695402	-112.3787734	5,499	4000 sf	83		--	Claim corner marker. Drilling debris downslope.	--	--
SG-03	005-Stevens Gulch	2007	SG-03-007	Stevens Gulch	--	--	Exploratory drill pad		47.03572699	-112.3782784	5,692	3850 sf	33		--	Two drilling sites within 100 feet of each other. Drilling debris downslope.	--	--
SG-04	006-Stevens Gulch	2007	--	Stevens Gulch	--	--	Exploratory drill pad		47.03638237	-112.3771576	5,656	4250 sf	15		--	Cement cap on toe of slope. Drilling debris downslope.	--	--
SG-05	007-Stevens Gulch	2007	--	Stevens Gulch	--	--	Exploratory drill pad		47.03554778	-112.3762386	5,673	3200 sf	41		--	Drilling debris downslope.	--	--
SG-06	008-Stevens Gulch	2007	--	Stevens Gulch	--	--	Exploratory drill pad/ logging		47.03245008	-112.3769536	5,741	3825 sf	--		--	Difficult to determine nature of disturbance as the area is on the edge of a logging unit.	--	--

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SG-07	009-Stevens Gulch	2007	SG-07-008	Stevens Gulch	--	--	Exploratory drill pad		47.03385682	-112.376701	5,761	2600 sf	78		--	Possibly mine site. Cut timber and other. Concentrated tailings area.	--	--
SG-08	010-Stevens Gulch	2007	SG-08-009	Stevens Gulch	--	--	Exploratory drill pad		47.03495284	-112.3775094	5,745	3500 sf	1		--	Waste rock pit with possible tailings. Drilling debris downslope.	--	--
SG-09	011-Stevens Gulch	2007	SG-9-010	Stevens Gulch	--	--	Exploratory drill pad		47.0335865	-112.3775877	5,866	3400 sf	--		--	No tailings evident.	--	--
SG-10	012-Stevens Gulch	2007	--	Stevens Gulch	--	--	Mine workings		47.02162301	-112.3700612	6,778	2250 sf	--		--	No tailings evident.	--	--
SG-11	013-Stevens Gulch	2007	--	Stevens Gulch	--	--	Exploratory dig out		47.02119662	-112.3738532	6,719	500 sf	--		--	Five dig outs all approximately 10 feet by 10 feet within 50 square foot area. No tailings evident.	--	--
SG-12	014-Stevens Gulch	2007	SG-12-011	Stevens Gulch	--	--	Exploratory dig out		47.0228176	-112.3710885	6,440	900 sf	11		--	Difficult to determine nature of disturbance but there are two cut slopes adjacent to each other with small waste rock piles and an original claim marker.	--	--
SG-13	015-Stevens Gulch	2007	SG-13-012	Stevens Gulch	Black Ore	--	Waste rock		47.02409492	-112.3671707	6,375	16500 sf	5,440		--	Large waste rock pile up to 20 feet deep.	--	--
SG-14	015-Stevens Gulch	2007	SG-14-013	Stevens Gulch	Black Ore	--	Trench		47.02409492	-112.3671707	6,375	3000 sf	111		--	Trench associated with SG-14.	--	--
SG-15	016-Stevens Gulch	2007	SG-15-014	Stevens Gulch	Capital	--	Trench		47.02506579	-112.3669593	6,345	22 cy	6		--	Possible tailings in waste rock.	--	--

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SG-16	017-Stevens Gulch	2007	SG-16-015	Stevens Gulch	Capital	Capital Tunnel 18	Exploratory pit		47.02536964	-112.3677736	6,306	7000 sf	333		--	Trench above possible adit location with large waste rock piles associated with both sites.	--	--
SG-17	018-Stevens Gulch	2007	--	Stevens Gulch	--	--	Exploratory drill pad		47.02604287	-112.3769694	6,414	2625 sf	--		--	Drilling debris downslope.	--	--
SG-18	019-Stevens Gulch	2007	SG-18-016	Stevens Gulch	B	--	Adit		47.02697318	-112.3772232	6,260	--	6		--	Possible adit location with tailings in waste rock pile.	--	--
SG-19	020-Stevens Gulch	2007	--	Stevens Gulch	--	--	Exploratory drill pad		47.02777617	-112.3782734	6,224	3000 sf	--		--	Drilling debris downslope.	--	--
SG-20	021-Stevens Gulch	2007	SG-20-017	Stevens Gulch	--	--	Waste rock		47.02822326	-112.3791317	6,155	--	15		--	Drilling debris downslope.	--	--
SG-21	022-Stevens Gulch	2007	--	Stevens Gulch	--	--	Exploratory drill pad		47.0278242	-112.3792606	6,276	3600 sf	53		--	Access road cuts waste rock piles. Possible tailings.	--	--
SG-22	023-Stevens Gulch	2007	--	Stevens Gulch	--	--	Exploratory site		47.02692063	-112.379191	6,247	5000 sf	--		--	Small scale exploratory disturbance. No tailings evident.	--	--
SG-23	024-Stevens Gulch	2007	SG-23-018 to 019	Stevens Gulch	--	--	Exploratory drill pad		47.02738926	-112.3793646	6,257	--	8		--	Roadbed impacted by tailings deposits.	--	--
SG-24	025-Stevens Gulch	2007	SG-24-020	Stevens Gulch	--	--	Trench		47.02885701	-112.3795323	6,175	2400 sf	293		--	Two trenches that intersect at waste rock pile. No tailings evident.	--	--
SG-25	026-Stevens Gulch	2007	--	Stevens Gulch	--	--	Exploratory pit		47.02918533	-112.3798434	6,155	20 cy	--		--	Test pit.No tailings evident.	--	--
SG-26	027-Stevens Gulch	2007	SG-26-021	Stevens Gulch	--	--	Exploratory drill pad		47.02948138	-112.3801314	6,158	--	4		--	Drilling debris downslope.	--	--
SG-27	028-Stevens Gulch	2007	--	Stevens Gulch	--	--	Exploratory dig out		47.03188422	-112.3797638	6,106	9 cy	--		--	Old point-of-discovery dig out. No tailings evident.	--	--

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SG-28	029-Stevens Gulch	2007	--	Stevens Gulch	--	--	Exploratory drill pad		47.03122322	-112.3795998	6,053	2800 sf	--		--	Drilling debris downslope.	--	--
SG-29	030-Stevens Gulch	2007	--	Stevens Gulch	--	--	Exploratory drill pad		47.03346589	-112.3801292	6,014	1800 sf	--		--	Exploratory pit adjacent (9 cubic yards). No tailings evident.	--	--
SG-30	031-Stevens Gulch	2007	--	Stevens Gulch	--	--	Exploratory drill pad		47.03695117	-112.3760586	5,978	3200 sf	--		--	Drilling debris downslope.	--	--
SG-31	032-Stevens Gulch	2007	SG-31-022	Stevens Gulch	--	--	Water quality		47.03604718	-112.3724879	5,515	300 sf	--		--	Deposit of iron rich soil impacting water quality. Likely native material.	--	--
SG-32	033-Stevens Gulch	2007	--	Stevens Gulch	--	--	Waste rock		47.03597308	-112.3729155	5,384	--	1		--	Tailings deposited in dig out pit. Source of the tailings is unknown.	--	--
SG-33	034-Stevens Gulch	2007	SG-33-023	Stevens Gulch	--	--	Waste rock		47.03615346	-112.3721647	5,417	--	104		--	Possible tailings in waste rock.	--	--
SG-34	035-Stevens Gulch	2007	SG-34-024	Stevens Gulch	--	--	Waste rock		47.03645479	-112.3725129	5,302	--	65		--	Possible tailings in waste rock.	--	--
SG-35	036-Stevens Gulch	2007	SG-35-025	Stevens Gulch	--	--	Trench		47.0365397	-112.3724723	5,384	108 cy	119		--	Standing water in trench adjacent to creek. No staining evident.	--	--
SG-36	037-Stevens Gulch	2007	SG-36-026	Stevens Gulch	--	--	Trench		47.03641824	-112.3721345	5,325	47 cy	67		--	Standing water in trench adjacent to creek. No staining evident.	--	--
SG-37	038-Stevens Gulch	2007	--	Stevens Gulch	--	--	Exploratory drill pad		47.03506432	-112.3726714	5,351	--	--		--	Debris entering creek from pad located 150 feet upslope.	--	--
SG-38	039-Stevens Gulch	2007	SG-38-027 to 029	Stevens Gulch	--	--	Waste rock		47.03747202	-112.3719595	5,289	--	97		--	White staining of material in creek bed. Possible old roadbed.	--	--

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SG-39	040- Stevens Gulch	2007	--	Stevens Gulch	--	--	Waste rock		47.03785876	-112.3708754	5,299	--	19		--	Two waste rock piles along Paymaster road.	--	--
SG-40	453- Capitol	2007	SG-40-069 to 070	Stevens Gulch	Capital	Capital Tunnel 8	Tunnel		47.02573467	-112.371028	5,886	--	--		--	Revegetation in good condition.	--	--
SG-41	454- Capital	2007	SG-41-071 to 072	Stevens Gulch	Capital	--	Trench		47.02573568	-112.3715472	5,928	3667 cy	2,444		--	Exploratory trench with possible tailings.	--	--
SG-42	455- Capital	2007	SG-42-073 to 074	Stevens Gulch	Copper Wreath	--	Waste rock		47.02688693	-112.3677282	5,873	--	33		--	Possible adit location with tailings in waste rock pile.	--	--
SG-43	456- Stevens Gulch	2007	SG-43-075 to 078	Stevens Gulch	Capital	Capital Tunnel 15	Exploratory pit		47.02449884	-112.3690797	6,266	625 cy	778		--	Exploratory pit with possible tailings. Photo 78 of ridge to the NE, no mining activity evident. Numerous roadcuts.	--	--
SG-44	457- Viking Mine	2007	SG-44-079 to 083	Stevens Gulch	--	Viking Mine	Adit		47.02375696	-112.3730159	6,227	27778 cy	20,000		--	Tailings pile in contact with intermittent portion of Stevens Creek.	--	--
SG-45	458- Stevens Gulch	2007	SG-45-084 to 085	Stevens Gulch	Capital No. 2	--	Exploratory drill pad		47.02658267	-112.3725299	5,925	6750 sf	23		--	Open well casing (16 inches). Possible safety hazard. Drilling deposition downslope.	--	--
SG-46	459- Stevens Gulch	2007	SG-46-086 to 088	Stevens Gulch	--	--	Exploratory drill pad		47.02706228	-112.3713408	5,781	15960 sf	15		--	Assess road and exploratory pad over possible adit location. Drilling debris downslope with possible tailings.	--	--
SG-47	460- Stevens Gulch	2007	SG-47-089 to 090	Stevens Gulch	Capital	Capital Tunnel 12	Adit	X	47.0265136	-112.3702679	5,712	1350 sf	278		--	Potential adit location. Tailings material in creek.	--	--
SG-48	461- Stevens Gulch	2007	SG-48-091 to 94	Stevens Gulch	Capital	Capital Tunnel 11	Adit	X	47.02638804	-112.37061	5,856	12 sf	28		--	adit in rock face adjacent to creek. Tailings material in creek.	--	--

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SG-49	462-Stevens Gulch	2007	SG-49-095	Stevens Gulch	Denver	Tunnel 9	Waste rock		47.02731198	-112.3698857	5,741	--	999		--	Waste rock associated with adit SG-51. Located adjacent to ephemeral creek.	--	--
SG-50	463-Stevens Gulch	2007	SG-50-096	Stevens Gulch	Denver	Tunnel 9	Adit	X	47.02716655	-112.3695823	5,741	3 cy	28		--	Adit entrance under rock overhang.	--	--
SG-51	464-Stevens Gulch	2007	SG-51-097 to 098	Stevens Gulch	Denver	--	Exploratory drill pad		47.02760367	-112.3703389	5,741	9000 cy	370		--	Large cutslope with waste rock pushed into creek.	--	--
SG-52	465-Stevens Gulch	2007	--	Stevens Gulch	Denver	--	Survey site		47.02754064	-112.370982	5,735	--	--		--	Capital claim marker	--	--
SG-53	466-Stevens Gulch	2007	SG-53-099 to 101	Stevens Gulch	Capital No. 2	Tunnel 22	Waste rock		47.02740619	-112.3726238	5,748	--	2,843		--	Three waste rock piles and a large dig out area.	--	--
SG-54	467-Stevens Gulch	2007	--	Stevens Gulch	Capital No. 2	--	Exploratory drill pad		47.02758866	-112.3734587	5,869	--	7		--	Possible tailings in waste rock.	--	--
SG-55	468-Stevens Gulch	2007	SG-55-142	Stevens Gulch	Capital No. 2	--	Exploratory drill pad		47.02750895	-112.3737973	5,892	13000 sf	200	X	650	Pipe (4 inch) protruding from toe of cutslope leaking small amounts of water.	--	SG-55SW
SG-56	469-Stevens Gulch	2007	SG-56-102 to 103	Stevens Gulch	B	--	Waste rock		47.02713612	-112.3748404	5,958	875 sf	370		--	Possible tailings in waste rock.	--	--
SG-57	470-Stevens Gulch	2007	--	Stevens Gulch	B	--	Exploratory drill pad		47.02688023	-112.374954	6,040	10000 sf	--		--	No tailings evident.	--	--
SG-58	471-Stevens Gulch	2007	SG-58-104 to 105	Stevens Gulch	B	--	Exploratory drill pad		47.02649273	-112.3764518	6,247	7360 sf	1,481		--	Possible tailings in waste rock.	--	--
SG-59	472-Stevens Gulch	2007	SG-59-106 to 107	Stevens Gulch	--	--	Exploratory drill pad		47.02425878	-112.3743948	6,381	8000 sf	--		--	No tailings evident.	--	--
SG-60	472-Stevens Gulch	2007	SG-60-108 to 109	Stevens Gulch	--	--	Trench		47.02425878	-112.3743948	6,381	--	5		--	Old hand dug trench. No tailings evident.	--	--

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SG-61	472-Stevens Gulch	2007	--	Stevens Gulch	--	--	Trench		47.02425878	-112.3743948	6,381	--	5		--	Old hand dug trench. No tailings evident.	--	--
SG-62	473-Stevens Gulch	2007	--	Stevens Gulch	--	--	Exploratory drill pad		47.0251652	-112.3752127	6,371	7200 sf	--		--	Drilling debris downslope. Possible tailings in waste rock.	--	--
SG-63	474-Stevens Gulch	2007	SG-63-110 to 115	Stevens Gulch	--	--	Mine workings		47.02513989	-112.3759722	6,470	404 cy	--		--	Large amount of disturbance with numerous trenches and waste rock piles. Possible tailings in waste rock piles.	--	--
SG-64	475-Stevens Gulch	2007	SG-64-112	Stevens Gulch	--	--	Trench		47.02410774	-112.3760751	6,509	556 cy	--		--	Associated with disturbance at location SG-68. No tailings evident.	--	--
SG-65	476-Stevens Gulch	2007	SG-65-117	Stevens Gulch	--	--	Exploratory pit		47.02530183	-112.3773848	6,496	11 cy	--		--	No tailings evident.	--	--
SG-66	477-Stevens Gulch	2007	SG-66-118 to 119	Stevens Gulch	--	--	Exploratory pit		47.02565353	-112.377866	6,434	28 cy	--		--	No tailings evident.	--	--
SG-67	478-Stevens Gulch	2007	SG-67-120 to 122	Stevens Gulch	--	--	Exploratory drill pad		47.02548506	-112.3762017	6,358	4800 sf	19,444		--	Large amount of waste rock associated with two cut slopes. Possible tailings in waste rock piles.	--	--
SG-68	479-Stevens Gulch	2007	SG-68-123	Stevens Gulch	Capital No. 2	--	Exploratory drill pad		47.0293207	-112.3757673	5,922	--	44		--	Drill debris downslope. No tailings evident.	--	--
SG-69	480-Stevens Gulch	2007	SG-69-124	Stevens Gulch	--	--	Exploratory dig out		47.02970132	-112.3745474	5,771	18 cy	13		--	Point-of-discovery and associated dig out.	--	--
SG-70	481-Stevens Gulch	2007	SG-70-125 to 126	Stevens Gulch	--	--	Cabins		47.02835376	-112.371297	5,614	1000 sf	--		--	Four old cabins in various states of decay.	--	--

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SG-71	482-Stevens Gulch	2007	SG-71-127 to 130	Stevens Gulch	Denver	--	Adit		47.02941902	-112.3728964	5,551	700 sf	463	X	70	Spring at possible adit location 70 feet from creek. Water has pooled and is 6 inches deep. Vegetation is in good condition adjacent to pond.	--	--
SG-72	483-Stevens Gulch	2007	--	Stevens Gulch	Denver	--	Survey site		47.03009435	-112.3735878	5,584	--	--		--	Denver claim corner marker.	--	--
SG-73	484-Stevens Gulch	2007	SG-73-131 to 132	Stevens Gulch	--	--	Exploratory drill pad		47.03331677	-112.3755916	5,686	4950 sf	11		--	No tailings evident.	--	--
SG-74	485-Stevens Gulch	2007	SG-74-133	Stevens Gulch	--	--	Exploratory drill pad		47.03376814	-112.3743896	5,561	4000 sf	--		--	No tailings evident.	--	--
SG-75	486-Stevens Gulch	2007	--	Stevens Gulch	--	--	Exploratory dig out		47.03342649	-112.3745879	5,594	500 sf	--		--	No tailings evident.	--	--
SG-76	487-Stevens Gulch	2007	--	Stevens Gulch	--	--	Ground disturbance		47.03369848	-112.3727658	5,410	900 sf	--		--	Possible shop or staging area with a dump and timbers from a structure. Possible tailings along roadcut.	--	--
SG-77	488-Stevens Gulch	2007	--	Stevens Gulch	--	--	Waste rock		47.03274144	-112.3730226	5,492	--	7		--	Possible tailings deposit 10 feet from creek.	--	--
SG-78	489-Stevens Gulch	2007	SG-78-134 to 135	Stevens Gulch	--	--	Exploratory drill pad/ adit		47.03118844	-112.3718187	5,689	10000 sf	741		--	Possible adit location with tailings in waste rock pile.	--	--
SG-79	490-Stevens Gulch	2007	--	Stevens Gulch	--	--	Culvert in stream		47.03123856	-112.3729163	5,574	--	--		--	Old culvert from road crossing, no longer functional.	--	--
SG-80	491-Stevens Gulch	2007	SG-80-136 to 137	Stevens Gulch	--	--	Exploratory drill pad		47.03109297	-112.3739448	5,574	4000 sf	--		--	Possible old mine works with timbers and other older debris	--	--
SG-81	492-Stevens Gulch	2007	SG-81-138	Stevens Gulch	--	--	Trench		47.03159622	-112.3731582	5,551	22 cy	4		--	No tailings evident.	--	--

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SG-82	493a-Stevens Gulch	2007	--	Stevens Gulch	--	--	Water quality		47.03159622	-112.3731582	5,551	--	156		--	Soil contributing to iron staining in creek, likely native material.	--	--
SG-83	493b-Stevens Gulch	2007	--	Stevens Gulch	--	--	Survey site		47.03238554	-112.3725435	5,515	--	--		--	"G2" claim marker.	--	--
SG-84	494-Stevens Gulch	2007	--	Stevens Gulch	--	--	Waste rock		47.03300262	-112.3728382	5,427	1750 sf	--		--	Bog area with noticeable increase in iron staining in stream below bog. Possible tailings deposited throughout.	--	--
SG-85	495-Stevens Gulch	2007	SG-85-139	Stevens Gulch	--	--	Exploratory drill pad		47.03456081	-112.3751743	5,587	3200 sf	--		--	No tailings evident.	--	--
SG-86	496-Stevens Gulch	2007	SG-86-140 to 141	Stevens Gulch	--	--	Waste rock		47.03511327	-112.3753531	5,627	--	2,105		--	Two waste rock piles with possible tailings.	--	--
SG-87	497-Stevens Gulch	2007	--	Stevens Gulch	--	--	Exploratory drill pad		47.03488151	-112.3739187	5,587	2850 sf	--		--	Drilling debris downslope with possible tailings.	--	--
SG-88	595	2008	--	Steven's Gulch	--		Trench		47.03783982	-112.37046489	5312	6,000 sf	--		--	Visible on aerial photo.	--	--
SG-89	617	2008	--	Steven's Gulch	--	--	Tailings edge		47.03904622	-112.37103017	5272	--	--		--	Apparent west edge of tailings along Steven's Creek. Other edges bound by roads.	--	--
SG-90	618	2008	--	Steven's Gulch	--	--	Claim corner		47.03932777	-112.37163342	5377	--	--		--	Claim corner J-2 x 0-2 10945	--	--
SG-91	620	2008	--	Steven's Gulch	--	--	Adit		47.03815506	-112.37292574	5361	--	--		--	Reclaimed adit	--	--
SG-92	621	2008	--	Steven's Gulch	--	--	Claim corner		47.03832161	-112.37124165	5308	--	--		--	Claim corner RO-4 x 10942	--	--
SG-93	630	2008	--	Steven's Gulch	Copper Wreath	Capital Mine	Adit and waste pile		47.02703638	-112.36977582	5850	--	--	X	50	Inventoried in 2007	SGWA-101, SGSE-101 (0-2)	SGSW-101, SGSW-102

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SG-94	631	2008	--	Steven's Gulch	Denver	--	Drill pad		47.02852459	-112.37162177	5718	--	--		--	Drill cuttings streak near old cabins with dead vegetation and yellow soil. Spring with cone shaped iron precipitate is also located downstream from this site.	SGWA-102, SGSE-103 (0-2), SGSE-104 (0-2) (iron precip spring)	SGSW-103, SGSW-104 (iron precip spring)
SG-95	632	2008	--	Steven's Gulch	--	--	Drill cuttings		47.03055426	-112.37292037	5564	4 cy	--		0	Fine grained yellow material in contact with stream	--	--
SG-96	633	2008	--	Steven's Gulch	--	--	Possible Staging area		47.03372774	-112.37251519	5469	3,800 sf	--		5	Flat area with wood and metal debris. Yellow orange fine grained material in area typically 1 to 4 inches thick.	SGWA-103, SGSE-107 (0-2)	SGSW-107
SG-97	634	2008	--	Steven's Gulch	B	--	Monitoring well		47.02563291	-112.37422904	5367	--	--		--	4 inch diameter steel casing with 16 inch stick-up and no cap. In middle of road.	--	--
SG-98	635	2008	--	Steven's Gulch	--	--	Adit and waste rock pile		47.02382008	-112.37311752	6191	--	--		--	Inventoried in 2007. Adit had flow at some point as evidenced by strong iron oxide staining but is now dry.	SGWA-104	--
SG-99	651	2008	--	Steven's Gulch	--	--	Adit		47.03122641	-112.37316160	5548	--	--		100	Collapsed adit. Waste pile, if present, has been worked by stream and is indistinguishable from other materials.	SGSE-105 (0-2), SGSE-106 (0-2)	SGSW-105, SGSW-106

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SG-100	653	2008	--	Steven's Gulch	--	--	Tailings deposit		47.03260649	-112.37284443	5499	--	--		0	Tailings deposit in open marshy area upgradient from feature 633 and 200 feet below SGSW-106. Possible breached tailings dam.	SGWA-104 (0-6)	--
SWG-01	427-Carbonate	2007	SWG-01-030	Swamp Gulch	--	--	Exploratory pit		47.04368443	-112.3968741	5,351	15 cy	3		--	Small dig out. No tailings evident.	--	--
SWG-02	428-Carbonate	2007	SWG-02-031-32	Swamp Gulch	Carbonate No. 3	--	Trench		47.04357991	-112.3995165	5,328	2037 cy	244		--	Possible tailings in waste rock piles.	--	--
SWG-03	429-Carbonate	2007	SWG-03-033	Swamp Gulch	Carbonate No. 3	--	Exploratory pit		47.04333826	-112.3992525	5,262	56 cy	11		--	Small dig out. No tailings evident.	--	--
SWG-04	430-Carbonate	2007	SWG-04-034	Swamp Gulch	Carbonate No. 3	Tunnel No. 2	Exploratory pit		47.04313994	-112.3990172	5,197	89 cy	11		--	Small dig out. No tailings evident.	--	--
SWG-05	431-Carbonate No. 3	2007	SWG-05-035 to 038	Swamp Gulch	Carbonate No. 3	Tunnel No. 2	Exploratory pit		47.04312167	-112.3987724	5,187	347 cy	--		--	Possible tailings in waste rock piles.	--	--
SWG-06	431-Carbonate No. 4	2007	--	Swamp Gulch	Carbonate No. 3	Tunnel No. 2	Trench		47.04312167	-112.3987724	5,187	22 cy	11		--	Possible tailings in waste rock piles. Cement footing, stove pipe and other debris.	--	--
SWG-07	432 to 433-Carbonate	2007	SWG-07-039	Swamp Gulch	--	--	Road		47.04110716	-112.3970316	5,187	622 cy	--		--	Possible tailings in roadbed.	--	--
SWG-08	434 to 435-Carbonate	2007	--	Swamp Gulch	Carbonate No. 3	--	Road		47.04221726	-112.3985684	5,174	346 cy	--		--	Possible tailings in roadbed.	--	--
SWG-09	436-Carbonate	2007	SWG-09-040 to 042	Swamp Gulch	Carbonate No. 2	--	Mine workings		47.04324145	-112.3953341	5,213	--	50		--	Mine workings and large footings on a constructed bench. Some waste rock but no tailings evident.	--	--
SWG-10	437-Carbonate	2007	SWG-10-043	Swamp Gulch	Carbonate No. 2	--	Ground disturbance		47.04340406	-112.3945718	5,266	--	--		--	No tailings evident.	--	--
SWG-11	438-Carbonate No. 2	2007	--	Swamp Gulch	Carbonate No. 2	Tunnel No. 2	Tunnel		47.04356113	-112.3941012	5,276	--	--		--	Revegetation in good condition.	--	--
SWG-12	439-Carbonate	2007	SWG-12-044 to 045	Swamp Gulch	--	--	Adit		47.04515286	-112.3935982	5,226	--	--		--	No tailings evident.	--	--

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*PBBS		2011		Porcupine Creek	--	Bobby Boy Mine	Mine	X	47.036747	-112.404389			(not noted)	X	(not noted)	--	*PBBS-SED-200 *PBBS-SED-201 *PBBS-SED-202	*PBBS-200 *PBBS-201 *PBBS-202

cy = cubic yards
sf = square feet
AMSL = above mean sea level
Latitude and longitude measured using a hand-held resource grade global positioning satellite unit. GPS settings were NAD83 UTM.
Unless otherwise noted "impacted vegetation" associated with drill pads consists of a streak of non-vegetated ground originating at drill pad and extending downhill for 100 to 300 feet – likely due to slurrying drill cuttings and/or fluids downhill.
[1] Association with historic features is an approximation as many historic mine areas have been disturbed or removed completely.
[2] Cubic yard for estimated disturbance of exploratory pits and trenches is an estimate of the length, width, and depth of the disturbed area
-- Information not available or sample not collected
*Samples collected by Pioneer Technical Services, Inc. in 2011

TABLE 13
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BR-02	Blackfoot River	Exploratory dig out	33		--	X	X	X	No tailings evident.
BR-03	Blackfoot River	Drill pad	--		--	X	X	X	Drill pad with possible second pad about 75 feet downhill of first. Twelve foot wide non-vegetated strip of ground stretching between the two pads.
BR-04	Blackfoot River	Drill pad	--		--	X		X	Impacted vegetation downgradient
BR-05	Blackfoot River	Drill pad	--		--	X		X	Impacted vegetation downgradient
BR-06	Blackfoot River	Drill pad	--		--	X		X	Impacted vegetation downgradient
BR-07	Blackfoot River	Adit	90		--	X	X	X	Portal location obscured by tree fall. Area is well vegetated. Excavated material difficult to delineate due to road building disturbances.
BR-08	Blackfoot River	Drill pad	--		--	X		X	Impacted vegetation downgradient
BR-09	Blackfoot River	Drill pad	--		--	X		X	Impacted vegetation downgradient
BR-10	Blackfoot River	Pipe	--		--	X	X	X	Pipe in ground. Not a well. Possible anchor point.
BR-11	Blackfoot River	Drill pad	50		--	X	X	X	No apparent mine workings but rock pile is present and incorporated into road fill.
BR-12	Blackfoot River	Drill pad	--		--	X		X	Impacted vegetation downgradient
BR-15	Blackfoot River	Exploratory pits	--		--	X	X	X	Two large prospect pits
BR-17	Blackfoot River	Adit and rock pile	7		--	X	X	X	Small excavated rock pile and collapsed adit that is almost completely filled and nearly level with grade.
BR-18	Blackfoot River	Shaft	15		--	X	X	X	Possible caved shaft measuring 10 feet in diameter by 5 feet deep with log timbers partially buried in center.
BR-19	Blackfoot River	Exploratory pit	--		--	X	X	X	Prospect pit 1- foot diameter by 5 feet deep.
BR-21	Blackfoot River	Breached dam (water supply – not tailings)	--	X	0	X	X		Pipe buried in creek channel above breached dam. Water flows out of pipe but appears to be creek water (not groundwater).
BR-22	Blackfoot River	Series of pits	20		--	X	X	X	Series of prospect pits and one caved shaft (10 feet in diameter by 5 feet deep).
BR-23	Blackfoot River	Adit and rock pile	35		--	X	X	X	Collapsed adit portal and rock pile. Rock pile has been partially cleared by road building activity.
BR-25	Blackfoot River	Trash	--		--	X	X	X	Road bed with trash poly pipe, antique beer cans, cable, etc
BR-26	Blackfoot River	Exploratory pit	--		--	X	X	X	--
BR-27	Blackfoot River	Exploratory pits	--		--	X	X	X	Six prospect pits all less than 5 feet diameter

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BR-28	Blackfoot River	Claim corner	--		--	X	X	X	#4 corner Mary P claim
BR-30	Blackfoot River	Exploratory pits	--		--	X	X	X	Three prospect pits all less than 5 feet diameter
BR-31	Blackfoot River	Exploratory pit	--		--	X	X	X	--
BR-33	Blackfoot River	Exploratory pits	--		--	X	X	X	One of these two pits may be a natural depression.
BR-34	Blackfoot River	Adit	--		--	X	X	X	Collapsed adit. No excavated rock is present other than what may be incorporated into roadbed/cut-fill slope.
BR-35	Blackfoot River	Exploratory pit	--		--	X	X	X	--
BR-40	Blackfoot River	Rock pile	--		--	X	X	X	Reclaimed rock pile above Anaconda Wetlands.
BR-41	Blackfoot River	Rock pile	--		--	X	X	X	Reclaimed rock pile above Anaconda Wetlands.
BR-42	Blackfoot River	Adit	--		--	X	X	X	Collapsed or reclaimed adit portal along creek. No excavated rock is evident.
BR-43	Blackfoot River	Shaft	--		--	X	X	X	12 foot diameter collapsed shaft above Anaconda adit.
BR-44	Blackfoot River	Exploratory pits	--		--	X	X	X	Two prospect pits 6x3x1 feet.
CG-01	Chambers Gulch	Adit	--		--				Collapsed adit with no rock pile evident.
CG-04	Chambers Gulch	Adit	--	X	--	X	X	X	Collapsed or reclaimed adit with pooled water nearby. Material at foot of adit channel is very well vegetated and indistinguishable from surrounding ground.
CG-05	Chambers Gulch	Claim corner	--		--	X	X	X	RTC-10907
PC-02	Pass Creek	Drill Pad	--		450	X	X	X	Located 400 ft uphill of feature 500.
PC-03	Pass Creek	Exploratory Pits	--		--	X	X	X	One 15 ft diameter by 4 ft deep prospect pit and several smaller (3 to 5 ft diameter) in general area.
PC-04	Pass Creek	Exploratory Pit	--		--	X	X	X	--
PC-05	Pass Creek	Exploratory Pit	--		--	X	X	X	--
PC-07	Pass Creek	Drill cuttings pile	--		--	X	X	X	--
PC-08	Pass Creek	Exploratory pits	--		--	X	X	X	Two small prospect pits near claim corner 10105 4TS.
PC-09	Pass Creek	Exploratory pit	--		--	X	X	X	--
PC-10	Pass Creek	Adit	--	X	--	X	X	X	Very large disturbance. Multi-tiered basin with seep at head of disturbance. Possible caved adit portal.

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PC-12	Pass Creek	Drill pad and well	--		--	X	X	X	3 ½ inch steel well with cap inside 5 inch protector.
PC-13	Pass Creek	Drill pad	--		--	X		X	Impacted vegetation downgradient
PC-14	Pass Creek	Drill pad	--		--	X		X	Impacted vegetation downgradient
PC-15	Pass Creek	Drill pad	--		--	X		X	Impacted vegetation downgradient
PC-16	Pass Creek	Drill pad	--		--	X		X	Impacted vegetation downgradient
PC-17	Pass Creek	Drill pad	--		--	X		X	Impacted vegetation downgradient
PC-18	Pass Creek	Drill pad	--		--	X		X	Impacted vegetation downgradient
PC-19	Pass Creek	Drill pad	--		--	X		X	Impacted vegetation downgradient underlain by yellow sandy/powdery soil that appears similar to tailings although no mine workings are apparent.
PC-20	Pass Creek	Drill pad	--		--	X		X	Impacted vegetation downgradient
JM-02	Paymaster Gulch	Exploratory drill pad	--		--	X		X	Appears tailings from Jumbo adit have been incorporated into fill material for drill pad (quantity unknown).
PM-01	Paymaster Gulch	Exploratory pit	11		--	X	X	X	No tailings evident.
PM-02	Paymaster Gulch	Tunnel	--		--	X	X	X	Revegetation in good condition.
PM-03	Paymaster Gulch	Trench	--		--	X	X	X	Four trenches east of Tunnel No. 3 200 feet.
PM-05	Paymaster Gulch	Trench	--		--	X	X	X	Two trenches located beyond Paymaster claim boundary.
PM-07	Paymaster Gulch	Exploratory dig out	--		--	X	X	X	Small dig out. No tailings evident.
PM-08	Paymaster Gulch	Tunnel	--		--	X	X	X	Revegetation in good condition.
PM-09	Paymaster Gulch	Trench	--		--	X	X	X	Trench just upslope of revegetation. No tailings evident.
PM-10	Paymaster Gulch	Trench	--		--	X	X	X	No tailings evident.
PM-11	Paymaster Gulch	Trench	33		--	X	X	X	300 feet southeast of Paymaster Tunnel No. 2 above access road. Copper salts observed on surface rock.
PM-13	Paymaster Gulch	Ground disturbance	--		--	X	X	X	Possible DD hole along powerline route. Fill material brought in to widen the road. Possible tailings material.
PM-14	Paymaster Gulch	Tunnel	--		--	X	X	X	Seep adjacent to adit reclamation sampled in 2007. Revegetation in good condition.
PM-15	Paymaster Gulch	Trench	6		--	X	X	X	Digout 10 feet upslope (1.8 cy). No tailings evident.
PM-16	Paymaster Gulch	Exploratory dig out	1		--	X	X	X	No tailings evident.
PM-17	Paymaster Gulch	Exploratory dig out	1		--	X	X	X	No tailings evident.
PM-18	Paymaster Gulch	Exploratory dig out	--		--	X	X	X	No defined rock pile or tailings evident.

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PM-19	Paymaster Gulch	Exploratory dig out	6		--	X	X	X	No tailings evident.
PM-20	Paymaster Gulch	Stream	--		--	X	X	X	Stream becomes intermittent above this point. No iron staining. White milky standing water.
PM-21	Paymaster Gulch	Cabins	--		--	X	X	X	--
PM-22	Paymaster Gulch	Ground disturbance	--		100	X	X		Large V-shape channel running 100 feet to main stream channel. Uncertain if this is natural or man-made. White staining on rocks in channel bottom. Head of channel sloughing into channel.
PM-23	Paymaster Gulch	Exploratory dig out	--		--	X	X	X	Three small dig outs (10 sf each). No tailings evident.
PM-24	Paymaster Gulch	Road	--		--	X	X	X	End of access road.
PM-25	Paymaster Gulch	Exploratory drill pad	--		--	X	X	X	Fill from road cut pushed into intermittent channel. No rock piles or tailings evident. Bucket, cable and wooden pole onsite. Wildlife wallow at upstream end of pad.
PM-27	Paymaster Gulch	Adit	--		--	X	X	X	Small moss mat is located were the old adit entrance was located. No surface water was visible.
PM-29	Paymaster Gulch	Exploratory dig out	--		--	X	X	X	No tailings evident.
PM-30	Paymaster Gulch	Exploratory dig out	--		--	X	X	X	Dig out on edge of access road. No excavated rock or tailings evident.
PM-31	Paymaster Gulch	Drill pad	--		0	X	X		Road cut material in contact with creek but no mine related material present.
PM-32	Paymaster Gulch	Claim corner	--		--	X	X	X	Claim corner CT4
PM-33	Paymaster Gulch	Exploratory pit	--		200	X	X	X	Excavated rock pile is well vegetated
PM-34	Paymaster Gulch	Exploratory pit	--		50	X	X	X	--
PM-36	Paymaster Gulch	Adit or large exploratory pit	--		--	X	X	X	No excavated material is visible and vegetation is very dense.
SH-01	Shave Gulch	Shaft and rock pile.	45		--	X	X	X	Caved shaft with associated rock pile and an estimated 20 prospect pits and channel cuts in vicinity.
SH-02	Shave Gulch	Drill pad	--		--	X	X	X	--
SH-03	Shave Gulch	Channel cut	--		--	X	X	X	Channel cut measuring 50x10x2 ft with associated rock piles. Possible infiltration basin for drilling activities.
SH-04	Shave Gulch	Channel cut	--		--	X	X	X	--
SH-05	Shave Gulch	Bearing Tree	--		--	X	X	X	Bearing tree SE Corner #1.
SH-08	Shave Gulch	Trench cut	--		--	X	X	X	Deep trench/road cut measuring 500 ft long x 25 ft wide x 12 ft deep.
SH-09	Shave Gulch	Exploratory pit	--		--	X	X	X	--
SH-10	Shave Gulch	Drill pad	--		--	X	X	X	Large area of impacted vegetation (appx 500 ft x 25 ft).

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SH-11	Shave Gulch	Exploratory pit	--		--	X	X	X	--
SH-12	Shave Gulch	Claim post	--		--	X	X	X	Metal post # A 32452
SH-15	Shave Gulch	Exploratory trench	--		--	X	X	X	--
SH-16	Shave Gulch	Exploratory pit	--		--	X	X	X	--
SH-18	Shave Gulch	Drill pad	--		--	X		X	Impacted vegetation downgradient. Drill hole is visible and about 2 feet deep.
SH-19	Shave Gulch	Exploratory pit	--		--	X	X	X	--
SH-20	Shave Gulch	Drill pad	--		--	X	X	X	2-inch diameter steel well casing with no cap. No impacts to vegetation.
SH-21	Shave Gulch	Exploratory pit	--		--	X	X	X	Prospect pit located on drill pad. No excavated rock is visible. 6 to 8 inch diameter tree growing in middle of pit.
SH-22	Shave Gulch	Water supply well	--		--	X	X	X	Possible drinking water well near old cabin at Tt staging area (2-foot square)
SH-24	Shave Gulch	Adit and rock pile	550		--				Collapsed adit portal and heavily vegetated rock pile.
SH-25	Shave Gulch	Adit and rock pile	67		--	X	X	X	Collapsed adit with small rock pile about 300 feet southwest of feature 556.
SH-26	Shave Gulch	USFS boundary sign	--		--	X	X	X	South Portal RTC Southwest #3 Corner
SH-27	Shave Gulch	Adit	--		--	X	X	X	Lower reclaimed Consolation Adit. Moss at foot of slope suggests seasonal adit seepage or overland flow.
SH-28	Shave Gulch	Exploratory cut	--		--	X	X	X	--
SH-30	Shave Gulch	Exploratory pit	--		--	X	X	X	Size of pit suggests that it could be a caved shaft but excavated rock volume appears to be just enough to fill currently visible depression. Area downgradient has been worked with heavy equipment.
SH-31	Shave Gulch	Exploratory trench	--		--	X	X	X	Faint scar of trench. Well vegetated.
SH-32	Shave Gulch	Exploratory trenches	--		--	X	X	X	Two faint scars of trenches. Well vegetated.
SH-33	Shave Gulch	Adit	15		--	X	X	X	Small collapsed adit (or large prospect pit) near three other prospect pits. Bearing tree nearby S48W 16 ft T15N, R6W, S21 Corner SE#3 10502.
SH-34	Shave Gulch	Exploratory pit	--		--	X	X	X	--
SH-35	Shave Gulch	Exploratory pit	--		--	X	X	X	--
SH-36	Shave Gulch	Exploratory pits	--		--	X	X	X	Four prospect pits ranging in diameter from 6 to 8 feet and 3 to 4 feet deep. Very lush vegetation in area.
SH-38	Shave Gulch	Adits	32		--	X	X	X	Two small collapsed adits with rock pile. Small prospect pits below road.
SH-39	Shave Gulch	Exploratory pit	--		--	X	X	X	--

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SH-40	Shave Gulch	Exploratory pit	--		--	X	X	X	--
SH-41	Shave Gulch	Exploratory pit	--		--	X	X	X	--
SH-42	Shave Gulch	Road cut or trench sample location	--		--	X	X	X	--
SH-45	Shave Gulch	Adit and rock pile	30		--	X	X	X	Certificate of discovery found near caved adit portal.
SH-46	Shave Gulch	Adit and rock pile	30		--	X	X	X	Caved adit. Prospect pit located 30 feet downhill of portal.
SG-02	Stevens Gulch	Exploratory drill pad	83		--	X	X	X	Claim corner marker. Drilling debris downslope.
SG-03	Stevens Gulch	Exploratory drill pad	33		--	X	X	X	Two drilling sites within 100 feet of each other. Drilling debris downslope.
SG-04	Stevens Gulch	Exploratory drill pad	15		--	X	X	X	Cement cap on toe of slope. Drilling debris downslope.
SG-05	Stevens Gulch	Exploratory drill pad	41		--	X	X	X	Drilling debris downslope.
SG-06	Stevens Gulch	Exploratory drill pad/ logging	--		--	X	X	X	Difficult to determine nature of disturbance as the area is on the edge of a logging unit.
SG-07	Stevens Gulch	Exploratory drill pad	78		--	X	X	X	Possibly mine site. Cut timber and other. Concentrated tailings area.
SG-08	Stevens Gulch	Exploratory drill pad	1		--	X	X	X	Excavated rock pile with possible tailings. Drilling debris downslope.
SG-09	Stevens Gulch	Exploratory drill pad	--		--	X	X	X	No tailings evident.
SG-10	Stevens Gulch	Mine workings	--		--	X	X	X	No tailings evident.
SG-11	Stevens Gulch	Exploratory dig out	--		--	X	X	X	Five dig outs all approximately 10 feet by 10 feet within 50 square foot area. No tailings evident.
SG-12	Stevens Gulch	Exploratory dig out	11		--	X	X	X	Difficult to determine nature of disturbance but there are two cut slopes adjacent to each other with small waste rock piles and an original claim marker.
SG-15	Stevens Gulch	Trench	6		--	X	X	X	Possible tailings in rock.
SG-17	Stevens Gulch	Exploratory drill pad	--		--	X	X	X	Drilling debris downslope.
SG-18	Stevens Gulch	Adit	6		--	X	X	X	Possible adit location with tailings in rock pile.
SG-19	Stevens Gulch	Exploratory drill pad	--		--	X	X	X	Drilling debris downslope.
SG-20	Stevens Gulch	rock	15		--	X	X	X	Drilling debris downslope.

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SG-21	Stevens Gulch	Exploratory drill pad	53		--	X	X	X	Access road cuts waste rock piles. Possible tailings.
SG-22	Stevens Gulch	Exploratory site	--		--	X	X	X	Small scale exploratory disturbance. No tailings evident.
SG-23	Stevens Gulch	Exploratory drill pad	8		--	X	X	X	Roadbed impacted by tailings deposits.
SG-25	Stevens Gulch	Exploratory pit	--		--	X	X	X	Test pit. No tailings evident.
SG-26	Stevens Gulch	Exploratory drill pad	4		--	X	X	X	Drilling debris downslope.
SG-27	Stevens Gulch	Exploratory dig out	--		--	X	X	X	Old point-of-discovery dig out. No tailings evident.
SG-28	Stevens Gulch	Exploratory drill pad	--		--	X	X	X	Drilling debris downslope.
SG-29	Stevens Gulch	Exploratory drill pad	--		--	X	X	X	Exploratory pit adjacent (9 cubic yards). No tailings evident.
SG-30	Stevens Gulch	Exploratory drill pad	--		--	X	X	X	Drilling debris downslope.
SG-32	Stevens Gulch	Rock pile	1		--	X	X	X	Tailings deposited in dig out pit. Source of the tailings is unknown.
SG-34	Stevens Gulch	Rock pile	65		--	X	X	X	Possible tailings in excavated rock.
SG-36	Stevens Gulch	Trench	67		--	X	X	X	Standing water in trench adjacent to creek. No staining evident.
SG-37	Stevens Gulch	Exploratory drill pad	--		150	X	X		Debris entering creek from pad located 150 feet upslope.
SG-38	Stevens Gulch	Rock pile	97		--	X	X	X	White staining of material in creek bed. Possible old roadbed.
SG-39	Stevens Gulch	Rock pile	19		--	X	X	X	Two excavated rock piles along Paymaster road.
SG-40	Stevens Gulch	Tunnel	--		--	X	X	X	Revegetation in good condition.
SG-42	Stevens Gulch	Rock pile	33		--	X	X	X	Possible adit location with tailings in rock pile.
SG-45	Stevens Gulch	Exploratory drill pad	23		--	X	X	X	Open well casing (16 inches). Possible safety hazard. Drilling deposition downslope.
SG-46	Stevens Gulch	Exploratory drill pad	15		--	X	X	X	Assess road and exploratory pad over possible adit location. Drilling debris downslope with possible tailings.
SG-52	Stevens Gulch	Survey site	--		--	X	X	X	Capital claim marker
SG-54	Stevens Gulch	Exploratory drill pad	7		--	X	X	X	Possible tailings in excavated rock.
SG-57	Stevens Gulch	Exploratory drill pad	--		--	X	X	X	No tailings evident.

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SG-59	Stevens Gulch	Exploratory drill pad	--		--	X	X	X	No tailings evident.
SG-60	Stevens Gulch	Trench	5		--	X	X	X	Old hand dug trench. No tailings evident.
SG-61	Stevens Gulch	Trench	5		--	X	X	X	Old hand dug trench. No tailings evident.
SG-62	Stevens Gulch	Exploratory drill pad	--		--	X	X	X	Drilling debris downslope. Possible tailings in waste rock.
SG-63	Stevens Gulch	Mine workings	--		--	X	X	X	Large amount of disturbance with numerous trenches and rock piles. Possible tailings in waste rock piles.
SG-64	Stevens Gulch	Trench	--		--	X	X	X	Associated with disturbance at location SG-68. No tailings evident.
SG-65	Stevens Gulch	Exploratory pit	--		--	X	X	X	No tailings evident.
SG-66	Stevens Gulch	Exploratory pit	--		--	X	X	X	No tailings evident.
SG-68	Stevens Gulch	Exploratory drill pad	44		--	X	X	X	Drill debris downslope. No tailings evident.
SG-69	Stevens Gulch	Exploratory dig out	13		--	X	X	X	Point-of-discovery and associated dig out.
SG-70	Stevens Gulch	Cabins	--		--	X	X	X	Four old cabins in various states of decay.
SG-72	Stevens Gulch	Survey site	--		--	X	X	X	Denver claim corner marker.
SG-73	Stevens Gulch	Exploratory drill pad	11		--	X	X	X	No tailings evident.
SG-74	Stevens Gulch	Exploratory drill pad	--		--	X	X	X	No tailings evident.
SG-75	Stevens Gulch	Exploratory dig out	--		--	X	X	X	No tailings evident.
SG-76	Stevens Gulch	Ground disturbance	--		--	X	X	X	Possible shop or staging area with a dump and timbers from a structure. Possible tailings along roadcut.
SG-77	Stevens Gulch	Rock pile	7		--	X	X	X	Possible tailings deposit 10 feet from creek.
SG-79	Stevens Gulch	Culvert in stream	--		--	X	X	X	Old culvert from road crossing, no longer functional.
SG-80	Stevens Gulch	Exploratory drill pad	--		--	X	X	X	Possible old mine works with timbers and other older debris
SG-81	Stevens Gulch	Trench	4		--	X	X	X	No tailings evident.
SG-83	Stevens Gulch	Survey site	--		--	X	X	X	"G2" claim marker.
SG-84	Stevens Gulch	Rock pile	--		--	X	X	X	Bog area with noticeable increase in iron staining in stream below bog. Possible tailings deposited throughout.

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SG-85	Stevens Gulch	Exploratory drill pad	--		--	X	X	X	No tailings evident.
SG-87	Stevens Gulch	Exploratory drill pad	--		--	X	X	X	Drilling debris downslope with possible tailings.
SG-88	Steven's Gulch	Trench	--		--	X	X	X	Visible on aerial photo.
SG-90	Steven's Gulch	Claim corner	--		--	X	X	X	Claim corner J-2 x 0-2 10945
SG-91	Steven's Gulch	Adit	--		--	X	X	X	Reclaimed adit
SG-92	Steven's Gulch	Claim corner	--		--	X	X	X	Claim corner RO-4 x 10942
SG-97	Steven's Gulch	Monitoring well	--		--	X	X	X	4 inch diameter steel casing with 16 inch stick-up and no cap. In middle of road.
SWG-01	Swamp Gulch	Exploratory pit	3		--	X	X	X	Small dig out. No tailings evident.
SWG-03	Swamp Gulch	Exploratory pit	11		--	X	X	X	Small dig out. No tailings evident.
SWG-04	Swamp Gulch	Exploratory pit	11		--	X	X	X	Small dig out. No tailings evident.
SWG-05	Swamp Gulch	Exploratory pit	--		--	X	X	X	Possible tailings in waste rock piles.
SWG-06	Swamp Gulch	Trench	11		--	X	X	X	Possible tailings in waste rock piles. Cement footing, stove pipe and other debris.
SWG-07	Swamp Gulch	Road	--		--	X	X	X	Possible tailings in roadbed.
SWG-08	Swamp Gulch	Road	--		--	X	X	X	Possible tailings in roadbed.
SWG-09	Swamp Gulch	Mine workings	50		--	X	X	X	Mine workings and large footings on a constructed bench. Some excavated rock but no tailings evident.
SWG-10	Swamp Gulch	Ground disturbance	--		--	X	X	X	No tailings evident.
SWG-11	Swamp Gulch	Tunnel	--		--	X	X	X	Revegetation in good condition.
SWG-12	Swamp Gulch	Adit	--		--	X	X	X	No tailings evident.

TABLE 14
Mine inventory features targeted for potential remedial actions or further study.

Site/Map ID Number	Drainage	Site Type	Adit Entrance Observed in Field	Estimated Volume of Excavated Material (cy)	Surface Water/ Seep Observed in Field	Distance to Nearest Observed Surface Water Feature (feet)	Sample Collected[1]			Comments/Notes	Hazard
							Surface Water	Stream Sediment	Mine Waste or Associated Material		
AC-1	Anaconda Creek	Adit		--		0	ACSW-101	**ACSE-101 (0-2)**		Caved or reclaimed adit on road cut-slope. Mine waste (if present) is incorporated into road fill slope, the toe of slope contacts Anaconda Ck.	Arsenic and copper exceed screening levels in stream sediment.
BC-01	Beartrap Creek	Adit and rock pile		1,100	X	50			**FLWA-101 (0-6)**	Collapsed adit leaks about 1 GPM (visual estimate) and has iron oxide staining.	Arsenic and lead exceed screening levels in excavated rock and may contribute to impacts on vegetation.
BR-01	Blackfoot River	Adit		700	X	200				Intermittent spring (150 square feet) at toe of slope where adit was likely located. Large floodplain bench which is possible tailings. Older trees in mined rock piles are dead while younger shrubs have established.	Potential intermittent adit seep may have poor quality water. Floodplain bench may consist of tailings or mined rock. Mined rock may impact vegetation.
BR-14	Blackfoot River	Adit and rock pile		2,000	X	--				Collapsed adit with leaking water that is pooled near entrance supporting vegetation. Collapsed tipple and woody debris is present. Mined rock difficult to distinguish from road fill slope and has been graded for structure footings.	Adit seepage may be of poor quality for wildlife use.
BR-16	Blackfoot River	Adit and rock pile		25		0			**SSWA-101 (0-6)**	Caved adit with collapsed and rotted wooden shoring. Small vegetated mined rock pile in direct communication with seasonal run-off channel (dry at time of visit).	Potential for impacts to surface water (arsenic, lead, and manganese) when seasonal run-off channel is flowing and in contact with mined rock.
BR-20	Blackfoot River	Adit and rock pile		2,100		400			**IHWA-101 (0-6)**	Large rock dump and caved adit with railroad tracks leading out of it. Woody debris scattered about and impacted vegetation below rock dump.	Arsenic, iron, and lead exceed screening levels in mined rock.
BR-29	Blackfoot River	Adit and rock pile		280		0				Collapsed adit and rock pile located in center of gully that may be a seasonal drainage (dry at time of visit).	Some potential for impact to surface water during flooding or high run-off events.
BR-32	Blackfoot River	Adit and rock pile		160		--				Collapsed portal. Impacted vegetation below rock dump.	Run-off from rock pile is impacting vegetation.
BR-36	Blackfoot River	Adit and rock pile		270	X	--				Caved or reclaimed adit portal. Mined rock pile has been graded in roadbeds in some areas. Water seeping from portal area and infiltrates into waste bench.	Adit seepage may be of poor quality and metals may be mobilized from regraded rock pile.
BR-37	Blackfoot River	Rock pile		225		--				No signs of adit portal – may be on road cut slope and filled with erosion.	Metals may be mobilized from rock pile.
BR-38	Blackfoot River	Adit and rock pile		555		--				Mined rock pile and caved or reclaimed adit	Arsenic, iron, and lead exceed screening levels in rock.
BR-39	Blackfoot River	Adit and rock pile		32		5	**BTSW-101**		**BTWA-101 (0-6)**	Caved adit and waste pile along edge of unnamed creek. No impacts to vegetation were observed and bushes grew from rock pile.	Lead exceeds standards in surface water while arsenic, iron, lead, and manganese exceed screening levels in rock pile.
CG-02	Chambers Gulch	Adit and rock pile		19,000	X	15	CGSW-101 **CGSW-102** CGSW-103		**CGWA-101 (0-6)**	Adit portal is not open but leaks water (1 GPM visual estimate). Collapsed tipple and other structure(s) present.	Poor quality water from adit seep. High potential for impacts to surface water (arsenic, cadmium, iron, lead, and manganese) from mined rock during run-off events.
CG-03	Chambers Gulch	Adit and rock pile		1,554	X	--				Seeping water is impounded in 8-foot diameter pool/marsh that is heavily vegetated with sedges etc. Difficult to identify edge of mined rock. Some regrading may have occurred.	Possible metal mobility or phytotoxicity from rock pile.
PC-01	Pass Creek	Adit with rock pile		133	X	20	**PCSW-102** PCSW-103 PCSW-104	**PCSE-103 (0-2)** **PCSE-104 (0-2)**	**PCWA-102 (0-6)**	Collapsed adit with timber and associated rock pile. A shallow, square, timber-framed "shaft" is nearby with dimensions 5x5x2 feet (possible drinking water well). Is filled with water.	Poor water quality (iron, lead, and manganese) in small "shaft" located near access road.
PC-06	Pass Creek	Collapsed adit and rock pile		1,700		--				Collapsed adit portal with large non-vegetated mined rock dump and scattered timbers and metal debris.	Mined rock appears phytotoxic and my present metal mobility hazard.
PC-11	Pass Creek	Adit		--		20	**PCSW-101**		**PCWA-101 (0-6)**	Possible caved adit at base of large disturbance. No visible adit flow but runoff channel passes near area. No rock pile is present – possibly reclaimed and regraded previously.	Lead exceeds standards or screening levels in surface water and rock samples.
PC-21	Pass Creek	Adit	X	--		--				Open adit (3x3 foot) in sandstone face near highway. Evidence of animal use.	Open Adit. Human entry is clearly possible.

TABLE 14
Mine inventory features targeted for potential remedial actions or further study.

Site/Map ID Number	Drainage	Site Type	Adit Entrance Observed in Field	Estimated Volume of Excavated Material (cy)	Surface Water/ Seep Observed in Field	Distance to Nearest Observed Surface Water Feature (feet)	Sample Collected[1]			Comments/Notes	Hazard
							Surface Water	Stream Sediment	Mine Waste or Associated Material		
JM-01	Paymaster Gulch	Adit		542		--				Adit trench and waste pile onsite.	Possible metal mobility or phytotoxicity from rock pile.
PM-04	Paymaster Gulch	Exploratory pit		106		--				Exploratory pit.	Possible metal mobility or phytotoxicity from rock pile.
PM-06	Paymaster Gulch	Trench		423		--				Two trenches located digout. Possible tailings.	Possible metal mobility or phytotoxicity from rock pile.
PM-12	Paymaster Gulch	Adit	X	1,288		5				Collapsed adit entrance and large rock pile within 5 feet of the creek.	Possible metal mobility and sedimentation from mined rock.
PM-26	Paymaster Gulch	Mined rock		2,689		--				Large tailings pile with access road at its toe which bisects the intermittent Paymaster creek channel.	Possible metal mobility or phytotxicity from tailings material or mined rock.
PM-28	Paymaster Gulch	Adit		167		--				Trench remaining from an old adit. Three lupine plants observed growing along the edge of the rock pile.	Possible metal mobility or phytotoxicity from rock pile.
PM-35	Paymaster Gulch	Adit and rock pile		--		--	**PMSW-102** **PMSW-103**	**PMSE-102 (0-2)** **PMSE-103 (0-2)**	**PMWA-101** **PMWA-102**	Inventoried in 2007	Some potential for impact to surface water (arsenic, iron, and lead) from rock pile during flooding or high run-off events. Mercury in stream sediments exceeds screening levels.
PM-37	Paymaster Gulch	Adit and rock pile		445		200	**PMSW-101**			Adit is caved and on opposite side of road from mined rock pile. Seep present on top of rock pile.	Some potential for impact to surface water during flooding or high run-off events. Rock pile is in very wet floodplain despite distance from flowing creek channel. Nearby surface water sample exceeded standards for aluminum, cadmium, copper, iron, lead, manganese, and zinc.
SH-06	Shave Gulch	Open adit portal	X	780		--				Open adit portal and associated mined rock pile. Rock is vegetated with evergreens with trunks measuring 1 to 3 inches in diameter.	Open Adit.
SH-07	Shave Gulch	Adit		590		--				Collapsed adit immediately downhill from feature 513	Possible phytoxicity from excavated rock.
SH-13	Shave Gulch	Adit		5,600		--				Little to no vegetation on mined rock or near toe. Faint sulfur smell was detected.	Possible metal mobility and acid generation from mined rock. Rock is impacting vegetation.
SH-14	Shave Gulch	Adits and rock pile		8,000		--				Very large mined rock dump and possibly 3 collapsed adits. Two collapsed wooden structures. Sulfur smell and impacted vegetation extending 75 ft below rock pile. Erosion channel cut into ground below rock pile but area is far from surface water.	Possible metal mobility and acid generation from mined rock. Rock is impacting vegetation.
SH-17	Shave Gulch	Adit and rock pile		9,200		75	**SHSW-101** SHSW-102	**SHSE-101 (0-2)** **SHSE-102 (0-2)**		Collapsed adit with mined rock pile.	Lead exceeds standards in surface water. Arsenic, cadmium, copper, lead, and mercury exceed screening levels in stream sediment.
SH-23	Shave Gulch	Adit and rock pile		330		--				Collapsed adit portal and sparsely vegetated rock pile.	Possible metal mobility or phytotoxicity from rock pile.
SH-29	Shave Gulch	Adit and pile		125		--				Collapsed Upper Consolation adit. With up to 7 small prospect pits nearby.	Possible metal mobility or phytotoxicity from rock pile.
SH-37	Shave Gulch	Adit and rock pile		55		0				Rock pile located at head of seasonal drainage/run-off channel. Channel was dry at time of visit.	Potential for impacts to surface water when seasonal run-off channel is flowing.
SH-43	Shave Gulch	Adit and rock pile		1,800	X	0	**SHSW-103** **SHSW-104**	**SHSE-103 (0-2)**	**SHWA-102 (0-6)**	Collapsed and leaking adit (2 to 5 GPM estimate) with additional flow contributed by seeps between adit and mined rock pile. Stream flows along top of dump.	Adit seepage in proximity to access road exceeds human health standards (arsenic, cadmium, iron, lead, manganese). Metals are mobilized from rock pile and arsenic, iron, and lead exceed screening levels.
SH-44	Shave Gulch	Adits(?)		110		--				Series of caved adits and/or prospect pits and trenches.	Possible metal mobility or phytotoxicity from rock pile.
SG-01	Stevens Gulch	Exploratory drill pad		29		--				Open well casing (8 inches).	Possible safety hazard.
SG-13	Stevens Gulch	rock		5,440		--				Large waste rock pile up to 20 feet deep.	Possible metal mobility or phytotoxicity from rock pile.

TABLE 14
Mine inventory features targeted for potential remedial actions or further study.

Site/Map ID Number	Drainage	Site Type	Adit Entrance Observed in Field	Estimated Volume of Excavated Material (cy)	Surface Water/ Seep Observed in Field	Distance to Nearest Observed Surface Water Feature (feet)	Sample Collected[1]			Comments/Notes	Hazard
							Surface Water	Stream Sediment	Mine Waste or Associated Material		
SG-14	Stevens Gulch	Trench		111		--				Trench with associated rock pile.	Possible metal mobility or phytotoxicity from rock pile.
SG-16	Stevens Gulch	Exploratory pit		333		--				Trench above possible adit location with large rock piles associated with both sites.	Possible metal mobility or phytotoxicity from rock pile.
SG-24	Stevens Gulch	Trench		293		--				Two trenches that intersect at rock pile. No tailings evident.	Possible metal mobility or phytotoxicity from rock pile.
SG-31	Stevens Gulch	Water quality		--		--				Deposit of iron rich soil impacting water quality. Likely native material.	Iron rich soil in contact with surface water.
SG-33	Stevens Gulch	Rock pile		104		--				Possible tailings in excavated rock.	Possible metal mobility from waste rock potentially interspersed with tailings.
SG-35	Stevens Gulch	Trench		119		--				Standing water in trench adjacent to creek. No staining evident.	Possible metal mobility or phytotoxicity from rock pile.
SG-41	Stevens Gulch	Trench		2,444		--				Exploratory trench with possible tailings.	Possible metal mobility or phytotoxicity from excavated rock and/or tailings.
SG-43	Stevens Gulch	Exploratory pit		778		--				Exploratory pit with possible tailings. Photo 78 of ridge to the NE, no mining activity evident. Numerous roadcuts.	Possible metal mobility or phytotoxicity from rock pile.
SG-44	Stevens Gulch	Adit		20,000		--				Mined rock pile in contact with intermittent portion of Stevens Creek.	Possible metal mobility or phytotoxicity from rock pile.
SG-47	Stevens Gulch	Adit	X	278		0				Potential adit location. Tailings material in creek.	Open Adit. Potential metal loading to creek.
SG-48	Stevens Gulch	Adit	X	28		0				Adit in rock face adjacent to creek. Tailings material in creek.	Open Adit. Potential metal loading to creek.
SG-49	Stevens Gulch	rock		999		--				Mined rock associated with adit SG-51. Located adjacent to ephemeral creek.	Possible metal mobility or phytotoxicity from rock pile.
SG-50	Stevens Gulch	Adit	X	28		--				Adit entrance under rock overhang.	Open Adit.
SG-51	Stevens Gulch	Exploratory drill pad		370		0				Large cutslope with rock pushed into creek.	Possible metal mobility or sediment loading from fill material.
SG-53	Stevens Gulch	rock		2,843		--				Three rock piles and a large dig out area.	Possible metal mobility or phytotoxicity from rock pile.
SG-55	Stevens Gulch	Exploratory drill pad		200	X	650	**SG-55SW**			Pipe (4 inch) protruding from toe of cutslope leaking small amounts of water.	Water from artesian well exceeds human health standards for arsenic, iron, lead, and manganese.
SG-56	Stevens Gulch	rock		370		--				Possible tailings in excavated rock.	Possible metal mobility or phytotoxicity from rock pile.
SG-58	Stevens Gulch	Exploratory drill pad		1,481		--				Possible tailings in excavated rock.	Possible metal mobility or phytotoxicity from rock pile.
SG-67	Stevens Gulch	Exploratory drill pad		19,444		--				Large amount of excavated rock associated with two cut slopes. Possible tailings in rock piles.	Possible metal mobility or phytotoxicity from rock pile.
SG-71	Stevens Gulch	Adit		463	X	70				Spring at possible adit location 70 feet from creek. Water has pooled and is 6 inches deep. Vegetation is in good condition adjacent to pond.	Adit seepage of unknown quality.
SG-78	Stevens Gulch	Exploratory drill pad/ adit		741		--				Possible adit location with tailings in rock pile.	Possible metal mobility or phytotoxicity from rock pile.
SG-82	Stevens Gulch	Water quality		156		--				Soil contributing to iron staining in creek, likely native material.	Iron and sediment loading from excavated material.
SG-86	Stevens Gulch	Rock pile		2,105		--				Two rock piles with possible tailings.	Possible metal mobility or phytotoxicity from rock pile.
SG-89	Steven's Gulch	Tailings edge		--		0				Apparent west edge of tailings along Steven's Creek. Other edges bound by roads.	Possible metal and sediment loading from tailings.

TABLE 14
Mine inventory features targeted for potential remedial actions or further study.

Site/Map ID Number	Drainage	Site Type	Adit Entrance Observed in Field	Estimated Volume of Excavated Material (cy)	Surface Water/ Seep Observed in Field	Distance to Nearest Observed Surface Water Feature (feet)	Sample Collected[1]			Comments/Notes	Hazard
							Surface Water	Stream Sediment	Mine Waste or Associated Material		
SG-93	Steven's Gulch	Adit and pile		Not measured	X	50	**SGSW-101** SGSW-102	**SGSE-102 (0-6)**	**SGWA-101**	Inventoried in 2007	Copper exceeds standards in surface water. Arsenic, cadmium, copper, lead, and mercury exceed screening levels in stream sediment. Iron exeeds screening levels in rock.
SG-94	Stevens Gulch	Spring		--	X	--	**SGSW-103 SGSW-104**	**SGSE-103 (0-2) SGSE-104 (0-2)**	**SGWA-102**	Iron precipitate cone-forming spring. Actually located about 250' downstream of SG-94 location.	Water from spring exceeds human health standards for arsenic, iron, and manganese. Excavated rock and stream sediment exceed screening levels for one or more of the following metals; arsenic, cadmium, copper, lead, and zinc.
SG-95	Steven's Gulch	Drill cuttings		--		0				Fine grained yellow material in contact with stream	Metal mobility or sediment loading from drill cuttings material.
SG-96	Steven's Gulch	Possible staging area		--		5	**SGSW-107**	**SGSE-107 (0-2)**	**SGWA-103**	Flat area with wood and metal debris. Yellow orange fine grained material in area typically 1 to 4 inches thick (likely to be tailings).	Dispersed tailings impacting surface water (copper, manganese, and zinc). Arsenic, cadmium, copper, lead, and zinc exceed screening levels in stream sediments and arsenic exceeds screening levels in material believed to be tailings.
SG-98	Steven's Gulch	Adit and rock pile		--		--			**SGWA-104**	Inventoried in 2007. Adit had flow at some point as evidenced by strong iron oxide staining but is now dry.	Screening levels exceeded for arsenic, lead, and manganese in rock sample.
SG-99	Steven's Gulch	Adit		--		100	**SGSW-105 SGSW-106**	**SGSE-105 (0-2) SGSE-106 (0-2)**		Collapsed adit. Excavated rock , if present, has been worked by stream and is indistinguishable from other materials.	Surface water exceeds standards for lead, manganese, and zinc. Sediments exceed screening levels for arsenic, cadmium, copper, lead, manganese, and zinc.
SG-100	Steven's Gulch	Tailings deposit		--		0			**SGWA-104 (0-6)**	Tailings deposit in open marshy area upgradient from feature 633 and 200 feet below SGSW-106. Possible breached tailings dam.	Dispersed tailings in contact with surface water exceed screening levels for copper, iron, and manganese.
SWG-02	Swamp Gulch	Trench		244		--				Possible tailings in rock piles.	Excavated rock may present metal mobility or other phytotoxicity hazard.
PBBS	Porcupine Gulch	Adit		--		--	**PBBS-201**	**PBBS-201, PBBS-202, PBBS-203**	**PBBS-200**	Possible mine waste dump.	Adit water, streambed sediment, and mine waste exceed one or more screening level or standard.

[1] Sample identification listed for areas where sample was collected. Blank cell indicates that no sample was collected.
[2] Mine features are considered to present No Significant Disturbance if they do not constitute a safety hazard or threat to human health or the environment.
Bold text indicates that sample exceeded applicable standard or screening level.
-- Indicates that waste rock was not present or that surface water was not visible from the site.

TABLE 15
BACKGROUND THRESHOLD VALUE SUMMARY FOR BACKGROUND SOIL (0 TO 2 FEET BGS)

Upper Blackfoot Mining Company
Lewis and Clark County, Montana

	Summary Statistics for Background Data										
			Range of Data							Background Threshold Value	
			Censored (Nondetect)		Detected						
Metal	Distribution (a)	Detection Frequency	Min	Max	Min	Max	95UPL (b)	95UTL (c)	95th Percentile	Value	Statistic (d)
Aluminum	Lognormal	30 / 30	N/A	N/A	8,730	43,000	31,092	31,565	30,326	31,092	UPL (95)
Arsenic	Gamma	30 / 30	N/A	N/A	2	44.9	40.4	41.3	38.8	40.4	UPL (95)
Cadmium	Normal	30 / 30	N/A	N/A	0.284	4.8	4.98	50.47	4.87	4.8	Max
Copper	Gamma	30 / 30	N/A	N/A	12.1	339	275	284	262	275	UPL (95)
Iron	Lognormal	30 / 30	N/A	N/A	14,900	64,200	58,270	59,526	56,251	58,270	UPL (95)
Lead	Nonparametric	30 / 30	N/A	N/A	31	1,230	1,109	1,010	763	1,109	UPL (95)
Manganese	Lognormal	30 / 30	N/A	N/A	66	7,740	4,893	5,162	4,477	4,893	UPL (95)
Mercury	N/A	0 / 30	0.5	0.5	N/A	N/A	N/A	N/A	N/A	0.5	Highest nondetected value
Zinc	Gamma	30 / 30	N/A	N/A	34	756	551	567	523	551	UPL (95)

Notes: All concentrations in milligram per kilogram.
Methods follow EPA (2010).

bgs Below ground surface
BTV Background threshold value
EPA U.S. Environmental Protection Agency
Max Maximum detected concentration
N/A Not applicable
RAGS Risk Assessment Guidance for Superfund
95UPL One-sided 95 percent upper prediction limit of the mean.
95UTL One-sided 95 percent upper tolerance limit for the 90th percentile.

a Tested for detected data only using the Shapiro-Wilk W test (normal and lognormal distributions) and the Anderson-Darling and Kolmogorov-Smirnov tests (gamma distributions).
A 5 percent level of significance was used in all tests. Distribution tests were conducted only for samples with at least 10 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in all statistical calculations.
b For Gamma distributed datasets, two 95UPLs are calculated by ProUCL version 4.1 using the approximate gamma method; one following the Wilson-Hilferty approximation and the other following the Hawkins-Wixley approximations. The 95UPL listed is the largest of the two 95UPLs unless one or both 95UPLs exceed the maximum detected value. In that case, the lower of the 95UPLs is listed.
c For Gamma distributed datasets, two 95UTLs are calculated by ProUCL version 4.1 using the approximate gamma method; one following the Wilson-Hilferty approximation and the other following the Hawkins-Wixley approximations. The 95UTL listed is the largest of the two 95UTLs unless one or both 95UTLs exceed the maximum detected value. In that case, the lower of the 95UTLs is listed.
d The BTV is the lesser of the UPL (95) and the maximum detected result. The maximum detected result is the default when there are fewer than six detected results; no 95 UPLs, 95UTLs, or 95th percentiles are calculated. The maximum nondetect value is the default when there are no detected results.

References:
EPA. 2010. "ProUCL Version 4.1.00 Technical Guide (Draft)." Prepared by Singh, A. and A.K. Singh. EPA/600/R-07/041. May
Available online at: http://www.epa.gov/osp/hstl/tsc/ProUCL_v4.1_user.pdf

TABLE 16
BACKGROUND THRESHOLD VALUE SUMMARY FOR BACKGROUND MARSH SEDIMENTS (0 TO 1 FOOT BGS)

Upper Blackfoot Mining Company
Lewis and Clark County, Montana

	Summary Statistics for Background Data										
			Range of Data							Background Threshold Value	
			Censored (Nondetect)		Detected						
Metal	Distribution (a)	Detection Frequency	Min	Max	Min	Max	95UPL (b)	95UTL (c)	95th Percentile	Value	Statistic (d)
Aluminum	N/A	3 / 3	N/A	N/A	7,500	8,030	N/A	N/A	N/A	8,030	Max
Arsenic	N/A	9 / 9	N/A	N/A	9.12	32.3	32.3	32.3	29.2	32.3	Max
Cadmium	N/A	9 / 9	N/A	N/A	0.471	1.84	1.84	1.84	1.73	1.84	Max
Copper	N/A	9 / 9	N/A	N/A	22	67.4	67.4	67.4	62.4	67.4	Max
Iron	N/A	3 / 3	N/A	N/A	12,100	14,500	N/A	N/A	N/A	14,500	Max
Lead	N/A	9 / 9	N/A	N/A	55	174	174	174	149.6	174	Max
Manganese	N/A	9 / 9	N/A	N/A	88	696	696	696	652	696	Max
Mercury	N/A	0 / 9	0.5	0.5	N/A	N/A	N/A	N/A	N/A	0.5	Highest nondetected value
Zinc	N/A	9 / 9	N/A	N/A	97.8	275	275	275	270.2	275	Max

Notes: All concentrations in milligram per kilogram.
Methods follow EPA (2010).

bgs Below ground surface
BTV Background threshold value
EPA U.S. Environmental Protection Agency
Max Maximum detected concentration
N/A Not applicable
RAGS Risk Assessment Guidance for Superfund
95UPL One-sided 95 percent upper prediction limit of the mean.
95UTL One-sided 95 percent upper tolerance limit for the 90th percentile.

a Tested for detected data only using the Shapiro-Wilk W test (normal and lognormal distributions) and the Anderson-Darling and Kolmogorov-Smirnov tests (gamma distributions).
A 5 percent level of significance was used in all tests. Distribution tests were conducted only for samples with at least 10 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in all statistical calculations.
b For Gamma distributed datasets, two 95UPLs are calculated by ProUCL version 4.1 using the approximate gamma method; one following the Wilson-Hilferty approximation and the other following the Hawkins-Wixley approximations. The 95UPL listed is the largest of the two 95UPLs unless one or both 95UPLs exceed the maximum detected value. In that case, the lower of the 95UPLs is listed.
c For Gamma distributed datasets, two 95UTLs are calculated by ProUCL version 4.1 using the approximate gamma method; one following the Wilson-Hilferty approximation and the other following the Hawkins-Wixley approximations. The 95UTL listed is the largest of the two 95UTLs unless one or both 95UTLs exceed the maximum detected value. In that case, the lower of the 95UTLs is listed.
d The BTV is the lesser of the UPL (95) and the maximum detected result. The maximum detected result is the default when there are fewer than six detected results; no 95 UPLs, 95UTLs, or 95th percentiles are calculated. The maximum nondetect value is the default when there are no detected results.

References:

EPA. 2010. "ProUCL Version 4.1.00 Technical Guide (Draft)." Prepared by Singh, A. and A.K. Singh. EPA/600/R-07/041. May
Available online at: http://www.epa.gov/osp/hstl/tsc/ProUCL_v4.1_user.pdf

TABLE 17

BACKGROUND THRESHOLD VALUE SUMMARY FOR BACKGROUND STREAMBED SEDIMENTS (0 TO 2 INCHES BGS)

Upper Blackfoot Mining Company
Lewis and Clark County, Montana

	Summary Statistics for Background Data										
			Range of Data							Background Threshold Value	
			Censored (Nondetect)		Detected						
Metal	Distribution (a)	Detection Frequency	Min	Max	Min	Max	95UPL (b)	95UTL (c)	95th Percentile	Value	Statistic (d)
Aluminum	N/A	1 / 1	N/A	N/A	8,980	8,980	N/A	N/A	N/A	8,980	Max
Arsenic	N/A	3 / 3	N/A	N/A	5.56	15.4	N/A	N/A	N/A	15.4	Max
Cadmium	N/A	0 / 3	0.5	0.5	N/A	N/A	N/A	N/A	N/A	N/A	Highest nondetected value
Copper	N/A	3 / 3	N/A	N/A	59.4	114	N/A	N/A	N/A	114	Max
Iron	N/A	1 / 1	N/A	N/A	23,900	23,900	N/A	N/A	N/A	23,900	Max
Lead	N/A	3 / 3	N/A	N/A	21.9	81.5	N/A	N/A	N/A	81.5	Max
Manganese	N/A	3 / 3	N/A	N/A	271	578	N/A	N/A	N/A	578	Max
Mercury	N/A	0 / 3	0.5	0.5	N/A	N/A	N/A	N/A	N/A	0.5	Highest nondetected value
Zinc	N/A	3 / 3	N/A	N/A	65.7	136	N/A	N/A	N/A	136	Max

Notes: All concentrations in milligram per kilogram.
Methods follow EPA (2010).

bgs Below ground surface
BTV Background threshold value
EPA U.S. Environmental Protection Agency
Max Maximum detected concentration
N/A Not applicable
RAGS Risk Assessment Guidance for Superfund
95UPL One-sided 95 percent upper prediction limit of the mean.
95UTL One-sided 95 percent upper tolerance limit for the 90th percentile.

a Tested for detected data only using the Shapiro-Wilk W test (normal and lognormal distributions) and the Anderson-Darling and Kolmogorov-Smirnov tests (gamma distributions).
A 5 percent level of significance was used in all tests. Distribution tests were conducted only for samples with at least 10 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in all statistical calculations.

b For Gamma distributed datasets, two 95UPLs are calculated by ProUCL version 4.1 using the approximate gamma method; one following the Wilson-Hilferty approximation and the other following the Hawkins-Wixley approximations. The 95UPL listed is the largest of the two 95UPLs unless one or both 95UPLs exceed the maximum detected value. In that case, the lower of the 95UPLs is listed.

c For Gamma distributed datasets, two 95UTLs are calculated by ProUCL version 4.1 using the approximate gamma method; one following the Wilson-Hilferty approximation and the other following the Hawkins-Wixley approximations. The 95UTL listed is the largest of the two 95UTLs unless one or both 95UTLs exceed the maximum detected value. In that case, the lower of the 95UTLs is listed.

d The BTV is the lesser of the UPL (95) and the maximum detected result. The maximum detected result is the default when there are fewer than six detected results; no 95 UPLs, 95UTLs, or 95th percentiles are calculated. The maximum nondetect value is the default when there are no detected results.

References:

EPA. 2010. "ProUCL Version 4.1.00 Technical Guide (Draft)." Prepared by Singh, A. and A.K. Singh. EPA/600/R-07/041. May
Available online at: http://www.epa.gov/osp/hstl/tsc/ProUCL_v4.1_user.pdf

Table 18a

Background Soil Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)		Total Arsenic (mg/kg)		Total Cadmium (mg/kg)		Total Copper (mg/kg)		Total Iron (mg/kg)		Total Lead (mg/kg)		Total Manganese (mg/kg)		Total Mercury (mg/kg)		Total Zinc (mg/kg)	
		Lab	XRF	Lab	XRF	Lab	XRF	Lab	XRF	Lab	XRF	Lab	XRF	Lab	XRF	Lab	XRF	Lab	XRF
DEQ Action Level/RSLs/UBMC BTVs		77,000 [a]		40 [b]		70 [a]		3,100 [a]		58,270 [c]		1,109 [c]		4,893 [c]		23 [a]		23,000 [a]	
EU1 Upper Anaconda Mine Waste Removal Areas and Waste Piles																			
ACBG-1 (0-6")	10/16/2007	16000		26.6	26.03	0.486	< 22.53	144 JM42	79.58	40700	26974.24	51	23.09	498 J	294.72	< 0.5	< 5.81	204 J	136.91
ACBG-2 (0-6")	10/16/2007	16600		17.4	18.33	0.52	< 25.14	242 JM42	250.03	36800	37089.75	46	38.26	1050 J	997.31	< 0.5	< 7.15	108 J	83.93
EU2 Blackfoot River Dispersed Tailings Associated with EE/CA Removal Action Area and Overbank Deposits																			
UBRBG-201 (0-6")	10/31/2011	23400 JF59		20 JF60		2.1 JF153		157 JF55		42100 JF59		70		216 JF71		< 0.5 JF59		46 JF59	
UBRBG-202 (0-6")	10/31/2011	18300 JF59		14 JF60		2.9 JF153		198 JF55		48200 JF59		45		846 JF71		< 0.5 JF59		160 JF59	
UBRBG-203 (0-6")	11/1/2011	18300 JF59		18 JF60		4.1 JF153		36.3 JF55		18400 JF59		222		1540 JF71		< 0.5 JF59		228 JF59	
UBRBG-204 (0-6")	10/31/2011	25100 JF59		16 JF60		2.7 JF153		160 JF55		41200 JF59		462		1030 JF71		< 0.5 JF59		308 JF59	
EU3 Stevens Gulch																			
SGBG-1 (0-6")	10/15/2007	18700		44.9	34.57	0.284	< 21.28	97 JM42	92.51	24500	19478.69	115	115.16	181 J	141.05	< 0.5	< 5.4	45.7 J	40.94
SGBG-201 (0-6")	10/31/2011	22500 JF59		19 JF60		2.2 JF153		52.2 JF55		20300 JF59		56		126 JF71		< 0.5 JF59		37 JF59	
EU4 Pass Creek																			
PSCBG-201 (0-6")	11/1/2011	21600 JF59		18 JF60		2.2 JF153		151		25900 JF59		126		135 JF71		< 0.5 JF59		66 JF59	
PSCBG-202 (0-6")	11/1/2011	16000 JF59		39 JF60		3.2 JF153		97 JF55		27700 JF59		1010		646 JF71		< 0.5 JF59		293 JF59	
PSCBG-203 (0-6")	11/1/2011	43000 JF59		39 JF60		3 JF153		208 JF55		51800 JF59		1230		963 JF71		< 0.5 JF59		279 JF59	
EU5 Shave Creek																			
SHGBG-1 (0-6")	10/16/2007	15400		29.7	27.38	3.32	< 22.55	50.8 JM42	39.55	22800	19598.2	342	321.54	3050 J	1470.06	< 0.5	< 6.04	266 J	290.52
SHGBG-2 (0-6")	10/16/2007	12700		24.6	16.06	2.46	< 16.68	53	58.61	14900	9533.49	43	32.69	2580	1008.4	< 0.5	< 4.42	150	99.21
SHGBG-201 (0-6")	11/1/2011	17400 JF59		16 JF60		2.5 JF153		108 JF55		32200 JF59		75		639 JF71		< 0.5 JF59		120 JF59	
SHGBG-202 (0-6")	11/1/2011	19100 JF59		14 JF60		2.4 JF153		82.3 JF55		35100 JF59		63		802 JF71		< 0.5 JF59		88 JF59	
SHGBG-203 (0-6")	11/1/2011	22300 JF59		16 JF60		4.8 JF153		24.6 JF55		18200 JF59		162		1290 JF71		< 0.5 JF59		456 JF59	
EU8 Mike Horse Mine Waste Piles																			
MHBG-201 (0-6")	10/31/2011	13800 JF59		9 JF60		4.5 JF153		35.8 JF55		17200 JF59		68		1100 JF71		< 0.5 JF59		144 JF59	
MHBG-202 (0-6")	10/31/2011	19800 JF59		11 JF60		4.6 JF153		17.6 JF55		17300 JF59		188		504 JF71		< 0.5 JF59		333 JF59	
EU9 Paymaster Creek																			
MGBG-1 (0-6")	10/15/2007	16600		23.2	33.08	4.44	< 20.65	87.8 JM42	82.15	23700	21739.53	96.8	311.02	7740 J	6433.67	< 0.5	< 5.19	756 J	650.47
MGBG-2 (0-6")	10/15/2007	19400		13.3	< 25.72	3.59	< 25.95	299 JM42	228.19	63900	53756.88	304	235.04	1810 J	1244.5	< 0.5	< 8.45	559 J	507.72
PCBG-1 (0-6")	10/15/2007	21200		7.68	< 10	0.543	< 21.26	12.1 JM42	< 26.19	16800	13890.53	34.4	29.08	1140 J	360.4	< 0.5	< 6.77	201 J	192.35
PCBG-201 (0-6")	10/31/2011	22600 JF59		11 JF60		2.2 JF153		339 JF55		64200 JF59		294		229 JF71		< 0.5 JF59		107 JF59	
PCBG-202 (0-6")	10/31/2011	20300 JF59		22 JF60		2.2 JF153		82.5 JF55		51800 JF59		60		233 JF71		< 0.5 JF59		55 JF59	
PCBG-203 (0-6")	10/31/2011	10300 JF59		24 JF60		3.7 JF153		33 JF55		31200 JF59		136		66 JF71		< 0.5 JF59		34 JF59	
EU11 Beartrap Creek Dispersed Tailings Deposits Associated with EE/CA Removal Action Area and Overbank Tailings Deposits and Flossie Louise Mine Waste Piles																			
BCBG-1 (0-6")	10/15/2007	24500		23.5	< 15.33	1.57	< 23.46	43.8 JM42	32.77	21400	19986.95	76.6	83.98	2500 J	864.53	< 0.5	< 7.26	282 J	297.33
BCBG-201 (0-6")	11/1/2011	16600 JF59		18 JF60		2.6		57.1		23300 JF59		92		1290 JF71		< 0.5 JF59		238 JF59	
BCBG-202 (0-6")	10/31/2011	28400 JF59		19 JF60		3.9		36.2		18500 JF59		74		2570 JF71		< 0.5 JF59		283 JF59	
BCBG-203 (0-6")	10/31/2011	8730 JF59		2 JF60		4.7		31.3		17500 JF59		31		549 JF71		< 0.5 JF59		70 JF59	
EU12 Swamp Gulch																			
SWGBG-1 (0-6")	10/15/2007	16100		16.1	< 13.32	0.83	< 21.77	43.3 JM42	< 29.52	27500	18605.18	65.8	60.82	972 J	568.95	< 0.5	< 6.18	92.2 J	113.7
SWGBG-2 (0-6")	10/15/2007	13500		10.6	< 17.49	1.79	< 22.97	48.4 JM42	48.02	20400	14867.15	145	125.09	1340 J	755.67	< 0.5	< 7.6	231 J	242.31

Notes:

mg/Kg - Milligrams per kilogram
-- - No standard/not analyzed
Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
M% - Matrix spike recoveries exceed acceptable limits. Number represents recovery value.
J - The associated value is an estimated quantity.
- Value meets or exceeds one or more soil screening level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

AC - Anaconda
BC - Beartrap Creek
MG - Meadow Creek
MH - Mike Horse Creek
PC - Paymaster Creek
PSC - Pass Creek Marsh
SG - Stevens Gulch
SH - Shave Creek
SW - Swamp Gulch
UBR - Upper Blackfoot River
BG - Background Sample

2011 data collected by Pioneer Technical Services, Inc.

Table 18b
Background Soil ABA and SPLP Analytical Results

Sample ID	Date Collected	Specific Conductance (µmhos/cm)	pH (s.u.)	TOC (%)	Acid - Base Accounting								Synthetic Precipitation Leaching Procedure								
					Sulfur, Hot Water Extractable (%)	Total Sulfur (%)	Sulfur Sulfate (%)	Sulfur Pyritic (%)	Sulfur Organic (%)	Neutral Potential (t/kt)	Acid Potential (t/kt)	Acid/Base Potential (t/kt)	Aluminum (mg/L)	Arsenic (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Iron* (mg/L)	Lead (mg/L)	Manganese* (mg/L)	Mercury (mg/L)	Zinc (mg/L)
Soil SPLP		--	--	--	--	--	--	--	--	--	--	--	--	**0.1**	**0.05**	**13**	**110**	**0.15**	**3.2**	**0.02**	**20**
EU1 Upper Anaconda Mine Waste Removal Areas and Waste Piles																					
ACBG-1 (0-6")	10/16/2007	190.00	4.7	1.77																	
ACBG-2 (0-6")	10/16/2007	270.00	6.6	1.71	0.01	0.02	< 0.01	0.01	< 0.01	33	0.36	32	15	< 0.1	< 0.01	0.1	16	< 0.1	0.5	< 0.0001	< 0.5
EU2 Blackfoot River Dispersed Tailings Associated with EE/CA Removal Action Area and Overbank Deposits																					
UBRBG-201 (0-6")	10/31/2011	80.00	5.6	1.88																	
UBRBG-202 (0-6")	10/31/2011	140.00	5.4	2.17																	
UBRBG-203 (0-6")	11/1/2011	310.00	6.1	4.65	< 0.01	< 0.01		< 0.01		J 14	< 0.3	J 14	27	0.022	JM179 0.00072	0.023	14	0.16	1.4	0.000025	0.25
UBRBG-204 (0-6")	10/31/2011	90.00	5.4	1.51	< 0.01	< 0.01		< 0.01		J 3	< 0.3	J 3	29	0.016	JM179 0.0003	0.07	21	0.16	0.48	0.00002	0.28
EU3 Stevens Gulch																					
SGBG-1 (0-6")	10/15/2007	220.00	4.7	6.20																	
SGBG-201 (0-6")	10/31/2011	80.00	5.2	2.55																	
EU4 Pass Creek																					
PSCBG-201 (0-6")	11/1/2011	70.00	5.3	1.38																	
PSCBG-202 (0-6")	11/1/2011	130.00	5.5	1.40	< 0.01	0.02		< 0.01		J 5	UJ 0.7	J 4	28	0.033	JM179 0.00068	0.054	23	0.28	0.73	0.000018	0.3
PSCBG-203 (0-6")	11/1/2011	100.00	5.2	1.62																	
EU5 Shave Creek																					
SHGBG-1 (0-6")	10/16/2007	780.00	5.2	5.27	0.03	0.03	< 0.01	0.02	< 0.01	31	0.54	31	9	< 0.1	< 0.01	< 0.1	7	< 0.1	0.4	< 0.0001	< 0.5
SHGBG-2 (0-6")	10/16/2007	110.00	4.8	14.90																	
SHGBG-201 (0-6")	11/1/2011	130.00	5.2	1.56																	
SHGBG-202 (0-6")	11/1/2011	260.00	5.2	1.99																	
SHGBG-203 (0-6")	11/1/2011	200.00	5.3	3.20																	
EU8 Mike Horse Mine Waste Piles																					
MHBG-201 (0-6")	10/31/2011	180.00	5.8	2.45																	
MHBG-202 (0-6")	10/31/2011	70.00	5.6	1.31																	
EU9 Paymaster Creek																					
MGBG-1 (0-6")	10/15/2007	370.00	5.8	8.00	0.09	0.11	0.02	0.08	0.01	25	2.4	23	16	< 0.1	< 0.01	< 0.1	11	< 0.1	0.7	< 0.0001	< 0.5
MGBG-2 (0-6")	10/15/2007	120.00	5.2	1.82																	
PCBG-1 (0-6")	10/15/2007	120.00	5.4	2.34																	
PCBG-201 (0-6")	10/31/2011	80.00	5.4	1.45	< 0.01	< 0.01		< 0.01		J 3	< 0.3	J 3	27	0.012	0.00013	0.22	19	0.13	0.18	0.000018	0.09
PCBG-202 (0-6")	10/31/2011	150.00	5.0	3.26	< 0.01	0.01		< 0.01		J 3	UJ 0.4	J 2	18	0.026	0.00015	0.047	19	0.034	0.17	0.000022	0.06
PCBG-203 (0-6")	10/31/2011	120.00	4.9	1.29																	
EU11 Beartrap Creek Dispersed Tailings Deposits Associated with EE/CA Removal Action Area and Overbank Tailings Deposits and Flossie Louise Mine Waste Piles																					
BCBG-1 (0-6")	10/15/2007	1430.00	4.5	1.96																	
BCBG-201 (0-6")	11/1/2011	300.00	5.6	3.12																	
BCBG-202 (0-6")	10/31/2011	270.00	5.1	3.76																	
BCBG-203 (0-6")	10/31/2011	80.00	4.6	2.90		0.04		< 0.01		< 0.01	UJ 1.3	J 1	14	0.004	0.0007	0.024	7.5	0.011	0.3	< 0.00001	0.05
EU12 Swamp Gulch																					
SWGBG-1 (0-6")	10/15/2007	220.00	5.0	5.53																	
SWGBG-2 (0-6")	10/15/2007	680.00	5.2	4.46																	

Notes:

%	- Percent
t/kt	- Tons per thousand tons
s.u.	- Standard units
µmhos/cm	- Micromhos per liter
mg/L	- Milligrams per liter
Blank	- No data/not analyzed
<	- Parameter not detected at or above the laboratory practical quantitation limit
TOC	- Total organic carbon

Aluminum and Iron were not sampled in 2007.
2011 data collected by Pioneer Technical Services, Inc.

Classification	Criteria for Classification [b]
Potentially Acid Generating	NP:AP [a] < 1 and NNP < -20 tons/kton
Uncertain Acid Generation Potential	NP:AP between 1 and 3 and/or NNP between -20 and +20 tons/kton
Unlikely to Generate Acid	NP:AP > 3 and NNP < +20 tons/kton

[a] NP = Neutralization Potenital, AP = Acidification Potential, NNP = Net Neutralization Potential.

[b] From BLM (1996) and EPA (1994).

*Iron and manganese SPLP Leachate Criterion for soil were calculated based on a DAF 10 and their respective EPA Tap Water standards. The SPLP Leachate Criterion for Soil for the remaining metals were calculated based on a DAF 10 and their respective DEQ-7 water quality standards (see Section 4 of RI report).

AC	- Anaconda
BC	- Beartrap Creek
MG	- Meadow Creek
MH	- Mike Horse Creek
PC	- Paymaster Creek
PG	- Pass Creek Gulch
SG	- Stevens Gulch
SH	- Shave Creek
SW	- Swamp Gulch
UBR	- Upper Blackfoot River
BG	- Background Sample

Table 19a

Pass Creek Marsh Background Sediment Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)		Total Arsenic (mg/kg)		Total Cadmium (mg/kg)		Total Copper (mg/kg)		Total Iron (mg/kg)		Total Lead (mg/kg)		Total Manganese (mg/kg)		Total Mercury (mg/kg)		Total Zinc (mg/kg)	
		Lab	XRF	Lab	XRF	Lab	XRF	Lab	XRF	Lab	XRF	Lab	XRF	Lab	XRF	Lab	XRF	Lab	XRF
Screening Levels	TEL[abfg]	--		5.9		0.596		35.7		--		35		--		0.174		123	
	PAET [cbdf]	--		19		97.5		340		--		240		1,400		0.16		500	
	SEL[ebf]	--		33		10		110		--		250		1,100		2		820	
Marsh Sediment RVs [h]		8,030		32.3		1.84		67.4		14,500		174		696		0.5		275	
Pass Creek Marsh																			
BRSD-5 (0-2)	7/17/2008	7500		17.2		0.619		39.2		13600		64.7		320		< 0.5		107	
BRSD-5 (2-6)	7/17/2008	8030		19.2		0.521		41.7		12100		61.7		250		< 0.5		100	
BRSD-5 (6-12)	7/17/2008	7620		24.6		0.471		45.3		14500		79		244		< 0.5		97.8	
PGBG-1 (0-2")	10/4/2007			12.4		1.51		34.7				55		696		< 0.5		158	
PGBG-1 (2-6")	10/4/2007			9.12		1.44		37				101		199		< 0.5		174	
PGBG-1 (6-12")	10/4/2007			9.4		0.649		22				174		88		< 0.5		133	
PGBG-2 (0-2")	10/3/2007			18.8		1.84		52				105		586		< 0.5		263	
PGBG-2 (2-6")	10/3/2007			18.5		1.54		55				108		498		< 0.5		252	
PGBG-2 (6-12")	10/3/2007			32.3		1.57		67.4				113		293		< 0.5		275	

Notes:

mg/Kg	- Milligrams per kilogram
--	- No Standard/screening level
<	- Parameter not detected at or above the laboratory practical quantitation limit
M%	- Matrix spike recoveries exceed acceptable limits.
J	- The associated value is an estimated quantity.
Blank	- No Data. Aluminum and iron were not sampled in 2007.
	- Value meets or exceeds one or more screening level.

BR	- Re-sample of Historic Pass Creek Marsh Sediment Sample Location
PG	- Pass Creek Marsh
BG	- Background Sample
RV	- Reference Values

[a] The TEL is calculated as the geometric mean of the 15th percentile concentration of the toxic effects data set and the median of the no-effect data set. As such it represents the concentration below which adverse effects are expected to occur only rarely. Freshwater TELs are based on benthic community metrics and toxicity texts results. Adverse biological effects rarely seen below TEL.

[b] Cubbage, James, David Batts, Scott Breidenback. 1997. "Creation and Analysis of Freshwater Sediment Quality Values in Washington State". July. http://www.ecy.wa.gov/pubs/97323a.pdf

[c] The PAET is defined as the 95th percentile of values with no significant biological effects and concentrations greater than the lowest "hit" level. It is designed as an alternative value to the Apparent Effect Threshold to reduce the effects of random error.

[d] Entry is lowest, reliable value among a compilation of PAET levels for; H – Hyalella azteca bioassay or M – Microtox bioassay.

[e] The SEL is defined as the 90th-95th percentile screening level concentration based on in-situ benthic community structure. Contaminant concentration above the SEL is likely detrimental to the majority of benthic species.

[f] SAIC and Avocet Consulting. 2002. "Phase I Report: Development of Freshwater Sediment Quality Values for Use in Washington State." September. – Prioritizing Areas for Attention – Areas exceeding the SEL are considered the highest-priority areas for biological testing. Areas between the PAET and the SEL are considered medium priority for attention, and areas between the TEL and the PAET are considered low priority. Areas below the TEL are screened out entirely. http://www.ecy.wa.gov/pubs/0209050.pdf

[g] SAIC and Avocet Consulting. 2003. "Phase II Report: Development and recommendation of SQVs for Freshwater Sediments in Washington State." September. – Recommendations for Screening – Report recommends SQVs as defined in the Phase I report be used (see note f above). http://www.ecy.wa.gov/pubs/0309088.pdf

[h] Marsh Sediment Reference Values are Sediment Background Threshold Value (Sediment BTV - calculated using ProUCL v4.1.00).

Table 19b
Pass Creek Marsh Background Sediment ABA and SPLP Analytical Results

Sample ID	Date Collected	Specific Conductance (µmhos/cm)	pH (s.u.)	TOC (%)	Acid - Base Accounting								Synthetic Precipitation Leaching Procedure								
					Sulfur, Hot Water Extractable (%)	Total Sulfur (%)	Sulfur Sulfate (%)	Sulfur Pyritic (%)	Sulfur Organic (%)	Neutral Potential (t/kt)	Acid Potential (t/kt)	Acid/Base Potential (t/kt)	Aluminum (mg/L)	Arsenic (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Zinc (mg/L)
Marsh SPLP		**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**0.01**	**0.005**	**1.3**	**11**	**0.015**	**0.32**	**0.002**	**2.0**
Pass Creek Marsh																					
BRSD-5 (0-2)	7/17/2008	320.00	5.1	2.00	0.03	0.04	< 0.01	0.02	< 0.01	4	0.8	3	7.6	0.019	0.00034	0.023	11	0.066	0.17	< 0.0001	0.09
BRSD-5 (2-6)	7/17/2008	160.00	5.1	1.40																	
BRSD-5 (6-12)	7/17/2008	140.00	5.0	1.30	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	4	0.22	4	6.2	0.016	0.00009	0.022	7.1	0.054	0.075	< 0.0001	0.07
PGBG-1 (0-2")	10/4/2007	320.00	5.7	9.81	0.07	0.07	0.01	0.06	0.01	15	1.9	13		< 0.1	< 0.01	0.1		< 0.1	0.1	< 0.0001	< 0.5
PGBG-1 (2-6")	10/4/2007	410.00	5.7	4.45																	
PGBG-1 (6-12")	10/4/2007	320.00	5.8	2.39	0.04	0.04	0.02	0.03	< 0.01	8	0.8	7		< 0.1	< 0.01	0.1		< 0.1	0.1	< 0.0001	< 0.5
PGBG-2 (0-2")	10/3/2007	410.00	5.6	4.05																	
PGBG-2 (2-6")	10/3/2007	350.00	6.0	3.14	0.07	0.09	0.06	0.03	< 0.01	9	1	8		< 0.1	< 0.01	0.1		< 0.1	0.1	< 0.0001	< 0.5
PGBG-2 (6-12")	10/3/2007	360.00	6.3	1.48																	

Notes:

%	- Percent
t/kt	- Tons per thousand tons
s.u.	- Standard units
µmhos/cm	- Micromhos per liter
mg/L	- Milligrams per liter
Blank	- No data/not analyzed
<	- Parameter not detected at or above the laboratory practical quantitation limit
TOC	- Total organic carbon

Aluminum and iron were not sampled in 2007.

Classification	Criteria for Classification [b]
Potentially Acid Generating	NP:AP[a] < 1 and NNP < -20 tons/kton
Uncertain Acid Generation Potential	NP:AP between 1 and 3 and/or NNP between -20 and +20 tons/kton
Unlikely to Generate Acid	NP:AP > 3 and NNP < +20 tons/kton

BR	- Re-sample of Historic Pass Creek Marsh Sediment Sample Location
PG	- Pass Creek Marsh
BG	- Background Sample

[a] NP = Neutralization Potenital, AP = Acidification Potential, NNP = Net Neutralization Potential.

[b] From BLM (1996) and EPA (1994).

*Iron and manganese SPLP Leachate Criterion for soil were calculated based on a DAF 1 and their respective EPA Tap Water standards. The SPLP Leachate Criterion for Soil for the remaining metals were calculated based on a DAF 1 and their respective DEQ-7 water quality standards (see Section 4 of RI report).

Table 2
Monthly Climatic Data Summary

Rogers Pass NOAA Weather Station 8/21/64 to 9/30/04													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Average Max. Temp (°F)	33.1	38.4	44.1	53.7	63.0	71.4	81.5	80.5	69.3	57.9	41.9	34.3	55.8
Average Min. Temp (°F)	13.4	18.1	22.3	29.6	37.7	44.5	49.8	48.4	39.2	32.5	23.0	15.9	31.2
Average Total Precip (in.)	0.86	0.65	1.22	1.75	2.93	3.10	1.36	1.69	1.68	1.12	0.70	0.92	17.99
Average Total Snow Fall (in.)	13.1	11.7	15.3	11.5	4.2	0.0	0.0	0.0	2.6	4.2	8.6	13.8	85.1

Table 20
Streambed Sediment Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)	Total Cadmium (mg/kg)	Total Copper (mg/kg)	Total Iron (mg/kg)	Total Lead (mg/kg)	Total Manganese (mg/kg)	Total Mercury (mg/kg)	Total Zinc (mg/kg)
Sediment Screening Levels	TEL [abfg]	--	5.9	0.596	35.7	--	35	--	0.174	123
	PAET [cbdfg]	--	19	97.5	340	--	240	1,400	0.16	500
	SEL [ebfg]	--	33	10	110	--	250	1,100	2	820
Streambed Sediment RVs[h]		8,980	15.4	0.5	114	23,900	81.5	578	0.5	136
DEQ Action Level/RSLs/UBMC BTVs		**77,000[i]**	**40[j]**	**70[i]**	**3,100[i]**	**58,270[k]**	**1,109[k]**	**4,893[k]**	**23[i]**	**23,000[i]**
BRSW-6 SE (0-2)*	10/10/2007		5.56 J	< 0.5 J	41.9 J		21.9 J	271 J	< 0.5	65.7 J
BRSW-6 SE (0-2)*	6/17/2008	8980	15.4	< 0.5	114	23900	81.5	578	< 0.5	128
BRSW-9 SE (0-2)	10/9/2007		24.9 J	18.1 J	322 J		578 J	4380 J	< 0.5	4810 J
BRSW-11 SE (0-2)*	10/5/2007		7.87	< 0.5	29.4		47.5	408	< 0.5	136
BRSW-12 SE (0-2)	10/5/2007		19	10.4	253		530	2770	< 0.5	2000
BRSW-12 SE (2-6)	10/5/2007		21.7	13.3	334		474	3140	< 0.5	2350
BRSW-12 SE (6-12)	10/5/2007		26.2	9.97	268		502	2540	< 0.5	1890
BRSW-13 SE (0-2)	10/5/2007		33.9	< 0.5	83.6		68.5	31.3	< 0.5	15.3
BRSW-13 SE (2-6)	10/5/2007		86.8	0.55	178		235	54.7	< 0.5	122
BRSW-13 SE (6-12)	10/5/2007		47	1.37	247		154	43.2	< 0.5	275
BRSW-16 SE (0-2)	10/4/2007		6.21	5.34	145		135	1500	< 0.5	1230
BRSW-16 SE (0-2)	6/17/2008	7690	10.6	2.75	140	20000	184	934	< 0.5	516
BRSW-17 SE (0-2)	10/3/2007		6.22	3.86	51		69.2	2280	< 0.5	936
BRSW-21 SE (0-2)	10/5/2007		4.73	< 0.5	26.9		7.5	8.24	< 0.5	8.5
BRSW-21 SE (2-6)	10/5/2007		18.1	< 0.5	71		56.4	55	< 0.5	48.8
BRSW-31 SE (0-2)	10/4/2007		7.74	8.8	262		244	2540	< 0.5	1710
BRSW-31 SE (0-2)	6/16/2008	7810	14.5	8.49	319	25800	502	3080	< 0.5	1650
BRSW-33 SE (0-2)	10/9/2007		24.6 J	8.33 J	320 J		542 J	1960 J	< 0.5	1670 J
BRSW-36 SE (0-2)	10/9/2007		26.9 J	16.4 J	404 J		1500 J	3900 J	< 0.5	3540 J
BRSW-101 SE (0-2)	10/3/2007		8.88	1.91	27.6		19.8	767	< 0.5	612
BRSW-101 SE (0-2)	6/16/2008	5130	9.87	0.839	36.2	13300	28.9	589	< 0.5	396
BRSW-102 SE (0-2)	10/3/2007		4.47	1.99	40.9		28.7	992	< 0.5	660
BRSW-102 SE (0-2)	6/16/2008	4550	4.86	1.21	46.5	11400	27.8	750	< 0.5	481
BRSW-102 SE (2-6)	6/16/2008	3920	3.03	0.767	33.8	9650	17.4	511	< 0.5	361
BRSW-103 SE (0-2)	10/3/2007		4.05	0.87	103		31.5	203	< 0.5	225
BRSW-103 SE (0-2)	6/16/2008	6780	3.68	< 0.5	78.9	22200	31.3	293	< 0.5	119
BRSW-104 SE (0-2)	10/3/2007		13.9	9.39	298		101	3760	< 0.5	1850

Notes:

mg/Kg - Milligrams per kilogram
-- - No standard/screening level
< - Parameter not detected at or above the laboratory practical quantitation limit
- Value meets or exceeds one or more screening level
Blank - No data. Aluminum and iron were not sampled in 2007.
J - The associated value is an estimated quanitity.
* - Background streambed sediment.
RV - Reference Values.
RSL - Regional Screening Level.
BTV - Background Threshold Value.

2011 data collected by PioneerTechnical Services, Inc.

[a] The TEL is calculated as the geometric mean of the 15th percentile concentration of the toxic effects data set and the median of the no-effect data set. As such it represents the concentration below which adverse effects are expected to occur only rarely. Freshwater TELs are based on benthic community metrics and toxicity texts results. Adverse biological effects rarely seen below TEL.

[b] Cubbage, James, David Batts, Scott Breidenback. 1997. "Creation and Analysis of Freshwater Sediment Quality Values in Washington State". July. http://www.ecy.wa.gov/pubs/97323a.pdf

[c] The PAET is defined as the 95th percentile of values with no significant biological effects and concentrations greater than the lowest "hit" level. It is designed as an alternative value to the Apparent Effect Threshold to reduce the effects of random error.

[d] Entry is lowest, reliable value among a compilation of PAET levels for; H – Hyalella azteca bioassay or M – Microtox bioassay.

[e] The SEL is defined as the 90th-95th percentile screening level concentration based on in-situ benthic community structure. Contaminant concentration above the SEL is likely detrimental to the majority of benthic species.

[f] SAIC and Avocet Consulting. 2002. "Phase I Report: Development of Freshwater Sediment Quality Values for Use in Washington State." September. – Prioritizing Areas for Attention – Areas exceeding the SEL are considered the highest-priority areas for biological testing. Areas between the PAET and the SEL are considered medium priority for attention, and areas between the TEL and the PAET are considered low priority. Areas below the TEL are screened out entirely. http://www.ecy.wa.gov/pubs/0209050.pdf

[g] SAIC and Avocet Consulting. 2003. "Phase II Report: Development and recommendation of SQVs for Freshwater Sediments in Washington State." September. – Recommendations for Screening – Report recommends SQVs as defined in the Phase I report be used (see note f above). http://www.ecy.wa.gov/pubs/0309088.pdf

[h] Site-specific background sediment screening level (calculated using ProUCL v4.1.00).

[i] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).

[j] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).

[k] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

Table 20
Streambed Sediment Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)	Total Cadmium (mg/kg)	Total Copper (mg/kg)	Total Iron (mg/kg)	Total Lead (mg/kg)	Total Manganese (mg/kg)	Total Mercury (mg/kg)	Total Zinc (mg/kg)
Sediment Screening Levels	TEL [abfg]	--	5.9	0.596	35.7	--	35	--	0.174	123
	PAET [cbdfg]	--	19	97.5	340	--	240	1,400	0.16	500
	SEL [ebfg]	--	33	10	110	--	250	1,100	2	820
Streambed Sediment RVs[h]		8,980	15.4	0.5	114	23,900	81.5	578	0.5	136
DEQ Action Level/RSLs/UBMC BTVs		**77,000[i]**	**40[j]**	**70[i]**	**3,100[i]**	**58,270[k]**	**1,109[k]**	**4,893[k]**	**23[i]**	**23,000[i]**
BRSW-104 SE (0-2)	6/16/2008	22800	16.9	18.2	2630	35400	59.6	10100	< 0.5	2370
BRSW-104 SE (2-6)	6/16/2008	23000	18.1	20.3	3030	35800	67.1	11300	< 0.5	2350
BRSW-105 SE (0-2)	10/4/2007		9.9	8.1	234		161	2060	< 0.5	2010
BRSW-105 SE (2-6)	10/4/2007		11.8	8.02	244		187	1830	< 0.5	1880
BRSW-105 SE (0-2)	6/16/2008	8740	14.2	7.49	251	24600	198	2360	< 0.5	1660
BRSW-105 SE (2-6)	6/16/2008	8440	14.1	6.97	231	23600	293	2250	< 0.5	1560
BRSW-106 SE (0-2)	10/4/2007		9.48	5.19	193		177	1390	< 0.5	1180
BRSW-106 SE (2-6)	10/4/2007		8.88	4.62	181		120	1300	< 0.5	1120
BRSW-106 SE (0-2)	6/16/2008	7850	14.7	3.51	214	28500	131	1270	< 0.5	878
BRSW-106 SE (2-6)	6/16/2008	8400	11	3.08	192	27000	138	1190	< 0.5	852
BRSW-107 SE (0-2)	10/4/2007		20.9	10.5	620		716	2580	< 0.5	2350
BRSW-107 SE (0-2)	6/16/2008	10200	19.7	1.93	372	29600	409	555	< 0.5	782
BRSW-108 SE (0-2)	10/10/2007		59.2 J	0.627 J	283 J		395 J	336 J	< 0.5	194 J
BRSW-109 SE (0-2)	10/9/2007		31.4 J	10.5 J	262 J		1330 J	3450 J	< 0.5	3240 J
BRSW-110 SE (0-2)	10/4/2007		13.3	4.35	127		351	979	< 0.5	865
BRSW-110 SE (2-6)	10/4/2007		12.9	5.48	158		395	1200	< 0.5	994
BRSW-110 SE (6-12)	10/4/2007		14.8	4.94	130		352	1160	< 0.5	908
BRSW-201 (0-2)	11/9/2011	4710	4.0	< 0.5	39.5	16300	13	311	< 0.5	150
BRSW-202 (0-2)	11/9/2011	4230	3.6	< 0.5	35.1	14600	11	218	< 0.5	146
BRSW-203 (0-2)	11/9/2011	4840	5.3	< 0.5	41.2	14400	14	247	< 0.5	126
BRSW-204 (0-2)	11/9/2011	4570	4.4	< 0.5	29.8	11800	11	259	< 0.5	125
BRSW-205 (0-2)	11/9/2011	5070	8.0	< 0.5	30.0	13100	21	396	< 0.5	202
BRSW-206 (0-2)	11/9/2011	5360	5.7	1.3	38.6	12500	18	749	< 0.5	534

Notes:

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Blank - No data. Aluminum and iron were not sampled in 2007.
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* - Background streambed sediment.
RV - Reference Values.
RSL - Regional Screening Level.
BTV - Background Threshold Value.

2011 data collected by PioneerTechnical Services, Inc.

[a] The TEL is calculated as the geometric mean of the 15th percentile concentration of the toxic effects data set and the median of the no-effect data set. As such it represents the concentration below which adverse effects are expected to occur only rarely. Freshwater TELs are based on benthic community metrics and toxicity texts results. Adverse biological effects rarely seen below TEL.

[b] Cubbage, James, David Batts, Scott Breidenback. 1997. "Creation and Analysis of Freshwater Sediment Quality Values in Washington State". July. http://www.ecy.wa.gov/pubs/97323a.pdf

[c] The PAET is defined as the 95th percentile of values with no significant biological effects and concentrations greater than the lowest "hit" level. It is designed as an alternative value to the Apparent Effect Threshold to reduce the effects of random error.

[d] Entry is lowest, reliable value among a compilation of PAET levels for; H – Hyalella azteca bioassay or M – Microtox bioassay.

[e] The SEL is defined as the 90th-95th percentile screening level concentration based on in-situ benthic community structure. Contaminant concentration above the SEL is likely detrimental to the majority of benthic species.

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[g] SAIC and Avocet Consulting. 2003. "Phase II Report: Development and recommendation of SQVs for Freshwater Sediments in Washington State." September. – Recommendations for Screening – Report recommends SQVs as defined in the Phase I report be used (see note f above). http://www.ecy.wa.gov/pubs/0309088.pdf

[h] Site-specific background sediment screening level (calculated using ProUCL v4.1.00).

[i] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).

[j] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).

[k] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

Table 21a
Surface Water Metals Analytical Results

Sample ID	Date Collected	Aluminum (mg/L)	Arsenic (mg/L)	Cadmium (mg/L)			Copper (mg/L)			Iron mg/L	Lead (mg/L)			Manganese mg/L	Zinc (mg/L)		
				Lab Results	Aquatic Life Standard*		Lab Results	Aquatic Life Standard*			Lab Results	Aquatic Life Standard*			Lab Results	Aquatic Life Standard*	
					Acute	Chronic		Acute	Chronic			Acute	Chronic			Acute	Chronic
Surface Water Standards	Acute[a] Chronic[b] Human Health[c]	0.75 0.087 --	0.34 0.15 0.01	-- -- 0.005			-- -- 1.3			-- 1.0 --	-- -- 0.015			-- -- --	-- -- 2		
AW-003A	10/9/2007	0.13	0.002	0.0872	0.0087	0.00076	0.226	0.052	0.030	0.110	< 0.0005	0.477	0.0186	30.900	60.40	0.388	0.388
BRSW-4	10/10/2007	0.05	< 0.002	0.0342	0.0037	0.00040	0.682	0.023	0.015	0.060	0.0481	0.160	0.0063	1.390	4.01	0.188	0.188
BRSW-4A	6/17/2008	0.08	< 0.003	0.0204	0.0021	0.00027	0.886	0.014	0.009	0.200	0.0798	0.080	0.0031	1.190	2.54	0.118	0.118
BRSW-6	10/9/2007	< 0.03	< 0.002	< 0.00008	0.0019	0.00025	< 0.001	0.013	0.009	0.030	< 0.0005	0.072	0.0028	< 0.003	< 0.01	0.111	0.111
BRSW-6	6/17/2008	0.03	< 0.003	< 0.00008	0.0012	0.00018	< 0.001	0.009	0.006	< 0.050	< 0.0005	0.042	0.0016	< 0.005	< 0.01	0.077	0.077
BRSW-7	10/5/2007																
BRSW-9	10/9/2007	< 0.03	< 0.002	0.00711	0.0044	0.00046	0.018	0.027	0.017	0.110	0.0019	0.200	0.0078	1.470	3.42	0.217	0.217
BRSW-11	10/5/2007	< 0.03	< 0.002	< 0.00008	0.0017	0.00023	< 0.001	0.012	0.008	0.610	< 0.0005	0.063	0.0025	0.126	< 0.01	0.101	0.101
BRSW-12	10/5/2007	< 0.03	< 0.002	0.00511	0.0034	0.00038	0.012	0.021	0.014	0.090	0.0019	0.144	0.0056	0.330	1.75	0.175	0.175
BRSW-13	10/5/2007	1.7	< 0.002	0.00038	0.0006	0.00011	0.136	0.004	0.003	6.720	0.0062	0.016	0.0006	0.354	0.07	0.041	0.041
BRSW-16	10/4/2007	< 0.03	< 0.002	0.00136	0.0029	0.00034	0.005	0.019	0.012	0.190	0.0009	0.120	0.0047	0.076	0.55	0.155	0.155
BRSW-16	6/17/2008	< 0.03	< 0.003	0.00141	0.0013	0.00019	0.010	0.009	0.006	0.120	0.0034	0.045	0.0018	0.051	0.42	0.081	0.081
BRSW-17	10/3/2007	< 0.03	< 0.002	< 0.00008	0.0025	0.00031	0.001	0.016	0.011	0.170	< 0.0005	0.101	0.0039	0.111	0.12	0.138	0.138
BRSW-17	6/16/2008	< 0.03	< 0.003	0.00053	0.0015	0.00021	0.003	0.010	0.007	0.060	0.0006	0.053	0.0021	0.019	0.23	0.090	0.090
BRSW-21	10/5/2007	1.42	< 0.002	0.00012	0.0005	0.00010	0.007	0.004	0.003	6.100	< 0.0005	0.015	0.0006	0.303	0.06	0.038	0.038
BRSW-23	10/10/2007	< 0.03	< 0.002	0.00328	0.0035	0.00039	0.014	0.022	0.014	0.700	0.0063	0.150	0.0058	1.210	0.69	0.179	0.179
BRSW-29	10/9/2007	< 0.03	< 0.002	0.00426	0.0028	0.00033	0.006	0.018	0.012	0.130	0.0024	0.114	0.0044	0.761	0.84	0.150	0.150
BRSW-31	10/4/2007	< 0.03	< 0.002	0.00225	0.0029	0.00034	0.022	0.019	0.012	1.030	0.0055	0.121	0.0047	0.273	0.81	0.155	0.155
BRSW-31	6/16/2008	< 0.03	< 0.003	0.00149	0.0013	0.00019	0.012	0.009	0.006	0.130	0.0042	0.044	0.0017	0.055	0.39	0.079	0.079
BRSW-33	10/9/2007	< 0.03	< 0.002	0.00575	0.0034	0.00038	0.012	0.022	0.014	0.070	0.0031	0.149	0.0058	0.341	1.67	0.178	0.178
BRSW-36	10/9/2007	< 0.03	< 0.002	0.00922	0.0048	0.00049	0.014	0.030	0.018	0.080	0.0013	0.224	0.0087	1.310	3.61	0.235	0.235
BRSW-39A	10/10/2007	< 0.03	< 0.002	0.005	0.0037	0.00041	0.009	0.023	0.015	0.410	0.0063	0.164	0.0064	2.120	1.06	0.191	0.191
BRSW-44	10/10/2007	< 0.03	< 0.002	0.0199	0.0043	0.00045	0.093	0.027	0.017	0.050	0.0257	0.195	0.0076	0.596	3.08	0.214	0.214
BRSW-44	6/17/2008	< 0.03	< 0.003	0.00622	0.0020	0.00026	0.085	0.013	0.009	0.090	0.0189	0.078	0.0030	1.019	1.11	0.116	0.116
BRSW-101	10/3/2007	< 0.03	< 0.002	0.00015	0.0025	0.00031	< 0.001	0.016	0.011	0.050	< 0.0005	0.102	0.0040	0.004	0.09	0.139	0.139
BRSW-101	6/16/2008	< 0.03	< 0.003	0.0005	0.0015	0.00021	0.003	0.010	0.007	0.070	0.0006	0.054	0.0021	0.015	0.24	0.091	0.091
BRSW-102	10/3/2007	< 0.03	< 0.002	0.00107	0.0025	0.00031	0.003	0.016	0.011	0.070	0.0016	0.101	0.0039	0.012	0.10	0.138	0.138
BRSW-102	6/16/2008	< 0.03	< 0.003	0.00051	0.0015	0.00021	0.003	0.010	0.007	0.060	0.0006	0.053	0.0021	0.016	0.22	0.090	0.090
BRSW-103	10/3/2007	< 0.03	< 0.002	< 0.00008	0.0024	0.00030	0.002	0.016	0.010	0.880	0.0016	0.096	0.0038	0.226	< 0.01	0.134	0.134
BRSW-103	6/16/2008	< 0.03	< 0.003	0.00011	0.0022	0.00028	0.004	0.015	0.010	0.780	0.0025	0.087	0.0034	0.103	0.03	0.125	0.125
BRSW-104	10/3/2007	< 0.03	< 0.002	0.0012	0.0029	0.00034	0.004	0.018	0.012	0.080	< 0.0005	0.119	0.0046	0.039	0.52	0.154	0.154
BRSW-104	6/16/2008	< 0.03	< 0.003	0.00129	0.0013	0.00019	0.010	0.009	0.006	0.140	0.0037	0.043	0.0017	0.050	0.38	0.078	0.078
BRSW-105	10/4/2007	< 0.03	< 0.002	0.00164	0.0029	0.00034	0.006	0.019	0.012	0.170	< 0.0005	0.121	0.0047	0.139	0.72	0.155	0.155
BRSW-105	6/16/2008	< 0.03	< 0.003	0.00139	0.0012	0.00018	0.013	0.009	0.006	0.130	0.004	0.042	0.0016	0.051	0.36	0.077	0.077
BRSW-106	10/4/2007	< 0.03	< 0.002	0.00193	0.0029	0.00033	0.015	0.018	0.012	0.820	0.0035	0.117	0.0046	0.216	0.76	0.153	0.153
BRSW-106	6/16/2008	< 0.03	< 0.003	0.00146	0.0013	0.00019	0.012	0.009	0.006	0.110	0.0034	0.044	0.0017	0.059	0.39	0.079	0.079
BRSW-107	10/4/2007	< 0.03	< 0.002	0.00228	0.0030	0.00035	0.027	0.019	0.013	0.810	0.0048	0.126	0.0049	0.256	0.93	0.160	0.160
BRSW-107	6/16/2008	< 0.03	< 0.003	0.00163	0.0014	0.00019	0.013	0.009	0.006	0.120	0.0045	0.046	0.0018	0.063	0.42	0.082	0.082
BRSW-108	10/10/2007	0.91	< 0.002	0.0011	0.0008	0.00013	0.159	0.006	0.004	0.010	0.0012	0.025	0.0010	0.374	0.22	0.054	0.054

Notes:

mg/L - Milligrams per liter
-- - No standard/not analyzed
Blank - No data
* - Acute and chronic results for cadmium, copper, lead and zinc were calculated using hardness results and equations in Montana Water Quality Standards (2010).
- Value meets or exceeds one or more water quality standard. Cadmium, copper, lead and zinc compared to calculated acute and chronic values, and human health standard.

2011 data collected by Pioneer Technical Services, Inc.

[a] Acute aquatic life criteria from circular DEQ-7, Montana Water Quality Standards (October 2012)

[b] Chronic aquatic life criteria from circular DEQ-7, Montana Water Quality Standards (October 2012)

[c] Human Health Standard from circular DEQ-7, Montana Water Quality Standards (October 2012)

Table 21a
Surface Water Metals Analytical Results

Sample ID	Date Collected	Aluminum (mg/L)	Arsenic (mg/L)	Cadmium (mg/L)			Copper (mg/L)			Iron mg/L	Lead (mg/L)			Manganese mg/L	Zinc (mg/L)		
				Lab Results	Aquatic Life Standard*		Lab Results	Aquatic Life Standard*			Lab Results	Aquatic Life Standard*			Lab Results	Aquatic Life Standard*	
					Acute	Chronic		Acute	Chronic			Acute	Chronic			Acute	Chronic
Surface Water Standards	**Acute[a]**	**0.75**	**0.34**	**--**			**--**			**--**	**--**			**--**	**--**		
	Chronic [b]	**0.087**	**0.15**	**--**			**--**			**1.0**	**--**			**--**	**--**		
	Human Health[c]	**--**	**0.01**	**0.005**			**1.3**			**--**	**0.015**			**--**	**2**		
BRSW-108	6/17/2008	< 0.03	< 0.003	0.00042	0.0006	0.00011	0.055	0.005	0.003	0.230	0.001	0.018	0.0007	0.137	0.10	0.044	0.044
BRSW-109	10/9/2007	< 0.03	< 0.002	0.00632	0.0039	0.00042	0.015	0.025	0.016	0.110	0.0019	0.176	0.0069	1.130	2.60	0.200	0.200
BRSW-110	10/4/2007	< 0.03	< 0.002	0.00316	0.0032	0.00037	0.015	0.021	0.013	3.180	0.0156	0.137	0.0053	0.278	1.04	0.169	0.169
BRSW-201	11/3/2011	< 0.03	< 0.003	< 0.00008	0.0026	0.00031	< 0.001	0.017	0.011	< 0.050	< 0.0005	0.105	0.0041	< 0.005	0.01	0.142	0.142
BRSW-202	11/3/2011	< 0.03	< 0.003	< 0.00008	0.0026	0.00031	< 0.001	0.017	0.011	< 0.050	< 0.0005	0.104	0.0041	< 0.005	0.02	0.141	0.141
BRSW-203	11/3/2011	< 0.03	< 0.003	< 0.00008	0.0026	0.00031	0.001	0.017	0.011	< 0.050	< 0.0005	0.105	0.0041	0.008	0.01	0.142	0.142
BRSW-204	11/3/2011	< 0.03	< 0.003	< 0.00008	0.0026	0.00031	< 0.001	0.017	0.011	< 0.050	< 0.0005	0.105	0.0041	0.008	0.01	0.142	0.142
BRSW-205	11/3/2011	< 0.03	< 0.003	< 0.00008	0.0022	0.00028	< 0.001	0.015	0.010	0.060	< 0.0005	0.087	0.0034	0.007	0.03	0.125	0.125
BRSW-206	11/3/2011	< 0.03	< 0.003	0.00017	0.0023	0.00029	< 0.001	0.015	0.010	< 0.050	< 0.0005	0.091	0.0036	0.013	0.12	0.129	0.129
MHSW-101	7/16/2008	< 0.03	< 0.003	0.00814	0.0027	0.00032	0.077	0.017	0.011	0.150	0.0252	0.107	0.0042	0.091	1.04	0.144	0.144
MHSW-102	7/16/2008	< 0.03	< 0.003	0.00081	0.0026	0.00031	0.001	0.017	0.011	< 0.050	0.0058	0.104	0.0041	< 0.005	0.12	0.141	0.141

Notes:

mg/L - Milligrams per liter
-- - No standard/not analyzed
Blank - No data
* - Acute and chronic results for cadmium, copper, lead and zinc were calculated using hardness results and equations in Montana Water Quality Standards (2010).
- Value meets or exceeds one or more water quality standard. Cadmium, copper, lead and zinc compared to calculated acute and chronic values, and human health standard.

2011 data collected by Pioneer Technical Services, Inc.

[a] Acute aquatic life criteria from circular DEQ-7, Montana Water Quality Standards (October 2012)

[b] Chronic aquatic life criteria from circular DEQ-7, Montana Water Quality Standards (October 2012)

[c] Human Health Standard from circular DEQ-7, Montana Water Quality Standards (October 2012)

Table 21b
Surface Water Field and General Chemistry Analytical Results

Sample ID	Date Collected	Field Parameters						Physiochemical						Common Anions					Common Cations			
		Specific Conductance (µmhos/cm)	pH (s.u.)	Temperature (^{o}C)	Oxidation-Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Discharge (cfs)	Electrical Conductivity (µmhos/cm)	pH (s.u.)	Hardness as $CaCO_3$ (mg/L)	Acidity as $CaCO_3$ (mg/L)	Total Diss. Solids (mg/L)	Total Susp. Solids (mg/L)	Alkalinity as $CaCO_3$ (mg/L)	Bicarb as HCO_3 (mg/L)	Carbonate as CO_3 (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)
Surface Water Standards	Acute[a]	--	--	--	--	4.0 - 8.0	--	--	6.5-8.5	--	--	--	--	--	--	--	--	--	--	--	--	--
	Chronic[b]	--	--	--	--	4.0 - 8.0	--	--	6.5-8.5	--	--	--	--	--	--	--	--	--	--	--	--	--
	Human Health[c]	--	--	--	--	4.0 - 8.0	--	--	6.5-8.5	--	--	--	--	--	--	--	--	--	--	--	--	--
AW-003A	10/9/2007	2347	5.9	11.3	42	7.9	0.23	2050	6.8	1510	130	2480	5	9	11	< 4	1	1590	324	171	4	3
BRSW-4	10/10/2007	350	7.5	6.4	18	10.1	0.01	351	7.7	170	< 4	228	10	85	100	< 4	< 1	87	37	19	< 1	1
BRSW-4A	6/17/2008	208	7.9	5.7	309	9.9	1.14	210	7.2	98		127	< 10	74	91	< 4	< 1	43	22	11	< 1	< 1
BRSW-6	10/9/2007	* 350	6.4	5.0	109	9.8	0.38	180	8.1	91	< 4	100	1	96	120	< 4	< 1	3	21	9	< 1	2
BRSW-6	6/17/2008	133	7.8	7.2	54	10.0	8.26	122	7.7	59		80	< 10	66	81	< 4	< 1	3	14	6	< 1	< 1
BRSW-7	10/5/2007	* 104	5.8	3.7	30	5.8	0.68															
BRSW-9	10/9/2007	382	7.8	11.9	10	8.5	0.69	396	7.5	202	< 4	274	< 1	82	100	< 4	1	121	44	23	< 1	2
BRSW-11	10/5/2007							185	7.5	82	< 4	102	< 10	69	84	< 4	10	11	19	8	1	3
BRSW-12	10/5/2007	315	7.0	6.6	-7	8.2	1.76	328	7.2	156	< 4	210	< 10	51	62	< 4	< 1	98	33	18	1	1
BRSW-13	10/5/2007	* 400	2.6	3.0	209	9.2	0.06	208	3.6	28	33	113	< 10	< 4	< 4	< 4	< 1	58	5	4	3	2
BRSW-16	10/4/2007	275	6.5	4.1	-95	8.7	3.19	278	7.4	135	< 4	197	< 10	44	54	< 4	2	87	29	15	1	2
BRSW-16	6/17/2008	156	7.7	6.0	281	10.6	65.49	142	7.5	63		87	< 10	44	54	< 4	1	26	14	7	< 1	1
BRSW-17	10/3/2007	247	7.2	6.2	16	9.0	5.85	244	7.8	118	< 4	161	< 10	75	91	< 4	2	45	26	13	1	2
BRSW-17	6/16/2008	167	7.8	10.3	327	8.6	92.48	154	7.6	71		97	< 10	59	72	< 4	1	23	16	8	< 1	1
BRSW-21	10/5/2007	* 250	2.7	3.8	217	8.1	0.10	180	3.6	26	28	99	13	< 4	< 4	< 4	1	51	5	3	3	2
BRSW-23	10/10/2007	320	7.4	9.9	11	8.5	0.29	326	8.0	161	< 4	201	4	96	120	< 4	1	64	31	20	< 1	1
BRSW-29	10/9/2007	254	7.3	8.0	9	8.7	1.09	268	7.8	130	< 4	172	1	90	110	< 4	< 1	45	28	15	< 1	1
BRSW-31	10/4/2007	282	7.2	5.4	-25	8.7	3.00	296	7.5	136	< 4	205	< 10	43	53	< 4	2	90	29	16	1	2
BRSW-31	6/16/2008	95	7.8	10.1	143	8.6	61.42	137	7.5	61		90	< 10	43	53	< 4	< 1	26	14	6	< 1	1
BRSW-33	10/9/2007	328	6.6	6.9	26	8.1	2.05	333	7.8	160	< 4	225	< 1	53	65	< 4	< 1	107	35	18	< 1	2
BRSW-36	10/9/2007	450	6.9	5.1	23	9.7	0.81	429	7.6	221	< 4	306	< 1	68	83	< 4	1	145	48	25	< 1	2
BRSW-39A	10/10/2007	342	7.5	7.2	24	9.5	0.39	346	8.1	173	< 4	216	3	97	120	< 4	1	75	35	21	< 1	1
BRSW-44	10/10/2007	371	7.8	7.7	18	9.7	0.03	403	7.8	198	< 4	276	10	80	98	< 4	< 1	122	46	20	< 1	1
BRSW-44	6/17/2008	229	8.0	7.1	245	10.2	8.52	194	7.6	96		123	< 10	76	93	< 4	< 1	31	19	12	< 1	< 1
BRSW-101	10/3/2007	243	7.1	5.3	5	9.1	5.04	247	8.0	119	< 4	158	< 10	73	89	< 4	3	46	26	13	1	2
BRSW-101	6/16/2008	94	7.9	8.2	298	8.2	105.28	157	7.8	72		100	< 10	58	71	< 4	1	22	16	7	< 1	1
BRSW-102	10/3/2007	243	7.7	6.0	8	9.2	4.92	242	8.0	118	< 4	156	< 10	73	89	< 4	3	46	26	13	1	2
BRSW-102	6/16/2008	95	8.0	9.4	331	9.1	94.77	155	7.8	71		97	< 10	58	71	< 4	1	22	16	7	< 1	1
BRSW-103	10/3/2007	224	6.7	6.2	14	5.4	E 4.00	225	7.6	114	< 4	134	14	120	140	< 4	2	5	25	12	< 1	2
BRSW-103	6/16/2008	217	7.8	10.5	284	7.9	15.00	198	7.6	105		117	< 10	100	120	< 4	2	7	25	10	< 1	1
BRSW-104	10/3/2007	287	7.3	7.1	21	8.8	3.03	287	7.6	134	< 4	192	< 10	43	53	< 4	2	83	29	15	1	2
BRSW-104	6/16/2008	145	7.8	9.6	193	9.1	96.16	137	7.6	60		83	< 10	42	51	< 4	1	25	13	6	< 1	1
BRSW-105	10/4/2007	277	7.1	4.4	-64	9.1	3.16	285	7.2	136	< 4	202	< 10	44	54	< 4	3	88	29	15	1	2
BRSW-105	6/16/2008	146	7.8	11.7	280	8.5	72.03	135	7.4	59		87	< 10	46	56	< 4	1	25	13	6	< 1	1
BRSW-106	10/4/2007	280	7.2	4.5	-66	9.0	3.04	284	7.2	133	< 4	198	< 10	44	54	< 4	2	88	28	15	1	2
BRSW-106	6/16/2008	147	7.3	11.1	232	9.3	69.60	135	7.4	61		88	< 10	42	51	< 4	1	25	14	6	< 1	1
BRSW-107	10/4/2007	292	7.3	5.7	-30	7.8	3.50	308	7.3	141	< 4	210	< 10	44	54	< 4	2	92	30	16	1	2
BRSW-107	6/16/2008	154	7.7	12.4	252	8.0	106.45	145	7.4	64		88	< 10	47	58	< 4	1	27	15	7	< 1	1

Notes:

µmhos/cm - Micromhos per liter
s.u. - Standard units
^{o}C - Degrees Celcius
mV - Millivolts
mg/L - Milligrams per liter
cfs - Cubic feet per second
-- - No Standard/screening level
Blank - No data/not analyzed
* - Fluctuating readings. Value shown is an estimate based on the value that appeared most often during measurement.
- Value meets or exceeds one or more water quality standard.

2011 data collected by Pioneer Technical Services, Inc.

Table 21b
Surface Water Field and General Chemistry Analytical Results

Sample ID	Date Collected	Field Parameters						Physiochemical						Common Anions					Common Cations			
		Specific Conductance (µmhos/cm)	pH (s.u.)	Temperature (^{o}C)	Oxidation-Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Discharge (cfs)	Electrical Conductivity (µmhos/cm)	pH (s.u.)	Hardness as $CaCO^3$ (mg/L)	Acidity as $CaCO^3$ (mg/L)	Total Diss. Solids (mg/L)	Total Susp. Solids (mg/L)	Alkalinity as $CaCO^3$ (mg/L)	Bicarb as HCO^3 (mg/L)	Carbonate as CO^3 (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)
Surface Water Standards	Acute[a]	--	--	--	--	4.0 - 8.0	--	--	6.5-8.5	--	--	--	--	--	--	--	--	--	--	--	--	--
	Chronic[b]	--	--	--	--	4.0 - 8.0	--	--	6.5-8.5	--	--	--	--	--	--	--	--	--	--	--	--	--
	Human Health[c]	--	--	--	--	4.0 - 8.0	--	--	6.5-8.5	--	--	--	--	--	--	--	--	--	--	--	--	--
BRSW-108	10/10/2007	* 87	3.7	7.8	157	8.6	0.01	129	4.7	39	5.9	109	< 1	< 4	< 4	< 4	1	43	9	4	2	2
BRSW-108	6/17/2008	96	7.0	6.0	124	10.6	1.03	90	5.9	31		69	< 10	< 4	< 4	< 4	< 1	35	8	3	1	< 1
BRSW-109	10/9/2007	347	7.6	10.8	98	9.2	1.34	370	7.6	183	< 4	241	< 1	75	92	< 4	< 1	96	39	21	< 1	2
BRSW-110	10/4/2007	303	7.1	5.9	-45	7.9	2.06	316	7.4	150	< 4	217	12	51	62	< 4	2	91	32	17	1	2
BRSW-201	11/3/2011	299	6.3	2.6	63	10.0	19.63	242	8.1	122		146	< 10	120	140	< 4	1	10	28	12	< 1	3
BRSW-202	11/3/2011	201	8.3	0.7	83	9.4	19.99	237	8.2	121		139	< 10	120	150	< 4	1	10	28	12	< 1	3
BRSW-203	11/3/2011	5	7.6	2.4	11	8.4	24.16	235	8.2	122		143	< 10	120	150	< 4	1	9	29	12	< 1	3
BRSW-204	11/3/2011	197	8.3	3.0	25	9.2	25.44	238	8.2	122		146	< 10	120	150	< 4	1	9	28	13	< 1	3
BRSW-205	11/3/2011	193	8.1	2.7	23	8.3	7.11	215	8.1	105		148	< 10	89	110	< 4	2	20	23	11	< 1	3
BRSW-206	11/3/2011	203	8.1	2.6	22	9.5	3.57	234	8.1	109		146	< 10	75	91	< 4	2	36	24	12	< 1	3
MHSW-101	7/16/2008	157	5.7	10.8	95	9.6	NM	202	7.1	124 0	< 4	132	< 10	83	100	< 4	< 1		29	12	< 1	< 1
MHSW-102	7/16/2008	123	5.1	9.5	114	9.4	NM	192	7.3	121 0	< 4	121	< 10	90	110	< 4	< 1	8	29	12	< 1	< 1

Notes:

µmhos/cm	- Micromhos per liter
s.u.	- Standard units
^{o}C	- Degrees Celcius
mV	- Millivolts
mg/L	- Milligrams per liter
cfs	- Cubic feet per second
--	- No Standard/screening level
Blank	- No data/not analyzed
*	- Fluctuating readings. Value shown is an estimate based on the value that appeared most often during measurement.
	- Value meets or exceeds one or more water quality standard.

2011 data collected by Pioneer Technical Services, Inc.

Table 22a
Upper Marsh, Middle Marsh, and Lower Marsh Sediment Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)	Total Cadmium (mg/kg)	Total Copper (mg/kg)	Total Iron (mg/kg)	Total Lead (mg/kg)	Total Manganese (mg/kg)	Total Mercury (mg/kg)	Total Zinc (mg/kg)
Screening Levels	TEL [abfg]	--	5.9	0.596	35.7	--	35	--	0.174	123
	PAET [cbdf]	--	19	97.5	340	--	240	1,400	0.16	500
	SEL [ebf]	--	33	10	110	--	250	1,100	2	820
DEQ Action Level/RSLs/UBMC BTVs		77,000	40 [i]	70 [h]	3,100 [h]	58,270 [j]	1,109 [j]	4,893 [j]	23 [h]	23,000 [h]
Marsh Sediment RVs [k]		8,030	32.3	1.84	67.4	14,500	174	696	0.5	275
Upper Marsh										
UM-0N-250E (0-2")	10/5/2007		13.0 JM74	19.2 J	585 JM15		305 JM10	65.8 J	< 0.5	1500 JM13
UM-0N-250E (2-6")	10/5/2007		19.5 JM74	3.52 J	302 JM15		282 JM10	62.6 J	< 0.5	1670 JM13
UM-0N-250E (6-12")	10/5/2007		14.7 JM74	6.01 J	344 JM15		269 JM10	97.4 J	< 1	1050 JM13
UM-0N-500E (0-2")	10/5/2007		10.1 JM74	2.1 J	450 JM15		163 JM10	55.1 J	< 0.5	218 JM13
UM-0N-500E (2-6")	10/5/2007		16.8 JM74	78 J	2760 JM15		522 JM10	47.3 J	< 0.5	2420 JM13
UM-0N-500E (6-12")	10/5/2007		6.9 JM74	13.3 J	729 JM15		154 JM10	83.5 J	< 0.5	1740 JM13
UM-0N-750E (0-2")	10/5/2007		1.2 JM74	< 0.15 J	1.52 JM15		1.86 JM10	75.5 J	< 0.5	< 2 JM13
UM-0N-750E (2-6")	10/5/2007		8.9 JM74	< 0.15 J	7.84 JM15		7.47 JM10	26.9 J	< 0.5	41.1 JM13
UM-0N-750E (6-12")	10/5/2007		12.4 JM74	0.16 J	4.76 JM15		6.46 JM10	51.8 J	< 0.5	41.9 JM13
UM-0N-1000E (0-2")	10/5/2007		1.8 JM74	< 0.15 J	2.94 JM15		3.39 JM10	29.2 J	< 0.5	4.38 JM13
UM-0N-1000E (2-6")	10/5/2007		2.7 JM74	< 0.15 J	5.12 JM15		5.05 JM10	36.6 J	< 0.5	5.6 JM13
UM-0N-1000E (6-12")	10/5/2007		3.6 JM74	< 0.15 J	7.88 JM15		6.48 JM10	23.5 J	< 0.5	10 JM13
UM-0N-1500E (0-2")	10/4/2007		6.7 JM74	0.624 J	90.8 JM15		102 JM10	133 J	< 0.5	286 JM13
UM-0N-1500E (2-6")	10/4/2007		7.3 JM74	1.13 J	135 JM15		111 JM10	131 J	< 0.5	255 JM13
UM-0N-1500E (6-12")	10/4/2007		8.8 JM74	2.71 J	184 JM15		111 JM10	162 J	< 0.5	572 JM13
UM-0N-2000E (0-2")	10/4/2007		47.2 JM74	14.6 J	788 JM15		2480 JM10	4320 J	< 0.5	2760 JM13
UM-0N-2000E (2-6")	10/4/2007		49.4 JM74	12.5 J	711 JM15		2460 JM10	3820 J	< 0.5	2760 JM13
UM-0N-2000E (6-12")	10/4/2007		59.0 JM74	19.6 J	1080 JM15		3280 JM10	7670 J	< 0.5	3110 JM13
UM-0N-2500E (0-2")	10/3/2007		117.0 JM74	23.1 J	510 JM15		2000 JM10	2050 J	< 0.5	3340 JM13
UM-0N-2500E (2-6")	10/3/2007		103.0 JM74	9.73 J	262 JM15		1260 JM10	3220 J	< 0.5	1460 JM13
UM-250N-1750E (0-2)	7/18/2008	10800	12.6	0.552	153	15200	96.2	126	< 0.5	126
UM-250N-1750E (2-6)	7/18/2008	9520	12.2	0.958	108	12500	93.6	178	< 0.5	286
UM-250N-1750E (6-12)	7/18/2008	11000	11.6	0.404	143	14800	98.7	99.6	< 0.5	99.5
UM-250N-2250E (0-2)	7/18/2008	3880	177.0	12	364	63000	1340	7620	< 0.5	2060
UM-250N-2250E (2-6)	7/18/2008	7320	8.6	3.38	143	9840	192	279	< 0.5	640
UM-250N-2250E (6-12)	7/18/2008	8170	9.9	1.99	180	14100	194	347	< 0.5	390
UM-250N-2500E (0-2")	10/3/2007		96.9 JM74	14.3 J	555 JM15		1520 JM10	3800 J	< 0.5	2990 JM13
UM-250N-2500E (2-6")	10/3/2007		116.0 JM74	14.4 J	512 JM15		1070 JM10	7980 J	< 0.5	2480 JM13
UM-250N-2500E (6-12")	10/3/2007		91.2 JM74	12.4 J	374 JM15		975 JM10	6740 J	< 0.5	1870 JM13
UM-500N-2500E (0-2")	10/3/2007		11.3 JM74	1.76 J	59.3 JM15		91.2 JM10	163 J	< 0.5	270 JM13
UM-500N-2500E (2-6")	10/3/2007		8.8 JM74	1.59 J	74.3 JM15		88.9 JM10	186 J	< 0.5	272 JM13

Notes:

mg/Kg - Milligrams per kilogram
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M% - Matrix spike recoveries exceed acceptable limits.
J - The associated value is an estimated quantity.
Blank - No Data. Aluminum and iron were not sampled in 2007.
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BRSD - Historic resample of Upper Marsh sediment sample locations
UM - Upper Marsh
MM - Middle Marsh
LM - Lower Marsh
RV - Reference Values

[a] The TEL is calculated as the geometric mean of the 15th percentile concentration of the toxic effects data set and the median of the no-effect data set. As such it represents the concentration below which adverse effects are expected to occur only rarely. Freshwater TELs are based on benthic community metrics and toxicity texts results. Adverse biological effects rarely seen below TEL.

[b] Cubbage, James, David Batts, Scott Breidenback. 1997. "Creation and Analysis of Freshwater Sediment Quality Values in Washington State". July. http://www.ecy.wa.gov/pubs/97323a.pdf

[c] The PAET is defined as the 95th percentile of values with no significant biological effects and concentrations greater than the lowest "hit" level. It is designed as an alternative value to the Apparent Effect Threshold to reduce the effects of random error.

[d] Entry is lowest, reliable value among a compilation of PAET levels for; H – Hyalella azteca bioassay or M – Microtox bioassay.

[e] The SEL is defined as the 90th-95th percentile screening level concentration based on in-situ benthic community structure. Contaminant concentration above the SEL is likely detrimental to the majority of benthic species.

[f] SAIC and Avocet Consulting. 2002. "Phase I Report: Development of Freshwater Sediment Quality Values for Use in Washington State." September. – Prioritizing Areas for Attention – Areas exceeding the SEL are considered the highest-priority areas for biological testing. Areas between the PAET and the SEL are considered medium priority for attention, and areas between the TEL and the PAET are considered low priority. Areas below the TEL are screened out entirely. http://www.ecy.wa.gov/pubs/0209050.pdf

[g] SAIC and Avocet Consulting. 2003. "Phase II Report: Development and recommendation of SQVs for Freshwater Sediments in Washington State." September. – Recommendations for Screening – Report recommends SQVs as defined in the Phase I report be used (see note f above). http://www.ecy.wa.gov/pubs/0309088.pdf

[h] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).

[i] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).

[j] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

[k] Marsh Sediment Reference Values are Sediment Background Threshold Value (Sediment BTV - calculated using ProUCL v4.1.00).

Table 22a
Upper Marsh, Middle Marsh, and Lower Marsh Sediment Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)	Total Cadmium (mg/kg)	Total Copper (mg/kg)	Total Iron (mg/kg)	Total Lead (mg/kg)	Total Manganese (mg/kg)	Total Mercury (mg/kg)	Total Zinc (mg/kg)
Screening Levels	TEL [abfg]	--	5.9	0.596	35.7	--	35	--	0.174	123
	PAET [cbdf]	--	19	97.5	340	--	240	1,400	0.16	500
	SEL [ebf]	--	33	10	110	--	250	1,100	2	820
DEQ Action Level/RSLs/UBMC BTVs		77,000	40 [i]	70 [h]	3,100 [h]	58,270 [j]	1,109 [j]	4,893 [j]	23 [h]	23,000 [h]
Marsh Sediment RVs [k]		8,030	32.3	1.84	67.4	14,500	174	696	0.5	275
UM-500N-2500E (6-12")	10/3/2007		11.6 JM74	0.809 J	32.7 JM15		76.4 JM10	206 J	< 0.5	176 JM13
UM-250S-250E (0-2")	10/5/2007		14.5 JM74	0.809 J	240 JM15		131 JM10	66.7 J	< 0.5	131 JM13
UM-250S-250E (2-6")	10/5/2007		9.6 JM74	1.4 J	208 JM15		121 JM10	89.1 J	< 0.5	172 JM13
UM-250S-250E (6-12")	10/5/2007		7.6 JM74	0.928 J	128 JM15		95.3 JM10	281 J	< 0.5	245 JM13
UM-250S-500E (0-2")	10/5/2007		7.8 JM74	0.868 J	80.8 JM15		70.1 JM10	81.3 J	< 0.5	148 JM13
UM-250S-500E (2-6")	10/5/2007		8.5 JM74	0.644 J	90.2 JM15		95.4 JM10	69.5 J	< 0.5	98.8 JM13
UM-250S-500E (6-12")	10/5/2007		17.7 JM74	< 0.15 J	114 JM15		98 JM10	65.7 J	< 0.5	112 JM13
UM-250S-1250E (0-2")	7/17/2008	9230	7.9	0.185	91.1	17800	94.8	79.6	< 0.5	98.8
UM-250S-1250E (2-6")	7/17/2008	10600	24.6	< 0.15	79.4	32200	93.3	84.8	< 0.5	140
UM-250S-1250E (6-12")	7/17/2008	10300	19.0	0.152	77.5	22600	102	93.5	< 0.5	146
UM-250S-1500E (0-2")	10/4/2007		33.3 JM74	16.4 J	571 JM15		1730 JM10	1170 J	< 0.5	2760 JM13
UM-250S-1500E (2-6")	10/4/2007		30.6 JM74	12.8 J	849 JM15		1660 JM10	1460 J	< 0.5	2010 JM13
UM-250S-1500E (6-12")	10/4/2007		17.5 JM74	3.13 J	513 JM15		931 JM10	446 J	< 0.5	882 JM13
UM-250S-2500E (0-2")	10/3/2007		12.3 JM74	2.95 J	204 JM15		115 JM10	235 J	< 0.5	576 JM13
UM-250S-2500E (6-12")	10/3/2007		8.5 JM74	1.23 J	147 JM15		85.4 JM10	150 J	< 0.5	253 JM13
UM-250S-2750E (0-2")	10/4/2007		165.0 JM74	7.05 J	273 JM15		968 JM10	7810 J	< 0.5	1510 JM13
UM-250S-2750E (2-6")	10/4/2007		141.0 JM74	13.6 J	442 JM15		2080 JM10	5850 J	< 0.5	2010 JM13
UM-250S-2750E (6-12")	10/4/2007		66.0 JM74	15.3 J	514 JM15		2410 JM10	1640 J	< 0.5	1930 JM13
UM-250S-3000E (0-2")	10/4/2007		107.0 JM74	17.9 J	971 JM15		1680 JM10	4400 J	< 0.5	4080 JM13
UM-250S-3000E (2-6")	10/4/2007		162.0 JM74	20.7 J	801 JM15		1950 JM10	2570 J	< 0.5	3550 JM13
UM-250S-3000E (6-12")	10/4/2007		183.0 JM74	15 J	730 JM15		1280 JM10	5000 J	< 0.5	2950 JM13
UM-250S-3250E (0-2")	10/4/2007		8.2 JM74	14.3 J	315 JM15		168 JM10	1470 J	< 0.5	948 JM13
UM-250S-3250E (2-6")	10/4/2007		6.2 JM74	3.27 J	81.8 JM15		93.5 JM10	129 J	< 0.5	760 JM13
UM-250S-3250E (6-12")	10/4/2007		10.5 JM74	3.48 J	86.9 JM15		107 JM10	220 J	< 0.5	652 JM13
UM-500S-500E (0-2")	10/5/2007		11.8 JM74	1.06 J	96.3 JM15		66.4 JM10	97.1 J	< 0.5	188 JM13
UM-500S-500E (2-6")	10/5/2007		9.3 JM74	0.76 J	88.3 JM15		76.3 JM10	101 J	< 0.5	177 JM13
UM-500S-500E (6-12")	10/5/2007		8.1 JM74	0.55 J	82 JM15		72.6 JM10	101 J	< 0.5	175 JM13
UM-500S-2000E (0-2")	10/4/2007		21.0 JM74	0.347 J	183 JM15		34.2 JM10	27.4 J	< 0.5	40.9 JM13
UM-500S-2000E (2-6")	10/4/2007		17.9 JM74	0.548 J	237 JM15		92.2 JM10	51.6 J	< 0.5	111 JM13
UM-500S-2000E (6-12")	10/4/2007		15.3 JM74	0.373 J	232 JM15		94 JM10	50.7 J	< 0.5	86 JM13
UM-500S-2500E (0-2")	10/3/2007		12.2 JM74	1.25 J	373 JM15		40.4 JM10	63.7 J	< 0.5	222 JM13
UM-500S-2500E (2-6")	10/3/2007		7.2 JM74	0.738 J	355 JM15		43.6 JM10	64.8 J	< 0.5	220 JM13

Notes:

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-- - No Standard/screening level
< - Parameter not detected at or above the laboratory practical quantitation limit
M% - Matrix spike recoveries exceed acceptable limits.
J - The associated value is an estimated quantity.
Blank - No Data. Aluminum and iron were not sampled in 2007.
- Value meets or exceeds one or more screening level.

BRSD - Historic resample of Upper Marsh sediment sample locations
UM - Upper Marsh
MM - Middle Marsh
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RV - Reference Values

[a] The TEL is calculated as the geometric mean of the 15th percentile concentration of the toxic effects data set and the median of the no-effect data set. As such it represents the concentration below which adverse effects are expected to occur only rarely. Freshwater TELs are based on benthic community metrics and toxicity texts results. Adverse biological effects rarely seen below TEL.

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[c] The PAET is defined as the 95th percentile of values with no significant biological effects and concentrations greater than the lowest "hit" level. It is designed as an alternative value to the Apparent Effect Threshold to reduce the effects of random error.

[d] Entry is lowest, reliable value among a compilation of PAET levels for; H – Hyalella azteca bioassay or M – Microtox bioassay.

[e] The SEL is defined as the 90th-95th percentile screening level concentration based on in-situ benthic community structure. Contaminant concentration above the SEL is likely detrimental to the majority of benthic species.

[f] SAIC and Avocet Consulting. 2002. "Phase I Report: Development of Freshwater Sediment Quality Values for Use in Washington State." September. – Prioritizing Areas for Attention – Areas exceeding the SEL are considered the highest-priority areas for biological testing. Areas between the PAET and the SEL are considered medium priority for attention, and areas between the TEL and the PAET are considered low priority. Areas below the TEL are screened out entirely. http://www.ecy.wa.gov/pubs/0209050.pdf

[g] SAIC and Avocet Consulting. 2003. "Phase II Report: Development and recommendation of SQVs for Freshwater Sediments in Washington State." September. – Recommendations for Screening – Report recommends SQVs as defined in the Phase I report be used (see note f above). http://www.ecy.wa.gov/pubs/0309088.pdf

[h] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).

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Table 22a
Upper Marsh, Middle Marsh, and Lower Marsh Sediment Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)	Total Cadmium (mg/kg)	Total Copper (mg/kg)	Total Iron (mg/kg)	Total Lead (mg/kg)	Total Manganese (mg/kg)	Total Mercury (mg/kg)	Total Zinc (mg/kg)
Screening Levels	TEL [abfg]	--	5.9	0.596	35.7	--	35	--	0.174	123
	PAET [cbdf]	--	19	97.5	340	--	240	1,400	0.16	500
	SEL [ebf]	--	33	10	110	--	250	1,100	2	820
DEQ Action Level/RSLs/UBMC BTVs		77,000	40 [i]	70 [h]	3,100 [h]	58,270 [j]	1,109 [j]	4,893 [j]	23 [h]	23,000 [h]
Marsh Sediment RVs [k]		8,030	32.3	1.84	67.4	14,500	174	696	0.5	275
UM-500S-2500E (6-12")	10/3/2007		11.0 JM74	0.851 J	364 JM15		122 JM10	152 J	< 0.5	188 JM13
UM-500S-2750E (0-2")	10/4/2007		156.0 JM74	11 J	504 JM15		1210 JM10	7160 J	< 0.5	2190 JM13
UM-500S-2750E (2-6")	10/4/2007		74.2 JM74	8.8 J	318 JM15		794 JM10	8360 J	< 0.5	1510 JM13
UM-500S-2750E (6-12")	10/4/2007		67.8 JM74	7.13 J	290 JM15		678 JM10	8160 J	< 0.5	1340 JM13
UM-500S-3000E (0-2")	10/4/2007		87.4 JM74	9.1 J	438 JM15		2120 JM10	1180 J	< 0.5	1410 JM13
UM-500S-3000E (2-6")	10/4/2007		22.6 JM74	1.82 J	82 JM15		138 JM10	317 J	< 0.5	265 JM13
UM-500S-3000E (6-12")	10/4/2007		15.1 JM74	1.74 J	88.6 JM15		112 JM10	389 J	< 0.5	320 JM13
UM-500S-3250E (0-2")	10/4/2007		138.0 JM74	2.79 J	528 JM15		2210 JM10	2590 J	< 0.5	940 JM13
UM-500S-3250E (2-6")	10/4/2007		150.0 JM74	0.824 J	286 JM15		1460 JM10	428 J	< 0.5	668 JM13
UM-500S-3250E (6-12")	10/4/2007		100.0 JM74	1.15 J	214 JM15		608 JM10	276 J	< 0.5	573 JM13
UM-750S-3000E (0-2")	10/4/2007		164.0 JM74	10.7 J	405 JM15		1200 JM10	7110 J	< 0.5	2130 JM13
UM-750S-3000E (2-6")	10/4/2007		143.0 JM74	9.12 J	354 JM15		1070 JM10	7440 J	< 0.5	1770 JM13
UM-750S-3000E (6-12")	10/4/2007		142.0 JM74	9.13 J	343 JM15		1120 JM10	7280 J	< 0.5	1710 JM13
UM-750S-3500E (0-2")	10/4/2007		116.0 JM74	8 J	894 JM15		2240 JM10	7430 J	< 0.5	1250 JM13
UM-750S-3500E (2-6")	10/4/2007		157.0 JM74	13.2 J	342 JM15		996 JM10	7090 J	< 0.5	3010 JM13
UM-750S-3500E (6-12")	10/4/2007		138.0 JM74	18.3 J	409 JM15		1210 JM10	6350 J	< 0.5	2820 JM13
UM-1000S-3500E (0-2")	10/4/2007		238.0 JM74	2.19 J	221 JM15		1770 JM10	283 J	< 0.5	1720 JM13
UM-1000S-3500E (2-6")	10/4/2007		38.1 JM74	< 0.15 J	106 JM15		320 JM10	430 J	< 0.5	396 JM13
UM-1000S-3500E (6-12"	10/4/2007		12.6 JM74	0.989 J	86.6 JM15		81.7 JM10	153 J	< 0.5	182 JM13
BRSD-2 (0-2)	7/17/2008	3400	177.0	10.3	343	66600	1290	7690	< 0.5	1750
BRSD-2 (2-6)	7/17/2008	3660	132.0	16.9	409	47800	1590	6090	< 0.5	1990
BRSD-2 (6-12)	7/17/2008	5880	73.1	27.2	918	15200	4220	1230	< 0.5	4220
BRSD-3 (0-2")	7/17/2008	8220	38.0	3.62	1120	22400	1090	1240	< 0.5	1020
BRSD-3 (2-6")	7/17/2008	6940	54.2	4.82	1420	20400	2160	1690	< 0.5	1140
BRSD-3 (6-12")	7/17/2008	7740	19.9	2.34	1240	12900	348	648	< 0.5	538
BRSD-4 (0-2")	7/16/2008	16700	6.4	0.759	62.3	13000	111	210	< 0.5	181
BRSD-4 (2-6")	7/16/2008	17600	9.9	0.671	129	11700	114	95.4	< 0.5	214
BRSD-4 (6-12")	7/16/2008	11800	20.4	1.49	92.5	14800	212	473	< 0.5	318
BRSD-6 (0-2")	7/17/2008	1090	1.0	0.982	2.13	22600	1.94	12.3	< 0.5	7.69
BRSD-6 (2-6")	7/17/2008	2670	7.0	0.898	15.9	20800	7.04	25.6	< 0.5	21.7
BRSD-6 (6-12")	7/17/2008	3220	6.6	0.964	7.6	22900	4.16	< 10	< 0.5	34.7
BRSD-7 (0-2")	7/17/2008	1660	6.4	1.83	18.2	16600	23.8	32.8	< 0.5	663

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[g] SAIC and Avocet Consulting. 2003. "Phase II Report: Development and recommendation of SQVs for Freshwater Sediments in Washington State." September. – Recommendations for Screening – Report recommends SQVs as defined in the Phase I report be used (see note f above). http://www.ecy.wa.gov/pubs/0309088.pdf

[h] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).

[i] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).

[j] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

[k] Marsh Sediment Reference Values are Sediment Background Threshold Value (Sediment BTV - calculated using ProUCL v4.1.00).

Table 22a
Upper Marsh, Middle Marsh, and Lower Marsh Sediment Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)	Total Cadmium (mg/kg)	Total Copper (mg/kg)	Total Iron (mg/kg)	Total Lead (mg/kg)	Total Manganese (mg/kg)	Total Mercury (mg/kg)	Total Zinc (mg/kg)
Screening Levels	TEL [abfg]	--	5.9	0.596	35.7	--	35	--	0.174	123
	PAET [cbdf]	--	19	97.5	340	--	240	1,400	0.16	500
	SEL [ebf]	--	33	10	110	--	250	1,100	2	820
DEQ Action Level/RSLs/UBMC BTVs		77,000	40 [i]	70 [h]	3,100 [h]	58,270 [j]	1,109 [j]	4,893 [j]	23 [h]	23,000 [h]
Marsh Sediment RVs [k]		8,030	32.3	1.84	67.4	14,500	174	696	0.5	275
BRSD-7 (2-6")	7/17/2008	7820	12.0	0.162	56.5	28300	62.3	68.8	< 0.5	148
BRSD-7 (6-12")	7/17/2008	9320	7.2	0.2	48.6	21800	115	76.7	< 0.5	116
BRSD-8 (0-2")	7/16/2008	20900	7.4	5.64	194	23100	226	493	< 0.5	521
BRSD-8 (2-6")	7/16/2008	16300	7.9	8.6	188	28300	332	1410	< 0.5	579
BRSD-8 (6-12")	7/16/2008	17100	10.3	5.02	200	40500	300	1130	< 0.5	590
BRSD-9 (0-2")	7/16/2008	23300	23.0	4.91	83.9	29200	285	5550	< 0.5	652
BRSD-9 (2-6")	7/16/2008	12100	17.4	2.44	52.9	16600	58.8	2110	< 0.5	300
BRSD-9 (6-12")	7/16/2008	13200	16.2	1.74	84.1	33400	84.9	1760	< 0.5	352
BRSD-10 (0-2")	7/17/2008	7360	30.3	18	651	23500	632	3410	< 0.5	2870
BRSD-10 (2-6")	7/17/2008	8400	35.8	15.8	690	23000	804	3330	< 0.5	2340
BRSD-10 (6-12")	7/17/2008	11600	38.3	23.5	971	37300	1370	4920	< 0.5	3620
BRSD-11 (0-2")	7/17/2008	23500	14.7	5.55	133	16200	92.4	1360	< 0.5	456
BRSD-11 (2-6")	7/17/2008	15300	10.8	2.53	154	13200	92.6	317	< 0.5	297
BRSD-11 (6-12")	7/17/2008	15700	9.9	2.04	148	15100	104	292	< 0.5	301
BRSD-15 (0-2")	7/16/2008	9340	14.9	1.52	89.2	16800	66.9	635	< 0.5	167
BRSD-15 (2-6")	7/16/2008	14300	15.6	1.29	97.4	21000	112	1000	< 0.5	243
BRSD-15 (6-12")	7/16/2008	16400	16.8	1.75	97.9	22800	87	1310	< 0.5	282
BRSD-16 (0-2")	7/17/2008	4260	193.0	5.19	371	64400	2100	1040	< 0.5	822
BRSD-16 (2-6")	7/17/2008	8080	507.0	34.7	1120	199000	3130	10100	< 0.5	3890
BRSD-16 (6-12)	7/17/2008	7300	92.8	18	568	33400	3220	2380	< 0.5	2310
BRSD-24 (0-2)	7/17/2008	2860	193.0	13.7	392	78100	1080	7990	< 0.5	2040
BRSD-24 (2-6)	7/17/2008	5440	119.0	28	740	38500	2660	2860	< 0.5	3450
BRSD-24 (6-12)	7/17/2008	6020	63.4	14.3	553	23100	2290	1200	< 0.5	1740
BRSD-25 (0-2)	7/17/2008	5980	66.0	6.25	265	33100	836	1500	< 0.5	836
BRSD-25 (2-6)	7/17/2008	5650	60.0	8.84	402	22600	1460	1060	< 0.5	1120
BRSD-25 (6-12)	7/17/2008	3800	29.0	7.69	191	8760	1050	174	< 0.5	1030
Middle Marsh										
MMSD-201 (0-2")	11/4/2011	12200	21.0	9.5	435	27700	504	2010	< 0.5	1470
MMSD-201 (2-6")	11/4/2011	12400	21.0	14.8	600	25100	622	1480	< 0.5	2060
MMSD-201 (6-12")	11/4/2011	12700	24.0	18.4	726	24900	967	1780	< 0.5	2590
MMSD-202 (0-2")	11/4/2011	11800	22.0	1.1	438	16200	695	158	< 0.5	410
MMSD-202 (2-6")	11/4/2011	11100	23.0	1.3	516	15800	828	225	< 0.5	539

Notes:

mg/Kg - Milligrams per kilogram
-- - No Standard/screening level
< - Parameter not detected at or above the laboratory practical quantitation limit
M% - Matrix spike recoveries exceed acceptable limits.
J - The associated value is an estimated quantity.
Blank - No Data. Aluminum and iron were not sampled in 2007.
- Value meets or exceeds one or more screening level.

BRSD - Historic resample of Upper Marsh sediment sample locations
UM - Upper Marsh
MM - Middle Marsh
LM - Lower Marsh
RV - Reference Values

[a] The TEL is calculated as the geometric mean of the 15th percentile concentration of the toxic effects data set and the median of the no-effect data set. As such it represents the concentration below which adverse effects are expected to occur only rarely. Freshwater TELs are based on benthic community metrics and toxicity texts results. Adverse biological effects rarely seen below TEL.

[b] Cubbage, James, David Batts, Scott Breidenback. 1997. "Creation and Analysis of Freshwater Sediment Quality Values in Washington State". July. http://www.ecy.wa.gov/pubs/97323a.pdf

[c] The PAET is defined as the 95th percentile of values with no significant biological effects and concentrations greater than the lowest "hit" level. It is designed as an alternative value to the Apparent Effect Threshold to reduce the effects of random error.

[d] Entry is lowest, reliable value among a compilation of PAET levels for; H – Hyalella azteca bioassay or M – Microtox bioassay.

[e] The SEL is defined as the 90th-95th percentile screening level concentration based on in-situ benthic community structure. Contaminant concentration above the SEL is likely detrimental to the majority of benthic species.

[f] SAIC and Avocet Consulting. 2002. "Phase I Report: Development of Freshwater Sediment Quality Values for Use in Washington State." September. – Prioritizing Areas for Attention – Areas exceeding the SEL are considered the highest-priority areas for biological testing. Areas between the PAET and the SEL are considered medium priority for attention, and areas between the TEL and the PAET are considered low priority. Areas below the TEL are screened out entirely. http://www.ecy.wa.gov/pubs/0209050.pdf

[g] SAIC and Avocet Consulting. 2003. "Phase II Report: Development and recommendation of SQVs for Freshwater Sediments in Washington State." September. – Recommendations for Screening – Report recommends SQVs as defined in the Phase I report be used (see note f above). http://www.ecy.wa.gov/pubs/0309088.pdf

[h] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).

[i] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).

[j] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

[k] Marsh Sediment Reference Values are Sediment Background Threshold Value (Sediment BTV - calculated using ProUCL v4.1.00).

Table 22a
Upper Marsh, Middle Marsh, and Lower Marsh Sediment Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)	Total Cadmium (mg/kg)	Total Copper (mg/kg)	Total Iron (mg/kg)	Total Lead (mg/kg)	Total Manganese (mg/kg)	Total Mercury (mg/kg)	Total Zinc (mg/kg)
Screening Levels	TEL [abfg]	--	5.9	0.596	35.7	--	35	--	0.174	123
	PAET [cbdf]	--	19	97.5	340	--	240	1,400	0.16	500
	SEL [ebf]	--	33	10	110	--	250	1,100	2	820
DEQ Action Level/RSLs/UBMC BTVs		77,000	40 [i]	70 [h]	3,100 [h]	58,270 [j]	1,109 [j]	4,893 [j]	23 [h]	23,000 [h]
Marsh Sediment RVs [k]		8,030	32.3	1.84	67.4	14,500	174	696	0.5	275
MMSD-202 (6-12")	11/4/2011	12100	16.0	1.4	292	19700	262	272	< 0.5	498
Lower Marsh										
LMSD-201 (0-2")	11/4/2011	15600	9.0	< 0.2	81.7	13800	29	202	< 0.5	105
LMSD-201 (2-6")	11/4/2011	14900	7.0	< 0.2	80.9	12300	20	175	< 0.5	98
LMSD-201 (6-12")	11/4/2011	15700	8.0	< 0.2	84.4	13100	19	182	< 0.5	97
LMSD-202 (0-2")	11/4/2011	12200	6.0	1.5	64.8	9480	29	71	< 0.5	353
LMSD-202 (2-6")	11/4/2011	15100	8.0	1.2	48	10900	20	83	< 0.5	390
LMSD-202 (6-12")	11/4/2011	15500	6.0	0.4	52.2	11200	21	72	< 0.5	283
LMSD-203 (0-2")	11/4/2011	21100	24.0	0.6	287	38400	80	2040	< 0.5	521
LMSD-203 (2-6")	11/4/2011	20400	23.0	0.8	285	37900	85	2300	< 0.5	511
LMSD-203 (6-12")	11/4/2011	19900	25.0	2.8	360	40600	81	7180	< 0.5	740
LMSD-204 (0-2")	11/4/2011	16300	16.0	1	224	24200	90	322	< 0.5	365
LMSD-204 (2-6")	11/4/2011	16700	16.0	0.8	227	28300	87	484	< 0.5	359
LMSD-204 (6-12")	11/4/2011	15700	16.0	0.6	226	28200	84	580	< 0.5	336

Notes:

mg/Kg	- Milligrams per kilogram
--	- No Standard/screening level
<	- Parameter not detected at or above the laboratory practical quantitation limit
M%	- Matrix spike recoveries exceed acceptable limits.
J	- The associated value is an estimated quantity.
Blank	- No Data. Aluminum and iron were not sampled in 2007.
	- Value meets or exceeds one or more screening level.

BRSD	- Historic resample of Upper Marsh sediment sample locations
UM	- Upper Marsh
MM	- Middle Marsh
LM	- Lower Marsh
RV	- Reference Values

[a] The TEL is calculated as the geometric mean of the 15th percentile concentration of the toxic effects data set and the median of the no-effect data set. As such it represents the concentration below which adverse effects are expected to occur only rarely. Freshwater TELs are based on benthic community metrics and toxicity texts results. Adverse biological effects rarely seen below TEL.

[b] Cubbage, James, David Batts, Scott Breidenback. 1997. "Creation and Analysis of Freshwater Sediment Quality Values in Washington State". July. http://www.ecy.wa.gov/pubs/97323a.pdf

[c] The PAET is defined as the 95th percentile of values with no significant biological effects and concentrations greater than the lowest "hit" level. It is designed as an alternative value to the Apparent Effect Threshold to reduce the effects of random error.

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[h] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).

[i] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).

[j] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

[k] Marsh Sediment Reference Values are Sediment Background Threshold Value (Sediment BTV - calculated using ProUCL v4.1.00).

Table 22b
Upper Marsh, Middle Marsh and Lower Marsh Sediment ABA and SPLP Analytical Results

Sample ID	Date Collected	Specific Conductance (µmhos/cm)	pH (s.u.)	TOC (%)	Acid - Base Accounting								Synthetic Precipitation Leaching Procedure								
					Sulfur, Hot Water Extractable (%)	Total Sulfur (%)	Sulfur Sulfate (%)	Sulfur Pyritic (%)	Sulfur Organic (%)	Neutral Potential (t/kt)	Acid Potential (t/kt)	Acid/Base Potential (t/kt)	Aluminum (mg/L)	Arsenic (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Zinc (mg/L)
Marsh SPLP		--	--	--	--	--	--	--	--	--	--	--	--	0.01	0.005	1.3	11	0.015	0.32	0.002	2.0
Upper Marsh																					
UM-0N-250E (0-2")	10/5/2007	1490	4.8	6.73																	
UM-0N-250E (2-6")	10/5/2007	870	4.8	4.73	0.5	0.59	0.06	0.44	0.08	11 J	14	-3		< 0.1	< 0.01	0.1		0.1	0.1	0.0002	< 0.5
UM-0N-250E (6-12")	10/5/2007	750	4.8	4.19																	
UM-0N-500E (0-2")	10/5/2007	980	5.1	11.30	1.8	1.81	0.01	0.72	1.08	18 J	22	-4		< 0.1	< 0.01	0.2		0.1	0.1	< 0.0001	< 0.5
UM-0N-500E (2-6")	10/5/2007	1020	5.2	19.40																	
UM-0N-500E (6-12")	10/5/2007	1210	5.1	19.60		4.03				15 J	130	-110		< 0.1	< 0.01	0.5		< 0.1	0.1	< 0.0001	1.1
UM-0N-750E (0-2")	10/5/2007	610	3.7	9.95																	
UM-0N-750E (2-6")	10/5/2007	620	4.7	37.40	2.85	2.96	0.11	2.4	0.45	23 J	75	-52		< 0.1	< 0.01	< 0.1		< 0.1	0.1	< 0.0001	< 0.5
UM-0N-750E (6-12")	10/5/2007	620	4.7	26.90																	
UM-0N-1000E (0-2")	10/5/2007	570	5.4	33.70	5	5	< 0.01	2.77	2.23	13 J	87	-74		< 0.1	< 0.01	< 0.1		< 0.1	0.1	< 0.0001	< 0.5
UM-0N-1000E (2-6")	10/5/2007	950	5.2	34.30																	
UM-0N-1000E (6-12")	10/5/2007	620	5.2	25.80	6.4	6.4	< 0.01	3.6	2.8	15 J	110	-98		< 0.1	< 0.01	< 0.1		< 0.1	0.1	< 0.0001	< 0.5
UM-0N-1500E (0-2")	10/4/2007	460	5.8	2.86																	
UM-0N-1500E (2-6")	10/4/2007	370	5.8	1.97	0.2	0.25	0.06	0.18	< 0.01	8 J	5.8	2		< 0.1	< 0.01	0.2		< 0.1	0.1	< 0.0001	< 0.5
UM-0N-1500E (6-12")	10/4/2007	360	5.4	3.18																	
UM-0N-2000E (0-2")	10/4/2007	370	6.4	6.10	0.21	0.21	0.02	0.17	0.03	20 J	5.2	14		< 0.1	< 0.01	< 0.1		0.2	0.1	< 0.0001	< 0.5
UM-0N-2000E (2-6")	10/4/2007	410	6.4	6.01																	
UM-0N-2000E (6-12")	10/4/2007	410	6.5	6.18	0.24	0.26	0.04	0.2	0.02	16 J	6.2	9		< 0.1	< 0.01	< 0.1		0.1	0.1	< 0.0001	< 0.5
UM-0N-2500E (0-2")	10/3/2007	970	6.3	4.01																	
UM-0N-2500E (2-6")	10/3/2007	600	6.5	3.58																	
UM-250N-1750E (0-2)	7/18/2008	230	4.2	1.70	0.09	0.11	0.02	0.07	0.01	-2	2.5	-4	130	0.11	0.00099	0.66	82	0.49	0.69	0.00012	0.62
UM-250N-1750E (2-6)	7/18/2008	340	4.7	2.90																	
UM-250N-1750E (6-12)	7/18/2008	310	4.2	2.20	0.08	0.11	0.03	0.07	< 0.01	2	2.4		78	0.076	0.00066	0.52	49	0.3	0.27	< 0.0001	0.35
UM-250N-2250E (0-2)	7/18/2008	630	6.4	3.90																	
UM-250N-2250E (2-6)	7/18/2008	490	6.1	4.20	5.6	5.92	0.32	5.37	0.24	140	190	-47	4.7	0.027	0.00065	0.074	3.1	0.095	0.026	< 0.0001	0.28
UM-250N-2250E (6-12)	7/18/2008	390	5.6	4.80																	
UM-250N-2500E (0-2")	10/3/2007	860	6.8	1.91																	
UM-250N-2500E (2-6")	10/3/2007	570	7.1	3.32																	
UM-250N-2500E (6-12")	10/3/2007	690	7.0	3.62																	
UM-250S-250E (0-2")	10/5/2007	600	3.7	5.96	0.14	0.16	0.02	0.14	0.01	0 J	4.3	-5		< 0.1	< 0.01	< 0.1		< 0.1	0.1	< 0.0001	< 0.5
UM-250S-250E (2-6")	10/5/2007	480	4.1	2.25																	
UM-250S-250E (6-12")	10/5/2007	460	5.2	0.95	0.03	0.03	0.01	0.02	< 0.01	5 J	0.6	4		< 0.1	< 0.01	0.2		0.1	0.2	< 0.0001	< 0.5
UM-250S-500E (0-2")	10/5/2007	690	5.0	9.76																	
UM-250S-500E (2-6")	10/5/2007	280	4.7	2.91	0.15	0.15	0.03	0.1	0.02	3 J	3.1			< 0.1	< 0.01	0.3		0.3	0.1	< 0.0001	< 0.5
UM-250S-500E (6-12")	10/5/2007	210	4.2	1.42																	
UM-250S-1250E (0-2")	7/17/2008	210	4.0	1.90																	
UM-250S-1250E (2-6")	7/17/2008	230	3.9	1.80	0.02	0.07	0.05	0.02	< 0.01	0	0.78	-1	28	0.031	0.00015	0.17	28	0.12	0.095	< 0.0001	0.19

Notes:

µmhos/cm - Micromho per liter
s.u. - Standard units
% - Percent
t/tk - Tons per thousand tons
mg/L - Milligrams per liter
-- - No Standard/screening level
< - Parameter not detected at or above the laboratory practical quantitation limit
Blank - No data/not analyzed
J - The associated value is an estimated quantity.

Classification	Criteria for Classification [b]
Potentially Acid Generating	NP:AP [a] < 1 and NNP < -20 tons/kton
Uncertain Acid Generation Potential	NP:AP between 1 and 3 and/or NNP between -20 and +20 tons/kton
Unlikely to Generate Acid	NP:AP > 3 and NNP < +20 tons/kton

[a] NP = Neutralization Potenital, AP = Acidification Potential, NNP = Net Neutralization Potential.

[b] From BLM (1996) and EPA (1994).

Aluminum and iron were not sampled in 2007.
2011 data collected by Pioneer Technical Services, Inc.

*Iron and manganese SPLP Leachate Criterion for soil were calculated based on a DAF 1 and their respective EPA Tap Water standards. The SPLP Leachate Criterion for Soil for the remaining metals were calculated based on a DAF 1 and their respective DEQ-7 water quality standards (see Section 4 of RI report).

BRSD - Re-sample of Historic Upper Marsh Sediment Sample Locations
LM - Lower Marsh
MM - Middle Marsh
UM - Upper Marsh

Table 22b
Upper Marsh, Middle Marsh and Lower Marsh Sediment ABA and SPLP Analytical Results

Sample ID	Date Collected	Specific Conductance (µmhos/cm)	pH (s.u.)	TOC (%)	Acid - Base Accounting								Synthetic Precipitation Leaching Procedure								
					Sulfur, Hot Water Extractable (%)	Total Sulfur (%)	Sulfur Sulfate (%)	Sulfur Pyritic (%)	Sulfur Organic (%)	Neutral Potential (t/kt)	Acid Potential (t/kt)	Acid/Base Potential (t/kt)	Aluminum (mg/L)	Arsenic (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Zinc (mg/L)
Marsh SPLP		--	--	--	--	--	--	--	--	--	--	--	--	**0.01**	**0.005**	**1.3**	**11**	**0.015**	**0.32**	**0.002**	**2.0**
UM-250S-1250E (6-12")	7/17/2008	200	3.9	1.50																	
UM-250S-1500E (0-2")	10/4/2007	520	6.4	2.10	0.11	0.11	0.03	0.08	< 0.01	8 J	2.6	6		< 0.1	< 0.01	0.2		0.6	0.3	< 0.0001	1.2
UM-250S-1500E (2-6")	10/4/2007	540	6.4	3.71																	
UM-250S-1500E (6-12")	10/4/2007	530	6.4	4.70	0.01	0.11	0.05	0.05	< 0.01	13 J	1.7	11		< 0.1	< 0.01	0.1		0.3	0.1	< 0.0001	< 0.5
UM-250S-2500E (0-2")	10/3/2007	770	6.2	3.72																	
UM-250S-2500E (6-12")	10/3/2007	420	5.8	2.52	0.14	0.17	0.04	0.13	< 0.01	10 J	3.9	6		< 0.1	< 0.01	0.1		< 0.1	0.1	< 0.0001	< 0.5
UM-250S-2750E (0-2")	10/4/2007	910	6.5	3.71	6.23	7	0.77	6.03	0.2	240 J	190	48		< 0.1	< 0.01	< 0.1		0.8	0.4	< 0.0001	< 0.5
UM-250S-2750E (2-6")	10/4/2007	740	6.1	4.07																	
UM-250S-2750E (6-12")	10/4/2007	1570	6.0	6.91	3.16	3.56	< 0.01	3.61	0.46	59 J	110	-54		0.1	< 0.01	0.2		1.7	0.1	0.00012	0.7
UM-250S-3000E (0-2")	10/4/2007	1100	6.2	3.68																	
UM-250S-3000E (2-6")	10/4/2007	1050	6.2	3.53	7.21	7.21	< 0.01	6.87	0.34	34 J	210	-180		< 0.1	< 0.01	0.2		0.3	0.1	< 0.0001	< 0.5
UM-250S-3000E (6-12")	10/4/2007	670	6.6	2.56																	
UM-250S-3250E (0-2")	10/4/2007	400	5.0	3.63	0.05	0.05	< 0.01	0.04	0.01	10 J	1.3	9		< 0.1	< 0.01	0.1		< 0.1	0.1	< 0.0001	0.8
UM-250S-3250E (2-6")	10/4/2007	390	5.5	2.49																	
UM-250S-3250E (6-12")	10/4/2007	360	5.5	1.00	0.02	0.02	0.01	< 0.01	< 0.01	7 J	0.12	7		< 0.1	< 0.01	0.1		0.1	0.1	< 0.0001	0.9
UM-500N-2500E (0-2")	10/3/2007	470	6.4	3.23																	
UM-500N-2500E (2-6")	10/3/2007	380	6.6	2.16																	
UM-500N-2500E (6-12")	10/3/2007	680	6.2	2.19																	
UM-500S-500E (0-2")	10/5/2007	440	4.8	3.11	0.24	0.3	0.06	0.22	0.02	8 J	6.9			< 0.1	< 0.01	< 0.1		< 0.1	0.1	< 0.0001	< 0.5
UM-500S-500E (2-6")	10/5/2007	310	4.8	3.13																	
UM-500S-500E (6-12")	10/5/2007	350	4.9	0.67	0.07	0.07	0.04	0.03	< 0.01	4 J	0.93	3		< 0.1	< 0.01	0.1		< 0.1	0.1	< 0.0001	< 0.5
UM-500S-2000E (0-2")	10/4/2007	450	4.6	19.40																	
UM-500S-2000E (2-6")	10/4/2007	470	4.4	5.72	0.16	0.2	0.07	0.1	0.03	0 J	3.2	-3		< 0.1	< 0.01	< 0.1		< 0.1	0.1	< 0.0001	< 0.5
UM-500S-2000E (6-12")	10/4/2007	430	4.5	4.58																	
UM-500S-2500E (0-2")	10/3/2007	1070	4.5	10.30																	
UM-500S-2500E (2-6")	10/3/2007	1110	4.6	7.69																	
UM-500S-2500E (6-12")	10/3/2007	310	5.2	2.14																	
UM-500S-2750E (0-2")	10/4/2007	1310	6.2	3.55																	
UM-500S-2750E (2-6")	10/4/2007	2240	6.3	3.03	8.16	8.5	0.34	7.74	0.42	210 J	240	-34		< 0.1	< 0.01	< 0.1		0.4	0.3	< 0.0001	< 0.5
UM-500S-2750E (6-12")	10/4/2007	1020	6.7	3.03																	
UM-500S-3000E (0-2")	10/4/2007	2120	6.0	3.10	11.4	11.4	< 0.01	10.7	0.73	160 J	330	-180		< 0.1	< 0.01	0.1		1.1	0.1	< 0.0001	< 0.5
UM-500S-3000E (2-6")	10/4/2007	910	5.9	2.56																	
UM-500S-3000E (6-12")	10/4/2007	920	5.9	1.69	0.41	0.44	0.1	0.32	0.02	9 J	10	0		< 0.1	< 0.01	< 0.1		0.1	0.1	< 0.0001	< 0.5
UM-500S-3250E (0-2")	10/4/2007	6530	2.4	2.33																	
UM-500S-3250E (2-6")	10/4/2007	7370	2.2	1.36	0.51	0.74	0.53	0.18	0.04	-4 J	5.5	-10		< 0.1	0.02	0.6		2.2	10	< 0.0001	3
UM-500S-3250E (6-12")	10/4/2007	15400	1.8	0.40																	
UM-750S-3000E (0-2")	10/4/2007	2380	6.6	3.73																	
UM-750S-3000E (2-6")	10/4/2007	1960	6.8	3.36	4.16	4.6	0.44	4.05	0.11	230 J	130	110		< 0.1	< 0.01	< 0.1		0.2	1.1	< 0.0001	< 0.5
UM-750S-3000E (6-12")	10/4/2007	1150	6.8	3.90																	
UM-750S-3500E (0-2")	10/4/2007	1210	4.2	4.67	0.91	1.07	0.18	0.86	0.03	6 J	27	-21		< 0.1	0.03	0.2		< 0.1	1.2	< 0.0001	2.7

Notes:

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% - Percent
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mg/L - Milligrams per liter
-- - No Standard/screening level
< - Parameter not detected at or above the laboratory practical quantitation limit
Blank - No data/not analyzed
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Classification	Criteria for Classification [b]
Potentially Acid Generating	NP:AP [a] < 1 and NNP < -20 tons/kton
Uncertain Acid Generation Potential	NP:AP between 1 and 3 and/or NNP between -20 and +20 tons/kton
Unlikely to Generate Acid	NP:AP > 3 and NNP < +20 tons/kton

BRSD - Re-sample of Historic Upper Marsh Sediment Sample Locations
LM - Lower Marsh
MM - Middle Marsh
UM - Upper Marsh

[a] NP = Neutralization Potenital, AP = Acidification Potential, NNP = Net Neutralization Potential.

[b] From BLM (1996) and EPA (1994).

Aluminum and iron were not sampled in 2007.
2011 data collected by Pioneer Technical Services, Inc.

*Iron and manganese SPLP Leachate Criterion for soil were calculated based on a DAF 1 and their respective EPA Tap Water standards. The SPLP Leachate Criterion for Soil for the remaining metals were calculated based on a DAF 1 and their respective DEQ-7 water quality standards (see Section 4 of RI report).

Table 22b
Upper Marsh, Middle Marsh and Lower Marsh Sediment ABA and SPLP Analytical Results

Sample ID	Date Collected	Specific Conductance (µmhos/cm)	pH (s.u.)	TOC (%)	Acid - Base Accounting								Synthetic Precipitation Leaching Procedure								
					Sulfur, Hot Water Extractable (%)	Total Sulfur (%)	Sulfur Sulfate (%)	Sulfur Pyritic (%)	Sulfur Organic (%)	Neutral Potential (t/kt)	Acid Potential (t/kt)	Acid/Base Potential (t/kt)	Aluminum (mg/L)	Arsenic (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Zinc (mg/L)
Marsh SPLP		--	--	--	--	--	--	--	--	--	--	--	--	**0.01**	**0.005**	**1.3**	**11**	**0.015**	**0.32**	**0.002**	**2.0**
UM-750S-3500E (2-6")	10/4/2007	2210	6.1	2.28																	
UM-750S-3500E (6-12")	10/4/2007	1150	6.8	2.67	7.38	7.41	0.03	7.16	0.22	180 J	220	-41		< 0.1	< 0.01	< 0.1		< 0.1	0.2	< 0.0001	< 0.5
UM-1000S-3500E (0-2")	10/4/2007	1180	4.2	0.79																	
UM-1000S-3500E (2-6")	10/4/2007	860	4.3	2.13	0.1	0.13	0.09	0.03	< 0.01	2 J	1	1		< 0.1	< 0.01	< 0.1		0.2	0.1	< 0.0001	< 0.5
UM-1000S-3500E (6-12")	10/4/2007	560	3.7	1.50																	
BRSD-2 (0-2)	7/17/2008	480	6.1	3.80																	
BRSD-2 (2-6)	7/17/2008	600	5.9	4.10	6.5	6.5	< 0.01	5.81	0.69	3	200	-200	4.0	0.072	0.0048	0.21	3.9	1.9	0.1	< 0.0001	0.78
BRSD-2 (6-12)	7/17/2008	580	5.9	4.90																	
BRSD-3 (0-2")	7/17/2008	1420	4.2	8.60	1.22	1.39	0.17	1.21	0.01	8	42	-34	0.04	< 0.003	0.0022	0.01	< 0.05	0.0052	2.8	0.00021	0.06
BRSD-3 (2-6")	7/17/2008	1280	4.0	7.70																	
BRSD-3 (6-12")	7/17/2008	1230	4.3	7.30	0.22	0.29	0.08	0.2	< 0.01	0	6.3	-6	0.68	< 0.003	0.00015	0.017	0.35	0.0082	0.46	< 0.0001	0.05
BRSD-4 (0-2")	7/16/2008	290	5.4	3.00																	
BRSD-4 (2-6")	7/16/2008	240	5.2	2.50	0.24	0.27	0.04	0.22	< 0.01	7	7	0	25	0.047	0.00083	0.18	12	0.1	0.064	< 0.0001	0.22
BRSD-4 (6-12")	7/16/2008	270	5.6	2.30																	
BRSD-6 (0-2")	7/17/2008	960	4.5	19.00																	
BRSD-6 (2-6")	7/17/2008	650	3.6	22.00	5.4	5.81	0.16	4.86	0.79	-6	150	-160	3.6	< 0.003	< 0.00008	0.011	19	0.0033	0.016	< 0.0001	0.02
BRSD-6 (6-12")	7/17/2008	790	3.7	23.00															<		
BRSD-7 (0-2")	7/17/2008	610	4.8	12.00	3.05	3.22	0.17	1.16	1.89	9	45	-36	40	0.049	0.00037	0.25	85	0.19	0.18	0.00011	0.52
BRSD-7 (2-6")	7/17/2008	320	4.1	2.90																	
BRSD-7 (6-12")	7/17/2008	220	3.9	0.90	0.06	0.1	0.05	0.05	< 0.01	0	1.5	-2	46	0.041	0.00029	0.36	60	0.22	0.16	< 0.0001	0.56
BRSD-8 (0-2")	7/16/2008	200	5.2	5.40	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	9	0.23	9	36	0.009	0.0042	0.28	33	0.3	0.23	< 0.0001	0.88
BRSD-8 (2-6")	7/16/2008	170	5.2	3.00																	
BRSD-8 (6-12")	7/16/2008	130	5.2	2.90	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	8	< 0.01	8	35	0.02	0.0014	0.13	30	0.16	0.82	0.0001	0.53
BRSD-9 (0-2")	7/16/2008	290	5.6	5.30																	
BRSD-9 (2-6")	7/16/2008	190	5.4	1.90	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	7	0.16	7	38	0.023	0.001	0.1	36	0.14	1.2	< 0.0001	0.59
BRSD-9 (6-12")	7/16/2008	220	5.6	1.40																	
BRSD-10 (0-2")	7/17/2008	300	6.2	5.60																	
BRSD-10 (2-6")	7/17/2008	280	6.3	5.00	0.36	0.41	0.03	0.37	< 0.01	17	12	5	3.4	0.015	0.0018	0.14	8.3	0.22	0.17	< 0.0001	0.63
BRSD-10 (6-12")	7/17/2008	250	6.3	5.20																	
BRSD-11 (0-2")	7/17/2008	180	4.8	8.70	0.02	0.04	< 0.01	0.05	0.01	7	1.1	6	110	0.033	0.0042	0.36	47	0.21	0.2	0.00019	1.2
BRSD-11 (2-6")	7/17/2008	550	5.0	4.30																	
BRSD-11 (6-12")	7/17/2008	100	5.4	3.40	< 0.01	< 0.01	< 0.01	0.03	< 0.01	0	0.07	0	180	0.069	0.0071	0.79	87	0.51	0.28	0.00031	2.1
BRSD-15 (0-2")	7/16/2008	260	4.7	3.30	< 0.01	0.01	0.01	< 0.01	< 0.01	4	0.39	4	20	0.024	0.00068	0.11	25	0.094	0.73	< 0.0001	0.31
BRSD-15 (2-6")	7/16/2008	360	5.4	2.80																	
BRSD-15 (6-12")	7/16/2008	260	5.4	2.60	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	7	< 0.01	7	18	0.02	0.00046	0.072	18	0.082	0.48	< 0.0001	0.26
BRSD-16 (0-2")	7/17/2008	1960	2.6	1.90																	
BRSD-16 (2-6")	7/17/2008	2730	2.9	2.30	1.13	1.31	0.39	0.9	0.02	-2	28	-30	0.06	< 0.003	0.001	0.007	< 0.05	0.0099	5.8	< 0.0001	0.02
BRSD-16 (6-12)	7/17/2008	1580	6.0	3.00																	
BRSD-24 (0-2)	7/17/2008	690	6.5	3.30																	
BRSD-24 (2-6)	7/17/2008	670	6.1	4.40	5.69	5.69	< 0.01	5.06	0.63	82	180	-96	3.3	0.047	0.0048	0.18	3.0	1.6	0.098	< 0.0001	0.98

Notes:

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< - Parameter not detected at or above the laboratory practical quantitation limit
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Classification	Criteria for Classification [b]
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Uncertain Acid Generation Potential	NP:AP between 1 and 3 and/or NNP between -20 and +20 tons/kton
Unlikely to Generate Acid	NP:AP > 3 and NNP < +20 tons/kton

[a] NP = Neutralization Potenital, AP = Acidification Potential, NNP = Net Neutralization Potential.

[b] From BLM (1996) and EPA (1994).

Aluminum and iron were not sampled in 2007.
2011 data collected by Pioneer Technical Services, Inc.

*Iron and manganese SPLP Leachate Criterion for soil were calculated based on a DAF 1 and their respective EPA Tap Water standards. The SPLP Leachate Criterion for Soil for the remaining metals were calculated based on a DAF 1 and their respective DEQ-7 water quality standards (see Section 4 of RI report).

BRSD - Re-sample of Historic Upper Marsh Sediment Sample Locations
LM - Lower Marsh
MM - Middle Marsh
UM - Upper Marsh

Table 22b
Upper Marsh, Middle Marsh and Lower Marsh Sediment ABA and SPLP Analytical Results

Sample ID	Date Collected	Specific Conductance (µmhos/cm)	pH (s.u.)	TOC (%)	Acid - Base Accounting								Synthetic Precipitation Leaching Procedure								
					Sulfur, Hot Water Extractable (%)	Total Sulfur (%)	Sulfur Sulfate (%)	Sulfur Pyritic (%)	Sulfur Organic (%)	Neutral Potential (t/kt)	Acid Potential (t/kt)	Acid/Base Potential (t/kt)	Aluminum (mg/L)	Arsenic (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Zinc (mg/L)
Marsh SPLP		--	--	--	--	--	--	--	--	--	--	--	--	**0.01**	**0.005**	**1.3**	**11**	**0.015**	**0.32**	**0.002**	**2.0**
BRSD-24 (6-12)	7/17/2008	570	5.9	4.30																	
BRSD-25 (0-2)	7/17/2008	1220	6.3	2.40	7.17	8.02	0.85	6.75	0.42	92	250	-160	6.3	0.03	0.0043	0.27	7.2	1.7	0.18	< 0.0001	0.68
BRSD-25 (2-6)	7/17/2008	800	6.3	3.20																	
BRSD-25 (6-12)	7/17/2008	950	6.3	4.10	5.95	6.03	0.09	5.6	0.34	69	190	-120	5.7	0.057	0.0077	0.31	5.0	1.8	0.05	< 0.0001	1.1
Middle Marsh																					
MMSD-201 (0-2")	11/4/2011	900	5.9	3.20																	
MMSD-201 (2-6")	11/4/2011	800	5.9	4.00																	
MMSD-201 (6-12")	11/4/2011	600	5.9	3.85									3.5	0.007	0.0031	0.13	4.9	0.18	0.043	0.000077	0.52
MMSD-202 (0-2")	11/4/2011	400	5.1	4.25																	
MMSD-202 (2-6")	11/4/2011	200	5.6	3.78																	
MMSD-202 (6-12")	11/4/2011	200	6.0	3.33																	
Lower Marsh																					
LMSD-201 (0-2")	11/4/2011	200	6.6	4.39																	
LMSD-201 (2-6")	11/4/2011	200	6.6	4.25																	
LMSD-201 (6-12")	11/4/2011	100	6.7	3.41																	
LMSD-202 (0-2")	11/4/2011	200	6.3	5.50																	
LMSD-202 (2-6")	11/4/2011	100	6.6	4.27																	
LMSD-202 (6-12")	11/4/2011	100	6.5	2.78																	
LMSD-203 (0-2")	11/4/2011	100	6.7	2.40																	
LMSD-203 (2-6")	11/4/2011	100	6.7	2.44																	
LMSD-203 (6-12")	11/4/2011	100	6.9	2.42									18	0.009	UB 0.0011	0.12	15	0.024	0.24	0.0001	UB 0.26
LMSD-204 (0-2")	11/4/2011	100	6.6	2.17																	
LMSD-204 (2-6")	11/4/2011	200	6.6	2.09																	
LMSD-204 (6-12")	11/4/2011	200	6.6	2.11																	

Notes:

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Aluminum and iron were not sampled in 2007.
2011 data collected by Pioneer Technical Services, Inc.

*Iron and manganese SPLP Leachate Criterion for soil were calculated based on a DAF 1 and their respective EPA Tap Water standards. The SPLP Leachate Criterion for Soil for the remaining metals were calculated based on a DAF 1 and their respective DEQ-7 water quality standards (see Section 4 of RI report).

Table 23a
Groundwater Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/L)	Total Arsenic (mg/L)	Total Cadmium (mg/L)	Total Copper (mg/L)	Total Iron (mg/L)	Total Lead (mg/L)	Total Manganese (mg/L)	Total Mercury (mg/L)	Total Zinc (mg/L)
Groundwater Standards	MDEQ 2012 [a]	--	0.01	0.005	1.3	--	0.015	--	0.002	2
ANMW-7	10/12/2007	0.04 BJ	< 0.002	0.00241	0.069	< 0.03	< 0.0005	0.245	< 0.00005	0.54
ANMW-7	7/9/2008	< 0.03	< 0.002	0.00095	0.021	< 0.03	< 0.0005	0.051	< 0.00005	0.37
ANMW-9	7/7/2008	< 0.03	< 0.002	< 0.00008	0.001	< 0.03	< 0.0005	0.008	< 0.00005	< 0.01
ANWS-1	10/12/2007	< 0.03	< 0.002	0.00009	< 0.001	0.07	< 0.0005	0.008	< 0.00005	< 0.01
ANWS-1	7/8/2008	< 0.03	< 0.002	< 0.00008	< 0.001	0.06	< 0.0005	0.007	< 0.00005	0.01
BCGW-115	10/26/2007	0.04	< 0.002	0.00018	< 0.001	< 0.03	< 0.0005	0.015	< 0.00005	0.03
BCGW-115	7/9/2008	< 0.03	< 0.002	0.00018	< 0.001	< 0.03	< 0.0005	0.005	< 0.00005	0.02
BCGW-116	7/31/2008	< 0.03	< 0.002	< 0.00008	< 0.001	< 0.03	< 0.0005	0.239	< 0.00005	< 0.01
BCMW-10	10/17/2007	0.65	< 0.002	0.08425	0.176	< 0.03	0.0352	6.74	< 0.00005	13.97
BCMW-10	7/7/2008	0.66	< 0.002	0.08954	0.156	< 0.03	0.0492	5.24	< 0.00005	17.35
BRGW-101	10/16/2007	< 0.03	< 0.002	< 0.00008	< 0.001	0.25	< 0.0005	0.184	< 0.00005	< 0.01
BRGW-101	7/11/2008	< 0.03	< 0.002	< 0.00008	< 0.001	0.5	< 0.0005	0.213	< 0.00005	< 0.01
BRGW-110	10/18/2007	0.04	< 0.002	0.0003	0.003	0.15	< 0.0005	0.186	< 0.00005	0.04
BRGW-110	7/9/2008	< 0.03	< 0.002	0.00028	0.052	< 0.03	< 0.0005	0.059	< 0.00005	0.04
EDGW-105	10/17/2007	1.91	< 0.002	0.00071	0.463	10.83	< 0.0005	0.786	< 0.00005	0.26
EDGW-105	7/10/2008	3.58	< 0.002	0.00065	0.555	9.41	0.0012	0.495	< 0.00005	0.26
EDMW-2	10/17/2007	< 0.03	< 0.002	0.00039	0.002	1.84	< 0.0005	1.039	< 0.00005	0.07
EDMW-2	7/10/2008	< 0.03	< 0.002	0.00046	0.002	1.24	< 0.0005	0.56	< 0.00005	0.02
EDP-2	10/17/2007	3.73	< 0.002	0.00115	0.117	23.98	< 0.0005	1.499	< 0.00005	0.58
EDP-2	7/10/2008	4.2	< 0.002	0.00122	0.118	24.15	< 0.0005	1.541	< 0.00005	0.64
LCMW-1	10/16/2007	< 0.03	< 0.002	0.00965	0.019	0.04 BJ	< 0.0005	0.119	< 0.00005	0.2
LCMW-1	7/11/2008	< 0.03	< 0.002	0.00325	0.02	0.17	< 0.0005	0.122	< 0.00005	0.2
LCMW-12D	10/16/2007	< 0.03	< 0.002	0.01923	0.029	43.8	< 0.0005	39.16	< 0.00005	1.26
LCMW-12D	7/11/2008	< 0.03	< 0.002	0.00576	0.004	10.16	0.0006	13.52	< 0.00005	0.48
LCMW-12D	11/3/2011	< 0.03	< 0.003	0.0219	0.048	54.2	< 0.0005	49.6	< 0.00001	1.58
LCMW-12S	10/16/2007	< 0.03	0.004	0.00009	< 0.001	45.23	< 0.0005	28.88	< 0.00005	0.57
LCMW-12S	7/15/2008	< 0.03	0.004	< 0.00008	< 0.001	46.99	< 0.0005	34.14	< 0.00005	0.56
LCMW-12S	11/3/2011	< 0.03	< 0.003	0.00009	0.002	50.3	< 0.0005	34.4	< 0.00001	0.58
LCMW-5	10/16/2007	1.83	< 0.002	0.1562	0.761	15.79	0.0342	20.01	< 0.00005	6.78
LCMW-5	7/10/2008	3.22	< 0.002	0.1775	1.375	6.52	0.0602	13.14	< 0.00005	7.53
LCMW-5	11/3/2011	0.23	< 0.003	0.0795	0.189	18.4	0.0042	11.9	< 0.00001	2.7
LCMW-6D	11/3/2011	< 0.03	< 0.003	0.00476	0.012	0.29	< 0.0005	5.2	< 0.00001	0.65
LCMW-6S	11/3/2011	0.06	< 0.003	0.121	0.138	0.37	< 0.0005	10.9	< 0.00001	5.47
MHGW-109	10/12/2007	< 0.03	< 0.002	0.03074	0.042	0.03	0.0012	0.098	< 0.00005	7.24
MHGW-109	7/8/2008	0.13	< 0.002	0.05209	0.136	< 0.03	0.004	0.567	< 0.00005	11.08
MHGW-112	10/26/2007	< 0.03	< 0.002	0.00957	0.002	< 0.03	0.001	1.12	< 0.00005	1.79
MHGW-112	7/8/2008	< 0.03	< 0.002	0.0073	0.002	< 0.03	< 0.0005	0.005	< 0.00005	1.79
MHGW-113	10/26/2007	0.18	< 0.002	< 0.00008	< 0.001	< 0.03	< 0.0005	0.177	< 0.00005	0.01
MHGW-113	7/8/2008	< 0.03	< 0.002	< 0.00008	< 0.001	< 0.03	< 0.0005	0.174	< 0.00005	< 0.01
MHGW-115 Dry	10/12/2007									
MHMW-8	10/12/2007	< 0.03	< 0.002	0.06788	0.05	0.03	0.0006	0.059	< 0.00005	14.9

Notes:

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[a] Human Health Standard from Circular DEQ-7, Montana Water Quality Standards (October 2012).

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MH	- Mike Horse	SW	- Swamp Gulch
MP	- Mary P.	UC	- Upper Carbonate
UMH and MW	- Upper Mike Horse	UM	- Upper Marsh

Table 23a
Groundwater Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/L)	Total Arsenic (mg/L)	Total Cadmium (mg/L)	Total Copper (mg/L)	Total Iron (mg/L)	Total Lead (mg/L)	Total Manganese (mg/L)	Total Mercury (mg/L)	Total Zinc (mg/L)
Groundwater Standards	MDEQ 2012 [a]	--	0.01	0.005	1.3	--	0.015	--	0.002	2
MHMW-8	7/8/2008	< 0.03	< 0.002	0.0669	0.046	< 0.03	0.0009	0.033	< 0.00005	18.21
MPP-4	10/18/2007	0.29	< 0.002	0.00254	0.07	0.12	< 0.0005	0.166	< 0.00005	0.46
MPP-4	7/29/2008	1.15	< 0.002	0.00298	0.108	< 0.03	0.019	0.13	< 0.00005	0.67
MPP-4	7/9/2008	1.21	< 0.002	0.00338	0.104	0.03	0.0012	0.174	< 0.00005	0.71
MW-1	10/11/2007	< 0.03	< 0.002	0.0002	0.001	< 0.03	< 0.0005	0.005	< 0.00005	0.04
MW-1	7/7/2008	< 0.03	0.004	0.00041	0.001	< 0.03	< 0.0005	0.377	< 0.00005	0.07
PDGW101	7/31/2008	3.47	< 0.002	0.0014	0.08	8.7	0.0027	0.668	< 0.00005	0.3
PDGW102	7/31/2008	6.63	0.003	< 0.00008	0.275	12.73	0.0007	0.376	< 0.00005	0.26
PGPZ-1	7/16/2008	< 0.03	0.04	< 0.00008	< 0.001	18.56	< 0.0005	2.149	< 0.00005	0.02
PMGW-116	10/25/2007	< 0.03	< 0.002	0.00263	0.004	< 0.03	< 0.0005	0.023	< 0.00005	0.3
PMGW-116	7/14/2008	< 0.03	< 0.002	0.00222	0.003	< 0.03	< 0.0005	0.005	< 0.00005	0.29
PMGW-117	10/25/2007	2.74	< 0.002	0.00562	0.895	0.05	0.0021	0.938	< 0.00005	0.82
PMGW-117	7/14/2008	5.31	< 0.0002	0.00431	1.029	< 0.03	0.0032	0.783	< 0.00005	0.69
PMGW-118	10/18/2007	0.29	< 0.002	0.0022	0.127	< 0.03	0.001	1.739	< 0.00005	0.2
PMGW-118	7/14/2008	< 0.03	< 0.002	< 0.00008	< 0.001	< 0.03	< 0.0005	0.163	< 0.00005	< 0.01
PMGW-119	10/18/2007	0.53	< 0.002	0.00175	2.866	1.37	< 0.0005	1.215	< 0.00005	0.41
PMGW-119	7/14/2008	4.44	< 0.002	0.00372	0.64	4.66	0.0007	1.308	< 0.00005	0.5
PMGW-120	10/15/2007	11.64	< 0.002	0.00102 J	1.666	21.25	0.001 J	0.972	< 0.00005	0.3
PMGW-120	7/15/2008	15.24	< 0.002	0.00103	1.222	18.87	0.0018	0.689	< 0.00005	0.2
PMMW-13	10/16/2007	3.05	< 0.002	0.00512	0.312	26.28	0.0007	3.277	< 0.00005	0.86
PMMW-13	7/14/2008	3.55	< 0.002	0.00482	0.397	24.6	0.0006	3.296	< 0.00005	0.86
PMMW-14	10/15/2007	0.22	< 0.002	0.00104 J	0.1	14.91	0.0011 J	1.546	< 0.00005	0.34
PMMW-14	7/14/2008	0.25	< 0.002	0.00134	0.186	11.3	0.001	2.286	< 0.00005	0.35
PMMW-15	10/15/2007	0.03	< 0.002	0.00008 J	0.034	0.67	< 0.0005	0.038	< 0.00005	0.07
PMMW-15	7/15/2008	< 0.03	< 0.002	< 0.00008	0.001	< 0.03	< 0.0005	0.005	< 0.00005	< 0.01
PMPZ-3	7/7/2008	3.93	< 0.002	0.00053	0.002	15.12	< 0.0005	0.495	< 0.00005	0.19
PMPZ-4	10/15/2007	4.51	< 0.002	0.00088 J	0.002	14.96	0.0009 J	0.501	< 0.00005	0.27
PMPZ-4	7/7/2008	0.42	< 0.002	< 0.00008	0.004	< 0.03	< 0.0005	0.133	< 0.00005	0.03
SGGW-101	10/15/2007	1.72	< 0.002	0.00048 J	0.266	0.1	0.0007 J	0.164	< 0.00005	0.23
SGGW-101	7/10/2008	1.73	< 0.002	0.00053	0.223	0.29	0.0019	0.158	< 0.00005	0.2
SGGW-102	10/15/2007	0.21	< 0.002	0.00174 J	0.14	0.06	< 0.0005	0.206	< 0.00005	0.33
SGGW-102	7/9/2008	0.19	< 0.002	0.00132	0.104	< 0.03	0.0024	0.115	< 0.00005	0.21
SHGW101	7/31/2008	< 0.03	< 0.002	0.00013	< 0.001	< 0.03	< 0.0005	0.005	< 0.00005	0.05
SHGW102	7/31/2008	< 0.03	< 0.002	0.0019	0.001	0.42	< 0.0005	1.928	< 0.00005	0.21
SWGW-101 Dry	10/16/2007									
SWGW-101 **	7/7/2008									
SWGW-101	11/3/2011									
SWGW-102 Dry	10/16/2007									
SWGW-102 **	7/7/2008									
SWGW-102	11/3/2011									
SWGW-103	10/17/2007	0.07	< 0.002	0.00156	0.043	1.56	0.0013	0.897	< 0.00005	0.11
SWGW-103	7/10/2008	< 0.03	< 0.002	0.0004	0.022	0.21	< 0.0005	0.323	< 0.00005	0.07
SWGW-103	11/3/2011	0.07	< 0.003	0.00033	0.032	0.05	< 0.0005	0.284	< 0.00001	0.06

Notes:

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UMH and MW	- Upper Mike Horse	UM	- Upper Marsh

Table 23a
Groundwater Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/L)	Total Arsenic (mg/L)	Total Cadmium (mg/L)	Total Copper (mg/L)	Total Iron (mg/L)	Total Lead (mg/L)	Total Manganese (mg/L)	Total Mercury (mg/L)	Total Zinc (mg/L)
Groundwater Standards	MDEQ 2012 [a]	--	0.01	0.005	1.3	--	0.015	--	0.002	2
UCMW-11	10/17/2007	0.14	< 0.002	< 0.00008	0.002	20.72	< 0.0005	62.9	< 0.00005	< 0.01
UCMW-11	7/7/2008	21.06	< 0.002	0.04187	0.004	9.5	0.0006	39.94	< 0.00005	16.54
UCMW-11	11/3/2011	21.9	< 0.003	0.245	1.48	4.74	0.0151	41	< 0.00001	12
UCMW-4	11/3/2011									
UMHMW-1D	10/11/2007	< 0.03	0.01	0.01535	0.006	12.54	0.0032	16.46	< 0.00005	3.98
UMHMW-1D	7/9/2008	< 0.03	< 0.002	0.01552	0.02	1.46	0.006	15	< 0.00005	4.42
UMHMW-1S Dry	10/11/2007									
UMHMW-1S	7/9/2008	58.52	0.006	1.061	46.5	0.05	1.01	148.8	< 0.00005	194.8
UMHMW-2D	10/11/2007	< 0.03	0.008	0.2139	0.037	10.12	0.0231	26.64	< 0.00005	50.84
UMHMW-2D	7/9/2008	< 0.03	0.008	0.2491	0.023	12.7	0.0296	33.58	< 0.00005	62.14
UMHMW-2S	10/11/2007	54.55	0.003	1.209	50.4	0.12	1.191	66.05	< 0.00005	149
UMHMW-2S	7/9/2008	21.58	0.005	0.6406	27.38	0.12	0.7229	37.36	< 0.00005	83.7
UMHMW-3	10/12/2007	< 0.03	< 0.002	0.00043	0.005	< 0.03	< 0.0005	0.007	< 0.00005	0.04
UMHMW-3	7/8/2008	< 0.03	< 0.002	0.00036	0.002	< 0.03	< 0.0005	0.005	< 0.00005	0.01
UMPZ-1	7/15/2008	< 0.03	< 0.002	0.00955	0.003	< 0.03	< 0.0005	0.055	< 0.00005	4.08
UMPZ-2	7/15/2008	< 0.03	< 0.002	< 0.00008	< 0.001	27.8	0.0006	1.503	< 0.00005	0.01
UMPZ-3	7/15/2008	0.03	0.011	< 0.00008	0.002	28.84	0.0019	3.074	< 0.00005	0.08
UMPZ-4	7/15/2008	< 0.03	< 0.002	0.00191	0.001	1.67	0.0005	3.027	< 0.00005	0.3
UMPZ-5	7/15/2008	0.85	< 0.002	0.00009	0.002	24.63	0.0006	0.756	< 0.00005	0.25

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Table 23b
Groundwater Field and General Chemistry Analytical Results

Sample ID	Date Collected	Survey Data			Field Parameters					Physiochemical							Common Anions				Common Cations				
		MPE (ft AMSL)	SWE (ft AMSL)	GWE (ft AMSL)	SC (µmhos/cm)	pH (s.u.)	Temp. (° C)	ORP (mV)	DO (mg/L)	SC (µmhos/cm)	pH (s.u.)	Turbidity (NTU)	Hardness as $CaCO_3$ (mg/L)	Acidity as $CaCO_3$ (mg/L)	Total Diss. Solids (mg/L)	Total Susp. Solids (mg/L)	Sulfate (mg/L)	Bicarb as HCO_3 (mg/L)	Carbonate as CO_3 (mg/L)	Chloride (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Alkalinity as CaCO3 (mg/L)
Groundwater Standards	MDEQ 2012[a]	--	--	--	--	6.5 - 8.5	--	--	--	--	6.5 - 8.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ANMW-7	10/12/2007	5303.98		5296.67	350	5.77	10.36	44.6	2.77	358	6.3	1	170	< 4	241	2	147	34	< 4	1	39	18	< 1	2	28 J
ANMW-7	7/9/2008	5303.98		5297.14	269	6.3	11.56	109.5	1.7	275	5.9	0.23	131	4.4	176	< 1	100	34	< 4	< 1	31	13	< 1	2	28
ANMW-9	7/7/2008	5353.34		5348.09	74	5.26	8.4	10.6	5.9	158	7.2	819	87	< 1	104	1810	3	110	< 4	< 1	20	9	< 1	< 1	86
ANWS-1	10/12/2007	5326.83		5321.94	166	6.35	7.3	75.3	8.97	183	7.3	40.9	89	< 4	95	51	6	120	< 4	< 1	21	9	< 1	2	98 J
ANWS-1	7/8/2008	5326.83		5322.23	74	4.98	8.44	17.6	6.7	155	7.3	7.46	86	< 1	98	20	4	96	< 4	< 1	20	9	< 1	< 1	78
BCGW-115	10/26/2007	5442.34		5371.61	377	1.62	6.66	-118.9	13.33	97	7.4	336	38	< 4	96	596	33	26	< 4	< 1	10	3	< 1	2	22
BCGW-115	7/9/2008	5442.34		5375.2	59	4.96	11.62	-136.6	9.02	64	6.8	77.9	25	< 1	54	120	9	26	< 4	< 1	10	2	< 1	2	21
BCGW-116	7/31/2008	5442.32		5363.01	125	8.28	9.01	245.2	4.19	193	7.9	126	104	< 1	118	301	24	100	< 4	1	29	7	1	3	83
BCMW-10	10/17/2007	5354.42		5347.59	684	5.19	9.17	-29.2	3.62	712	5.4	< 0.01	353	19	588	6 J	351	11	< 4	2 BJ	74	41	1	2	9 J
BCMW-10	7/7/2008	5354.42		5347.82	680	5.65	8.86	93.3	3.45	640	5.2	0.37	340	27	512	< 1	350	5	< 4	< 1	71	39	1	2	4
BRGW-101	10/16/2007	5149.84		5141.75	6.49	5.38	6.76	-90.6	1.45	654	7.6	58.3	347	< 4	490	76	279	120	< 4	1	95	27	2	7	100 J
BRGW-101	7/11/2008	5149.84		5142.28	677	7.1	6.61	-78.7	6.64	682	7.4	9.6	408	< 1	539	17	290	120	< 4	< 1	111	32	2	6	100
BRGW-110	10/18/2007	5278.48		5265.93	276	4.23	361	-11.7	10.2	298	6.5	3.2 J	120	< 4	221	18 J	115	18	< 4	2 BJ	28	12	4	5	15 J
BRGW-110	7/9/2008	5278.48		5268.51	81	4.8	10.08	215	3.47	273	6.1	2.82	117	5.6	196	8	110	17	< 4	< 1	28	12	3	4	14
EDGW-105	10/17/2007	5206.29		5199.05	247	6.24	6.4	13.7	5.72	266	4.7	1.61 J	61	39	206	15 J	121	< 4	< 4	1 BJ	14	6	5	7	< 4 J
EDGW-105	7/10/2008	5206.29		5200.32	242	5.29	9.63	231.7	0.5	315	3.5	3.52	51	49	182	17	110	< 4	< 4	< 1	10	6	4	3	< 4
EDMW-2	10/17/2007	5206.72		5199.63	237	3.07	6.78	-12.9	1.45	251	6.8	3.76 J	109	< 4	175	16 J	87	30	< 4	1 BJ	25	11	1	2	25 J
EDMW-2	7/10/2008	5206.72		5201.94	64	5.56	8.79	-18.4	2.19	223	6.3	5.36	111	7.4	148	3	82	27	< 4	< 1	26	12	1	1	22
EDP-2	10/17/2007	5217.61		5213.93	396	3.59	6.1	0.3	3.39	585	3.5	< 0.01	105	75	326	4 J	174	< 4	< 4	1 BJ	21	13	6	6	< 4 J
EDP-2	7/10/2008	5217.61		5214.74	398	6.05	7.42	188.1	2.01	543	3.2	1.39	107	73	313	3	200	< 4	< 4	< 1	21	13	6	6	< 4
LCMW-1	10/16/2007	5150.44		5141.49	251	4.76	7.82	8.2	1.82	273	7.1	< 0.01	121	< 4	161	1	76	49	< 4	2	27	13	2	3	40 J
LCMW-1	7/11/2008	5150.44		5142.04	143	5.65	7.75	62.6	4.09	208	6.6	1.24	105	5.3	131	1	57	49	< 4	1	24	11	1	2	40
LCMW-12D	10/16/2007	5173.57		5171.86	1234	3.95	10.14	-39.8	0.93	1280	5.6	198	605	130	1110	126	791	< 4	< 4	2	145	59	4	11	< 4 J
LCMW-12D	7/11/2008	5173.57		5172.23	459	6.47	7.91	136.7	0.89	470	4.3	7.15	206	15	342	14	230	< 4	< 4	< 1	50	20	2	6	< 4
LCMW-12D	11/3/2011	5173.57		5172.45						1310	5.3	57.3	728		1380	23	910	< 4	< 4	< 1	176	70	3	11	< 4
LCMW-12S	10/16/2007	5174.10		5171.7	1041	4.1	9.04	-63.3	0.71	1010	6.1	86.6	475	88	869	104	632	< 4	< 4	2	114	46	3	10	< 4 J
LCMW-12S	7/15/2008	5174.10		5172.14	1109	5.54	10.51	18.1	0.56	1160	6.1	43.3	503	88	936	92	620	< 4	< 4	< 1	120	49	3	10	< 4
LCMW-12S	11/3/2011	5174.10		5171.79						1080	6.7	129	553		1050	28	670	21	< 4	2	135	53	3	11	17
LCMW-5	10/16/2007	5173.51		5170.43	764	4.21	10.11	-74.8	1.38	785	4.8	24.5	328	61	655	35	435	< 4	< 4	7	87	27	3	6	< 4 J
LCMW-5	7/10/2008	5173.51		5170.82	662	5.42	18.21	192.7	2.19	679	3.9	6.35	295	49	367	21	340	< 4	< 4	4	80	23	2	6	< 4
LCMW-5	11/3/2011	5173.51		5170.73						741	5.2	21.8	334		654	5	410	< 4	< 4	3	98	29	2	8	< 4
LCMW-6D	11/3/2011									973	7.7	23.7	525		876	17	560	49	< 4	1	133	47	3	37	40
LCMW-6S	11/3/2011									1370	7.7	9.5	885		1300	14	870	86	< 4	1	240	69	3	13	70
MHGW-109	10/12/2007	5550.01		5541.18	505	5.56	8.6	37.4	5.33	503	6.2	6.64	239	< 4	367	13	262	32	< 4	< 1	60	21	2	2	26 J
MHGW-109	7/8/2008	5550.01		5540.22	415	5.52	12.98	134.9	5.02	402	5.4	0.35	194	14	302	< 1	200	7	< 4	< 1	51	16	2	2	6
MHGW-112	10/26/2007	5561.40		5559.49	418	2.17	472	31.3	8.69	438	7.1	70.1	207	< 4	277	348	135	100	< 4	1	50	20	1	1	84

Notes:

*	- Surveyor unable to locate piezometer PGPZ-1. Distance to groundwater = 4.10'; Distance to surface water = 3.23' from top of casing.
**	- Insufficient water to collect sample.
***	- Well destroyed per surveyor.
SC	- Specific conductivity
Temp.	- Temperature
ORP	- Oxidation reduction potential
DO	- Dissolved oxygen
MPE	- Measuring point elevation
SWE	- Surface water elevation
GWE	- Groundwater elevation
MDEQ	- Montana Department of Environmental Quality
AMSL	- Above mean sea level
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2011 data collected by Pioneer Technical Services, Inc.

[a] Human Health Standard from circular DEQ-7, Montana Water Quality Standards (October 2012).

µmhos/cm	- Micromhos per centimeter
° C	- Degrees Celcius
mg/L	- Milligrams per liter
mV	- Millivolts
NTU	- Nephelometric turbidity units
s.u.	- Standard units
NM	- Not measured
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btoc	- Below top of casing
<	- Parameter not detected at or above the laboratory practical quantitation limit
B	- Laboratory method blank shows evidence of contamination.
J	- The associated value is an estimated quantity.

Note:
LCMW-6D and LCMW-6S were not surveyed.

AN	- Anaconda
BC	- Beartrap Creek
BR	- Blackfoot River
ED	- Edith
LC	- Lower Carbonate
UMH and MH	- Mike Horse
MP	- Mary P.
PD	- Pass Creek
PG	- Pass Creek Marsh
PM	- Paymaster Gulch
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Table 23b
Groundwater Field and General Chemistry Analytical Results

Sample ID	Date Collected	Survey Data			Field Parameters					Physiochemical							Common Anions				Common Cations				
		MPE (ft AMSL)	SWE (ft AMSL)	GWE (ft AMSL)	SC (µmhos/cm)	pH (s.u.)	Temp. (°C)	ORP (mV)	DO (mg/L)	SC (µmhos/cm)	pH (s.u.)	Turbidity (NTU)	Hardness as $CaCO_3$ (mg/L)	Acidity as $CaCO_3$ (mg/L)	Total Diss. Solids (mg/L)	Total Susp. Solids (mg/L)	Sulfate (mg/L)	Bicarb as HCO_3 (mg/L)	Carbonate as CO_3 (mg/L)	Chloride (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Alkalinity as CaCO3 (mg/L)
Groundwater Standards	MDEQ 2012[a]	--	--	--	--	6.5 - 8.5	--	--	--	--	6.5 - 8.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MHGW-112	7/8/2008	5561.40		5559.3	444	6.39	13.61	115.7	3.1	430	6.8	99.2	243	7.5	315	156	160	99	< 4	< 1	60	23	1	1	81
MHGW-113	10/26/2007	5561.40		5558.97	375	2.31	4.79	21.9	0.78	400	7.9	0.37	177	< 4	236	< 1	80	150	< 4	< 1	42	17	1	9	120
MHGW-113	7/8/2008	5561.40		5560.46	362	6.53	9.5	62.1	0.69	355	7.8	0.65	190	3.1	230	< 1	78	140	< 4	< 1	46	19	< 1	7	120
MHGW-115 Dry	10/12/2007	5667.13																							
MHMW-8	10/12/2007	5549.82		5538.84	581	5.36	8.66	32.4	2.24	572	6	1.82	267	< 4	436	1	301	27	< 4	< 1	66	25	3	5	22 J
MHMW-8	7/8/2008	5549.82		5539.68	599	5.95	11.43	122.5	3.3	582	5.8	0.75	298	28	461	1	310	26	< 4	< 1	74	27	2	4	21
MPP-4	10/18/2007	5278.08		5265.9	280	4.63	6.19	-1.1	10.86	401	6.2	31.7 J	180	< 4	308	68 J	169	13	< 4	< 1	41	19	2	4	11 J
MPP-4	7/9/2008	5278.08		5268.23	376	6.13	7.65	185.9	5.35	378	4.8	3.52	176	11	273	7	180	< 4	< 4	< 1	41	18	2	3	< 4
MPP-4	7/29/2008	5278.08		5267.8						424	4.9	1.23	172	12	298	5	200	< 4	< 4	1	39	18	2	3	< 4
MW-1	10/11/2007	5774.49		5735.79	437	7.46	5.84	6	4.71	440	7.6	3.18	222	< 4	268	7	80	200	< 4	< 1	56	20	1	5	160 J
MW-1	7/7/2008	5774.49		5748	424	6.56	6.78	59.4	3.9	411	7.5	1.9	239	< 1	268	5	84	180	< 4	< 1	59	22	1	3	150
PDGW101	7/31/2008	5217.62		5208.38	196	4.52	12.07	189.9	0.09	263	4.2	11.9	62	42	242	17	120	< 4	< 4	1	14	7	6	4	< 4
PDGW102	7/31/2008	5217.89		5208.14	190	4.14	10.07	206.7	0.17	282	3.9	0.47	43	67	243	1	130	< 4	< 4	1	8	6	6	4	< 4
PGPZ-1	7/16/2008	*			214	6.26	6.96	-126.1	0.91	176	7	294	86	< 1	158	286	2	100	< 4	6	21	8	< 1	3	84
PMGW-116	10/25/2007	5184.75		5173.62	340	2.72	6	21.3	12.09	359	6.4	49.8	141	< 4	245	62	154	23	< 4	1	37	12	2	7	19
PMGW-116	7/14/2008	5184.75		5180.88	285	6.48	12.36	112.9	8.84	290	6.2	99.3	127	8.5	209	123	120	25	< 4	< 1	33	11	2	6	20
PMGW-117	10/25/2007	5192.37		5180.63	253	2.5	5.41	63.6	4.41	277	4.3	148	76	28	226	356	124	< 4	< 4	1	18	8	2	5	< 4
PMGW-117	7/14/2008	5192.37		5182.13	253	4.99	10.77	166.4	2.5	263	3.9	20.3	68	45	218	41	120	< 4	< 4	< 1	15	7	2	5	< 4
PMGW-118	10/18/2007	5198.32		5188.47	332	3.52	5.64	-1.2	12.61	354	4.8	1620 J	129	47	296	10200 J	173	< 4	< 4	2 BJ	30	13	2	10	< 4 J
PMGW-118	7/14/2008	5198.32		5189.31	59	4.67	8.37	-121	8.78	98	6.1	363	36	11	78	635	23	27	< 4	1	8	4	< 1	4	22
PMGW-119	10/18/2007	5198.21		5186.81	296	3.04	6.08	36.9	3.69	334	4.8	629 J	81	53	268	1570 J	176	< 4	< 4	2 BJ	19	8	4	19	< 4 J
PMGW-119	7/14/2008	5198.21		5188.76	429	5.43	10.54	217.2	0.52	488	3.7	29.4	118	47	347	45	220	< 4	< 4	< 1	22	16	4	28	< 4
PMGW-120	10/15/2007	5223.33		5208.4	411	4.41	8.88	71.1	2.7	574	4.3	36	90	110	360	84	214	< 4	< 4	1	19	10	4	9	< 4 J
PMGW-120	7/15/2008	5223.33		5212.47	407	6.23	6.23	217.6	0.77	554	4	34.9	69	130	382	105	220	< 4	< 4	< 1	14	8	3	6	< 4
PMMW-13	10/16/2007	5244.39		5240.25	645	3.45	6.86	-14.6	1.4	660	4.3	8.66	262	83	569	5	365	< 4	< 4	2	62	26	4	7	< 4 J
PMMW-13	7/14/2008	5244.39		5240.39	652	5.98	9.4	162	0.47	649	4.2	12	258	84	555	24	350	< 4	< 4	1	60	26	3	6	< 4
PMMW-14	10/15/2007	5331.42		5320.79	206	4.5	8.58	87.7	1.7	351	5.2	15.8	53	35	167	14	78	< 4	< 4	1	13	5	3	4	< 4 J
PMMW-14	7/14/2008	5331.42		5321.42	94	4.25	11.23	87.6	0.67	216	4.2	20.8	53	30	178	22	91	< 4	< 4	< 1	13	5	2	5	< 4
PMMW-15	10/15/2007	5222.58		5209.86	500	6.45	17.7	7	4.01	550	6.6	275	283	< 4	365	292	139	150	< 4	1	92	13	4	3	120 J
PMMW-15	7/15/2008	5222.58		5216.04	539	6.88	11.41	157	3.82	514	6.7	1.56	279	< 1	413	3	180	140	< 4	< 1	92	12	3	2	120
PMPZ-3	7/7/2008	5457.49		5456.04	129	3.78	5.62	113	1.39	213	3.9	16.2	29	60	177	7	89	< 4	< 4	< 1	5	4	3	1	< 4
PMPZ-4	10/15/2007	5608.59		5607.16	215	3.87	5.94	27.1	3.37	302	4.2	29.2	30	65	156	55	88	< 4	< 4	1	5	4	4	2	< 4 J
PMPZ-4	7/7/2008	5608.59		5603.87	60	3.87	6.78	-89.7	6.88	73	4.8	39.8	23	8.8	61	53	27	< 4	< 4	< 1	5	2	< 1	1	< 4
SGGW-101	10/15/2007	5311.83		5282.33	261	3.3	5.01	136.8	9.82	190	4.2	85.4	52	19	113	220	69	< 4	< 4	1	11	6	4	2	< 4 J
SGGW-101	7/10/2008	5311.83		5287.68	458	4.59	8.6	279.9	5.59	202	4	0.33	59	24	138	< 1	78	< 4	< 4	< 1	13	7	3	2	< 4
SGGW-102	10/15/2007	5311.85		5297.22	84	3.99	5.62	182.1	11.02	130	5.5	86.1	42	< 4	76	148	47	< 4	< 4	1	10	4	3	3	< 4 J

Notes:

- * - Surveyor unable to locate piezometer PGPZ-1. Distance to groundwater = 4.10'; Distance to surface water = 3.23' from top of casing.
- ** - Insufficient water to collect sample.
- *** - Well destroyed per surveyor.
- SC - Specific conductivity
- Temp. - Temperature
- ORP - Oxidation reduction potential
- DO - Dissolved oxygen
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- NM - Not measured
- -- - No standard
- btoc - Below top of casing
- < - Parameter not detected at or above the laboratory practical quantitation limit
- B - Laboratory method blank shows evidence of contamination.
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Note:
LCMW-6D and LCMW-6S were not surveyed.

- AN - Anaconda
- BC - Beartrap Creek
- BR - Blackfoot River
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Table 23b
Groundwater Field and General Chemistry Analytical Results

Sample ID	Date Collected	Survey Data			Field Parameters					Physiochemical							Common Anions				Common Cations				
		MPE (ft AMSL)	SWE (ft AMSL)	GWE (ft AMSL)	SC (µmhos/cm)	pH (s.u.)	Temp. (° C)	ORP (mV)	DO (mg/L)	SC (µmhos/cm)	pH (s.u.)	Turbidity (NTU)	Hardness as $CaCO_3$ (mg/L)	Acidity as $CaCO_3$ (mg/L)	Total Diss. Solids (mg/L)	Total Susp. Solids (mg/L)	Sulfate (mg/L)	Bicarb as HCO_3 (mg/L)	Carbonate as CO_3 (mg/L)	Chloride (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Alkalinity as CaCO3 (mg/L)
Groundwater Standards	MDEQ 2012[a]	--	--	--	--	6.5 - 8.5	--	--	--	--	6.5 - 8.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SGGW-102	7/9/2008	5311.85		5297.08	79	3.95	12.54	75	7.22	153	3.8	41.1	33	16	85	127	37	< 4	< 4	< 1	8	3	2	2	< 4
SHGW101	7/31/2008	5262.90		5254.32	73	7.07	10.49	155.4	5.43	109	7.1	60.3	56	< 1	80	57	4	64	< 4	1	13	6	< 1	1	52
SHGW102	7/31/2008	5262.24		5252.07	139	7.15	12.31	121.8	5.04	194	6.8	3.51	80	< 1	134	6	48	51	< 4	1	23	6	2	6	42
SWGW-101	11/3/2011	5321.56		5312.65																					
SWGW-101 **	7/7/2008	5321.56		5312.65																					
SWGW-101 Dry	10/16/2007	5321.56																							
SWGW-102 Dry	10/16/2007	5258.71																							
SWGW-102	11/3/2011	5258.71		5236.68																					
SWGW-102 **	7/7/2008	5258.71		5236.69																					
SWGW-103	10/17/2007	5242.72		5234.41	75	2.38	6.28	30.7	6.27	249	3.8	357 J	43	22	146	415 J	45	< 4	< 4	2 BJ	11	4	2	6	< 4 J
SWGW-103	7/10/2008	5242.72		5233.02	81	4.88	10.92	-70.1	6.54	199	5.8	181	35	7.7	92	297	33	5	< 4	< 1	9	3	1	4	4
SWGW-103	11/3/2011	5242.72		5232.4						88	6.9	3.5	26		95	< 1	25	9	< 4	< 1	6	3	< 1	4	7
UCMW-11	10/17/2007	5242.39			1961	6.03	7.53	-26.5	3.51	1960	6.6	551 J	1010	260	1850	5380 J	1100	410	< 4	6	242	100	8	37	340
UCMW-11	7/7/2008	5242.39		5171.46	1504	4.93	8.14	78	3.67	1510	4.4	1170	698	400	1330	700	980	< 4	< 4	2	184	58	4	14	< 4
UCMW-11	11/3/2011	5242.39		5169.43						1410	3.8	13.1	713	230	1510	17	1000			2	198	64	4	18	
UCMW-4	11/3/2011	5245.77		5191.15																					
UMHMW-1D	10/11/2007	***			3175	6.17	7.01	-1.4	2.86	2590	5.8	795	2220	5.9 BJ	3230	1230	2010	34	< 4	2	578	188	6	10	28 J
UMHMW-1D	7/9/2008	***			3145	6.01	7.63	153.7	3.73	3430	6.3	296	2410	< 1	3360	475	1200	44	< 4	< 1	620	209	5	9	36
UMHMW-1S Dry	10/11/2007	5781.31		5764.42																					
UMHMW-1S	7/9/2008	5781.31		5767.22	3450	5.04	6.61	234.8	8.93	5400	3.9	46.1	1940	680	4270	111	1300	< 4	< 4	2	264	312	8	11	< 4
UMHMW-2D	10/11/2007	5731.98		5723.38	2054	6.24	8.11	5.8	2.15	1810	6.3	85.8	1250	16	2020	38	1230	100	< 4	1	289	127	4	4	82 J
UMHMW-2D	7/9/2008	5731.98		5725.58	2290	6.02	7.84	57.3	1.57	2540	6.2	72.5	1540	68	2220	39	820	78	< 4	< 1	368	151	3	4	64
UMHMW-2S	10/11/2007	5732.21		5725.97	2695	3.95	8.47	98.2	3.24	2490	4.1	130	1330	670	3230	294	2020	< 4	< 4	2	224	187	5	4	< 4 J
UMHMW-2S	7/9/2008	5732.21		5726.61	1714	5.03	6.75	229.9	8.49	1610	4.1	133	820	320	1730	346	1100	< 4	< 4	1	151	108	3	2	< 4
UMHMW-3	10/12/2007	5666.43		5657.07	278	7.64	6.6	6.6	1.32	269	7.7	2.64	108	< 4	165	3	43	110	< 4	1	34	5	2	4	92 J
UMHMW-3	7/8/2008	5666.43		5657.93	257	7.66	13.97	67	1.94	218	7.7	1.76	111	< 1	155	3	39	99	< 4	< 1	35	5	1	3	81
UMPZ-1	7/15/2008	5197.67		5194.12	291	6.59	11.09	8.1	4.02	283	6.3	6.67	129	< 1	220	19	110	39	< 4	< 1	29	14	< 1	1	32
UMPZ-2	7/15/2008	5191.62		5189.63	483	6.79	7.19	-70.2	2.01	427	6.2	291	191	1.5	334	700	190	32	< 4	< 1	43	20	1	2	26
UMPZ-3	7/15/2008	5190.38	5187.92	5186.23	1	4.57		-0.3	0.12	308	6.3	965	146	< 1	266	5070	98	91	< 4	< 1	34	15	3	3	74
UMPZ-4	7/15/2008	5163.15		5160.39	285	6.79	7.1	34.2	0.61	272	6.2	91.5	107	1.6	235	200	120	18	< 4	< 1	24	12	3	5	15
UMPZ-5	7/15/2008	5170.33	5166.93	5167.42						473	5	14.3	66	51	275	31	130	< 4	< 4	< 1	14	7	4	5	< 4

Notes:

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**	- Insufficient water to collect sample.
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Table 23b
Groundwater Field and General Chemistry Analytical Results

Sample ID	Date Collected	Survey Data			Field Parameters					Physiochemical							Common Anions				Common Cations				
		MPE (ft AMSL)	SWE (ft AMSL)	GWE (ft AMSL)	SC (µmhos/cm)	pH (s.u.)	Temp. (° C)	ORP (mV)	DO (mg/L)	SC (µmhos/cm)	pH (s.u.)	Turbidity (NTU)	Hardness as $CaCO_3$ (mg/L)	Acidity as $CaCO_3$ (mg/L)	Total Diss. Solids (mg/L)	Total Susp. Solids (mg/L)	Sulfate (mg/L)	Bicarb as HCO_3 (mg/L)	Carbonate as CO_3 (mg/L)	Chloride (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Alkalinity as CaCO3 (mg/L)
Groundwater Standards	MDEQ 2012[a]	--	--	--	--	6.5 - 8.5	--	--	--	--	6.5 - 8.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ANMW-7	10/12/2007	5303.98		5296.67	350	5.77	10.36	44.6	2.77	358	6.3	1	170	< 4	241	2	147	34	< 4	1	39	18	< 1	2	28 J
ANMW-7	7/9/2008	5303.98		5297.14	269	6.3	11.56	109.5	1.7	275	5.9	0.23	131	4.4	176	< 1	100	34	< 4	< 1	31	13	< 1	2	28
ANMW-9	7/7/2008	5353.34		5348.09	74	5.26	8.4	10.6	5.9	158	7.2	819	87	< 1	104	1810	3	110	< 4	< 1	20	9	< 1	< 1	86
ANWS-1	10/12/2007	5326.83		5321.94	166	6.35	7.3	75.3	8.97	183	7.3	40.9	89	< 4	95	51	6	120	< 4	< 1	21	9	< 1	2	98 J
ANWS-1	7/8/2008	5326.83		5322.23	74	4.98	8.44	17.6	6.7	155	7.3	7.46	86	< 1	98	20	4	96	< 4	< 1	20	9	< 1	< 1	78
BCGW-115	10/26/2007	5442.34		5371.61	377	1.62	6.66	-118.9	13.33	97	7.4	336	38	< 4	96	596	33	26	< 4	< 1	10	3	< 1	2	22
BCGW-115	7/9/2008	5442.34		5375.2	59	4.96	11.62	-136.6	9.02	64	6.8	77.9	25	< 1	54	120	9	26	< 4	< 1	10	2	< 1	2	21
BCGW-116	7/31/2008	5442.32		5363.01	125	8.28	9.01	245.2	4.19	193	7.9	126	104	< 1	118	301	24	100	< 4	1	29	7	1	3	83
BCMW-10	10/17/2007	5354.42		5347.59	684	5.19	9.17	-29.2	3.62	712	5.4	< 0.01	353	19	588	6 J	351	11	< 4	2 BJ	74	41	1	2	9 J
BCMW-10	7/7/2008	5354.42		5347.82	680	5.65	8.86	93.3	3.45	640	5.2	0.37	340	27	512	< 1	350	5	< 4	< 1	71	39	1	2	4
BRGW-101	10/16/2007	5149.84		5141.75	6.49	5.38	6.76	-90.6	1.45	654	7.6	58.3	347	< 4	490	76	279	120	< 4	1	95	27	2	7	100 J
BRGW-101	7/11/2008	5149.84		5142.28	677	7.1	6.61	-78.7	6.64	682	7.4	9.6	408	< 1	539	17	290	120	< 4	< 1	111	32	2	6	100
BRGW-110	10/18/2007	5278.48		5265.93	276	4.23	361	-11.7	10.2	298	6.5	3.2 J	120	< 4	221	18 J	115	18	< 4	2 BJ	28	12	4	5	15 J
BRGW-110	7/9/2008	5278.48		5268.51	81	4.8	10.08	215	3.47	273	6.1	2.82	117	5.6	196	8	110	17	< 4	< 1	28	12	3	4	14
EDGW-105	10/17/2007	5206.29		5199.05	247	6.24	6.4	13.7	5.72	266	4.7	1.61 J	61	39	206	15 J	121	< 4	< 4	1 BJ	14	6	5	7	< 4 J
EDGW-105	7/10/2008	5206.29		5200.32	242	5.29	9.63	231.7	0.5	315	3.5	3.52	51	49	182	17	110	< 4	< 4	< 1	10	6	4	3	< 4
EDMW-2	10/17/2007	5206.72		5199.63	237	3.07	6.78	-12.9	1.45	251	6.8	3.76 J	109	< 4	175	16 J	87	30	< 4	1 BJ	25	11	1	2	25 J
EDMW-2	7/10/2008	5206.72		5201.94	64	5.56	8.79	-18.4	2.19	223	6.3	5.36	111	7.4	148	3	82	27	< 4	< 1	26	12	1	1	22
EDP-2	10/17/2007	5217.61		5213.93	396	3.59	6.1	0.3	3.39	585	3.5	< 0.01	105	75	326	4 J	174	< 4	< 4	1 BJ	21	13	6	6	< 4 J
EDP-2	7/10/2008	5217.61		5214.74	398	6.05	7.42	188.1	2.01	543	3.2	1.39	107	73	313	3	200	< 4	< 4	< 1	21	13	6	6	< 4
LCMW-1	10/16/2007	5150.44		5141.49	251	4.76	7.82	8.2	1.82	273	7.1	< 0.01	121	< 4	161	1	76	49	< 4	2	27	13	2	3	40 J
LCMW-1	7/11/2008	5150.44		5142.04	143	5.65	7.75	62.6	4.09	208	6.6	1.24	105	5.3	131	1	57	49	< 4	1	24	11	1	2	40
LCMW-12D	10/16/2007	5173.57		5171.86	1234	3.95	10.14	-39.8	0.93	1280	5.6	198	605	130	1110	126	791	< 4	< 4	2	145	59	4	11	< 4 J
LCMW-12D	7/11/2008	5173.57		5172.23	459	6.47	7.91	136.7	0.89	470	4.3	7.15	206	15	342	14	230	< 4	< 4	< 1	50	20	2	6	< 4
LCMW-12D	11/3/2011	5173.57		5172.45						1310	5.3	57.3	728		1380	23	910	< 4	< 4	< 1	176	70	3	11	< 4
LCMW-12S	10/16/2007	5174.10		5171.7	1041	4.1	9.04	-63.3	0.71	1010	6.1	86.6	475	88	869	104	632	< 4	< 4	2	114	46	3	10	< 4 J
LCMW-12S	7/15/2008	5174.10		5172.14	1109	5.54	10.51	18.1	0.56	1160	6.1	43.3	503	88	936	92	620	< 4	< 4	< 1	120	49	3	10	< 4
LCMW-12S	11/3/2011	5174.10		5171.79						1080	6.7	129	553		1050	28	670	21	< 4	2	135	53	3	11	17
LCMW-5	10/16/2007	5173.51		5170.43	764	4.21	10.11	-74.8	1.38	785	4.8	24.5	328	61	655	35	435	< 4	< 4	7	87	27	3	6	< 4 J
LCMW-5	7/10/2008	5173.51		5170.82	662	5.42	18.21	192.7	2.19	679	3.9	6.35	295	49	367	21	340	< 4	< 4	4	80	23	2	6	< 4
LCMW-5	11/3/2011	5173.51		5170.73						741	5.2	21.8	334		654	5	410	< 4	< 4	3	98	29	2	8	< 4
LCMW-6D	11/3/2011									973	7.7	23.7	525		876	17	560	49	< 4	1	133	47	3	37	40
LCMW-6S	11/3/2011									1370	7.7	9.5	885		1300	14	870	86	< 4	1	240	69	3	13	70
MHGW-109	10/12/2007	5550.01		5541.18	505	5.56	8.6	37.4	5.33	503	6.2	6.64	239	< 4	367	13	262	32	< 4	< 1	60	21	2	2	26 J
MHGW-109	7/8/2008	5550.01		5540.22	415	5.52	12.98	134.9	5.02	402	5.4	0.35	194	14	302	< 1	200	7	< 4	< 1	51	16	2	2	6
MHGW-112	10/26/2007	5561.40		5559.49	418	2.17	472	31.3	8.69	438	7.1	70.1	207	< 4	277	348	135	100	< 4	1	50	20	1	1	84

Notes:

*	- Surveyor unable to locate piezometer PGPZ-1. Distance to groundwater = 4.10'; Distance to surface water = 3.23' from top of casing.
**	- Insufficient water to collect sample.
***	- Well destroyed per surveyor.
SC	- Specific conductivity
Temp.	- Temperature
ORP	- Oxidation reduction potential
DO	- Dissolved oxygen
MPE	- Measuring point elevation
SWE	- Surface water elevation
GWE	- Groundwater elevation
MDEQ	- Montana Department of Environmental Quality
AMSL	- Above mean sea level
--	- Not collected/not available
	- Value meets or exceeds groundwater standard

2011 data collected by Pioneer Technical Services, Inc.

[a] Human Health Standard from circular DEQ-7, Montana Water Quality Standards (October 2012).

µmhos/cm	- Micromhos per centimeter
° C	- Degrees Celcius
mg/L	- Milligrams per liter
mV	- Millivolts
NTU	- Nephelometric turbidity units
s.u.	- Standard units
NM	- Not measured
--	- No standard
btoc	- Below top of casing
<	- Parameter not detected at or above the laboratory practical quantitation limit
B	- Laboratory method blank shows evidence of contamination.
J	- The associated value is an estimated quantity.

Note:
LCMW-6D and LCMW-6S were not surveyed.

AN	- Anaconda
BC	- Beartrap Creek
BR	- Blackfoot River
ED	- Edith
LC	- Lower Carbonate
UMH and MH	- Mike Horse
MP	- Mary P.
PD	- Pass Creek
PG	- Pass Creek Marsh
PM	- Paymaster Gulch
SG	- Stevens Gulch
SH	- Shave Creek
SW	- Swamp Gulch
UC	- Upper Carbonate
UM	- Upper Marsh

Table 23b
Groundwater Field and General Chemistry Analytical Results

Sample ID	Date Collected	Survey Data			Field Parameters					Physiochemical							Common Anions				Common Cations				
		MPE (ft AMSL)	SWE (ft AMSL)	GWE (ft AMSL)	SC (µmhos/cm)	pH (s.u.)	Temp. (°C)	ORP (mV)	DO (mg/L)	SC (µmhos/cm)	pH (s.u.)	Turbidity (NTU)	Hardness as $CaCO_3$ (mg/L)	Acidity as $CaCO_3$ (mg/L)	Total Diss. Solids (mg/L)	Total Susp. Solids (mg/L)	Sulfate (mg/L)	Bicarb as HCO_3 (mg/L)	Carbonate as CO_3 (mg/L)	Chloride (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Alkalinity as CaCO3 (mg/L)
Groundwater Standards	MDEQ 2012[a]	--	--	--	--	6.5 - 8.5	--	--	--	--	6.5 - 8.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MHGW-112	7/8/2008	5561.40		5559.3	444	6.39	13.61	115.7	3.1	430	6.8	99.2	243	7.5	315	156	160	99	< 4	< 1	60	23	1	1	81
MHGW-113	10/26/2007	5561.40		5558.97	375	2.31	4.79	21.9	0.78	400	7.9	0.37	177	< 4	236	< 1	80	150	< 4	< 1	42	17	1	9	120
MHGW-113	7/8/2008	5561.40		5560.46	362	6.53	9.5	62.1	0.69	355	7.8	0.65	190	3.1	230	< 1	78	140	< 4	< 1	46	19	< 1	7	120
MHGW-115 Dry	10/12/2007	5667.13																							
MHMW-8	10/12/2007	5549.82		5538.84	581	5.36	8.66	32.4	2.24	572	6	1.82	267	< 4	436	1	301	27	< 4	< 1	66	25	3	5	22 J
MHMW-8	7/8/2008	5549.82		5539.68	599	5.95	11.43	122.5	3.3	582	5.8	0.75	298	28	461	1	310	26	< 4	< 1	74	27	2	4	21
MPP-4	10/18/2007	5278.08		5265.9	280	4.63	6.19	-1.1	10.86	401	6.2	31.7 J	180	< 4	308	68 J	169	13	< 4	< 1	41	19	2	4	11 J
MPP-4	7/9/2008	5278.08		5268.23	376	6.13	7.65	185.9	5.35	378	4.8	3.52	176	11	273	7	180	< 4	< 4	< 1	41	18	2	3	< 4
MPP-4	7/29/2008	5278.08		5267.8						424	4.9	1.23	172	12	298	5	200	< 4	< 4	1	39	18	2	3	< 4
MW-1	10/11/2007	5774.49		5735.79	437	7.46	5.84	6	4.71	440	7.6	3.18	222	< 4	268	7	80	200	< 4	< 1	56	20	1	5	160 J
MW-1	7/7/2008	5774.49		5748	424	6.56	6.78	59.4	3.9	411	7.5	1.9	239	< 1	268	5	84	180	< 4	< 1	59	22	1	3	150
PDGW101	7/31/2008	5217.62		5208.38	196	4.52	12.07	189.9	0.09	263	4.2	11.9	62	42	242	17	120	< 4	< 4	1	14	7	6	4	< 4
PDGW102	7/31/2008	5217.89		5208.14	190	4.14	10.07	206.7	0.17	282	3.9	0.47	43	67	243	1	130	< 4	< 4	1	8	6	6	4	< 4
PGPZ-1	7/16/2008	*			214	6.26	6.96	-126.1	0.91	176	7	294	86	< 1	158	286	2	100	< 4	6	21	8	< 1	3	84
PMGW-116	10/25/2007	5184.75		5173.62	340	2.72	6	21.3	12.09	359	6.4	49.8	141	< 4	245	62	154	23	< 4	1	37	12	2	7	19
PMGW-116	7/14/2008	5184.75		5180.88	285	6.48	12.36	112.9	8.84	290	6.2	99.3	127	8.5	209	123	120	25	< 4	< 1	33	11	2	6	20
PMGW-117	10/25/2007	5192.37		5180.63	253	2.5	5.41	63.6	4.41	277	4.3	148	76	28	226	356	124	< 4	< 4	1	18	8	2	5	< 4
PMGW-117	7/14/2008	5192.37		5182.13	253	4.99	10.77	166.4	2.5	263	3.9	20.3	68	45	218	41	120	< 4	< 4	< 1	15	7	2	5	< 4
PMGW-118	10/18/2007	5198.32		5188.47	332	3.52	5.64	-1.2	12.61	354	4.8	1620 J	129	47	296	10200 J	173	< 4	< 4	2 BJ	30	13	2	10	< 4 J
PMGW-118	7/14/2008	5198.32		5189.31	59	4.67	8.37	-121	8.78	98	6.1	363	36	11	78	635	23	27	< 4	1	8	4	< 1	4	22
PMGW-119	10/18/2007	5198.21		5186.81	296	3.04	6.08	36.9	3.69	334	4.8	629 J	81	53	268	1570 J	176	< 4	< 4	2 BJ	19	8	4	19	< 4 J
PMGW-119	7/14/2008	5198.21		5188.76	429	5.43	10.54	217.2	0.52	488	3.7	29.4	118	47	347	45	220	< 4	< 4	< 1	22	16	4	28	< 4
PMGW-120	10/15/2007	5223.33		5208.4	411	4.41	8.88	71.1	2.7	574	4.3	36	90	110	360	84	214	< 4	< 4	1	19	10	4	9	< 4 J
PMGW-120	7/15/2008	5223.33		5212.47	407	6.23	6.23	217.6	0.77	554	4	34.9	69	130	382	105	220	< 4	< 4	< 1	14	8	3	6	< 4
PMMW-13	10/16/2007	5244.39		5240.25	645	3.45	6.86	-14.6	1.4	660	4.3	8.66	262	83	569	5	365	< 4	< 4	2	62	26	4	7	< 4 J
PMMW-13	7/14/2008	5244.39		5240.39	652	5.98	9.4	162	0.47	649	4.2	12	258	84	555	24	350	< 4	< 4	1	60	26	3	6	< 4
PMMW-14	10/15/2007	5331.42		5320.79	206	4.5	8.58	87.7	1.7	351	5.2	15.8	53	35	167	14	78	< 4	< 4	1	13	5	3	4	< 4 J
PMMW-14	7/14/2008	5331.42		5321.42	94	4.25	11.23	87.6	0.67	216	4.2	20.8	53	30	178	22	91	< 4	< 4	< 1	13	5	2	5	< 4
PMMW-15	10/15/2007	5222.58		5209.86	500	6.45	17.7	7	4.01	550	6.6	275	283	< 4	365	292	139	150	< 4	1	92	13	4	3	120 J
PMMW-15	7/15/2008	5222.58		5216.04	539	6.88	11.41	157	3.82	514	6.7	1.56	279	< 1	413	3	180	140	< 4	< 1	92	12	3	2	120
PMPZ-3	7/7/2008	5457.49		5456.04	129	3.78	5.62	113	1.39	213	3.9	16.2	29	60	177	7	89	< 4	< 4	< 1	5	4	3	1	< 4
PMPZ-4	10/15/2007	5608.59		5607.16	215	3.87	5.94	27.1	3.37	302	4.2	29.2	30	65	156	55	88	< 4	< 4	1	5	4	4	2	< 4 J
PMPZ-4	7/7/2008	5608.59		5603.87	60	3.87	6.78	-89.7	6.88	73	4.8	39.8	23	8.8	61	53	27	< 4	< 4	< 1	5	2	< 1	1	< 4
SGGW-101	10/15/2007	5311.83		5282.33	261	3.3	5.01	136.8	9.82	190	4.2	85.4	52	19	113	220	69	< 4	< 4	1	11	6	4	2	< 4 J
SGGW-101	7/10/2008	5311.83		5287.68	458	4.59	8.6	279.9	5.59	202	4	0.33	59	24	138	< 1	78	< 4	< 4	< 1	13	7	3	2	< 4
SGGW-102	10/15/2007	5311.85		5297.22	84	3.99	5.62	182.1	11.02	130	5.5	86.1	42	< 4	76	148	47	< 4	< 4	1	10	4	3	3	< 4 J

Notes:

- * - Surveyor unable to locate piezometer PGPZ-1. Distance to groundwater = 4.10'; Distance to surface water = 3.23' from top of casing.
- ** - Insufficient water to collect sample.
- *** - Well destroyed per surveyor.
- SC - Specific conductivity
- Temp. - Temperature
- ORP - Oxidation reduction potential
- DO - Dissolved oxygen
- MPE - Measuring point elevation
- SWE - Surface water elevation
- GWE - Groundwater elevation
- MDEQ - Montana Department of Environmental Quality
- AMSL - Above mean sea level
- -- - Not collected/not available
- (highlighted) - Value meets or exceeds groundwater standard

2011 data collected by Pioneer Technical Services, Inc.

[a] Human Health Standard from circular DEQ-7, Montana Water Quality Standards (October 2012).

- µmhos/cm - Micromhos per centimeter
- °C - Degrees Celcius
- mg/L - Milligrams per liter
- mV - Millivolts
- NTU - Nephelometric turbidity units
- s.u. - Standard units
- NM - Not measured
- -- - No standard
- btoc - Below top of casing
- < - Parameter not detected at or above the laboratory practical quantitation limit
- B - Laboratory method blank shows evidence of contamination.
- J - The associated value is an estimated quantity.

Note:
LCMW-6D and LCMW-6S were not surveyed.

- AN - Anaconda
- BC - Beartrap Creek
- BR - Blackfoot River
- ED - Edith
- LC - Lower Carbonate
- UMH and MH - Mike Horse
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- PG - Pass Creek Marsh
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- SH - Shave Creek
- SW - Swamp Gulch
- UC - Upper Carbonate
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Table 23b
Groundwater Field and General Chemistry Analytical Results

Sample ID	Date Collected	Survey Data			Field Parameters					Physiochemical							Common Anions				Common Cations				
		MPE (ft AMSL)	SWE (ft AMSL)	GWE (ft AMSL)	SC (µmhos/cm)	pH (s.u.)	Temp. (° C)	ORP (mV)	DO (mg/L)	SC (µmhos/cm)	pH (s.u.)	Turbidity (NTU)	Hardness as $CaCO_3$ (mg/L)	Acidity as $CaCO_3$ (mg/L)	Total Diss. Solids (mg/L)	Total Susp. Solids (mg/L)	Sulfate (mg/L)	Bicarb as HCO_3 (mg/L)	Carbonate as CO_3 (mg/L)	Chloride (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Alkalinity as CaCO3 (mg/L)
Groundwater Standards	MDEQ 2012[a]	--	--	--	--	6.5 - 8.5	--	--	--	--	6.5 - 8.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SGGW-102	7/9/2008	5311.85		5297.08	79	3.95	12.54	75	7.22	153	3.8	41.1	33	16	85	127	37	< 4	< 4	< 1	8	3	2	2	< 4
SHGW101	7/31/2008	5262.90		5254.32	73	7.07	10.49	155.4	5.43	109	7.1	60.3	56	< 1	80	57	4	64	< 4	1	13	6	< 1	1	52
SHGW102	7/31/2008	5262.24		5252.07	139	7.15	12.31	121.8	5.04	194	6.8	3.51	80	< 1	134	6	48	51	< 4	1	23	6	2	6	42
SWGW-101	11/3/2011	5321.56		5312.65																					
SWGW-101 **	7/7/2008	5321.56		5312.65																					
SWGW-101 Dry	10/16/2007	5321.56																							
SWGW-102 Dry	10/16/2007	5258.71																							
SWGW-102	11/3/2011	5258.71		5236.68																					
SWGW-102 **	7/7/2008	5258.71		5236.69																					
SWGW-103	10/17/2007	5242.72		5234.41	75	2.38	6.28	30.7	6.27	249	3.8	357 J	43	22	146	415 J	45	< 4	< 4	2 BJ	11	4	2	6	< 4 J
SWGW-103	7/10/2008	5242.72		5233.02	81	4.88	10.92	-70.1	6.54	199	5.8	181	35	7.7	92	297	33	5	< 4	< 1	9	3	1	4	4
SWGW-103	11/3/2011	5242.72		5232.4						88	6.9	3.5	26		95	< 1	25	9	< 4	< 1	6	3	< 1	4	7
UCMW-11	10/17/2007	5242.39			1961	6.03	7.53	-26.5	3.51	1960	6.6	551 J	1010	260	1850	5380 J	1100	410	< 4	6	242	100	8	37	340
UCMW-11	7/7/2008	5242.39		5171.46	1504	4.93	8.14	78	3.67	1510	4.4	1170	698	400	1330	700	980	< 4	< 4	2	184	58	4	14	< 4
UCMW-11	11/3/2011	5242.39		5169.43						1410	3.8	13.1	713	230	1510	17	1000			2	198	64	4	18	
UCMW-4	11/3/2011	5245.77		5191.15																					
UMHMW-1D	10/11/2007	***			3175	6.17	7.01	-1.4	2.86	2590	5.8	795	2220	5.9 BJ	3230	1230	2010	34	< 4	2	578	188	6	10	28 J
UMHMW-1D	7/9/2008	***			3145	6.01	7.63	153.7	3.73	3430	6.3	296	2410	< 1	3360	475	1200	44	< 4	< 1	620	209	5	9	36
UMHMW-1S Dry	10/11/2007	5781.31		5764.42																					
UMHMW-1S	7/9/2008	5781.31		5767.22	3450	5.04	6.61	234.8	8.93	5400	3.9	46.1	1940	680	4270	111	1300	< 4	< 4	2	264	312	8	11	< 4
UMHMW-2D	10/11/2007	5731.98		5723.38	2054	6.24	8.11	5.8	2.15	1810	6.3	85.8	1250	16	2020	38	1230	100	< 4	1	289	127	4	4	82 J
UMHMW-2D	7/9/2008	5731.98		5725.58	2290	6.02	7.84	57.3	1.57	2540	6.2	72.5	1540	68	2220	39	820	78	< 4	< 1	368	151	3	4	64
UMHMW-2S	10/11/2007	5732.21		5725.97	2695	3.95	8.47	98.2	3.24	2490	4.1	130	1330	670	3230	294	2020	< 4	< 4	2	224	187	5	4	< 4 J
UMHMW-2S	7/9/2008	5732.21		5726.61	1714	5.03	6.75	229.9	8.49	1610	4.1	133	820	320	1730	346	1100	< 4	< 4	1	151	108	3	2	< 4
UMHMW-3	10/12/2007	5666.43		5657.07	278	7.64	6.6	6.6	1.32	269	7.7	2.64	108	< 4	165	3	43	110	< 4	1	34	5	2	4	92 J
UMHMW-3	7/8/2008	5666.43		5657.93	257	7.66	13.97	67	1.94	218	7.7	1.76	111	< 1	155	3	39	99	< 4	< 1	35	5	1	3	81
UMPZ-1	7/15/2008	5197.67		5194.12	291	6.59	11.09	8.1	4.02	283	6.3	6.67	129	< 1	220	19	110	39	< 4	< 1	29	14	< 1	1	32
UMPZ-2	7/15/2008	5191.62		5189.63	483	6.79	7.19	-70.2	2.01	427	6.2	291	191	1.5	334	700	190	32	< 4	< 1	43	20	1	2	26
UMPZ-3	7/15/2008	5190.38	5187.92	5186.23	1	4.57		-0.3	0.12	308	6.3	965	146	< 1	266	5070	98	91	< 4	< 1	34	15	3	3	74
UMPZ-4	7/15/2008	5163.15		5160.39	285	6.79	7.1	34.2	0.61	272	6.2	91.5	107	1.6	235	200	120	18	< 4	< 1	24	12	3	5	15
UMPZ-5	7/15/2008	5170.33	5166.93	5167.42						473	5	14.3	66	51	275	31	130	< 4	< 4	< 1	14	7	4	5	< 4

Notes:

*	- Surveyor unable to locate piezometer PGPZ-1. Distance to groundwater = 4.10'; Distance to surface water = 3.23' from top of casing.
**	- Insufficient water to collect sample.
***	- Well destroyed per surveyor.
SC	- Specific conductivity
Temp.	- Temperature
ORP	- Oxidation reduction potential
DO	- Dissolved oxygen
MPE	- Measuring point elevation
SWE	- Surface water elevation
GWE	- Groundwater elevation
MDEQ	- Montana Department of Environmental Quality
AMSL	- Above mean sea level
--	- Not collected/not available
	- Value meets or exceeds groundwater standard

2011 data collected by Pioneer Technical Services, Inc.

[a] Human Health Standard from circular DEQ-7, Montana Water Quality Standards (October 2012).

µmhos/cm	- Micromhos per centimeter
° C	- Degrees Celcius
mg/L	- Milligrams per liter
mV	- Millivolts
NTU	- Nephelometric turbidity units
s.u.	- Standard units
NM	- Not measured
--	- No standard
btoc	- Below top of casing
<	- Parameter not detected at or above the laboratory practical quantitation limit
B	- Laboratory method blank shows evidence of contamination.
J	- The associated value is an estimated quantity.

AN	- Anaconda
BC	- Beartrap Creek
BR	- Blackfoot River
ED	- Edith
LC	- Lower Carbonate
UMH and MH	- Mike Horse
MP	- Mary P.
PD	- Pass Creek
PG	- Pass Creek Marsh
PM	- Paymaster Gulch
SG	- Stevens Gulch
SH	- Shave Creek
SW	- Swamp Gulch
UC	- Upper Carbonate
UM	- Upper Marsh

Note:
LCMW-6D and LCMW-6S were not surveyed.

Table 24a
Mine Inventory Surface Water Metals Analytical Results

Sample ID	Date Collected	Aluminum mg/L	Arsenic mg/L	Cadmium (mg/L)			Copper (mg/L)			Iron mg/L	Lead (mg/L)			Manganese mg/L	Zinc (mg/L)		
				Lab Results	Aquatic Life Standard*		Lab Results	Aquatic Life Standard*			Lab Results	Aquatic Life Standard*			Lab Results	Aquatic Life Standard*	
					Acute	Chronic		Acute	Chronic			Acute	Chronic			Acute	Chronic
Surface Water Standards	**Acute [a]**	**0.75**	**0.34**	**--**			**--**			**--**	**--**			**--**	**--**		
	Chronic [b]	**0.087**	**0.15**	**--**			**--**			**1.0**	**--**			**--**	**--**		
	Human Health [c]	**--**	**0.01**	**0.005**			**1.3**			**--**	**0.015**			**--**	**2**		
ACSW-101	7/24/2008	< 0.03	< 0.003	< 0.00008	0.0022	0.00027	< 0.001	0.014	0.009	< 0.05	< 0.0005	0.084	0.0033	0.006	< 0.01	0.122	0.122
BTSW-101	7/24/2008	< 0.03	< 0.003	0.00099	0.0020	0.00025	< 0.001	0.013	0.009	< 0.05	< 0.0005	0.073	0.0029	< 0.005	0.16	0.112	0.112
CGSW-101	7/17/2008		< 0.003	< 0.00008	0.0008	0.00013	< 0.001	0.006	0.004	< 0.05	< 0.0005	0.025	0.0010	< 0.005	0.01	0.054	0.054
CGSW-102	7/17/2008	< 0.03	0.087	0.00757	0.0022	0.00027	0.117	0.014	0.009	9.07	0.6001	0.084	0.0033	1.16	0.94	0.122	0.122
CGSW-103	7/17/2008		< 0.003	< 0.00008	0.0009	0.00014	< 0.001	0.006	0.004	< 0.05	< 0.0005	0.026	0.0010	< 0.005	< 0.01	0.056	0.056
MHSW-101	7/16/2008	< 0.03	< 0.003	0.00814	0.0027	0.00032	0.077	0.017	0.011	0.15	0.0252	0.107	0.0042	0.091	1.04	0.144	0.144
MHSW-102	7/16/2008	< 0.03	< 0.003	0.00081	0.0026	0.00031	0.001	0.017	0.011	< 0.05	0.0058	0.104	0.0041	< 0.005	0.12	0.141	0.141
PBBS-200	11/8/2011	< 0.03	< 0.003	0.00017	0.0013	0.00019	< 0.001	0.009	0.006	< 0.05	< 0.0005	0.045	0.0018	< 0.005	0.03	0.081	0.081
PBBS-201	11/8/2011	< 0.03	0.009	0.0272	0.0025	0.00030	0.084	0.016	0.011	7.28	0.121	0.100	0.0039	4.34	2.68	0.137	0.137
PBBS-202	11/8/2011	< 0.03	< 0.003	< 0.00008	0.0014	0.00019	0.001	0.009	0.006	< 0.05	< 0.0005	0.046	0.0018	< 0.005	< 0.01	0.082	0.082
PCSW-101	7/17/2008	< 0.03	< 0.003	0.00122	0.0043	0.00045	< 0.001	0.027	0.017	< 0.05	< 0.0005	0.196	0.0076	< 0.005	0.37	0.215	0.215
PCSW-102	7/22/2008		< 0.003	0.00179	0.0009	0.00015	0.045	0.006	0.005	6.86	0.0005	0.029	0.0011	0.406	0.47	0.060	0.060
PCSW-103	7/22/2008	< 0.03	< 0.003	< 0.00008	0.0019	0.00024	< 0.001	0.012	0.008	< 0.05	< 0.0005	0.068	0.0027	< 0.005	< 0.01	0.106	0.106
PCSW-104	7/22/2008	< 0.03	< 0.003	< 0.00008	0.0018	0.00024	< 0.001	0.012	0.008	< 0.05	< 0.0005	0.066	0.0026	0.006	< 0.01	0.104	0.104
PM-Adit 1	10/23/2007																
PMSW-101	7/16/2008	3.73	< 0.003	0.00029	0.0009	0.00014	0.239	0.006	0.004	4.75	0.0278	0.026	0.0010	0.465	0.1	0.056	0.056
PMSW-102	7/16/2008		< 0.003	0.00011	0.0005	0.00010	0.005	0.004	0.003	1.49	< 0.0005	0.014	0.0005	0.163	0.05	0.037	0.037
PMSW-103	7/16/2008		< 0.003	0.0001	0.0005	0.00010	0.003	0.004	0.003	1.37	< 0.0005	0.014	0.0005	0.148	0.05	0.037	0.037
SG-55SW	7/23/2008	< 0.03	0.022	< 0.00008	0.0038	0.00041	< 0.001	0.024	0.015	13.9	0.0006	0.166	0.0065	1.505	0.11	0.193	0.193
SG-Adit 1	10/23/2007																
SGSW-101	7/23/2008	< 0.03	< 0.003	0.00018	0.0018	0.00024	0.086	0.012	0.008	0.11	0.0065	0.066	0.0026	0.024	0.03	0.104	0.104
SGSW-102	7/23/2008	< 0.03	< 0.003	< 0.00008	0.0015	0.00021	0.004	0.010	0.007	< 0.05	0.002	0.055	0.0021	0.007	0.01	0.092	0.092
SGSW-103	7/23/2008	0.03	< 0.003	0.00047	0.0012	0.00018	0.011	0.008	0.006	< 0.05	0.0009	0.040	0.0016	0.024	0.1	0.074	0.074
SGSW-104	7/23/2008		0.016	< 0.00008	0.0011	0.00017	< 0.001	0.008	0.006	27.42	< 0.0005	0.037	0.0015	3.474	0.13	0.071	0.071
SGSW-105	7/23/2008		< 0.003	0.00032	0.0009	0.00014	0.015	0.006	0.004	0.1	0.0028	0.026	0.0010	0.02	0.06	0.056	0.056
SGSW-106	7/23/2008		< 0.003	0.00053	0.0006	0.00011	0.054	0.004	0.003	0.06	0.0022	0.016	0.0006	0.18	0.12	0.041	0.041
SGSW-107	7/23/2008		< 0.003	0.00076	0.0008	0.00013	0.076	0.005	0.004	0.14	0.0025	0.023	0.0009	0.299	0.17	0.052	0.052
SHSW-101	7/17/2008		< 0.003	0.00013	0.0011	0.00016	0.007	0.007	0.005	< 0.05	< 0.0005	0.034	0.0013	< 0.005	0.02	0.067	0.067
SHSW-102	7/17/2008		< 0.003	0.00013	0.0010	0.00016	< 0.001	0.007	0.005	< 0.05	< 0.0005	0.033	0.0013	< 0.005	0.02	0.065	0.065
SHSW-103	7/22/2008	< 0.03	0.019	0.0173	0.0010	0.00015	0.191	0.007	0.005	6.81	0.3697	0.031	0.0012	4.133	1.42	0.063	0.063
SHSW-104	7/22/2008	< 0.03	< 0.003	0.00019	0.0011	0.00017	0.002	0.008	0.005	< 0.05	0.006	0.036	0.0014	< 0.005	0.03	0.070	0.070

Notes:

mg/L - Milligrams per liter
-- - No standard/not analyzed
Blank - No data
* - Acute and chronic results for cadmium, copper, lead and zinc were calculated using hardness results and equations in Montana Water Quality Standards (2006).
- Value meets or exceeds one or more water quality standard.

2011 data collected by Pioneer Technical Services, Inc.

[a] Acute aquatic life criteria from circular DEQ-7, Montana Water Quality Standards (October 2012)

[b] Chronic aquatic life criteria from circular DEQ-7, Montana Water Quality Standards (October 2012)

[c] Human Health Standard from circular DEQ-7, Montana Water Quality Standards (October 2012)

AC - Anaconda
BT - Blackfoot Tributary
CG - Chambers Gulch
PB - Bobby Boy
PC - Pass Creek
PM - Paymaster Gulch
SG - Stevens Gulch
SH - Shave Creek

Table 24b
Mine Inventory Surface Water Field and General Chemistry Analytical Results

Sample ID	Date Collected	Field Parameters						Physiochemical						Common Anions					Common Cations			
		Specific Conductance (µmhos/cm)	pH (s.u.)	Temperature (^{o}C)	Oxidation-Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Discharge (cfs)	Specific Conductivity (µmhos/cm)	pH (s.u.)	Hardness as $CaCO_3$ (mg/L)	Acidity as $CaCO_3$ (mg/L)	Total Diss. Solids (mg/L)	Total Susp. Solids (mg/L)	Alkalinity as $CaCO_3$ (mg/L)	Bicarb as HCO_3 (mg/L)	Carbonate as CO_3 (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)
Surface Water Standards	Acute[a]	--	--	--	--	4.0 - 8.0	--	--	6.5-8.5	--	--	--	--	--	--	--	--	--	--	--	--	--
	Chronic[b]	--	--	--	--	4.0 - 8.0	--	--	6.5-8.5	--	--	--	--	--	--	--	--	--	--	--	--	--
	Human Health[c]	--	--	--	--	4.0 - 8.0	--	--	6.5-8.5	--	--	--	--	--	--	--	--	--	--	--	--	--
ACSW-101	7/24/2008	173.9	7.79	9.2	228.5	8.79	4.48	169	7.8	102	< 4	95	< 10	86	110	< 4	< 1	3	23	11	< 1	1
BTSW-101	7/24/2008	161.2	7.06	10.3	210.3	8.75	< 0.039	159	7.8	92	< 4	89	< 10	72	88	< 4	< 1	9	24	8	< 1	1
CGSW-101	7/17/2008	52	3.5	10	-92.9	9.42	NM	87	7.6	39	< 4	62	< 10	44	54	< 4	< 1	2	9	4	< 1	1
CGSW-102	7/17/2008	100	3.18	5.44	39	10.3	< 0.002	181	7.3	102	< 4	122	< 10	58	71	< 4	< 1	30	25	5	< 1	2
CGSW-103	7/17/2008	52	3.33	10.72	-103.4	9.19	NM	90	7.4	41	< 4	64	< 10	44	54	< 4	< 1	< 1	10	4	< 1	1
MHSW-101	7/16/2008	157	5.71	10.8	94.8	9.56	NM	202	7.1	124	< 4	132	< 10	83	100	< 4	< 1		29	12	< 1	< 1
MHSW-102	7/16/2008	123	5.05	9.47	113.8	9.36	NM	192	7.3	121	< 4	121	< 10	90	110	< 4	< 1	8	29	12	< 1	< 1
PBBS-200	11/8/2011	105	7.24	2	193.5	9.62	NM	124	7.8	63		78	< 10	53	65	< 4	< 1	12	13		< 1	2
PBBS-201	11/8/2011	197.6	7.54	1.1	182.5	9.24	NM	224	7.2	117		160	2250	31	38	< 4	< 1	73	27		1	3
PBBS-202	11/8/2011	111.7	7.91	0.8	15.8	8.92	NM	124	7.7	64		86	12	58	71	< 4	< 1	9	13		< 1	2
PCSW-101	7/17/2008	319	6.68	8.78	83.8	9.15	< 0.002	324	7.3	199	< 4	224	< 10	90	110	< 4	< 1	79	50	18	2	2
PCSW-102	7/22/2008	253	3.88	8.5	293.9	1.1	NM	312	3.4	44	47	196	< 10	< 4	< 4	< 4	1	100	8	6	5	4
PCSW-103	7/22/2008	179	6.69	10.8	246.3	7.54	1.85	168	7.8	87	< 4	112	< 10	74	91	< 4	7	5	21	8	< 1	3
PCSW-104	7/22/2008	179.4	7.55	10.5	190.3	7.92	2.25	169	7.6	85	< 4	114	< 10	70	86	< 4	7	5	21	8	< 1	3
PM-Adit 1	10/23/2007							1190	2.9	139	330	846	300	< 4	< 4	< 4	1	450				
PMSW-101	7/16/2008	297	4.5	8.32	253.3	8.62	< 0.002	277	3.6	41	52	204	92	< 4	< 4	< 4	1	97	10	4	4	5
PMSW-102	7/16/2008	60	3.22	10.5	137	9.88	0.634	121	3.9	20	15	99	< 10	< 4	< 4	< 4	1	35	4	2	1	2
PMSW-103	7/16/2008	64	2.96	10.54	102.8	9.04	0.436	111	4	19	13	93	< 10	< 4	< 4	< 4	< 1	32	4	2	1	1
SG-55SW	7/23/2008	382	6.56	5.9		0.74	< 0.002	332	6.6	175	4.1	212	24	38	47	< 4	< 1	120	38	19	2	1
SG-Adit 1	10/23/2007							332	6.2	62	32	206	11	< 4	< 4	< 4	1	93				
SGSW-101	7/23/2008	168.9	6.92	6	266.9	8.18	0.001	151	7.2	85	< 4	89	< 10	56	69	< 4	< 1	20	22	7	< 1	< 1
SGSW-102	7/23/2008	153.5	7.15	7.8	258.8	8.55	0.51	147	7.1	73	4.4	95	< 10	23	28	< 4	< 1	43	20	6	< 1	< 1
SGSW-103	7/23/2008	132.9	6.2	8.6	244	8.4	21.4	125	5.8	57	< 4	89	< 10	< 4	< 4	< 4	< 1	48	15	5	1	1
SGSW-104	7/23/2008	267	6.16	6.7	22.9	0.68	< 0.008	253	3.8	54	30	163	32	< 4	< 4	< 4	< 1	100	11	7	2	2
SGSW-105	7/23/2008	123.5	5.87	9.8	141.5	8.08	< 0.045	120	5.9	41	< 4	96	14	< 4	< 4	< 4	< 1	46	11	3	< 1	1
SGSW-106	7/23/2008	123.6	4.82	10	261.1	8.21	0.15	119	4.6	28	7.8	93	< 10	< 4	< 4	< 4	< 1	47	7	3	1	< 1
SGSW-107	7/23/2008	142.9	4.3	11.3	373.6	8.51	0.15	139	4.3	37	12	102	< 10	< 4	< 4	< 4	< 1	53	9	4	2	1
SHSW-101	7/17/2008	66	4.74	12.03	-111.1	8.66	4.33	106	7.6	50	< 4	393	< 10	54	66	< 4	< 1	3	12	5	< 1	1
SHSW-102	7/17/2008	100	5.3	11.46	-68.7	8.86	3.8	107	7.6	49	< 4	76	< 10	54	66	< 4	< 1	3	12	5	< 1	1
SHSW-103	7/22/2008	109	6.22	5.9	-43	8.17	0.006	100	7.1	47	< 4	79	146	32	39	< 4	< 1	16	13	4	< 1	2
SHSW-104	7/22/2008	107.4	7.36	8.6	-7.1	9.03	0.017	103	7.7	53	< 4	76	< 10	46	56	< 4	< 1	7	14	5	< 1	1

Notes:

µmhos/cm - Micromhos per centimeter
s.u. - Standard units
^{o}C - Degrees Celcius
mV - Millivolts
mg/L - Milligrams per liter
cfs - Cubic feet per second
-- - No standard/screening level
Blank - No data/not analyzed
V - Visual Estimate
NM - Not Measured

2011 data collected by Pioneer Technical Services, Inc

[a] Acute aquatic life criteria from circular DEQ-7, Montana Water Quality Standards (October 2012)
[b] Chronic aquatic life criteria from circular DEQ-7, Montana Water Quality Standards (October 2012)
[c] Human Health Standard from circular DEQ-7, Montana Water Quality Standards (October 2012)

AC - Anaconda
BT - Beartrap Creek
CG - Chambers Gulch
PBBS - Porcupine Gulch - Bobby Boy
PC - Pass Creek
PM - Paymaster Gulch
SG - Stevens Gulch
SH - Shave Creek

Table 25
Mine Inventory Streambed Sediment Analytical Results

Sample ID	Date Collected	Metals								
		Aluminum (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)
Screening Levels	TEL [abfg]	--	5.9	0.596	35.7	--	35	--	0.174	123
	PAET [cbdfg]	--	19	9.3	340	--	490	1,400	1.60	1,000
	SEL [ebfg]	--	33	10	110	--	250	--	2	820
Streambed Sediment RVs [h]		8,980	15.4	--	114	23,900	81.5	578	0.5	136
DEQ Action Level/RSLs/UBMC BTVs		**77,000 [i]**	**40 [j]**	**70 [i]**	**3,100 [i]**	**58,270 [k]**	**1,109 [k]**	**4,893 [k]**	**23 [i]**	**23,000 [i]**
ACSE-101 (0"-2")	7/23/2008	7210	10.60	< 0.5	42.4	15000	16.9	241	< 0.5	48.7
PBBS Sed 200	11/8/2011	5500	33.20	5.9	67.2	32000	107	1480		715
PBBS Sed 201	11/8/2011	4170	35.00	14.4	110	33600	149	3850		1330
PBBS Sed 202	11/8/2011	5370	14.40	< 0.5	19.3	12400	22	271		77
PCSE-103 (0-2)	7/22/2008	8060	11.50	< 0.5	15.5	14500	43.3	126	< 0.5	167
PCSE-104 (0-2)	7/22/2008	7040	9.70	< 0.5	39.3	14100	38.7	202	< 0.5	168
PMSE-102 (0-2)	7/16/2008	1710	4.65	< 0.5	16.7	97500	9.96	9.36	16	7.86

Notes:

mg/kg - Milligrams per kilogram
-- - No standard/screening level available
Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
2011 data collected by Pioneer Technical Services, Inc.
RV - Reference Values
RSL - Regional Screening Level.
BTV - Background Threshold Value.

ACSE - Anaconda
PBBS - Porcupine Gulch - Bobby Boy Mine
PMSE - Paymaster
PCSE - Pass Creek
SGSE - Stephens Gulch
SHSE - Shave Gulch
SG SED - 2011 Shave Gulch Samples

[a] The TEL is calculated as the geometric mean of the 15th percentile concentration of the toxic effects data set and the median of the no-effect data set. As such it represents the concentration below which adverse effects are expected to occur only rarely. Freshwater TELs are based on benthic community metrics and toxicity texts results. Adverse biological effects rarely seen below TEL.

[b] Cubbage, James, David Batts, Scott Breidenback. 1997. "Creation and Analysis of Freshwater Sediment Quality Values in Washington State". July. http://www.ecy.wa.gov/pubs/97323a.pdf

[c] The PAET is defined as the 95th percentile of values with no significant biological effects and concentrations greater than the lowest "hit" level. It is designed as an alternative value to the Apparent Effect Threshold to reduce the effects of random error.

[d] Entry is lowest, reliable value among a compilation of PAET levels for; H – Hyalella azteca bioassay or M – Microtox bioassay.

[e] The SEL is defined as the 90th-95th percentile screening level concentration based on in-situ benthic community structure. Contaminant concentration above the SEL is likely detrimental to the majority of benthic species.

[f] SAIC and Avocet Consulting. 2002. "Phase I Report: Development of Freshwater Sediment Quality Values for Use in Washington State." September. – Prioritizing Areas for Attention – Areas exceeding the SEL are considered the highest-priority areas for biological testing. Areas between the PAET and the SEL are considered medium priority for attention, and areas between the TEL and the PAET are considered low priority. Areas below the TEL are screened out entirely. http://www.ecy.wa.gov/pubs/0209050.pdf

[g] Cubbage, James, David Batts, Scott Breidenback. 1997. "Creation and Analysis of Freshwater Sediment Quality Values in Washington State". July. http://www.ecy.wa.gov/pubs/97323a.pdf

[h] Streambed Sediment Background Threshold Value (Streambed Sediment BTV - calculated using ProUCL v4.1.00).

[i] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).

[j] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).

[k] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

Table 25
Mine Inventory Streambed Sediment Analytical Results

Sample ID	Date Collected	Metals								
		Aluminum (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)
Screening Levels	TEL [abfg]	--	5.9	0.596	35.7	--	35	--	0.174	123
	PAET [cbdfg]	--	19	9.3	340	--	490	1,400	1.60	1,000
	SEL [ebfg]	--	33	10	110	--	250	--	2	820
Streambed Sediment RVs [h]		8,980	15.4	--	114	23,900	81.5	578	0.5	136
DEQ Action Level/RSLs/UBMC BTVs		**77,000 [i]**	**40 [j]**	**70 [i]**	**3,100 [i]**	**58,270 [k]**	**1,109 [k]**	**4,893 [k]**	**23 [i]**	**23,000 [i]**
PMSE-103 (0-2)	7/16/2008	1050	4.62	< 0.5	11.4	99000	4.97	13.5	15	4.23
SG Sed 100	11/8/2011								< 0.5	
SG Sed 101	11/8/2011								< 0.5	
SG Sed 102	11/8/2011								< 0.5	
SG Sed 103	11/8/2011								< 0.5	
SG Sed 104	11/8/2011								< 0.5	
SG Sed 105	11/8/2011								< 0.5	

Notes:

mg/kg - Milligrams per kilogram
-- - No standard/screening level available
Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
2011 data collected by Pioneer Technical Services, Inc.
RV - Reference Values
RSL - Regional Screening Level.
BTV - Background Threshold Value.

ACSE - Anaconda
PBBS - Porcupine Gulch - Bobby Boy Mine
PMSE - Paymaster
PCSE - Pass Creek
SGSE - Stephens Gulch
SHSE - Shave Gulch
SG SED - 2011 Shave Gulch Samples

[a] The TEL is calculated as the geometric mean of the 15th percentile concentration of the toxic effects data set and the median of the no-effect data set. As such it represents the concentration below which adverse effects are expected to occur only rarely. Freshwater TELs are based on benthic community metrics and toxicity texts results. Adverse biological effects rarely seen below TEL.

[b] Cubbage, James, David Batts, Scott Breidenback. 1997. "Creation and Analysis of Freshwater Sediment Quality Values in Washington State". July. http://www.ecy.wa.gov/pubs/97323a.pdf

[c] The PAET is defined as the 95th percentile of values with no significant biological effects and concentrations greater than the lowest "hit" level. It is designed as an alternative value to the Apparent Effect Threshold to reduce the effects of random error.

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[e] The SEL is defined as the 90th-95th percentile screening level concentration based on in-situ benthic community structure. Contaminant concentration above the SEL is likely detrimental to the majority of benthic species.

[f] SAIC and Avocet Consulting. 2002. "Phase I Report: Development of Freshwater Sediment Quality Values for Use in Washington State." September. – Prioritizing Areas for Attention – Areas exceeding the SEL are considered the highest-priority areas for biological testing. Areas between the PAET and the SEL are considered medium priority for attention, and areas between the TEL and the PAET are considered low priority. Areas below the TEL are screened out entirely. http://www.ecy.wa.gov/pubs/0209050.pdf

[g] Cubbage, James, David Batts, Scott Breidenback. 1997. "Creation and Analysis of Freshwater Sediment Quality Values in Washington State". July. http://www.ecy.wa.gov/pubs/97323a.pdf

[h] Streambed Sediment Background Threshold Value (Streambed Sediment BTV - calculated using ProUCL v4.1.00).

[i] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).

[j] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).

[k] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

Table 25
Mine Inventory Streambed Sediment Analytical Results

Sample ID	Date Collected	Metals								
		Aluminum (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)
Screening Levels	TEL [abfg]	--	5.9	0.596	35.7	--	35	--	0.174	123
	PAET [cbdfg]	--	19	9.3	340	--	490	1,400	1.60	1,000
	SEL [ebfg]	--	33	10	110	--	250	--	2	820
Streambed Sediment RVs [h]		8,980	15.4	--	114	23,900	81.5	578	0.5	136
DEQ Action Level/RSLs/UBMC BTVs		**77,000 [i]**	**40 [j]**	**70 [i]**	**3,100 [i]**	**58,270 [k]**	**1,109 [k]**	**4,893 [k]**	**23 [i]**	**23,000 [i]**
SGSE-102 (0"-2")	7/23/2008	3740	324.00	11	500	147000	2300	436	0.6	2170
SGSE-103 (0"-2")	7/23/2008	4450	300.00	10.9	588	159000	1220	370	< 0.5	2320
SGSE-104 (0"-2")	7/23/2008	147	201.00	< 0.5	0.798	178000	2.92	61.3	< 0.5	101
SGSE-105 (0"-2")	7/23/2008	5000	196.00	4.12	375	91400	1070	481	< 0.5	895
SGSE-106 (0"-2")	7/23/2008	5870	145.00	1.29	336	58000	674	383	< 0.5	369
SGSE-107 (0"-2")	7/23/2008	6460	168.00	1.84	341	73400	694	259	< 0.5	415
SHSE-101 (0-2)	7/17/2008	6070	10.80	0.871	61	10400	70.6	349	380	94.3

Notes:

mg/kg - Milligrams per kilogram
-- - No standard/screening level available
Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
2011 data collected by Pioneer Technical Services, Inc.
RV - Reference Values
RSL - Regional Screening Level.
BTV - Background Threshold Value.

ACSE - Anaconda
PBBS - Porcupine Gulch - Bobby Boy Mine
PMSE - Paymaster
PCSE - Pass Creek
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SG SED - 2011 Shave Gulch Samples

[a] The TEL is calculated as the geometric mean of the 15th percentile concentration of the toxic effects data set and the median of the no-effect data set. As such it represents the concentration below which adverse effects are expected to occur only rarely. Freshwater TELs are based on benthic community metrics and toxicity texts results. Adverse biological effects rarely seen below TEL.

[b] Cubbage, James, David Batts, Scott Breidenback. 1997. "Creation and Analysis of Freshwater Sediment Quality Values in Washington State". July. http://www.ecy.wa.gov/pubs/97323a.pdf

[c] The PAET is defined as the 95th percentile of values with no significant biological effects and concentrations greater than the lowest "hit" level. It is designed as an alternative value to the Apparent Effect Threshold to reduce the effects of random error.

[d] Entry is lowest, reliable value among a compilation of PAET levels for; H – Hyalella azteca bioassay or M – Microtox bioassay.

[e] The SEL is defined as the 90th-95th percentile screening level concentration based on in-situ benthic community structure. Contaminant concentration above the SEL is likely detrimental to the majority of benthic species.

[f] SAIC and Avocet Consulting. 2002. "Phase I Report: Development of Freshwater Sediment Quality Values for Use in Washington State." September. – Prioritizing Areas for Attention – Areas exceeding the SEL are considered the highest-priority areas for biological testing. Areas between the PAET and the SEL are considered medium priority for attention, and areas between the TEL and the PAET are considered low priority. Areas below the TEL are screened out entirely. http://www.ecy.wa.gov/pubs/0209050.pdf

[g] Cubbage, James, David Batts, Scott Breidenback. 1997. "Creation and Analysis of Freshwater Sediment Quality Values in Washington State". July. http://www.ecy.wa.gov/pubs/97323a.pdf

[h] Streambed Sediment Background Threshold Value (Streambed Sediment BTV - calculated using ProUCL v4.1.00).

[i] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).

[j] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).

[k] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

Table 25
Mine Inventory Streambed Sediment Analytical Results

Sample ID	Date Collected	Metals								
		Aluminum (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)
Screening Levels	TEL [abfg]	--	5.9	0.596	35.7	--	35	--	0.174	123
	PAET [cbdfg]	--	19	9.3	340	--	490	1,400	1.60	1,000
	SEL [ebfg]	--	33	10	110	--	250	--	2	820
Streambed Sediment RVs [h]		8,980	15.4	--	114	23,900	81.5	578	0.5	136
DEQ Action Level/RSLs/UBMC BTVs		**77,000 [i]**	**40 [j]**	**70 [i]**	**3,100 [i]**	**58,270 [k]**	**1,109 [k]**	**4,893 [k]**	**23 [i]**	**23,000 [i]**
SHSE-102 (0-2)	7/17/2008	8240	27.20	2.22	95.2	18000	210	761	< 0.5	209
SHSE-103 (0-2)	7/22/2008	5940	42.20	42.9	338	13000	646	16100	< 0.5	2890

Notes:

mg/kg - Milligrams per kilogram
-- - No standard/screening level available
Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
2011 data collected by Pioneer Technical Services, Inc.
RV - Reference Values
RSL - Regional Screening Level.
BTV - Background Threshold Value.

ACSE - Anaconda
PBBS - Porcupine Gulch - Bobby Boy Mine
PMSE - Paymaster
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SG SED - 2011 Shave Gulch Samples

[a] The TEL is calculated as the geometric mean of the 15th percentile concentration of the toxic effects data set and the median of the no-effect data set. As such it represents the concentration below which adverse effects are expected to occur only rarely. Freshwater TELs are based on benthic community metrics and toxicity texts results. Adverse biological effects rarely seen below TEL.

[b] Cubbage, James, David Batts, Scott Breidenback. 1997. "Creation and Analysis of Freshwater Sediment Quality Values in Washington State". July. http://www.ecy.wa.gov/pubs/97323a.pdf

[c] The PAET is defined as the 95th percentile of values with no significant biological effects and concentrations greater than the lowest "hit" level. It is designed as an alternative value to the Apparent Effect Threshold to reduce the effects of random error.

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[g] Cubbage, James, David Batts, Scott Breidenback. 1997. "Creation and Analysis of Freshwater Sediment Quality Values in Washington State". July. http://www.ecy.wa.gov/pubs/97323a.pdf

[h] Streambed Sediment Background Threshold Value (Streambed Sediment BTV - calculated using ProUCL v4.1.00).

[i] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).

[j] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).

[k] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

Table 26a
Mine Inventory Waste Sample Total Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)[c]	Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M
DEQ Action Level/RSLs/UBMC BTV		77,000[a]	40[b]			70[a]			3,100[a]			58,270[d]			1,109[d]			4,893[d]			23[a]			23,000[a]		
BTWA-101	7/24/2008	5420			575.07	2.3					178			146245			5264.67			7530.52			< 11.15			1209.22
CGWA-101	7/17/2008	4500			795.87	26					59			129124			16389.97			1967.52			< 15.45			2563.02
FLWA-101	7/22/2008	3350			212.35	1.5					70.57			54036			1865.23			241.52			< 7.55			283.71
IHWA-101	7/22/2008	3490			245.58	< 0.5					332.68			122245			596.26			490.02			13.74			92.14
PBBS WP 200	11/2/2011	8490	21			4.2			106			30900			153			1610			< 0.5			540		
PCMW-101	7/17/2008	26700			35.19	9.5					100.39			32014			917.58			2182.79			< 5.98			2149.11
PCWA-102	7/22/2008	9110			< 15.40	< 0.5					149			115771			110.90			299.31			< 8.07			39
PMWA-101	7/15/2008	4630			139.46	0.6					147			78920			5378.7			233.75			< 10.36			74.46
PMWA-102	7/15/2008	6370	30.4		25.74	< 0.5			179		194	46200		55339	264		301.22	26.5		115.86	< 0.5		< 6.21	15		32.68
SGWA-101	7/22/2008	9690	< 21.92		< 15.72	< 0.5			172		75	110863		72872	275.5		149.55	263		155.03			< 6.73	370		< 21.89
SGWA-102	7/15/2008	15600			22.62	< 0.5					222			68340			123.6			210.73			< 7.43			< 22.03
SGWA-103	7/15/2008	9410			44.85	< 0.5					314			20445			394.89			80.44			8.15			80.72
SGWA-104	7/23/2008	11800			144.34	< 0.5					104			56566			1509.21			196.13			< 6.82			30.44
SGWA-104 (0-6)	7/25/2008	6890			14.76	1.1					353			109352			101.92			578.53			< 7.65			68.57
SGWP 200	11/2/2011	11800	23			< 0.2			70.4			45600			113			62			< 0.5			22		
SHWA-102	7/22/2008	2080	490		1007.07	52.7			446		762	80300		131607	34300		30913.22	286		566.92	0.98		< 23.59	7720		7346.21
SSWA-101	7/22/2008	11200			52.16	4.3					123			44056			1816.68			2502.62			< 6.77			627.85

Notes:

mg/kg - Milligrams per kilogram
Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
M% - Matrix spike recoveries exceed acceptable limits.
J - The associated value is an estimated quantity.
- Value meets or exceeds one or more soil screening level.

[a] EPA Region 9 Preliminary Remediation Goals (PRGs) for residential soil (November 2012).
[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[c] XRF did not report values for Aluminum.
[d] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

XRF Field - XRF measurements recorded from ground surface in field.
XRF 10 M - XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab - Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.

Note:
SSWA-101 is referenced as SGWA-101 on mine inventory map.
PCMW-101 is referenced as PCWA-101 on mine inventory map.

BTWA - Blackfoot Tributary
CGWA - Chambers Gulch Waste Area
FLWA - Flossie Louise Waste Area
IHWA - Iron Hill Waste Area
PBBS - Bobby Boy Waste Pile
PCWA - Pass Creek Waste Area
PMWA - Paymaster Mine Waste Area
SGWA/SSWA - Stevens Gulch
SGWP - 2011 Shave Gulch Waste Pile at SH-17
SHWA - Shave Gulch Waste Area

Table 26b
Mine Inventory Waste ABA and SPLP Analytical Results

Sample ID	Date Collected	Specific Conductance (µmhos/cm)	pH (s.u.)	TOC (%)	Acid - Base Accounting								Synthetic Precipitation Leaching Procedure								
					Sulfur, Hot Water Extractable (%)	Total Sulfur (%)	Sulfur Sulfate (%)	Sulfur Pyritic (%)	Sulfur Organic (%)	Neutral Potential (t/kt)	Acid Potential (t/kt)	Acid/Base Potential (t/kt)	Aluminum (mg/L)	Arsenic (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Zinc (mg/L)
Soil SPLP		--	--	--	--	--	--	--	--	--	--	--	--	0.1	0.05	13	110	0.15	3.2	0.02	20
BTWA-101	7/24/2008																				
CGWA-101 (0-6")	7/17/2008																				
FLWA-101	7/22/2008																				
IHWA-101	7/22/2008																				
PBBS WP 200	11/2/2011	0.40	5.2	0.00	< 0.01	0.02	0	0	0	7	.6	6	22	0.03	0.0023	0.082	30	0.15	0.85	0.000093	0.5
PCWA-101	7/17/2008																				
PCWA-102	7/22/2008																				
PMWA-101	7/15/2008																				
PMWA-102	7/15/2008	0.31	3.1	0.50	0.88	0.96	0.19	0.77	< 0.01	-4	24	-28		< 0.003	< 0.00008	0.019	0.42	0.0058	0.005	< 0.0001	0.01
SGWA-101	7/22/2008																				
SGWA-102	7/15/2008																				
SGWA-103	7/15/2008																				
SGWA-104	7/23/2008																				
SGWA-104	7/25/2008																				
SGWP 200	11/2/2011	0.50	2.9	0.00	< 0.01	2.2	0	0	0	-0	62	-63	0.46	< 0.003	0.00046	0.004	2.1	0.0051	0.005	0.0002	< 0.01
SHWA-102	7/22/2008	6.49	2.2	0.50	6.22	6.37	1.12	5.19	0.06	-10	160	-170		< 0.003	0.01	0.085	1.3	5.7	0.73	< 0.0001	1.6
SSWA-101	7/22/2008																				

Notes:

µmhos/cm	- Micromhos per centimeter
s.u.	- Standard units
%	- Percent
t/tk	- Tons per thousand tons
mg/L	- Milligrams per liter
--	- No standard/screening level
<	- Parameter not detected at or above the laboratory practical quantitation limit
Blank	- No data/not analyzed
TOC	- Total organc carbon

Classification	Criteria for Classification [a]
Potentially Acid Generating	NP:AP < 1 and NNP < -20 tons/kton
Uncertain Acid Generation Potential	NP:AP between 1 and 3 and/or NNP between -20 and +20 tons/kton
Unlikely to Generate Acid	NP:AP > 3 and NNP < +20 tons/kton

[a] From BLM (1996) and EPA (1994).

BTWA	- Blackfoot Tributary
CGWA	- Chambers Gulch Waste Area
FLWA	- Flossie Louise Waste Area
IHWA	- Iron Hill Waste Area
PCWA	- Pass Creek Waste Area
PMWA	- Paymaster Mine Waste Area
SGWA/SSWA	- Stevens Gulch
SHWA	- Shave Gulch Waste Area

Note:
SSWA-101 is referenced as SGWA-101 on mine inventory map.
PCMW-101 is referenced as PCWA-101 on mine inventory map.

*Iron and manganese SPLP Leachate Criterion for soil were calculated based on a DAF 10 and their respective EPA Tap Water standards. The SPLP Leachate Criterion for Soil for the remaining metals were calculated based on a DAF 10 and their respective DEQ-7 water quality standards (see Section 4 of RI report).

Table 27a
Mine Waste Removal and Reclamation Areas Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M
DEQ Action Level/RSLs/UBMC BTVs		77,000[a]	40[b]			70[a]			3,100[a]			58,270[c]			1,109[c]			4,893[c]			23[a]			23,000[a]		
EU1 Upper Anaconda Mine Waste Removal Areas and Waste Piles																										
UAW1-COMP 1 (0-6")	10/12/2007	1400	253		1201.81	3.41		57.23	3050		478.81	97300		39330.65	55200		41468.69	38.7		< 244.99	0.98		< 31.88	1270		728.34
UAW1-00 (0-6")	10/12/2007				321.02			< 28.41			133.45			132863.22			6211.6			630.71			< 13.29			390.21
UAW1-00+12.5 (0-6")	7/18/2008			51.2						101.82			18869.13			341.11			1707.8			< 8.84			526.78	
UAW1-00+50 (0-6")	7/18/2008			26.59						48.78			21818.29			291.42			1496.94			< 8.13			337.41	
UAW1-00+25 (0-6")	7/21/2008	15800		21.56	22.09	3.5				42.64	45.49		20399.33	22511.1		195.11	340.46		1946.26	2016.71		< 8.11	< 6.23		317	480.63
UAW1-50 (0-6")	10/12/2007				116.96			< 21.62			139.15			24215.78			1688.61			2854.17			< 6.72			832.75
UAW1-50+25 (0-6")	7/18/2008			132.1						82.12			23557.8			1588.49			3545.87			< 8.21			725.41	
UAW1-50+50 (0-6")	7/18/2008			42.39						60.19			23152.38			746.77			1825.44			< 9.37			517.93	
UAW1-50+75 (0-6")	7/18/2008			< 114.92						103.8			25053.96			6249.28			1722.76			< 12.13			768.08	
UAW1-50+100 (0-6")	7/18/2008			< 51.08						50.42			22121.85			1408.9			2061.67			< 8.16			493.28	
UAW1-50+125 (0-6")	7/18/2008			58.1						78.94			14390.45			491.3			2711.38			< 7.56			596.95	
UAW1-50+150 (0-6")	7/18/2008			69.83						64.98			22616.34			428.01			2763.02			< 8.77			673.81	
UAW1-50+175 (0-6")	7/18/2008			49.04						< 30.51			21314.73			260.17			2852.93			< 8.21			830.18	
UAW1-50+200 (0-6")	7/18/2008			< 33.23						< 31.32			22848.6			545.79			1204.99			< 8.41			857.71	
UAW1-100 (0-6")	10/12/2007				345.79			< 26.25			130.39			85327.69			11077.1			< 195.09			< 12.91			56.43
UAW1-150 (0-6")	10/12/2007				208.77			< 23.59			175.02			38174.68			2478.43			477.79			< 8.79			423.28
UAW1-150+25 (0-6")	7/18/2008			97.83						112.39			29022.93			981.22			4231.13			< 10.39			314.16	
UAW1-150+50 (0-6")	7/18/2008			47.84						83.19			24700.15			554.8			3207.75			< 7.94			859.75	
UAW1-150+75 (0-6")	7/18/2008	17000	52.8	68.96	39.78	6.85			79.6	91.02	89.33	27800	33808.32	23946.2	771	655.16	767.99	2250	2250.9	2271.31	< 0.5	< 9.17	< 6.1	1020	817.83	1229
UAW1-150+100 (0-6")	7/18/2008			27.93						57.91			23521.41			398.81			2016.63			< 7.69			784.81	
UAW2-COMP1 (0-6")	10/12/2007	8950	50.7		< 25.09	0.4		< 22.24	198		61.54	30600		16784.46	2740		323.18	489		473.34	< 0.5		< 7.1	156		57.06
UAW2-00 (0-6")	10/12/2007				61.36			< 21.51			351.41			22246.46			859.28			1758.51			< 6.4			385.06
UAW2-00+25 (0-6")	7/16/2008			211.5						723.89			30007.11			1791.14			2395.71			< 8.3			593.29	
UAW2-00+50 (0-6")	7/16/2008			116.97						188.4			31646.89			1051.85			2219.4			< 10.73			692.42	
UAW2-00+75 (0-6")	7/16/2008			96.09						213.74			20029.46			915.73			2746.57			< 9.04			629.62	
UAW2-00+100 (0-6")	7/16/2008			76.54						280.69			34517.38			1247.93			2906.95			< 9.41			993.63	
UAW2-00+125 (0-6")	7/16/2008			112.78						22			39140.47			1055.51			2578.56			< 9.42			1174.67	
UAW2-00+150 (0-6")	7/16/2008			180.09						394.14			44634.64			1286.74			4018.42			< 9.2			1060.2	
UAW2-00+225 (0-6")	7/16/2008			45.95	36.9					140.95	148		28016.95	30083		292.37	250.1		1796.79	2227		< 7.86	< 5.68		576.16	715.9
UAW2-50 (0-6")	10/12/2007				< 22.12			< 23.9			90.58			23706.17			187.87			823.62			< 7.04			138.05
UAW2-100 (0-6")	10/12/2007				< 38.19			< 22.16			215.82			17486.62			753.63			1333.51			< 6.77			457.53
UAW2-100+25 (0-6")	7/17/2008			43.94						131.35			22503.36			623.91			1859.59			< 7.38			501.46	
UAW2-100+50 (0-6")	7/17/2008			< 37.11						99.53			20967.3			695.63			951.69			< 8.49			661.86	
UAW2-100+75 (0-6")	7/17/2008			75.76						89.49			17149.05			769.02			2217.18			< 12.36			576.91	
UAW2-100+100 (0-6")	7/17/2008			< 49.35						84.73			33310.18			1184.43			1895.89			< 8.61			685.5	
UAW2-100+150 (0-6")	7/17/2008			81.76						51.64			21770.25			524.12			1837.97			< 11.2			541.03	
UAW2-100+200 (0-6")	7/17/2008			70.61						67.7			23874.73			1532.29			2472.43			< 9.34			1041.09	
UAW2-100+250 (0-6")	7/17/2008			31.96	38.2					76.15	93		22376.68	20474.4		100.02	147.9		2820.75	3914		< 8.06	< 5.06		301.02	433.1
UAW2-150 (0-6")	10/12/2007				< 16.62			< 22.66			91.32			15793.78			125.46			436.29			< 7.21			67.27
UAW2-200 (0-6")	10/12/2007		77.7		174.07	0.97		< 26.74	661		498.16			52489.47	4540		3708.11	601		586.81	< 0.5		< 10.89	362		263.18
UAW2-250 (0-6")	10/12/2007		79.4		< 115.21	1.01		< 30.14	631		487.93			68840.46	5600		4393.83	363		< 212.57	< 0.5		< 11.21	312		179.64
UAW2-250+25 (0-6")	7/17/2008			72.22						173.76			37740.46			476.77			2161.36			< 8.31			322.61	

Notes:

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Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
M% - Matrix spike recoveries exceed acceptable limits.
J - The associated value is an estimated quantity.
- Value exceeds EPA RSI or DEQ Action Level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

AMHR - Above Mike Horse Repository
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UAW3-51 through UAW3-75 and UAW4 through UAW4-50 XRF results from ground surface of unreclaimed Upper Anaconda Waste Areas. UAW3-X represents XRF reading number.

XRF Field - XRF measurements recorded from ground surface in field.
XRF 10 M - XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab - Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
XRF samples were sent to lab for confirmation analysis at a a frequence of 10%.

Table 27a
Mine Waste Removal and Reclamation Areas Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M
DEQ Action Level/RSLs/UBMC BTVs		77,000[a]	40[b]			70[a]			3,100[a]			58,270[c]			1,109[c]			4,893[c]			23[a]			23,000[a]		
UAW2-250+100 (0-6")	7/17/2008			< 44.49						21			35436.75			971.65			1470.58			< 8.82			472.86	
UAW2-250+50 (0-6")	7/17/2008	14800		39.61	31.9	4.4				144.47	140		23645.25	31001.9		399.74	508.2		2565.83	2551.95		< 8.82	< 6.10		412.35	499.4
UAW2-300 (0-6")	10/12/2007				170.37			< 26.38			760.97			55875.84			4541.9			366.76			< 11.82			198
UAW2-350 (0-6")	10/12/2007				84.54			< 22.64			317.23			32345.37			1053.81			3297.61			< 7.18			666.33
UAW2-350+25 (0-6")	7/16/2008			197.68						798.84			39869.59			2039.33			996.9			< 9.49			795.31	
UAW2-350+50 (0-6")	7/16/2008			40.47	< 22.7					128.42	130		24486.55	31088.1		270.89	377.2		2077.11	774		< 8.57	< 6.65		341.34	414.2
UAW2-400 (0-6")	10/12/2007				78.86			< 25.94			174.4			34289.75			1218.52			562.99			< 9.66			137.03
UAW2-400+25 (0-6")	7/16/2008			177.94						322.95			47626.57			1736			868.74			< 8.8			210.7	
UAW2-400+50 (0-6")	7/16/2008			75.1						255.22			37161.59			2099.49			759.88			< 10.45			147.06	
UAW2-400+75 (0-6")	7/16/2008			385.57						1121.46			123263.35			6394.55			658.48			< 13.24			176.53	
UAW2-400+100 (0-6")	7/16/2008			61.34						654.82			76466.02			457.21			2067.2			< 12.1			272.63	
UAW2-400+125 (0-6")	7/16/2008			69.56						751.1			90017.32			849.56			1421.11			< 10.6			295.11	
UAW2-400+150 (0-6")	7/16/2008			37.4	41.4					435.56	583		76926.21	83484.1		213.92	274.2		1599.84	1799		< 9.49	< 8.20		263.9	315.8
UAW2-450 (0-6")	10/12/2007				45.26			< 22.35			302.42			24248.53			925.42			1755.07			< 7.53			504.1
UAW2-450+25 (0-6")	7/16/2008			84.75						395.8			31249.56			833.29			2989.59			< 8.36			853.18	
UAW2-450+50 (0-6")	7/16/2008			34.66	32.2					155	232		24401.17	25450.3		334.23	512.6		1414.15	1048		< 8.42	< 5.81		369.78	411.3
UAW2-1000 (0-6")	7/21/2008	10600		38.88	38.88	1.5				383	382.98		88744.96	88744.96		316.64	316.64		1728	1728.32			< 7.73		428.21	428.21
UAW2-1000+25 (0-6")	7/16/2008			70.42						193.62			46841.34			938.21			3172.44			< 9.11			970.14	
UAW2-1000+50 (0-6")	7/16/2008			51.34						130.37			20323.59			1212.25			2970.02			< 7.36			684.77	
UAW2-1000+75 (0-6")	7/16/2008			< 42.28						154.29			30354.64			943.52			1831.39			< 8.25			877.51	
UAW2-1000+100 (0-6")	7/16/2008			47.44						87.59			25149.8			441.29			1625.24			< 7.57			563.5	
UAW2-1000+125 (0-6")	7/16/2008			51.56						118.92			32283.12			696.11			1798.71			< 7.91			697.47	
UAW2-1000+150 (0-6")	7/16/2008			57.63						142.21			16369.8			569.5			1903.85			< 7.37			521.7	
UAW2-1000+175 (0-6")	7/16/2008			66.13						112.26			26974.29			711.82			1695.3			< 7.32			526.54	
UAW2-1000+200 (0-6")	7/16/2008			36.67						359.86			72778.99			332.21			1716.67			< 10.54			414.48	
UAW3-COMP 1 (0-6")	10/12/2007	2510	158		2702.7	15.3		69.06	1060		1560.56	68100		79648.82	55100		78258.55	224		< 481.4	0.5		< 48.82	3200		10101.98
UAW3-51 (0-6")	7/17/2008									< 76.67			29202.54			5262.12			769.13						618.4	
UAW3-52 (0-6")	7/17/2008			407.4						< 57.44			26358.73			4057.72			1999.78						1606.45	
UAW3-53 (0-6")	7/17/2008			65.3						< 36.95			14694.34			437.47			1356.73						296.73	
UAW3-54 (0-6")	7/17/2008									< 53.03			21065.91			166.5			1461.21						153.68	
UAW3-55 (0-6")	7/17/2008			133						72.42			22307.43			2627.37			2098.06						1642	
UAW3-56 (0-6")	7/17/2008			43						< 39.71			16328.64			351.61			1219.08						416.71	
UAW3-57 (0-6")	7/17/2008			133.5						< 46.9			24947.43			2136.27			1074.76						454.82	
UAW3-58 (0-6")	7/17/2008									< 56.78			23014.73			553.48			1463.1						393.24	
UAW3-59 (0-6")	7/17/2008									< 41.82			18500.61			319.92			1804.95						448.35	
UAW3-60 (0-6")	7/17/2008			76.5						< 38.48			11667.08			492.8			1328.75						504.39	
UAW3-61 (0-6")	7/17/2008			139.6						< 62.76			23185.42			926.69			1942.82						1587.54	
UAW3-63 (0-6")	7/17/2008									< 48.03			19199.43			1043.89			2472.87						1018.37	
UAW3-65 (0-6")	7/17/2008			236.2						146.19			20648.89			4074.66			3376.57						1062.8	
UAW3-66 (0-6")	7/17/2008			157.2						< 48.47			25521.42			1693.88			2517.16						778.54	
UAW3-67 (0-6")	7/17/2008									< 44.33			21996.04			1477.48			2470.76						762.66	
UAW3-69 (0-6")	7/17/2008			49.4						< 42.06			21017.12			479.6			1890.5						692.84	
UAW3-70 (0-6")	7/17/2008			51.2						< 42.29			19295.83			353.37			162						564.93	

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UAW3-51 through UAW3-75 and UAW4 through UAW4-50 XRF results from ground surface of unreclaimed Upper Anaconda Waste Areas. UAW3-X represents XRF reading number.

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Lab - Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
XRF samples were sent to lab for confirmation analysis at a a frequence of 10%.

Table 27a
Mine Waste Removal and Reclamation Areas Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M
DEQ Action Level/RSLs/UBMC BTVs		77,000[a]	40[b]			70[a]			3,100[a]			58,270[c]			1,109[c]			4,893[c]			23[a]			23,000[a]		
UAW3-71 (0-6")	7/17/2008									< 44.94			21540.57			318.71			1509.79						542.58	
UAW3-72 (0-6")	7/18/2008									< 45.23			20898.79			693.21			2088.28						789.8	
UAW3-73 (0-6")	7/18/2008			67.2						< 39.12			20826.88			525.36			3010.54						777.13	
UAW3-74 (0-6")	7/18/2008									< 39.73			25620.09			360.8			2534.19						806.28	
UAW3-75 (0-6")	7/18/2008			39						< 33.32			15255.71			300.95			2682.27						572.8	
UAW4-COMP 1 (0-6")	10/11/2007		121		469.79	1.4		< 28.66	954		673.69			55688	22600 JM		13337.09	117		242.16	< 0.5		< 15.93	641		511.41
UAW4 (0-6")	7/17/2008									< 49.8			23745.21			99.14			1259.67						156.86	
UAW4-42 (0-6")	7/17/2008			112						< 62.38			19693.52			1056.16			1248.51						276	
UAW4-44 (0-6")	7/17/2008									< 41.19			15368.22			91.18			2106.66						254.2	
UAW4-45 (0-6")	7/17/2008			117.2						120.69			26085.02			1256.82			2424.76						611.74	
UAW4-46 (0-6")	7/17/2008			89.2						80.3			21818.67			589.84			3710.7						471.94	
UAW4-47 (0-6")	7/17/2008									< 39.87			14692.94			307.58			1552.38						261.84	
UAW4-48 (0-6")	7/17/2008									< 53.25			19711.72			401.28			1514.78						468.25	
UAW4-49 (0-6")	7/17/2008									< 42.6			18586.74			421.71			2503.49						356.54	
UAW4-50 (0-6")	7/17/2008									< 36.09			20712.35			162.56			2132.31						253.48	
UAW5-COMP 1 (0-6")	10/16/2007		40		< 50.16	2.05		< 26.55	255		223.14			45251.4	1140		980.24	1430		937.28	< 0.5		< 8.19	588		452.09
UAW5-00 (0-6")	10/16/2007				34.52			< 23.36			53.38			26737.85			317			878.32			< 7.63			431.92
UAW5-50 (0-6")	10/17/2007				< 26.6			< 20.97			37.65			15995.31			375.76			1062.18			< 6.29			470.17
UAW5-100 (0-6")	10/17/2007				< 33.27			< 22.68			123.79			21357.99			562.84			934.85			< 6.76			421.91
UAW5-100+25 (0-6")	7/17/2008			37.93	34.3					75	62		17520.75	28364.7		305.13	461.5		1775.28	1436		< 7.75	< 6.44		544.77	684.7
UAW5-150 (0-6")	10/16/2007				< 34.83			< 20.84			100.35			22492.31			654.3			1142.14			< 6.47			428.91
UAW5-150+25 (0-6")	7/17/2008			41.11						98.33			25557.23			802.71			2730.53			< 7.32			936.86	
UAW5-150+37.5 (0-6")	7/17/2008			52.22						11			17041.61			30			2656.14			< 7.9			549.02	
UAW5-150+50 (0-6")	7/17/2008			< 21.13	26.7					78.36	51		8201.2	23455.7		259.14	474		2066.61	1908		< 6.85	< 5.93		556.51	725
UAW5-200 (0-6")	10/17/2007				< 39.38			< 23.56			54.75			22091.98			723.53			484.65			< 7.88			354.25
UAW5-200+25 (0-6")	7/17/2008			67.74						56.95			21514.17			682.62			1797.62			< 10.53			396.4	
UAW5-200+50 (0-6")	7/17/2008			< 41.89						72.79			2099			903.81			1866.39			< 8.09			552.63	
UAW5-200+75 (0-6")	7/17/2008			< 47.74						85.43			12254.13			778.13			2131.4			< 11.84			326.95	
UAW5-200+100 (0-6")	7/17/2008			75.76						59.59			16740.5			618.39			2050.14			< 7.45			613.8	
UAW5-200+125 (0-6")	7/17/2008			< 31.12						73.16			19910.88			476.87			562.44			< 8.93			353.58	
UAW5-200+150 (0-6")	7/17/2008			82.57						50.37			17752.58			708.73			2821.8			< 7.6			603.93	
UAW5-200+175 (0-6")	7/17/2008			269.04						158.16			63836.16			2162.29			427.35			< 10.52			352.1	
UAW5-250 (0-6")	10/16/2007				68.99			< 24.04			140.12			35951.05			1180.38			2551.96			< 7.91			472.1
UAW5-250+25 (0-6")	7/17/2008			48.37						72.93			25275.86			555.94			2046.28			< 8.05			490.66	
UAW5-250+50 (0-6")	7/17/2008			38.83	< 23.6					72.48	37		18566.03	21308		374.49	462.2		732.23	732		< 7.58	< 5.99		332.12	399.3
UAW5-300 (0-6")	10/17/2007				< 35.67			< 21.63			48.36			18002.29			680.64			2020.32			< 6.91			923.18
UAW5-300+25 (0-6")	7/17/2008			47.41						107.15			12641.05			249.4			1489.57			< 7.22			702.83	
UAW5-300+50 (0-6")	7/17/2008			52.24						75.99			11745.27			318.4			2271.36			< 7.58			981.1	
UAW5-300+75 (0-6")	7/17/2008			24.78	43.2					47.16	37		6384.7	20497.2		13	409.6		1811.66	2551		< 5.92	< 5.88		464.52	831.3
UAW5-300+75 (0-6")	7/17/2008	14600		24.78	43.2	7.3				47.16	37		6384.7	20497.2		13	409.6		1811.66	2551		< 5.92	< 5.88		464.52	831.3
UAW5-350 (0-6")	10/16/2007				59.06			< 24.59			183.99			46431.86			755.83			845.08			< 8.44			163.6
UAW5-400 (0-6")	10/16/2007				85.68			< 25.78			370.47			63221.84			940.45			1702.57			< 9.28			541.71
UAW5-400+50 (0-6")	7/17/2008			92.45						357.88			58057.21			764.74			2720.44			< 10.27			1173.38	

Notes:

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Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
M% - Matrix spike recoveries exceed acceptable limits.
J - The associated value is an estimated quantity.
- Value exceeds EPA RSl or DEQ Action Level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

AMHR - Above Mike Horse Repository
CARM - Carbonate Mine Waste Area
CEA - Central Edith Mine Waste Area
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UAW3-51 through UAW3-75 and UAW4 through UAW4-50 XRF results from ground surface of unreclaimed Upper Anaconda Waste Areas. UAW3-X represents XRF reading number.

XRF Field - XRF measurements recorded from ground surface in field.
XRF 10 M - XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab - Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
XRF samples were sent to lab for confirmation analysis at a a frequence of 10%.

Table 27a
Mine Waste Removal and Reclamation Areas Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M
DEQ Action Level/RSLs/UBMC BTVs		77,000[a]	40[b]			70[a]			3,100[a]			58,270[c]			1,109[c]			4,893[c]			23[a]			23,000[a]		
UAW5-400+85 (0-6")	7/17/2008			40.67						254.63			36774.08			595.64			2744.05			< 8.65			761.07	
UAW5-450 (0-6")	10/16/2007				47.44			< 23.59			359.5			31987.18			48			777.82			< 7.15			202.37
UAW5-450+20 (0-6")	7/17/2008			< 42.07						164.33			55251.81			927.18			940.19			< 8.65			276.45	
UAW5-500 (0-6")	10/16/2007				143.48			< 29.59			455.48			136002.23			2554.73			292.73			< 12.54			374.64
UAW5-500+50 (0-6")	7/17/2008	18200		33	< 31.5	6.7				245.66	304		35601.99	51199.4		366.39	704.1		2052.08	2483.5		< 9.06	< 7.30		563.72	769.4
UAW5-500+25 (0-6")	7/17/2008			65.07						167.31			31702.53			338.32			1787.01			< 7.1			260.24	
UAW5-550 (0-6")	10/17/2007				77.16			< 25.05			151.36			38930.27			820.68			1224.76			< 8.33			705.36
UAW5-550+25 (0-6")	7/17/2008			121.46						759.37			65189.27			546.38			1051.92			< 1			657.87	
UAW5-550+50 (0-6")	7/17/2008			75.39						940.93			55692.84			789.33			2762.88			< 8.9			691.86	
UAW5-550+75 (0-6")	7/17/2008			61.54						660.98			81088.05			137.28			3120.13			< 11.34			480.19	
UAW5-550+100 (0-6")	7/17/2008			55.62						746.04			80780.19			191.45			3098.96			< 1			517.83	
UAW5-550+125 (0-6")	7/17/2008			60.76						425.68			73646.18			273.05			2953.91			< 9.65			531.14	
UAW5-550+150 (0-6")	7/17/2008			< 21.25						191.89			58452.12			168.82			1691.18			< 10.15			317.21	
UAW5-600 (0-6")	10/16/2007				< 37.71			< 24.91			122.65			32038.15			608.22			1263.97			< 8.59			559.14
EU3 Capital Mine Waste Area																										
CMWA-COMP 1 (0-6")	10/8/2007	2850	1570		184	3.04		< 25.53	361		288.88	194000		29769.05	2140		1570.95	178		334.22	1.3		< 9.25	628		1066.52
CMWA-COMP 2 (0-6")	10/8/2007	11100	354		1103.09	2.98		< 32.62	462		269.55	51600		243112.63	2270		1986.73	712		< 338.24	0.84		< 12.83	1230		362.67
CMWA-0+12.5 (0-6")	7/16/2008			35.07	64.9					199.32	390.0		28050.1	44549.4		216.48	593.8		784.67	1216		< 7.23	< 6.66		198.67	435.9
CMWA-0+12.5 (0-6")	7/16/2008	14900	58.4	35.07	64.9	2.7			529	199.32	390.0	40900	28050.1	44549.4	574	216.48	593.8	1000	784.67	1216	< 0.5	< 7.23	< 6.66	475	198.67	435.9
CMWA-0+25 (0-6")	7/16/2008			< 13.97						101.63			18464.46			89.25			671.14			< 7.09			208.69	
CMWA-50 (0-6")	10/8/2007				110.45			< 24.81			750.18			31051.7			950.75			1752.48			< 9.6			1200.07
CMWA-50+12.5 (0-6")	7/16/2008			30.06	< 15.9					93.71	120		20726.29	26080.2		86.72	206.8		662.67	1165		< 7.32	< 5.96		140.26	211.1
CMWA-100 (0-6")	10/8/2007				577.49			< 27.8			467.98			79573.09			1780.7			267.37			< 12.18			1834.58
CMWA-100+12.5 (0-6")	7/16/2008	12500		17.59	24.6	1.1				91.22	106.0		16412.32	21902.6		112.72	144.2		761.36	940		< 6.69	< 5.11		192.96	242.2
CMWA-150 (0-6")	10/8/2007				348.32			< 27.41			406.88			94050.74			2554.66			< 205.2			< 10.38			647.9
CMWA-150+12.5 (0-6")	7/16/2008			30.77	19.2					109.93	155.0		19915.12	24716.2		150.81	238.7		760.06	803		< 7	< 5.98		256.8	342.8
CMWA-150+25 (0-6")	7/16/2008			< 16.94						56.78			16411.5			165.17			533.08			< 7.07			229.88	
CMWA-150+edge (0-6")	7/16/2008			39.41						650.6			20550.88			165.75			3164.99			< 5.66			260.52	
CMWA-200 (0-6")	10/8/2007				1250.57			< 27.81			56.08			225782.77			358.52			< 291.04			< 10.07			< 45.48
CMWA-250 (0-6")	10/8/2007		150		118.59	0.968		< 23.76	130		112.57			49050.63	476		401.74	741		744.47	< 0.5		< 7.6	343		265.98
CMWA-250+25 (0-6")	7/16/2008			53.82						148.13			21681.95			233.83			1317.42			< 8.03			253.51	
CMWA-250+50 (0-6")	7/21/2008	13500	52	36.24	32.4	0.611			166	137	137.48	34600	33223.55	33223.55	356	314.72	314.72	258	331	330.80	< 0.5		< 6.33	132	151.64	151.64
CMWA-250+501 (0-6")	7/16/2008			30.13						115.92			25724.22			313.24			343.82			< 8.27			146.6	
CMWA-300 (0-6")	10/8/2007				48.4			< 23.27			414.66			25048.86			401.4			408.38			< 7.28			575.73
CMWA-300+25 (0-6")	7/16/2008	11100		29.92	29.2	< 0.5				192.87	99		33805.17	28691.6		177.31	292.1		349.43	418		< 7.81	< 6.56		77.32	124.7
CMWA-300+6 (0-6")	7/16/2008			73.14						219.68			24779.61			469.57			526.2			< 7.47			697.53	
CMWA-350 (0-6")	10/8/2007				37.17			< 23.86			185.7			31842.34			405.26			224.39			< 7.46			102.85
CMWA-350+0 (0-6")	7/21/2008			24.61						91	91.33		25023.86	25023.86		151.94	151.94		278	278.12			< 5.86		175.14	175.14
CMWA-350+6 (0-6")	7/16/2008			32.03						92.55			27597.68			105.54			304.74			< 7.9			153.05	
CMWA2-250 (0-6")	10/8/2007				< 47.68			< 26.42			340.88			63127.3			808.93			236.21			< 9			121.71
EU4 Carbonate Mine Waste Area																										
CARM-00 (0-6")	10/16/2007				26.31			< 21.57			114.51			22161.2			146.1			943.7			< 6.3			305.74
CARM-COMP 1 (0-6")	10/15/2007				< 32.38			< 26.75			570.97			53484			351.3			1378.57			< 8.75			466.13

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[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
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UAW3-51 through UAW3-75 and UAW4 through UAW4-50 XRF results from ground surface of unreclaimed Upper Anaconda Waste Areas. UAW3-X represents XRF reading number.

XRF Field - XRF measurements recorded from ground surface in field.
XRF 10 M - XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab - Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
XRF samples were sent to lab for confirmation analysis at a a frequence of 10%.

Table 27a
Mine Waste Removal and Reclamation Areas Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M
DEQ Action Level/RSLs/UBMC BTVs		77,000[a]	40[b]			70[a]			3,100[a]			58,270[c]			1,109[c]			4,893[c]			23[a]			23,000[a]		
CARM-50 (0-6")	10/15/2007				< 36.39			< 27.62			330.08			72423.84			430.67			966.85			< 9.74			683.49
CARM-50+12.5 (0-6")	7/17/2008			< 21.22	< 31.87					142.34	386.34		16174.23	96673.06		305.13	578.97		386.16	1594.35		< 6.33	< 8.24		454.32	809.63
CARM-50+25 (0-6")	7/10/2008			< 20.01						119.82			13756.14			285.88			463.38			< 6.15			399	
CARM-50+6.25 (0-6")	7/10/2008			43.24						164.43			33297.8			470.42			1014.24			< 6.64			1120.96	
CARM-100 (0-6")	10/15/2007				< 40.97			< 29.62			412.71			84306.55			526.29			1343.94			< 10.52			599.57
CARM-100+12.5 (0-6")	7/10/2008			50.45						254.43			53809.93			426.47			1220.95			< 9.46			662.44	
CARM-100+18.75 (0-6")	7/10/2008			51.48						377.34			58063.57			471.65			1687.34			< 8.62			738.49	
CARM-100+25 (0-6")	7/10/2008	18800		< 20.3	< 34.1	8.2				105.3	431.0		20009.4	113674.1		260	619.1		737.5	1591		< 6.4	< 9.03		544	762.6
CARM-150 (0-6")	10/15/2007				< 35.72			< 27.15			376.92			73769.04			411.87			863.25			< 1			540.32
CARM-150+25 (0-6")	7/10/2008			54.21						243.02			56706.33			349.1			1332.72			< 8.26			456.81	
CARM-150+50 (0-6")	7/10/2008			36.06	< 25.4					231.5	291.0		53394.9	65860.2		397.38	417.8		1247.8	1280.0		< 8.72	< 7.16		520.4	498.5
CARM-200 (0-6")	10/16/2007				< 35.15			< 28.03			391.3			77582.87			411.61			928.25			< 7.98			372.34
CARM-200+25 (0-6")	7/10/2008	16400		117.5	27.1	9.5				492.7	544.0		74525.2	127803.8		2215.19	271.8		640.5	1522.0		< 10.8	< 8.4		339.8	561.7
CARM-200+50 (0-6")	7/10/2008			< 30.47						309.12			41448.57			416.04			1702.51			< 9			427.24	
CARM-200+62.5 (0-6")	7/10/2008			73.1						327.71			60001.32			354.69			1997.92			< 8.07			459.34	
CARM-200+75 (0-6")	7/10/2008			81.45						357.57			66299.29			371.64			1306.47			< 9.07			498.14	
CARM-200+95 (0-6")	7/10/2008			54.17						526.73			85823.14			347.83			1421.03			< 9.64			536.28	
CARM-200+125 (0-6")	7/10/2008			33.34						346.48			65256.88			238.19			1019.37			< 8.21			351.05	
CARM-250 (0-6")	10/16/2007		24.4		< 33.62	7.71		< 28.93	324		329			79140.19	405		329.57	1100		1094.94	< 0.5		< 9.66	399		449.68
CARM-300 (0-6")	10/15/2007				< 33.14			< 30.74			491.25			120757.18			311.93			1434.93			< 10.62			545.97
CARM-350 (0-6")	10/16/2007				38.28			< 30.85			486.84			110609.64			260.36			2216.93			< 11.39			459.08
CARM-400 (0-6")	10/15/2007		27.8		< 32.3	11.1		< 30.73	439		548.5			114508.66	226		260.31	1460		2576.21	< 0.5		< 10.11	384		514.53
CARM-500 (0-6")	10/16/2007				< 8.61			< 18.35			26.92			7014.35			27.4			126.71			< 4.95			35.2
CARM-550 (0-6")	10/16/2007				< 35.43			< 26.76			215.84			40134.7			468.78			610.41			< 8.41			193.85
CARM-600 (0-6")	10/16/2007				< 31.33			< 26.69			496.52			66433.4			343.45			1513.21			< 9.55			398.32
CARM-650 (0-6")	10/16/2007				< 10.6			< 25.07			< 32.62			15703.48			29.43			310.86			< 7.88			55.34
CARM-700 (0-6")	10/16/2007				< 17.01			< 23.22			80.49			20391.79			108.24			557.43			< 6.8			171.31
CARM-750 (0-6")	10/15/2007				16.3			< 23.95			95.42			31405.64			63.72			291.13			< 7.82			92.51
CARM-800 (0-6")	10/16/2007				< 25.8			< 29.07			640.96			80370.27			169.22			760.81			< 10.1			125.17
CARM-850 (0-6")	10/15/2007				< 10.26			< 16.64			93.68			15578.09			64.86			258.68			< 4.24			77.1
CARM-900+0 (0-6")	7/10/2008			< 7.02						22.42			1484.57			29.78			62.15			< 3.85			23.51	
CARM-950 (0-6")	10/15/2007				< 12.29			< 16.96			133.56			15133.63			104.01			294.04			< 4.76			104.28
CARM-1000 (0-6")	10/16/2007				22.91			< 26.86			169.63			145052.41			77.43			17005.27			< 9.24			316.14
CARM-1050 (0-6")	10/15/2007				< 66.33			< 19.67			299.21			34525.38			2554.57			1005.55			< 7.22			273.63
CARM-1050+6.25 (0-6")	7/10/2008	15000		< 10.3	< 18.1	8.9				113	268.0		2345.1	40173.0		78.39	274.4		1754.9	13808.0		< 4.8	< 5.43		320.2	814.9
CARM-1050+12.5 (0-6")	7/10/2008			54.4						239.82			41980.84			203.7			1055.22			< 5.82			428.81	
CARM-1050+12.5 (0-6")	7/10/2008			< 16.62						308.32			65594.28			435.6			3146.23			< 8.08			629.84	
CARM-1050+18.75 (0-6"	7/10/2008			< 34.22						429.33			65594.28			534.34			1002.51			< 9.06			327.1	
CARM-1050+25 (0-6")	7/10/2008			< 16.57						369.86			69203.89			96.95			1681.96			< 8.43			279.43	
CARM-1100 (0-6")	10/15/2007				< 31.15			< 25.72			488.76			66945.55			326.74			1215.88			< 8.38			294.74
CARM-1150 (0-6")	10/15/2007		28.3		49.02	3.43		< 26.86	443		452.23			60375.76	524		496.36	845		1040.68	< 0.5		< 10.05	260		278.62
CARM-1150+25 (0-6")	7/17/2008				15.97						574.25			96279.74		101.9	101.9			1744.76						315.01

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- Value exceeds EPA RSl or DEQ Action Level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

AMHR - Above Mike Horse Repository
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UAW3-51 through UAW3-75 and UAW4 through UAW4-50 XRF results from ground surface of unreclaimed Upper Anaconda Waste Areas. UAW3-X represents XRF reading number.

XRF Field - XRF measurements recorded from ground surface in field.
XRF 10 M - XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab - Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
XRF samples were sent to lab for confirmation analysis at a a frequence of 10%.

Table 27a
Mine Waste Removal and Reclamation Areas Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M
DEQ Action Level/RSLs/UBMC BTVs		77,000[a]	40[b]			70[a]			3,100[a]			58,270[c]			1,109[c]			4,893[c]			23[a]			23,000[a]		
EU5 Edith Mine Waste Areas																										
CEA1-3-COMP 1 (0-6")	10/12/2007	12200	24.5		< 27.53	0.52		< 26.17	167		166.02	28700		27970.32	284		283.22	302		299.69	< 0.5		< 8.19	117		82.14
CEA1-3-COMP 2 (0-6")	10/12/2007	12100	21.7		< 21.05	1.35		< 24.92	175		108.5	31400		16153.74	198		163.05	518		232	< 0.5		< 7.35	234		62.73
CEA1-3-COMP 3 (0-6")	10/12/2007		84.5		86.51	4.31		< 24.34	286		237.44			41494.34	1380		1133.01	243		242.48	< 0.5		< 7.55	868		188.26
CEA1-3-00 (0-6")	10/15/2007				37.33			< 25.73			243.65			49312.75			139.29			1260.28			< 9.3			141.88
CEA1-3-50 (0-6")	10/15/2007				24.04			< 21.59			1158.24			22197.87			108.4			406.49			< 6.1			134.15
CEA1-3-100 (0-6")	10/15/2007				23.36			< 24.95			130.26			24688.74			126.33			1222.27			< 8.01			191.91
CEA1-3-150 (0-6")	10/15/2007				< 21.38			< 24.27			489.88			22068.4			175.93			213.55			< 7.62			166.1
CEA1-3-200 (0-6")	10/15/2007				25.87			< 24.55			111.02			24095.59			115.74			594.32			< 7.65			100.98
CEA1-3-250 (0-6")	10/15/2007				27.47			< 24.18			126.37			25525.83			154.58			263.95			< 7.27			90.99
CEA1-3-300 (0-6")	10/15/2007				18.58			< 23.8			164.03			26057.88			94.03			493.22			< 7.48			223.57
CEA1-3-350 (0-6")	10/15/2007				35.5			< 23.22			70.31			27209.6			95.1			1049.94			< 6.84			280.86
CEA1-3-400 (0-6")	10/15/2007				37.58			< 24.35			140.15			34464.88			372.13			836.71			< 8.04			214.77
CEA1-3-450 (0-6")	10/15/2007				< 15.74			< 22.38			93.77			20936.8			100.26			< 125.34			< 6.48			173.62
CEA1-3-500 (0-6")	10/15/2007				14.64			< 23.04			94.05			20407.45			73.71			695.33			< 6.6			323.29
CEA1-3-550 (0-6")	10/15/2007		19.1		25.05	1.92		< 21.62	78.9 J		79.55			21156.72	96.3		87.59	461 JM		459.75	< 0.5		< 6.33	256		240.4
CEA1-3-600 (0-6")	10/15/2007				16.7			< 23.89			1338.55			31998.06			88.48			1387.08			< 6.93			163.87
CEA1-3-650 (0-6")	10/15/2007				21.62			< 23.04			77.11			26667.58			86.04			403.92			< 6.67			237
CEA1-3-700 (0-6")	10/12/2007				< 18.84			< 23.14			99.34			24019.08			140.23			414.7			< 7.6			110.19
CEA1-3-750 (0-6")	10/15/2007				< 23.63			< 24.2			92.05			16355.18			232.11			< 119.9			< 7.53			48.65
CEA1-3-800 (0-6")	10/12/2007				< 20.17			< 24.43			182.97			16672.16			156.4			< 112.66			< 8.24			34.11
CEA1-3-850 (0-6")	10/15/2007		20.8		< 24.85	0.535		< 23.66	107		112.22			19400.57	224		261.67	300		202.47	< 0.5		< 7.15	114		124.1
CEA1-3-850 (0-6")	10/15/2007				< 24.85			< 23.66			112.22			19400.57			261.67			202.47			< 7.15			124.1
CEA4-COMP (0-6")	10/12/2007				36.71			< 26.9			168.14			71921.23			424.71			231.26			< 8.93			101.78
CEA4-00 (0-6")	10/12/2007				< 29.6			< 31.43			269.39			171530.84			190.11			< 318.8			< 12.59			< 50.67
CEA4-20 (0-6")	10/12/2007				26.58			< 32.41			382.86			165784.69			104.36			< 312.11			< 11.52			< 46.92
CEA4-40 (0-6")	10/12/2007				25.96			< 21.9			130.46			27869.06			234.47			505.31			< 6.64			212.9
EEA1-COMP 1 (0-6")	10/11/2007				< 11.77			< 22.63			56.68			17107.56			41.47			430.7			< 7.12			65.1
EEA1-00 (0-6")	10/12/2007				16.48			< 23.52			90.45			25747.52			88.15			249.57			< 7.23			44.59
EEA1-50 (0-6")	10/12/2007				20.96			< 22.81			112.37			23723.54			89.74			238.24			< 6.93			55.23
EEA1-100 (0-6")	10/12/2007				< 12.72			< 24.63			77.29			26389.82			40.17			446.71			< 7.78			51.62
EEA1-150 (0-6")	10/12/2007				14.93			< 22.76			41.2			17463.23			24.37			340.53			< 6.3			44.69
EEA1-200 (0-6")	10/12/2007				< 10.12			< 22.47			64.84			15544.56			30.53			447.34			< 7.53			30.75
EEA1-250 (0-6")	10/12/2007				13.24			< 23.53			< 30.81			18038.91			36.18			401.96			< 6.75			41.77
EEA1-300 (0-6")	10/12/2007				15.85			< 23.8			77.22			25744.3			62.02			514.59			< 8.2			52.04
EEA1-350 (0-6")	10/12/2007				19.02			< 25.38			136.77			33540.54			99.4			599.92			< 7.87			121.09
EEA1-400 (0-6")	10/12/2007				< 22.69			< 25.2			134.97			31545.82			188.79			704.9			< 7.46			197.12
EEA1-450 (0-6")	10/12/2007				< 20.5			< 24.9			86.12			37267.45			152.12			451.43			< 8.44			82.08
EEA1-500 (0-6")	10/12/2007				< 22.61			< 26.18			102.68			36107.77			172.91			957.74			< 8.53			178.89
EEA2-COMP 1 (0-6")	10/11/2007				18.62			< 23.41			133.5			23331.11			109.13			523.36			< 8.2			98.2
EEA2-00 (0-6")	10/11/2007				< 10.14			< 23.2			36.85			15663.03			30.43			376.27			< 7.47			47.4
EEA2-50 (0-6")	10/11/2007				< 24.17			< 23.35			107.09			28526.84			244.35			823.34			< 7.72			207.28
EEA2-100 (0-6")	10/11/2007				< 16.63			< 22.4			81.53			29595.34			104.87			1287.26			< 6.49			138.38

Notes:

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Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
M% - Matrix spike recoveries exceed acceptable limits.
J - The associated value is an estimated quantity.
- Value exceeds EPA RSI or DEQ Action Level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
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UAW3-51 through UAW3-75 and UAW4 through UAW4-50 XRF results from ground surface of unreclaimed Upper Anaconda Waste Areas. UAW3-X represents XRF reading number.

XRF Field - XRF measurements recorded from ground surface in field.
XRF 10 M - XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab - Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
XRF samples were sent to lab for confirmation analysis at a a frequence of 10%.

Table 27a
Mine Waste Removal and Reclamation Areas Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M
DEQ Action Level/RSLs/UBMC BTVs		77,000[a]	40[b]			70[a]			3,100[a]			58,270[c]			1,109[c]			4,893[c]			23[a]			23,000[a]		
EEA2-150 (0-6")	10/11/2007		11.3		< 12.7	0.35		< 23.14	53.9		75.94			18375.36	76.3 JM		52.42	524		439.35	< 0.5		< 7.23	64.8		64.63
EEA2-200 (0-6")	10/11/2007		12.6		< 19.41	0.35		< 24.39	66.2		81.15			23022.43	120 JM		157.32	488		508.92	< 0.5		< 7.62	72.7		61
EEA2-250 (0-6")	10/11/2007				10.93			< 21.34			39.23			15492.63			33.89			559.87			< 6.91			63.41
EEA2-300 (0-6")	10/11/2007				23.98			< 24.47			165.16			31206.59			133.29			1183.79			< 7.56			135.65
WEA1-COMP 1 (0-6")	10/15/2007				19.88			< 25.77			429.59			53139.64			113.18			2581			< 7.4			148.33
WEA1-COMP 2 (0-6")	10/15/2007				< 19.64			< 25.8			196.52			46088.84			134.24			3347.14			< 8.48			178.86
WEA1-00 (0-6")	10/15/2007		19		< 23.16	0.248		< 23.77	119 J		9			18538.59	246		24	396 JM		452.56	< 0.5		< 7.65	129		128.51
WEA1-100 (0-6")	10/15/2007				< 15.81			< 21.98			56.03			21350.1			103.84			849.33			< 7.17			306.84
WEA1-150 (0-6")	10/15/2007				23.31			< 27.2			349.38			38280.55			117.24			1930.43			< 9.18			199.92
WEA1-200 (0-6")	10/15/2007				< 19.74			< 25.84			187.99			43559.09			130.68			1512.64			< 7.66			256.56
WEA1-250 (0-6")	10/15/2007				26.36			< 23.99			68.7			30292.46			113.99			1372.48			< 6.63			280.93
WEA1-300 (0-6")	10/15/2007				26.62			< 24.16			77.19			32996.01			111.93			1389.89			< 7.95			236.9
WEA1-350 (0-6")	10/15/2007				27.73			< 25.6			447.46			53562.17			164.89			634.49			< 8.36			154.96
WEA1-400 (0-6")	10/15/2007		27.6		< 22.68	0.478		< 24.03	105 J		119.03			21374.5	242		211.19	324 JM		239.38	< 0.5		< 6.8	97.3		71.86
WEA1-450 (0-6")	10/15/2007				< 21.58			< 23.88			119.7			31611.13			181.64			66			< 7.35			304.94
WEA1-500 (0-6")	10/15/2007				< 18.82			< 23.65			121.25			30834.43			141.92			389.16			< 7.85			175.37
WEA1-550 (0-6")	10/15/2007				< 18.3			< 23.39			112.87			29334.42			138.76			81			< 7.14			227.23
EU6 Consolation Mine Waste Area																										
CONM-COMP 1 (0-6")	10/10/2007	20200	148		< 46.33	2.05		< 23.91	410		216.81	60100		42987.15	1600		900.8	1220		801.82	< 0.5		< 8.34	419		232.83
CONM-COMP 2 (0-6")	10/10/2007	21000	283		60.6	3.38		< 24.22	394		135.25	73600		25072.45	1540		713.17	1250		429.54	< 0.5		< 7.39	914		782.29
CONM-Pile 1 (0-6")	10/10/2007	14700	673		486.49	1.19		< 27.51	296		276.34	65700		60003.03	6780		5934.86	232		< 206.59	< 0.5		< 11.39	333		258.66
CONM-000 (0-6")	10/9/2007				30.84			< 21.98			40.59			16703.18			206.08			211.94			< 6.42			224.53
CONM-50 (0-6")	10/10/2007				45.36			< 26.23			202.95			41748.38			637.03			515.37			< 8.37			255.68
CONM-50+25 (0-6")	7/9/2008			71.8						53.79			14663.4			265.37			2103.98			< 6.25			254.86	
CONM-50+50 (0-6")	7/9/2008	27000		67.63	37.6	1.9				95.87	93		23103.23	21693.4		329.6	385.1		2195.57	1525		< 7.83	< 5.97		434.06	479.9
CONM-50+75 (0-6")	7/9/2008			59.45						77.54			22942.16			311.05			1881.8			< 6.86			440.54	
CONM-100 (0-6")	10/9/2007				< 34.15			< 22.49			141.5			29124.13			552.46			713.72			< 7.4			330.88
CONM-100+25 (0-6")	7/9/2008			58.31	26.4					60.39	51		20919.58	23874		256.36	346.1		2535.94	1441		< 6.64	< 5.91		243.88	417.5
CONM-150 (0-6")	10/9/2007				35.37			< 21.02			57.97			16994.29			204.72			274.22			< 6.43			335.43
CONM-200 (0-6")	10/10/2007				33.01			< 21.18			41.93			18586.02			260.65			721.13			< 6.41			349.92
CONM-250 (0-6")	10/9/2007		1010		1087.56	1.5		< 28.13	366		318.42			77779.7	5010		4696.69	476		514.29	< 0.5		< 12.84	474		494.42
CONM-250+12.5 (0-6")	7/9/2008			814.24						330.85			53195.43			2674.85			389.69			< 9.2			1490.65	
CONM-250+25 (0-6")	7/9/2008	20900	105	< 21.34	73.3	3.2			203	69.01	178	40400	12450.52	34872.5	942	269.52	872.6	1500	1153.77	1385	< 0.5	< 6.65	< 6.73	498	324.08	607.4
CONM-300 (0-6")	10/10/2007				< 41.47			< 25.01			129.33			28686.25			722.26			728.86			< 7.84			460.93
CONM-300+25 (0-6")	7/9/2008			39.46	26.5					50.81	< 26.61		17623.25	16512.4		203.84	280.5		2909.47	1180		< 7.33	< 5.76		319.69	378.7
CONM-350 (0-6")	10/10/2007				< 37.81			< 25.42			216.87			43490.79			546.01			648.21			< 8.93			249.12
CONM-350+25 (0-6")	7/9/2008			< 39.43						355.43			61241.57			785.44			1011.72			< 8.79			397.97	
CONM-350+50 (0-6")	7/9/2008			40.61	29.9					158.08	61		24209.56	19123.5		204.92	259.7		408.69	2400		< 7.06	< 6.19		270.35	402.7
CONM-400 (0-6")	10/10/2007				37.04			< 23.85			145.11			29850.18			565.76			501.74			< 7.86			205.02
CONM-400+25 (0-6")	7/9/2008			80.79	< 20.9					462.83	64		61445.13	19887.5		374.85	348.7		1568.55	661		< 9.08	< 5.84		627.87	337.6
CONM-400+25 (0-6")	7/9/2008	23400		80.79	< 20.9	1.6				462.83	64		61445.13	19887.5		374.85	348.7		1568.55	661		< 9.08	< 5.84		627.87	337.6
CONM-450 (0-6")	10/9/2007				45.36			< 21.26			108.92			19231.49			413.53			851.66			< 7.3			511.25
CONM-450+25 (0-6")	7/9/2008			50.85	29.7					67.31	78		11895.46	29146.5		285.61	567.7		953.2	723		< 6.56	< 6.51		266.51	328.7

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		Lab	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M
DEQ Action Level/RSLs/UBMC BTVs		77,000[a]	40[b]			70[a]			3,100[a]			58,270[c]			1,109[c]			4,893[c]			23[a]			23,000[a]		
CONM-500 (0-6")	10/10/2007				21.73			< 17.34			4			11844.54			188.91			183.53			< 4.85			143.28
CONM-550 (0-6")	10/9/2007				< 25.97			< 21.87			58			22296.42			336.38			396.11			< 6.74			388.19
CONM-600 (0-6")	10/10/2007				< 49.4			< 24.7			221.67			44378.57			968.31			651.07			< 8.08			281.92
CONM-600+12.5 (0-6")	7/9/2008	23700		15.46	15	1.6				49.62	67		6943.17	18004.4		123.74	175.6		194.46	483		< 5.51	< 5.01		95.44	427.1
CONM-600+25 (0-6")	7/9/2008			< 13.64						36.59			1022			135.18			849.78			< 5.4			287.05	
CONM-650 (0-6")	10/9/2007				21.65			< 19.57			43.99			16258.81			125.07			888.31			< 5.71			360.44
CONM-700 (0-6")	10/10/2007		21.2		< 23.95	0.912		< 22.8	107		77.44			19350.96	410		275.09	702		237.76	< 0.5		< 7.29	228		239.77
CONM-750 (0-6")	10/9/2007				92.56			< 23.86			315.38			40084.43			1691.71			742.19			< 7.49			745.86
CONM-750 (0-6")	10/9/2007		83.6		92.56	6.72		< 23.86	282		315.38			40084.43	2350		1691.71	747		742.19	< 0.5		< 7.49	740		745.86
CONM-750+6.0 (0-6")	7/17/2008	11700	16.4	24.37	14.16	0.605			56.9	84.46	6.00	23700	15669.17	24739.39	125	154.69	136.49	313	726.86	571.61	< 0.5	< 6.32	< 5.35	126	226.82	156.69
CONM-750+12.5 (0-6")	7/10/2008			19.28						56.95			17753.11			164.34			964.33			< 6.99			307.24	
CONM-750+25 (0-6")	7/10/2008			38.37						68.3			20456.38			144.61			2768.49			< 8.97			139.92	
CONM-800 (0-6")	10/9/2007				525.92			< 20.76			103.73			46216.98			1898.68			< 140.12			< 7.51			106.65
CONM-800+12.5 (0-6")	7/10/2008			515.11						247.32			59021.41			3877.94			< 115.08			< 1			184.36	
CONM-800+18.75 (0-6")	7/10/2008			322.68						247.48			32552.56			1496.44			237.84			< 8.21			235.95	
CONM-800+25 (0-6")	7/10/2008			< 24.88	23.2					78.68	101		24125.24	27228.4		369.73	282.8		530.75	717		< 7.32	< 5.91		195.47	325.4
CONM-850 (0-6")	10/9/2007				63.09			< 26.19			297.27			42162.87			397.89			1687.26			< 9.04			577.82
CONM-900 (0-6")	10/10/2007				< 91.45			< 24.72			234.21			46773.5			3580.49			267.51			< 1			814.67
CONM-900+12.5 (0-6")	7/10/2008			< 20.38	< 20.9					90.62	146		43695.9	52251.3		199.35	275.2		969.42	1330		< 7.94	< 7.38		204.83	252.8
CONM-900+25 (0-6")	7/10/2008			< 1						46.03			16932.09			35.26			257.13			< 6.7			62.51	
CONM-950 (0-6")	10/10/2007				52.9			< 24.76			164.49			35371.36			338.2			657.43			< 8.27			214.87
CONM-1000 (0-6")	10/10/2007				71.92			< 24.55			186.92			37698.37			1206.06			726.44			< 8.89			252.26
CONM-1000+35 (0-6")	7/10/2008			32.04	29					155.49	233		28017.14	28447.2		352.99	407.1		724.82	614		< 8.36	< 6.00		168.22	315.8
EU7 Mary P. Mine Waste Pile																										
MPWA-0 (0-6")	7/16/2008	12900			< 82.42	0.9					572.87			96328.47			3999.89			601.96			< 9.84			275.58
MPWA-50+155 (0-6")	7/10/2008			60.02						233.87			42316.44			581.52			< 218.59			< 7.83			77.29	
MPWA-50+39 (0-6")	7/16/2008				44.64						392.44			39348.39			591.37			960.77			< 6.12			513.71
MPWA-75 (0-6")	7/10/2008			235.74						457.57			112241.78			4169.12			< 304.53			11.99			100.85	
MPWA-100+15 (0-6")	7/16/2008				59.68						424.21			73553.48			569.81			512.38			< 7.59			148.84
MPWA-100+25 (0-6")	7/16/2008				< 23.32						279.24			67683.81			332.68			877.72			< 7.82			260.31
MPWA-200+0 (0-6")	7/16/2008	12800	29.5		23.12	0.578			377		479.77	28400		42434.35	268			190		282.55	< 0.5		< 6.20	123		145.75
MPWA-200+25 (0-6")	7/16/2008				35.95						87.34			48930.95			141.85			871.5			< 6.43			194.64
MPWA-230+25 (0-6")	7/16/2008				< 19.28						481.40			54491.54			246.60			1084.53			< 6.81			162.55
EU8 Mike Horse Mine Waste Piles																										
AMHR-0 (0-6")	10/11/2007				< 17.86			< 23.54			56.62			18149.1			114.4			223.66			< 7.28			203.51
AMHR-200 (0-6")	10/11/2007		17.9		< 17.57	0.978		< 24.1	88		52.99			20374.05	153 JM		110.86	624		206.14	< 0.5		< 7.62	173		134.45
AMHR-400 (0-6")	10/12/2007				< 37.46			< 25.91			55.61			27885.22			562.17			1383.59			< 7.69			558.19
AMHR-600 (0-6")	10/12/2007				< 38.14			< 24.41			78.88			19380.61			659.8			722.48			< 7.41			676.93
MHCS-00-E25 (0-6")	10/16/2007				143.45			< 26.62			405.32			34062.31			3869.36			6332.25			< 10.58			1830.97
MHCS-00-W5 (0-6")	10/16/2007				40.99			< 24.54			48.83			17191.41			318.5			2769.55			< 8.38			236.52
MHCS-00-W25 (0-6")	10/16/2007				< 31.48			< 24.32			71.78			17667.86			446.11			1029.04			< 6.73			246.09
MHCS-100-E25 (0-6")	10/16/2007				411.61			30.42			556.94			38921.87			5700.98			4490.45			< 11.5			1211.82
MHCS-100-W1 (0-6")	10/16/2007				192.21			< 26.35			385.88			35970.31			3891.43			4638.1			< 10.7			1278.74

Notes:

mg/kg - Milligrams per kilogram
Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
M% - Matrix spike recoveries exceed acceptable limits.
J - The associated value is an estimated quantity.
- Value exceeds EPA RSl or DEQ Action Level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

AMHR - Above Mike Horse Repository
CARM - Carbonate Mine Waste Area
CEA - Central Edith Mine Waste Area
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CONM - Consolate Mine Waste Area
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MPWA - Mary P. Mine Waste Area
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SHWA - Shave Gulch Waste Area
UAW - Upper Anaconda Mine Waste Area
UMH - Upper Mike Horse Mine Waste Area
WEA - West Edith Mine Waste Area

UAW3-51 through UAW3-75 and UAW4 through UAW4-50 XRF results from ground surface of unreclaimed Upper Anaconda Waste Areas. UAW3-X represents XRF reading number.

XRF Field - XRF measurements recorded from ground surface in field.
XRF 10 M - XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab - Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
XRF samples were sent to lab for confirmation analysis at a a frequence of 10%.

Table 27a
Mine Waste Removal and Reclamation Areas Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M
DEQ Action Level/RSLs/UBMC BTVs		77,000[a]	40[b]			70[a]			3,100[a]			58,270[c]			1,109[c]			4,893[c]			23[a]			23,000[a]		
MHCS-100-W25 (0-6")	10/16/2007				< 28.85			< 24.79			50.63			13553.31			341.56			646.68			< 8.25			175.96
MHCS-200-E10 (0-6")	10/16/2007				112.51			< 26.3			216.33			29900.39			1947.86			4074.31			< 9.35			929.21
MHCS-200-E25 (0-6")	10/16/2007		37		22.6	0.428		< 24.12	33.8		< 31.85			20806.49	116		102.61	425		401.16	< 0.5		< 7.1	194		202.26
MHCS-200-E25 (0-6")	10/16/2007				22.6			< 24.12			< 31.85			20806.49			102.61			401.16			< 7.1			202.26
MHCS-200-W10 (0-6")	10/16/2007				< 25.5			< 23.17			77.65			17964.16			291.84			1158.36			< 7.05			269.23
MHCS-525-E5 (0-6")	10/18/2007		200		173.02	11.2 JM		< 29.61	116 J		106.87			168585.16	447 J		373.88	7480		9058.73	< 0.5		< 10.69	3840		2488.39
MHCS-600-E10 (0-6")	10/17/2007				135.42			< 26.13			208.93			42834.7			3452.65			3472.38			< 10.27			1089.25
MHCS-600-W10 (0-6")	10/16/2007				215.29			< 22.72			2848.96			35664.51			3085.67			5016.67			< 9.29			3205.39
MHCS-700-E10 (0-6")	10/17/2007				147.24			< 26.4			310.56			39205.56			3027.21			5295.28			< 1			1374.02
MHCS-700-E25 (0-6")	10/16/2007		70		32.52	0.731		< 23.79	69.2		47.11			28654.02	217		178.38	784		455.41	< 0.5		< 7.38	291		257.55
MHCS-700-W10 (0-6")	10/17/2007				150.3			< 25.82			1607.95			48452.46			3308.55			11572.65			< 10.83			1549.04
MHCS-800-E5 (0-6")	10/17/2007				129.77			< 26.61			442.88			39235.63			2633.5			7052.56			< 11.18			1628.09
MHCS-800-E15 (0-6")	10/17/2007				18.5			< 18.99			27.5			12719.16			166.42			1118.49			< 5.59			161.78
MHCS-800-W5 (0-6")	10/16/2007				85.11			< 20.85			657.76			19915.83			1571.8			2265.69			< 7.47			637.07
MHCS-900-E5 (0-6")	10/18/2007				173.14			< 25.56			434.98			41460.98			2682.77			5129.02			< 9.79			1407.2
MHCS-900-E15 (0-6")	10/16/2007				22.05			< 22.24			< 28.57			17567.02			130.54			257.4			< 6.58			308.59
MHCS-900-W5 (0-6")	10/18/2007				100.4			< 26.46			543.88			37436.8			1771.29			3330.84			< 9.1			543.78
MHCS-1000-E10 (0-6")	10/16/2007				50.42			< 22.25			35.09			18009.78			303.08			413.93			< 7.56			618.63
MHCS-1000-W5 (0-6")	10/17/2007				188.82			< 26.85			1374.83			53619.91			3701.36			7156.68			< 9.74			2745.53
MHCS-1100-E10 (0-6")	10/16/2007				57.39			< 24.84			135.59			25767.27			240.71			6613.12			< 8.18			939.94
MHCS-1100-E35 (0-6")	10/16/2007				20.7			< 23.17			< 28.96			18470.76			109.29			758.55			< 7.27			159.28
MHCS-1200-E15 (0-6")	10/18/2007				49.19			< 25.86			134.88			37811.12			618.16			2256.24			< 8.23			754.2
MHCS-1200-E30 (0-6")	10/16/2007				35.04			< 24.01			42.04			29425.5			194.63			1725.3			< 8			202.3
MHCS-1300-E20 (0-6")	10/17/2007				87.04			< 25.07			171.75			38455.53			872.09			2389.45			< 8.44			1428.74
MHCS-1300-E35 (0-6")	10/16/2007				< 33.11			< 28.8			161.19			76737.85			342.51			2151.86			< 10.16			401.63
MHCS-S25-W15 (0-6")	10/17/2007				243.97			< 31.27			299.65			222135.42			2733.62			4503.95			< 14.61			2350.79
MHTS-COMP 1 (0-6")	10/11/2007		75.3		77.85	0.408		< 24.49	105		111.97			40563.73	460 JM		451.62	496		386.56	< 0.5		< 7.28	212		203.02
MHTS-COMP 2 (0-6")	10/12/2007		59.2		47.58	0.347		< 24.61	94.2		83.74			30305.29	380		300.22	588		485.36	< 0.5		< 7.54	190		156.8
MHTS-COMP 3 (0-6")	10/11/2007				34.68			< 23.79			37.71			25273.54			219.24			414.03			< 6.93			140.1
UMH1-COMP (0-6")	10/11/2007	9780	86.8		130.25	9.74		< 25.27	130		120.05	30700		28572.3	2240		1936.56	7540		4218.67	< 0.5		< 9.74	1600		1391.04
UMH1-00 (0-6")	10/11/2007				< 63.82			< 24.37			118.89			27598.05			1764.07			2266.76			< 9.2			897.44
UMH1-00+12.5 (0-6")	7/14/2008			148.33						281.82			25567.48			2837.74			1909.13			< 10.83			1019.62	
UMH1-00+22 (0-6")	7/14/2008			104.26						239.83			22080.84			991			1432.06			< 7.82			415.58	
UMH1-00+25a (0-6")	7/14/2008			< 68.96						146.72			27733.34			2511.49			2647.52			< 9.34			1104.11	
UMH1-00+35 (0-6")	7/14/2008			< 54.19						424.54			77290.74			1170.76			657.32			< 11.06			119.3	
UMH1-50 (0-6")	10/11/2007				< 46.58			< 24.33			84.3			24708.69			103			1610.82			< 8.18			753.82
UMH1-100 (0-6")	10/11/2007				80.39			< 26.35			179.36			33487.76			2181.51			6952.92			< 9.8			1659.67
UMH1-100+25 (0-6")	7/14/2008			89.44						571.58			127045.83			1103.97			839.44			< 10.6			148.72	
UMH1-150 (0-6")	10/11/2007				< 48.33			< 24.24			52.24			23807.28			1032.57			2909.77			< 8.65			795.76
UMH1-200 (0-6")	10/11/2007				30.61			< 25.36			< 34.38			21272.76			49.48			322.32			< 8.41			101.77
UMH1-250 (0-6")	10/11/2007				92.84			< 25.07			< 32.43			22587.21			807.89			4489.5			< 8.46			965.78
UMH1-250+25 (0-6")	7/14/2008			38	37.5					36.16	30		17238.27	21434.2		76.96	183.6		4224.42	6021		< 7.79	< 5.74		281.88	410
UMH1-300 (0-6")	10/11/2007				100.43			< 26.71			98.74			31717.42			1698.17			8503.19			< 10.13			1463.65

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Sample ID	Sample Date	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M
DEQ Action Level/RSLs/UBMC BTVs		77,000[a]	40[b]			70[a]			3,100[a]			58,270[c]			1,109[c]			4,893[c]			23[a]			23,000[a]		
UMH1-300+14 (0-6")	7/14/2008	9770		32.49	32.5	3				75.16	57		10237.24	12179.9		99.49	122.7		4401.17	3286		< 6.31	< 4.94		375.41	288.4
UMH1-300+25 (0-6")	7/14/2008			19.54						41.03			14166.88			59.61			298.13			< 6.38			202.06	
UMH1-350 (0-6")	10/11/2007				124.28			< 27.47			101.56			34063.89			1977.5			7990.29			< 9.46			1522.2
UMH1-350+12.5 (0-6")	7/14/2008			24.95	37.6					39.13	35		16713.48	17883.3		133.42	159.7		3059.37	1656		< 7	< 5.43		400.08	476.9
UMH1-350+25 (0-6")	7/14/2008			18.78						< 28.04			15317.7			57.27			1851.44			< 7.11			389.66	
UMH1-400 (0-6")	10/10/2007				< 40.87			< 22.5			64.26			18196.14			827.51			1544			< 7.35			754.37
UMH1-400+12.5 (0-6")	7/14/2008	20200		32.3	22.2	4.3				79.06	< 22.47		8711.45	15154.5		263.33	103		3412.24	4445		< 6.43	< 5.15		507.01	787.3
UMH1-400+25 (0-6")	7/14/2008			17.74						31.67			24705.61			16.94			1109.43			< 7.26			486.52	
UMH1-450 (0-6")	10/11/2007				< 49.78			< 23.89			36.03			19105.68			1163.46			1445.66			< 8.04			775.63
UMH1-450+12.5 (0-6")	7/14/2008			11.83	30.18					33.48	31.95		2266.74	15479.89		99.01	87.22		125.77	767.51		< 4.6	< 4.98		112.89	774.5
UMH1-450+25 (0-6")	7/14/2008			< 13.7						37.01			16995.48			93.64			3803.76			< 6.77			1261.33	
UMH2-COMP 1 (0-6")	10/11/2007	6900	193		263.56	4.65		< 25.8	264		474.55	23800		30062.86	5660		7916.71	3560		4565.28	< 0.5		< 13.16	765		1310.25
UMH2-COMP 2 (0-6")	10/11/2007	6170	144		356.08	9.12		< 28.15	605		934.65	29800		34206.83	9820		10329.23	3820		5564.43	< 0.5		< 15.47	1150		1339.45
UMH2-00 (0-6")	10/11/2007				498.62			< 26.34			396.32			21745.79			6572.28			2276.89			< 11.62			887.75
UMH2-00+12.5 (0-6")	7/15/2008			330.98						323.81			29775.96			5057.53			3403.12			< 10.41			802.93	
UMH2-00+25 (0-6")	7/15/2008			44.87	46.5					< 29.85	47		21243.59	20254.3		141.45	207.8		1450.13	2413		< 8.35	< 5.63		259.89	383.3
UMH2-00+40 (0-6")	7/15/2008			18.44						37.17			19908.3			99.43			366.15			< 8.31			208.48	
UMH2-50 (0-6")	10/11/2007				45.88			< 24.32			125.43			23558.51			652.02			2188.17			< 7.75			457.82
UMH2-50+25b (0-6")	7/21/2008				47.63						35.46			19002.03		365.66				1731			< 5.8			370.78
UMH2-100 (0-6")	10/11/2007				343.61			< 26.95			503.63			35071.17			7300.29			4100.26			< 13.5			1615.43
UMH2-100+25 (0-6")	7/14/2008			< 33.84						108.06			23074.92			615.92			2437.02			< 8.24			410.91	
UMH2-100+35 (0-6")	7/14/2008			33.68	35.5					111.97	100		20036.38	22596		446.08	472.9		1572.16	2368		< 8.13	< 5.85		347.11	412.2
UMH2-150 (0-6")	10/11/2007				177.6			< 25.05			267.14			24288.21			3370.59			1567.38			< 10.36			549.66
UMH2-150+25 (0-6")	7/14/2008			50.09						85.37			21734			755.07			425.17			< 7.55			696.33	
UMH2-150+35 (0-6")	7/14/2008			98.85						206.77			22993.5			2225.04			1929.01			< 9.69			839.75	
UMH2-150+60 (0-6")	7/14/2008			< 28.22	< 20.3					105.17	104		10876.14	6959		494.22	409.6		426.78	618		< 6.91	< 5.11		213.23	157.8
UMH2-150+70 (0-6")	7/14/2008			< 27.88						87.66			8747.75			524.47			349.27			< 6.67			165.15	
UMH2-200 (0-6")	10/11/2007				249.21			< 27.27			489.1			35922.1			6826.62			5748.86			< 12.05			1612.04
UMH2-200+25 (0-6")	7/15/2008			472.41						655.74			53587.14			6134.15			6768.49			< 12.46			1736.82	
UMH2-200+65 (0-6")	7/15/2008			67.03						143.23			17865.44			1009.21			1310.23			< 7.03			427.7	
UMH2-200+85 (0-6")	7/15/2008	10400		78.75	< 31.7	1.5				97.36	94		23530.56	23690.3		779.36	847		1368.52	1306		< 8	< 6.15		284.34	272.6
UMH2-250 (0-6")	10/10/2007				271.19			< 26.48			450.24			26161			5398.81			4056.8			< 11.6			1573.59
UMH2-250+25 (0-6")	7/15/2008			334.45						558.85			35699.71			8686.71			5396.32			< 13.44			1276.92	
UMH2-250+50 (0-6")	7/15/2008			156.34						355.19			32371.51			5952.39			4209.12			< 12.23			1135.98	
UMH2-250+75 (0-6")	7/15/2008			21.22	51.49					46.07	116		20702.84	21326.02		132.29	468.57		1983.7	2307.65		< 7.84			1084.26	388.05
UMH2-300 (0-6")	10/11/2007				52.4			< 22			77.41			14400.68			760.43			1012.97			< 7.47			677.89
UMH2-300+12.5 (0-6")	7/15/2008			519.62						460.21			26996.41			7215.78			4504.76			< 12.72			1592.58	
UMH2-300+25 (0-6")	7/15/2008			< 18.38	36.2					58.31	39		17227.86	19328.9		157.41	123.9		871.89	1075		< 8.05	< 5.81		956.88	1164.6
UMH2-350 (0-6")	10/11/2007				39.9			< 22.51			53.44			17169.54			580.8			511.85			< 7.18			720.69
UMH2-350+25 (0-6")	7/15/2008			49.7	31.2					83.08	37		13712.63	20124.5		51.25	126		4548.81	6086		< 10.81	< 6.07		744.02	1185.2
UMH2-350+37.5 (0-6")	7/15/2008			68.23						71.58			17873.21			197.14			4863.76			< 7.93			1017.76	
UMH2-400 (0-6")	10/11/2007				52.07			< 22.05			31.72			14696.13			604.25			462.52			< 7.56			297.7
UMH2-400+12.5 (0-6")	7/15/2008			51.16						46.79			16323.29			828.3			1441.16			< 7.97			317.44	

Notes:

mg/kg - Milligrams per kilogram
Blank - No data/not analyzed
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M% - Matrix spike recoveries exceed acceptable limits.
J - The associated value is an estimated quantity.
- Value exceeds EPA RSI or DEQ Action Level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

AMHR - Above Mike Horse Repository
CARM - Carbonate Mine Waste Area
CEA - Central Edith Mine Waste Area
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UAW3-51 through UAW3-75 and UAW4 through UAW4-50 XRF results from ground surface of unreclaimed Upper Anaconda Waste Areas. UAW3-X represents XRF reading number.

XRF Field - XRF measurements recorded from ground surface in field.
XRF 10 M - XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab - Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
XRF samples were sent to lab for confirmation analysis at a a frequence of 10%.

Table 27a
Mine Waste Removal and Reclamation Areas Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M
DEQ Action Level/RSLs/UBMC BTVs		77,000[a]	40[b]			70[a]			3,100[a]			58,270[c]			1,109[c]			4,893[c]			23[a]			23,000[a]		
UMH2-400+25 (0-6")	7/15/2008			< 13.23	11.9					44.13	35		21150.86	17546.7		60.92	75.7		2357.82	1527		< 8.38	< 5.77		515.18	732.8
UMH2-450 (0-6")	10/11/2007				< 92.7			< 22.69			52.87			14999.79			4247.16			977.94			< 9.13			397.76
UMH2-450+12.5 (0-6")	7/15/2008			451.68						198.08			17209.8			5882.29			2701.99			< 11.19			543.56	
UMH2-450+25 (0-6")	7/15/2008			23.24	< 17.8					27.21	34		10133.04	16282.3		145.08	270.3		1298.68	551		< 6.85	< 5.60		421.02	592.1
UMH2-500 (0-6")	10/10/2007				338.24			< 27.92			463.31			28214.67			8648.34			2802.84			< 13.31			823.28
UMH2-500+50 (0-6")	7/15/2008			< 42.57						65.99			14756.43			1058.36			987.27			< 8.66			317.6	
UMH2-500+75 (0-6")	7/15/2008	19200		< 17.24	32.8	2.2				< 28.31	32		16508.85	16872.3		151.87	261.4		2095.77	1811		< 7.77	< 5.37		278.48	610.7
UMH2-550 (0-6")	10/11/2007				440.27			< 28.86			849.12			41743.84			11060.14			7807.35			< 14.33			2418.11
UMH2-550+25 (0-6")	7/15/2008			93.15						89.78			14668.17			1121.81			4785.17			< 7.49			614.14	
UMH2-550+50 (0-6")	7/15/2008			46.99						49.4			15317.3			460.53			859.75			< 7.71			249.08	
UMH2-550+75 (0-6")	7/15/2008			23.23	18.74					< 26.97	< 23.02		13462.85	15987.2		62.24	61.63		3874.2	1959.96		< 7.1	< 5.30		325.84	393.64
UMH2-600 (0-6")	10/11/2007				146.85			< 26.01			102.83			25445.14			2711.28			2194.24			< 9.17			510.54
UMH2-600+25 (0-6")	7/15/2008	16200		41.55	33.9	1.4				43.11	28		18829.62	16964.7		93.82	115.4		3797.13	1260		< 7.31	< 5.75		465.54	377.7
UMH2-650 (0-6")	10/11/2007				156.35			< 25.22			186.19			20253.53			3576.09			1967.95			< 9.37			472.11
UMH2-650+25 (0-6")	7/15/2008			27.2	28.97					39.39	43.02		19514.7	19656.6		103.34	229.77		601.11	745.07		< 7.79	< 5.96		259.39	420.61
UMH3-COMP 1 (0-6")	10/11/2007				< 39.48			< 23.66			85.96			16654.73			730.29			608.1			< 7.48			197.63
UMH3-COMP 2 (0-6")	10/11/2007	11200	313		218.03	15.9		< 26.03	873		669.92	36400		25898.42	13600		8725.32	1320		831.97	< 0.5		< 13.1	2940		772.78
UMH3-COMP 3 (0-6")	10/11/2007	12000	262		660.57	4.95		< 28.31	1340		880.18	50700		49847.02	30700		14375.43	1270		1516.96	0.92		< 16.93	1270		2246.32
UMH3-00 (0-6")	10/11/2007				< 20.09			< 24.77			63.35			15422.7			164.66			529.17			< 7.3			123.15
UMH3-50 (0-6")	10/11/2007				< 22.7			< 23.16			42.91			19317.34			212.49			587.71			< 7.46			374.51
UMH3-50+12.5 (0-6")	7/15/2008			61.35						77.91			18223.68			721.05			7070.2			< 8.03			389.57	
UMH3-50+25 (0-6")	7/15/2008			100.93						75.9			16432.85			588.29			286			< 6.9			436.8	
UMH3-50+50 (0-6")	7/15/2008			40.59	< 19.47					47.32	54.86		18681.99	19771.9		294.87	314.4		1677.49	1304.11		< 8.47	< 5.70		383.37	427.64
UMH3-100 (0-6")	10/11/2007				37.62			< 24.45			54.13			18544.52			224.49			807.11			< 8.45			231.61
UMH3-150 (0-6")	10/11/2007				< 62.9			< 23.55			351.59			20264.13			1892.01			546.68			< 8.81			547.02
UMH3-150+25 (0-6")	7/15/2008			299.58						127.8			22398.59			4162.87			986.07			< 11.11			295.88	
UMH3-150+50 (0-6")	7/15/2008			104.36						63.12			15956.43			594.6			4949.89			< 8.01			589.47	
UMH3-150+75 (0-6")	7/15/2008			59.38						123.34			9564.88			1059.78			3240.67			< 9.26			503.37	
UMH3-150+100 (0-6")	7/15/2008			174.72						135.6			10268.78			2852.12			2395.85			< 8.64			421.7	
UMH3-200 (0-6")	10/11/2007				121.78			< 24.97			234.47			25184.63			3029.14			1466			< 9.46			437.44
UMH3-250 (0-6")	10/11/2007				454.93			< 29.35			784.14			37763.4			11296.28			848.51			< 14.11			766.79
UMH3-250+25 (0-6")	7/15/2008			49.6						102.44			18907.94			527.04			1530.24			< 8.36			309.47	
UMH3-250+50 (0-6")	7/15/2008			56.81						63.99			10923.25			254.11			4924.63			< 7.38			283.13	
UMH3-250+75 (0-6")	7/15/2008			37.53						76.04			8559.88			343.47			2015.98			< 6.6			227.19	
UMH3-350 (0-6")	10/11/2007				535.04			< 29.59			1317.3			51800.26			16817.24			1697.15			< 16			1001.82
UMH3-350+50 (0-6")	7/15/2008			50.82						91.43			23101.3			569.28			1501.66			< 9.1			295.12	
UMH3-350+75 (0-6")	7/15/2008	13700		27.55	20.9	1.5				72.25	51		23488.64	22039.7		170.3	171.1		2333.38	1910		< 8.2	< 5.93		252.38	307.5
UMH3-400 (0-6")	10/11/2007				260.15			< 27.64			642.35			35352.9			9593.95			986.73			< 14.27			656.08
UMH3-400+25 (0-6")	7/15/2008	14300	29.4	< 31.41	28.1	0.758			63.6	46.12	77	21300	2554	20466	534	510.85	369.1	684	1126.58	484	< 0.5	< 8.23	< 5.52	240	278.42	270.6
UMH3-450 (0-6")	10/11/2007				19.19			< 23.1			74.53			15784.67			99.25			435.12			< 7.19			151.78
UMH3-500 (0-6")	10/11/2007				71.85			< 23.92			141.08			21523.98			1496.71			617.48			< 8.5			377.36
UMH3-550 (0-6")	10/11/2007				418.39			< 28.45			993.8			49552.5			12377.3			1525.85			< 15.64			1000.99
UMH3-550+25 (0-6")	7/16/2008			344.99						469.27			22560.54			4904.55			2307.49			< 10.09			739.59	

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XRF 10 M - XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab - Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
XRF samples were sent to lab for confirmation analysis at a a frequence of 10%.

Table 27a
Mine Waste Removal and Reclamation Areas Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M
DEQ Action Level/RSLs/UBMC BTVs		77,000[a]	40[b]			70[a]			3,100[a]			58,270[c]			1,109[c]			4,893[c]			23[a]			23,000[a]		
UMH3-550+50 (0-6")	7/16/2008			153.71						164.12			14890.82			1260.17			1873.98			< 8.31			624.58	
UMH3-600 (0-6")	10/11/2007				904.3			< 30.22			1212.31			57228.44			15449.31			1322.12			< 17.61			947.9
UMH3-650 (0-6")	10/11/2007				401.34			< 28.51			946.94			51585.38			15468.85			1491.37			< 17.37			869.37
UMH3-700 (0-6")	10/11/2007				484.56			< 3			886.97			45886.02			14940.59			854.07			< 15.98			649.66
UMH3-750 (0-6")	10/11/2007				55.12			< 22.98			93.42			16816.54			1141.04			824.81			< 8.05			285.15
UMH3-800 (0-6")	10/10/2007				106.03			< 24.51			201.85			22766.99			2104.21			1099.06			< 8.93			297.17
EU9 Paymaster Mine Waste Areas																										
PMWA1-COMP 1 (0-6")	10/8/2007	18200	19.2		< 42.79	0.54		< 27.33	328		326.66	55900		58094.71	679		631.56	343		385.93	< 0.5		< 9.6	142		117.22
PMWA1-COMP 2 (0-6")	10/8/2007	16200	18		< 41.05	0.47		< 26.87	339		230.18	63600		58427.81	725		564.84	269		226.23	< 0.5		< 9.9	133		97.15
PMWA1-1 (0-6")	10/8/2007				< 24.69			< 25.72			280.8			52661.43			230.9			413.66			< 9.3			66.33
PMWA1-50 (0-6")	10/8/2007		10.1		< 28.22	0.446		< 25.93	388		305.62			48023.07	290		265.02	359		352.64	< 0.5		< 8.31	115		125.87
PMWA1-50 (0-6")	10/8/2007				< 28.22			< 25.93			305.62			48023.07			265.02			352.64			< 8.31			125.87
PMWA1-100 (0-6")	10/8/2007				< 39.93			< 26.15			269.12			56363.86			577.52			333.43			< 8.71			92.66
PMWA1-100+25 (0-6")	7/10/2008	19200		37.92		< 0.5				158.28			58160.39			191.04			1130.68			< 10.47			181.79	
PMWA1-150 (0-6")	10/8/2007				< 27.65			< 25.45			411.72			58316.75			237.28			221.44			< 9.29			127.05
PMWA1-200 (0-6")	10/8/2007				< 53.8			< 30.46			355.21			73551.64			851.42			421.1			< 10.25			116.22
PMWA1-200+15 (0-6")	7/10/2008			94.47						305.17			64421.54			399.01			986.01			< 8.15			100.5	
PMWA1-200+30 (0-6")	7/10/2008			15.32						181.47			25291.9			97.11			184			< 6.5			189.03	
PMWA1-230 (0-6")	10/8/2007				< 50.36			< 28.78			280.18			64290.52			796.6			513.79			< 10.9			113.28
PMWA1-230+25 (0-6")	7/10/2008	13600		< 21.98		< 0.5				518.66			40457.59			222.32			1569.39			< 8.14			140.18	
PMWA2-COMP 1 (0-6")	10/8/2007	16000	20.4		< 40.66	0.69		< 25.69	344		300.12	49800		54116.34	559		592.1	376		418.17	< 0.5		< 8.47	149		100.15
PMWA2-0 (0-6")	10/8/2007				< 22.03			< 23.64			166.88			35441.59			178.32			171.43			< 7.77			130.67
PMWA2-50 (0-6")	10/8/2007				< 18.98			< 21.96			88.85			24082.85			153.52			916.34			< 7.19			157.6
PMWA2-100 (0-6")	10/8/2007				< 25.61			< 25.02			601.18			47958.98			222.72			526.29			< 8.99			78.72
PMWA2-150 (0-6")	10/8/2007		20.6		< 28.91	0.494		< 25.81	395		336.71			39433.75	330		281.23	264		344.88	< 0.5		< 9.36	109		128.84
PMWA2-200 (0-6")	10/8/2007				< 43.25			< 26.51			315.78			60189.92			644.74			460.91			< 10.14			119.9
PMWA2-200+12.5 (0-6")	7/10/2008			106.16						192.44			21071.91			1001.96			210.13			< 6.21			65.08	
PMWA2-200+25 (0-6")	7/10/2008	18000		< 18.09		0.7				110.96			26082.41			185.34			396.97			< 6.81			163.91	
EU10 Number 3 Tunnel Waste Area																										
N3TA fine tail (0-6")	10/8/2007				< 28.99			< 22.88			124.9			23386.93			385.97			< 118.12			< 7.69			< 28.21
N3TA-0 (0-6")	10/8/2007				< 13.67			< 22.79			224.07			20943.83			70.77			< 119.16			< 7.37			< 26.97
N3TA-COMP 1 (0-6")	10/8/2007		27		25.2	0.22		< 23.14	188		157.25			25189.75	62.4		42.22	348		187	< 0.5		< 7.93	59.2		38.34
N3TA-COMP 2 (0-6")	10/8/2007				20.75			< 23.92			257.75			28221.13			117.86			< 139.19			< 8.76			< 29.8
N3TA-COMP 3 (0-6")	10/8/2007				< 64.44			< 36.68			279.79			33766.71			814.17			1287.61			< 12.62			601.63
N3TA-Det Pond (0-6")	10/9/2007				< 12.09			< 22.92			216.92			25304.89			46.06			< 127.62			< 6.63			42.21
N3TA-Pile #1 (0-6")	10/9/2007				28.27			< 25.39			989.82			81978.98			164.9			6193.92			< 7.52			645.12
N3TA-Pile #2 (0-6")	10/8/2007				< 17.09			< 22.32			103.98			19174.29			125.74			480.57			< 7.19			86.61
N3TA-50 (0-6")	10/8/2007				< 26.39			< 39.68			216.12			36481.82			78.56			< 259.82			< 14.1			< 44.23
N3TA-100 (0-6")	10/8/2007				31.34			< 36.51			216.39			45480.27			58.16			< 213.75			< 12.15			< 45.19
N3TA-150 (0-6")	10/8/2007				< 19.27			< 31.46			139.66			30661.28			57.23			< 197.12			< 1			< 38.72
N3TA-200 (0-6")	10/8/2007				< 21.11			< 33.97			140.42			34146.42			68.08			< 199.08			< 10.67			< 41.5
N3TA-250 (0-6")	10/8/2007				< 24.06			< 32.43			114.77			18954.38			116.29			< 150.78			< 11.25			< 36.15
N3TA-350 (0-6")	10/9/2007				15.37			< 22.13			81.7			21458.7			42.59			< 126.62			< 6.77			< 27.61

Notes:

mg/kg - Milligrams per kilogram
Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
M% - Matrix spike recoveries exceed acceptable limits.
J - The associated value is an estimated quantity.
- Value exceeds EPA RSI or DEQ Action Level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

AMHR - Above Mike Horse Repository
CARM - Carbonate Mine Waste Area
CEA - Central Edith Mine Waste Area
CMWA - Capital Mine Waste Area
CONM - Consolate Mine Waste Area
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MHCS - Mike Horse Creek Floodplain Sediments/Mine Waste
MHTS - Mike Horse Town Site

MPWA - Mary P. Mine Waste Area
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PMWA - Paymaster Mine Waste Area
SHWA - Shave Gulch Waste Area
UAW - Upper Anaconda Mine Waste Area
UMH - Upper Mike Horse Mine Waste Area
WEA - West Edith Mine Waste Area

UAW3-51 through UAW3-75 and UAW4 through UAW4-50 XRF results from ground surface of unreclaimed Upper Anaconda Waste Areas. UAW3-X represents XRF reading number.

XRF Field - XRF measurements recorded from ground surface in field.
XRF 10 M - XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab - Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
XRF samples were sent to lab for confirmation analysis at a a frequence of 10%.

Table 27a
Mine Waste Removal and Reclamation Areas Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M	Lab	XRF Field	XRF 10 M
DEQ Action Level/RSLs/UBMC BTVs		77,000[a]	40[b]			70[a]			3,100[a]			58,270[c]			1,109[c]			4,893[c]			23[a]			23,000[a]		
N3TA-400 (0-6")	10/9/2007				22			< 24.17			103.84			33628.4			62.78			< 136.44			< 7.01			< 27.96
N3TA-450 (0-6")	10/9/2007				< 16.39			< 24.07			111.22			36133.1			85.11			< 131.55			< 7.65			< 3
N3TA-500 (0-6")	10/9/2007				24.93			< 24.77			143.03			36034.8			103.22			201.04			< 7.7			< 33.43
N3TA-550 (0-6")	10/8/2007				19.85			< 23.83			172.57			31556.42			108			< 120.86			< 8.17			< 30.4
N3TA-600 (0-6")	10/8/2007				22.15			< 24.23			163.62			36166.35			137.88			< 140.09			< 8.23			< 32.69
N3TA-650 (0-6")	10/8/2007				19.56			< 23.22			179.61			34251.34			94.66			< 144.8			< 7.13			< 29.74
N3TA-700 (0-6")	10/9/2007				71.46			< 21.09			755.03			46138.58			320.23			1865.34			< 6.29			185.89
N3TA-750 (0-6")	10/9/2007		50.3		46.27	1.36		< 24.88	970		726.13			83696.45	246		225.65	3700		3323.06	< 0.5		< 7.94	330		275.71
N3TA-800 (0-6")	10/9/2007				21.42			< 21.77			653.3			37004.28			127.27			2676.19			< 6.69			697.46
N3TA-850 (0-6")	10/9/2007				< 18.69			< 23.96			225.59			28399.75			126.39			210.35			< 7.74			152.72
N3TA-900 (0-6")	10/8/2007				< 18.97			< 22.65			90.18			17427.6			167.82			244.47			< 7.31			73.98
N3TA-950 (0-6")	10/8/2007				< 24.36			< 24.63			196.57			35589.76			227.54			< 141.27			< 7.53			< 29.09
N3TA-1000 (0-6")	10/9/2007				< 28.37			< 24.06			126.71			24935			366.89			< 144.97			< 6.89			40.9
N3TA-1000-EOT (0-6")	10/9/2007		11		18.74	0.36		< 21.67	75.9		66.92			17214.89	143		102.07	200		< 121.56	< 0.5		< 6.46	67.1		66.62
N3TA-1050 (0-6")	10/9/2007				< 25.8			< 24.05			176.23			36663.04			261.86			334.93			< 8.54			143.7

Notes:

mg/kg - Milligrams per kilogram
Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
M% - Matrix spike recoveries exceed acceptable limits.
J - The associated value is an estimated quantity.
- Value exceeds EPA RSl or DEQ Action Level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

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UAW3-51 through UAW3-75 and UAW4 through UAW4-50 XRF results from ground surface of unreclaimed Upper Anaconda Waste Areas. UAW3-X represents XRF reading number.

XRF Field - XRF measurements recorded from ground surface in field.
XRF 10 M - XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab - Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
XRF samples were sent to lab for confirmation analysis at a a frequence of 10%.

Table 27b
Mine Waste Removal and Reclamation Areas ABA and SPLP Analytical Results

Sample ID	Date Collected	SC (µmhos/cm)	pH (s.u.)	TOC (%)	Acid - Base Accounting: Sulfur, Hot Water Extractable (%)	Total Sulfur (%)	Sulfur Sulfate (%)	Sulfur Pyritic (%)	Sulfur Organic (%)	Neutral Potential (t/kt)	Acid Potential (t/kt)	Acid/Base Potential (t/kt)	Synthetic Precipitation Leaching Procedure: Aluminum (mg/L)	Arsenic (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Zinc (mg/L)
Soil SPLP		--	--	--	--	--	--	--	--	--	--	--	--	0.1	0.05	13	110	0.15	3.2	0.02	20
EU1 Upper Anaconda Mine Waste Removal Areas and Waste Piles																					
UAW1-COMP 1 (0-6")	10/11/2007	23.7	1.9		0.27	5.1					150	-150		0.02	0.0091	1.5		3.5	0.52	< 0.0002	1.8
UAW1-150+75 (0-6")	7/15/2008	0.36	6.3	5.9	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	13	0.12	13	20	0.024	0.0014	0.023	12	0.32	0.85	< 0.0001	0.68
UAW2-COMP1 (0-6")	10/11/2007	1.77	6.2		< 0.01	0.17				8	5	3		0.018	< 0.0002	0.062		0.78	0.12	< 0.0002	0.07
UAW2-200 (0-6")	10/11/2007	0.84	3.3	1.46	0.59	0.83	0.46	0.32	0.04	1	10	-9		< 0.1	< 0.01	0.1		1.6	0.1	< 0.0001	< 0.5
UAW2-250 (0-6")	10/11/2007	1.13	2.7	1.27	1.1	1.29	0.75	0.47	0.07	-2	15	-17		< 0.1	< 0.01	0.5		0.2	0.2	< 0.0001	< 0.5
UAW3-COMP 1 (0-6")	10/11/2007	16.2	2		0.02	4.1				< 1	130	-130		< 0.003	0.28	2.2		3.7	5.5	< 0.0002	51
UAW4-COMP 1 (0-6")	10/11/2007	3.9	2.2	0.09	7.46	7.78	0.29	6.73	0.76	-6	210	-220		< 0.1	0.02	0.3		6.2	1.4	0.00032	3.3
UAW5-COMP 1 (0-6")	10/16/2007	0.18	4.6	1.01	0.15	0.18	0.06	0.11	0.01	4	3.4	1		< 0.1	< 0.01	0.2		1.3	0.8	< 0.0001	0.6
EU3 Capital Mine Waste Area																					
CMWA-COMP 1 (0-6")	10/4/2007	7.55	2.1		0.19	2				< 1	56	-56		< 0.003	0.0058	0.44		0.16	2.7	< 0.0002	0.67
CMWA-COMP 2 (0-6")	10/4/2007	2.69	7.7		0.02	1.4				120	45	+73		0.042	< 0.0002	0.008		0.015	0.005	< 0.0002	0.02
CMWA-0+12.5 (0-6")	7/16/2008	0.43	6.9	3.3	0.34	0.34	< 0.01	0.33	< 0.01	19	11	8	3.4	0.018	0.00025	0.069	6.6	0.14	0.12	< 0.0001	0.07
CMWA-250 (0-6")	10/4/2007	2.66	4.9	3.83																	
CMWA-250+50 (0-6")	7/16/2008	0.19	5.7	1.4	0.02	0.02	< 0.01	0.01	< 0.01	2	0.43	1	7.9	0.018	0.00086	0.033	7.2	0.09	0.089	< 0.0001	0.05
EU4 Carbonate Mine Waste Area																					
CARM-250 (0-6")	10/15/2007	0.26	5.3	2.29																	
CARM-400 (0-6")	10/15/2007	0.14	6.6	0.87	0.02	0.02	0.01	< 0.01	< 0.01	7	0.23	7		< 0.1	< 0.01	0.3		0.2	1.6	< 0.0001	< 0.5
CARM-1150 (0-6")	10/15/2007	0.13	6	0.98																	
EU5 Edith Mine Waste Areas																					
CEA1-3-COMP 1 (0-6")	10/12/2007	1.45	7.6		< 0.01	0.13				57	4	+53		0.01	< 0.0002	0.037		0.11	0.026	< 0.0002	0.05
CEA1-3-COMP 2 (0-6")	10/12/2007	0.59	7.5		< 0.01	0.05				29	1	+27		0.012	0.0003	0.05		0.097	0.093	< 0.0002	0.08
CEA1-3-COMP 3 (0-6")	10/11/2007	1.45	2.9	2.13																	
CEA1-3-550 (0-6")	10/12/2007	0.17	5.4	4.48																	
CEA1-3-850 (0-6")	10/12/2007	0.31	7.5	1.24																	
EEA2-150 (0-6")	10/10/2007	0.55	6.1	1.19																	
EEA2-200 (0-6")	10/10/2007	0.49	6.1	1.22																	
WEA1-00 (0-6")	10/12/2007	0.48	7.2	1.58																	
WEA1-400 (0-6")	10/12/2007	0.12	5.3	1.07																	
EU6 Consolation Mine Waste Area																					
CONM-COMP 1 (0-6")	10/9/2007	0.28	5.8		< 0.01	0.06				6	2	+4		0.018	0.0004	0.069		0.25	0.28	< 0.0002	0.1
CONM-COMP 2 (0-6")	10/9/2007	0.98	7.5		< 0.01	0.11				42	3	+38		0.021	< 0.0002	0.028		0.13	0.069	< 0.0002	0.1
CONM-Pile 1 (0-6")	10/9/2007	0.19	3.4		0.05	0.53				< 1	15	-15		< 0.003	< 0.0002	0.012		0.0024	0.014	< 0.0002	0.02
CONM-250 (0-6")	10/9/2007	1.51	2.6	1.28																	
CONM-250+25 (0-6")	7/9/2008	0.31	4.7	3.9	0.02	0.02	< 0.01	0.02	< 0.01	0	0.58	0	13	0.034	0.00054	0.031	8.5	0.2	0.38	< 0.0001	0.2
CONM-700 (0-6")	10/9/2007	0.17	5.2	1.07																	
CONM-750 (0-6")	10/9/2007	0.77	4	5.36	0.5	0.56	0.25	0.27	0.04	1	8.5	-8		< 0.1	< 0.01	< 0.1		0.4	0.1	< 0.0001	< 0.5
CONM-750+6.0 (0-6")	7/10/2008	0.19	5.2	2.5	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0	0.03	0	9.4	0.014	0.00022	0.026	8.5	0.061	0.17	< 0.0001	0.06
EU7 Mary P. Mine Waste Pile																					
MPWA-200+0 (0-6")	7/10/2008	0.22	4.2	3.5	0.01	0.02	0.01	0.01	< 0.01	-3	0.44	-4	12	0.015	0.00031	0.13	13	0.13	0.1	< 0.0001	0.09

Notes:

SC - Specific conductance
µmhos/cm - Micromhos per centimeter
s.u. - Standard units
% - Percent
t/kt - Tons per thousand tons
mg/L - Milligrams per liter
TOC - Total organic carbon

-- - No standard/screening level available
Blank - No data collected/not analyzed
M% - Matrix spike recoveries exceed acceptable limits. Number represents percent recovery value.
J - The associated value is an estimated quantity.
< - Parameter not detected at or above the laboratory practical quantitation limit

Classification	Criteria for Classification [a]
Potentially Acid Generating	NP:AP < 1 and NNP < -20 tons/kton
Uncertain Acid Generation Potential	NP:AP between 1 and 3 and/or NNP between -20 and +20 tons/kton
Unlikely to Generate Acid	NP:AP > 3 and NNP < +20 tons/kton

[a] From BLM (1996) and EPA (1994).

*Iron and manganese SPLP Leachate Criterion for soil were calculated based on a DAF 10 and their respective EPA Tap Water standards. The SPLP Leachate Criterion for Soil for the remaining metals were calculated based on a DAF 10 and their respective DEQ-7 water quality standards (see Section 4 of RI report).

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CARM - Carbonate Mine Waste Area
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EEA - East Edith Mine Waste Area
MHCS - Mike Horse Creek Soil
MHTS - Mike Horse Town Site
MPWA - Mary P. Mine Waste Area
N3TA - No. 3 Tunnel Mine Waste Area
PMWA - Paymaster Mine Waste Area
UAW - Upper Anaconda Mine Waste Area
UMH - Upper Mike Horse Mine Waste Area
WEA - West Edith Mine Waste Area

Table 27b
Mine Waste Removal and Reclamation Areas ABA and SPLP Analytical Results

Sample ID	Date Collected	SC (µmhos/cm)	pH (s.u.)	TOC (%)	Acid - Base Accounting								Synthetic Precipitation Leaching Procedure								
					Sulfur, Hot Water Extractable (%)	Total Sulfur (%)	Sulfur Sulfate (%)	Sulfur Pyritic (%)	Sulfur Organic (%)	Neutral Potential (t/kt)	Acid Potential (t/kt)	Acid/Base Potential (t/kt)	Aluminum (mg/L)	Arsenic (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Zinc (mg/L)
Soil SPLP		**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**0.1**	**0.05**	**13**	**110**	**0.15**	**3.2**	**0.02**	**20**
EU8 Mike Horse Mine Waste Piles																					
AMHR-200 (0-6")	10/11/2007	0.74	5.2	0.54																	
MHCS-200-E25 (0-6")	10/15/2007	0.17	5.2	0.91																	
MHCS-525-E5 (0-6")	10/16/2007	0.19	6	2.11																	
MHCS-700-E25 (0-6")	10/16/2007	0.12	5.3	0.81	< 0.01	0.01	< 0.01	< 0.01	< 0.01	4	0.17	4		< 0.1	< 0.01	< 0.1		< 0.1	0.3	< 0.0001	< 0.5
MHTS-COMP 1 (0-6")	10/11/2007	0.54	4	1.3																	
MHTS-COMP 2 (0-6")	10/11/2007	0.24	4	1.13																	
UMH1-COMP (0-6")	10/10/2007	0.53	7.6		< 0.01	0.04				15	1	13		0.027	0.0003	0.009		0.11	0.16	< 0.0002	0.09
UMH2-COMP 1 (0-6")	10/10/2007	0.79	7.4		< 0.01	0.06				7	2	5		0.066	0.0013	0.057		1.2	1.1	< 0.0002	0.26
UMH2-COMP 2 (0-6")	10/10/2007	0.85	7.5		0.04	0.23				16	6	10		0.023	0.0007	0.054		0.86	0.31	< 0.0002	0.13
UMH2-0400+025	7/15/2008	0.19	5.2	2.6	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	2	< 0.01	2	19	0.008	0.0011	0.014	9.3	0.035	0.69	< 0.0001	0.41
UMH3-COMP 2 (0-6")	10/10/2007	1.09	7.5		0.06	0.3				22	8	15		0.04	0.0005	0.11		1.6	0.096	< 0.0002	0.09
UMH3-COMP 3 (0-6")	10/10/2007	0.29	4.5		0.03	0.46				< 1	13	-13		< 0.003	0.0006	0.007		0.026	0.23	< 0.0002	0.05
UMH3-400+25 (0-6")	7/15/2008	0.19	5.2	2.6	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	2	< 0.01	2	8.9	0.011	0.00018	0.022	5.8	0.22	0.23	< 0.0001	0.1
EU9 Paymaster Mine Waste Areas																					
PMWA1-COMP 1 (0-6")	10/3/2007	0.15	5.3		< 0.01	0.05				4	1	+3		0.01	< 0.0002	0.11		0.23	0.091	< 0.0002	0.09
PMWA1-COMP 2 (0-6")	10/3/2007	0.19	4.9		< 0.01	0.06				2	2	0		0.019	< 0.0002	0.14		0.43	0.14	< 0.0002	0.12
PMWA1-50 (0-6")	10/3/2007	0.51	3.7	0.93	0.1	0.13	0.05	0.08	< 0.01	2	2.4	0		< 0.1	< 0.01	< 0.1		< 0.1	0.1	0.00013	< 0.5
PMWA2-COMP 1 (0-6")	10/3/2007	0.25	6.7		< 0.01	0.05				4	1	+3		0.015	0.0003	0.14		0.33	0.19	< 0.0002	0.11
PMWA2-150 (0-6")	10/3/2007	0.15	4.3	1.26																	
EU10 Number 3 Tunnel Waste Area																					
N3TA-COMP 1 (0-6")	10/4/2007	0.28	5.8	1.34	0.06	0.06	< 0.01	0.05	0.01	4	1.5	3		< 0.1	< 0.01	0.2		0.1	0.6	< 0.0001	< 0.5
N3TA-750 (0-6")	10/8/2007	0.14	4.7	2.5																	
N3TA-1000-EOT (0-6")	10/8/2007	0.23	5.2	2.59	0.03	0.03	< 0.01	0.02	< 0.01	0	0.6	0		< 0.1	< 0.01	< 0.1		< 0.1	0.1	< 0.0001	< 0.5

Notes:

SC	- Specific conductance
µmhos/cm	- Micromhos per centimeter
s.u.	- Standard units
%	- Percent
t/kt	- Tons per thousand tons
mg/L	- Milligrams per liter
TOC	- Total organic carbon
--	- No standard/screening level available
Blank	- No data collected/not analyzed
M%	- Matrix spike recoveries exceed acceptable limits. Number represents percent recovery value.
J	- The associated value is an estimated quantity.
<	- Parameter not detected at or above the laboratory practical quantitation limit

Classification	Criteria for Classification [a]
Potentially Acid Generating	NP:AP < 1 and NNP < -20 tons/kton
Uncertain Acid Generation Potential	NP:AP between 1 and 3 and/or NNP between -20 and +20 tons/kton
Unlikely to Generate Acid	NP:AP > 3 and NNP < +20 tons/kton

[a] From BLM (1996) and EPA (1994).

*Iron and manganese SPLP Leachate Criterion for soil were calculated based on a DAF 10 and their respective EPA Tap Water standards. The SPLP Leachate Criterion for Soil for the remaining metals were calculated based on a DAF 10 and their respective DEQ-7 water quality standards (see Section 4 of RI report).

AMHR	- Above Mike Horse Repository	MHTS	- Mike Horse Town Site
CARM	- Carbonate Mine Waste Area	MPWA	- Mary P. Mine Waste Area
CEA	- Central Edith Mine Waste Area	N3TA	- No. 3 Tunnel Mine Waste Area
CMWA	- Capital Mine Waste Area	PMWA	- Paymaster Mine Waste Area
CONM	- Consolate Mine Waste Area	UAW	- Upper Anaconda Mine Waste Area
EEA	- East Edith Mine Waste Area	UMH	- Upper Mike Horse Mine Waste Area
MHCS	- Mike Horse Creek Soil	WEA	- West Edith Mine Waste Area

Table 28

Paymaster Constructed Wetlands Underlying Soil Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)	Total Cadmium (mg/kg)	Total Copper (mg/kg)	Total Iron (mg/kg)	Total Lead (mg/kg)	Total Manganese (mg/kg)	Total Mercury (mg/kg)	Total Zinc (mg/kg)
DEQ Action Level/RSLs/UBMC BTVs		77,000[a]	40[b]	70 [a]	3,100[a]	58,270 [c]	1,109 [c]	4,893 [c]	23 [a]	23,000 [a]
PAYCW-1 (0-6")	6/2/08	6820	228	0.169	201	45900	422	148	< 0.5	53.2
PAYCW-1 (6-12")	6/2/08	6920	181	< 0.15	211	58100	212	70.4	< 0.5	32.1
PAYCW-1 (12-24")	6/2/08	7250	319	< 0.15	184	65200	93.9	216	< 0.5	28.0
PAYCW-2 (0-6")	6/2/08	7040	240	0.218	190	146000	122	50.5	< 0.5	47.8
PAYCW-2 (6-12")	6/2/08	4700	1130	< 0.15	114	184000	77.2	90.9	< 0.5	25.7
PAYCW-2 (12-24")	6/2/08	4380	1030	< 0.15	122	218000	89.9	77.8	< 0.5	24.1
PAYCW-3 (0-6")	6/2/08	5470	1370	< 0.15	151	145000	132	50.9	< 0.5	25.4
PAYCW-3 (6-12")	6/2/08	5640	491	< 0.15	202	114000	94.5	126	< 0.5	37.0
PAYCW-3 (12-24")	6/2/08	5080	193	< 0.15	115	57400	118	154	< 0.5	28.6
PAYCW-4 (0-6")	6/2/08	7370	620	< 0.15	162	140000	138	88.2	< 0.5	39.8
PAYCW-4 (6-12")	6/2/08	4020	735	< 0.15	212	208000	49.9	26.8	< 0.5	26.4
PAYCW-4 (12-24")	6/2/08	3550	468	< 0.15	172	192000	43.4	32.9	< 0.5	24.5
PAYRD-1 (0-6")	6/2/08	10100	18.6	< 0.15	264	51700	286	82.8	< 0.5	47.6

Notes:

mg/kg	- Milligrams per kilogram
--	- No standard/screening level
<	- Parameter not detected at or above the laboratory practical quantitation limit
	- Meets or exceeds one or more screening level
Blank	- No data

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).

[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).

[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

Table 29a

Blackfoot River - River Floodplain Sediment Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)			Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M
DEQ Action Level/RSLs/UBMC BTVs		77,000 [a]			40 [b]			70 [a]			3,100 [a]			58,270 [c]			1,109 [c]			4,893 [c]			23 [a]			23,000 [a]		
BREOT-N2+100 (0-6")	7/10/2008					< 17.48						235.00			32,366.39			187.22			721.00						189.47	
BREOT-N10+25 (0-6")	10/9/2007						20.8			< 24.06			172.5			29062.63			131.67			786.61			< 7.9			229.27
BREOT-N10-0 (0-6")	10/9/2007						1065.06			62.35			3539.8			94585.44			23489.36			8051.61			< 26.6			18327.25
BREOT-N10-12.5 (0-6")	10/9/2007						479.81			< 29.11			1570.12			51516.42			9658.18			3565.84			< 14.72			4625.95
BREOT-N11+25 (0-6")	10/9/2007				15.10		< 20.56	1.50		< 25.1	328.00 J		301.99			34969.47	170.00 J		138.02	1,130.00		897.4	< 0.50		< 7.7	204.00		182.9
BREOT-N11-0 (0-6")	10/9/2007						292.16			< 29.08			294.95			87203.71			2858.47			376.17			< 11.24			635.39
BREOT-N11-12.5 (0-6")	10/9/2007						244.76			< 28.71			222.91			79303.23			2688.98			493.58			< 11.2			485.28
BREOT-N11-125 (0-6")	10/9/2007						171.66			< 26.63			166.82			74368.89			2225.06			319.11			< 10.11			398.8
BREOT-N12+25 (0-6")	10/9/2007						< 25.82			< 23.74			163.64			27635.65			273.11			981.07			< 7.65			264.87
BREOT-N12-0 (0-6")	10/9/2007						109.63			< 25.51			256.68			49639.57			1033.66			1046.75			< 9.52			320.85
BREOT-N12-12.5 (0-6")	10/9/2007				72.60		115.35	9.13		< 25.25	286.00 J		292.34			45103.05	1,970.00 J		1521.42	1,600.00		2241.87	< 0.50		< 9.13	1,440.00		1176.38
BREOT-N13+25 (0-6")	10/9/2007						< 25.9			< 23.31			233.77			32443.17			271.91			1313.55			< 7.77			263.48
BREOT-N13-0 (0-6")	10/9/2007						1256.09			49.96			1910.45			173311.94			26470.24			1553.82			< 27.58			10290.07
BREOT-N14+25 (0-6")	10/9/2007						39.54			< 23.12			260.98			30038.21			293.67			1538.91			< 7.5			436.24
BREOT-N14-0 (0-6")	10/9/2007						164.44			< 26.52			428.24			65885.85			2905.39			1548.95			< 9.4			347.73
BREOT-N15+25 (0-6")	10/9/2007						104.46			44.34			1312.45			25251.81			4602.45			5066.42			< 10.96			9592.28
BREOT-N15+50 (0-6")	7/9/2008					22.82	< 17.7					266.59	271		40,960.15	34037.7		164.47	192.6		1,717.67	1271		< 7.71			279.48	301
BREOT-N15-0 (0-6")	10/9/2007						322.92			< 28.19			333.89			87349.92			3596.13			810			< 11.98			984.09
BREOT-N15-12.5 (0-6")	10/9/2007						273.1			< 28.13			289.27			106463.85			2842.6			270.24			< 11.92			2709.06
BREOT-N16-0 (0-6")	10/9/2007						202.07			< 28.49			246.21			105679.86			1770.53			613.11			< 11.45			376.59
BREOT-N16-12.5 (0-6")	10/9/2007						218.83			< 28.78			370.95			94124.91			2704.88			2158.76			< 12.38			891.38
BREOT-N16-25 (0-6")	10/9/2007						< 28.44			< 24.1			205.35			30010.2			329.07			1143.5			< 8.24			175.38
BREOT-N17+25 (0-6")	10/9/2007						163.39			< 28.68			792.03			64208.05			8164.14			1434.83			< 13.36			1921.61
BREOT-N17-0 (0-6")	10/9/2007						193.64			< 25.99			260.46			74921.03			2862.04			1656.67			< 10.76			434.23
BREOT-N17-12.5 (0-6")	10/9/2007						160.2			< 28.11			157.39			105555.53			2330.84			602.57			< 10.38			384.17
BREOT-N18-0 (0-6")	10/9/2007						169.28			< 28.86			240.22			98489.16			2315.72			650.34			< 10.86			522.43
BREOT-N18-12.5 (0-6")	10/9/2007						207.74			< 28.43			450.44			99240.13			2015.18			5987.63			< 12.33			1599.79
BREOT-N18-25 (0-6")	10/9/2007						22.86			< 21.63			57.4			18327.55			180.3			565.89			< 6.88			307.33
BREOT-N19+25 (0-6")	10/10/2007						< 14.98			< 22.76			50.85			19887.68			82.27			721.63			< 7.04			200.04
BREOT-N19-0 (0-6")	10/10/2007						241.81			< 28.56			293.75			94590.21			1578.85			4494.9			< 10.98			1409.23
BREOT-N19-10 (0-6")	10/10/2007						185.08			< 27.62			237.52			81194.05			1881.36			884			< 10.79			472.82
BREOT-N20+25 (0-6")	10/10/2007						< 24.49			< 28.55			522.73			42965.69			170.39			976.85			< 10			286.82
BREOT-N20-0 (0-6")	10/10/2007						172.31			< 29.64			420.4			74194.39			1291.74			9986.95			< 11.41			2243.01
BREOT-N20-12.5 (0-6")	10/10/2007						243.16			< 30.97			169.8			123587.43			1165.52			765.48			< 10.82			330.85
BREOT-N21+100 (0-6")	7/8/2008					< 23.32						214.15			31,231.20			186.38			556.77			< 9.11			163.31	
BREOT-N21+25 (0-6")	10/9/2007				115.00		207.58	3.18		< 27.51	330.00 J		315.02			99549.42	3,950.00 J		3523.56	171.00		< 215.87	< 0.50		< 11.96	581.00		428.16
BREOT-N21+50 (0-6")	7/8/2008					90.29						231.97			56,301.47			1,926.24			449.40			< 11.29			304.85	
BREOT-N21-0 (0-6")	10/9/2007						481.32			1547.44			13483.34			17591628			< 115.03			648789.38			< 442.45			< 2484.52
BREOT-N21-12.5 (0-6")	10/9/2007						97.67			< 26.44			283.61			54307.73			1147.33			6826.54			< 8.93			2568.01

Notes:

mg/kg - Milligrams per kilogram
Blank - No data
< - Parameter not detected at or above the laboratory practical quantitation limit
XRF Field - XRF measurements recorded from ground surface in field.
XRF 10 M - XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab - Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
B - Method blank shows evidence of contamination.
M% - Matrix spike recoveries exceed acceptable limits. Number represents percent recovery value.
J - The associated value is an estimated quantity.
- Value meets or exceeds one or more screening level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00)..

BR - Blackfoot River
EOT - Edge of tailings
N - North side of river
S - South side of river

Aluminum was not analyzed in 2007.

BREOT-S47-999 is located 65 feet south of river.

Table 29a

Blackfoot River - River Floodplain Sediment Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)			Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M
DEQ Action Level/RSLs/UBMC BTVs		77,000 [a]			40 [b]			70 [a]			3,100 [a]			58,270 [c]			1,109 [c]			4,893 [c]			23 [a]			23,000 [a]		
BREOT-N22+125 (0-6")	7/8/2008					< 28.00						220.81			23,099.27			285.09			832.68			< 8.53			269.92	
BREOT-N22+150 (0-6")	7/8/2008					< 18.92	< 16.6					174.75	244		29,551.59	38561.9		125.92	280.3		877.53	902		< 8.63			145.18	204.7
BREOT-N22+25 (0-6")	10/9/2007						92			< 24.63			480.99			30287.28			2468.14			2582.15			< 9.72			2993.38
BREOT-N22+50 (0-6")	7/8/2008					136.72						528.03			11,473.56			863.37			1,660.06			< 8.03			3,596.83	
BREOT-N22+75 (0-6")	7/8/2008					68.34						914.71			14,609.85			607.93			3,365.85			< 7.28			928.94	
BREOT-N22-0 (0-6")	10/10/2007						207.81			< 30.11			321.38			120471.47			1455.46			854.87			< 12.34			952.11
BREOT-N22-12.5 (0-6")	10/9/2007						184.79			< 28.76			206.34			102038.8			1477.5			671.89			< 10.89			413.84
BREOT-N23+115 (0-6")	7/8/2008	11,000				14.39	23.3	2.40				94.45	76		9,056.82	16400.1		74.57	65.8		559.13	698		< 6.75			427.17	362.5
BREOT-N23+25 (0-6")	10/10/2007						328.83			43.96			1266.31			43209.01			7213.83			4784.69			< 14.64			7374.61
BREOT-N23+50 (0-6")	7/8/2008					400.40						1,282.10			49,963.28			6,534.45			4,046.11			< 16.81			12,591.27	
BREOT-N23-0 (0-6")	10/10/2007				264.00		207.62	17.20		< 30.95	930.00 J		515.35			123068.8	1,630.00 J		1205.43	4,050.00		2998.84	< 0.50		< 11.83	2,490.00 J		1192.53
BREOT-N23-12.5 (0-6")	10/10/2007						199.12			< 27.85			234.05			80916.92			1233.96			1464.2			< 10.07			680.85
BREOT-N24+25 (0-6")	10/10/2007						157.58			< 28.57			313.27			57871.5			917.05			9125.91			< 11.06			1827.29
BREOT-N24+50 (0-6")	7/11/2008					205.18						819.73			32,960.08			6,512.97			1,491.66			< 10.14			833.08	
BREOT-N24+75 (0-6")	7/11/2008					26.18	22.1					90.00	83		16,469.30	22507.8		98.13	108.5		758.80	995		< 6.74			451.06	290.7
BREOT-N24-0 (0-6")	10/10/2007						231.38			< 26.76			493.42			53527.23			2555.23			1334.68			< 10.57			1925.8
BREOT-N25+25 (0-6")	10/10/2007						< 15.14			< 24.22			167.55			29367.47			67.68			330.76			< 7.44			104.64
BREOT-N25-0 (0-6")	10/10/2007						219.39			< 26.86			775.49			69947.83			6230.34			4036.23			< 11.87			1413.12
BREOT-N25-50 (0-6")	10/10/2007						337.73			39.35			1619.17			44442.73			8799.84			4818.56			< 14.47			7971.48
BREOT-N25-95 (0-6")	10/10/2007						274.98			< 27.97			107.5			94350.59			1372.31			< 204.03			< 10			101.2
BREOT-N26+25 (0-6")	10/10/2007						18.52			< 22.64			99.63			24118.28			75.36			457.95			< 6.91			152.98
BREOT-N26-0 (0-6")	10/10/2007				238.00		472.42	30.00		< 30.55	1,110.00 J		925.35			96201.8	11,900.00 J		11405.62	1,540.00		2628.88	< 0.50		< 16.51	5,020.00 J		2123.6
BREOT-N26-25 (0-6")	10/10/2007						111.59			< 24.05			734.66			22781.46			1938.67			1901.45			< 9.06			2552.45
BREOT-N26-50 (0-6")	10/10/2007						248.11			52.37			1245.76			45421.72			6356.76			4810.68			< 16.14			11429.52
BREOT-N26-75 (0-6")	10/10/2007						212.11			25.04			1035.92			25945.06			4206.52			2654.83			< 11.04			5833.52
BREOT-N27+25 (0-6")	10/10/2007						< 18.98			< 24.65			198.45			38133.99			117.04			749.82			< 7.65			268.08
BREOT-N27-0 (0-6")	10/10/2007						465.4			41.74			2510.37			62177.36			12254.56			5015.07			< 17.3			11285.22
BREOT-N27-30 (0-6")	10/10/2007						414.94			< 29.44			1230.19			75834.41			8804.76			2657.24			< 13.74			2635.83
BREOT-N27-75 (0-6")	10/10/2007				298.00		411.76	84.80		56.72	2,750.00 J		2168.38			51329.66	15,400.00 J		10203.9	6,790.00		7569.65	< 0.50		< 18.68	14,300.00 J		10273.2
BREOT-N28+25 (0-6")	10/10/2007				14.20		< 18.85	1.33		< 23.24	133.00 J		63.42			25099.54	181.00 J		137.19	810.00		602.78	< 0.50		< 7.76	198.00 J		185.96
BREOT-N28-0 (0-6")	10/10/2007						123.72			< 23.15			548.05			34422.46			4728.84			2166.36			< 9.71			729.8
BREOT-N28-110 (0-6")	10/10/2007						115.48			< 21.93			509.19			21522.15			2353.45			1403.29			< 9.07			1554.62
BREOT-N28-55 (0-6")	10/10/2007						1224.98			80.56			2950.39			144866.55			21759.55			3717.41			< 25.62			14964.78
BREOT-N29+25 (0-6")	10/11/2007						< 26.15			< 20.34			195.19			24937.12			371.1			1444.43			< 6.18			700.85
BREOT-N29-30 (0-6")	10/10/2007						625.48			56.73			2473.12			89952.9			11328.4			5761.55			< 20.4			13665.5
BREOT-N30+25 (0-6")	10/11/2007						< 31.55			< 20.04			317.98			27376.67			552.21			1129.04			< 6.99			395.91
BREOT-N30-0 (0-6")	10/10/2007						441.08			< 31.52			1482.71			81680.13			8583.87			3453.89			< 15.65			5209.78
BREOT-N30-12.5 (0-6")	10/10/2007				128.00 JM74		103.32	4.84		< 26.18	584.00 J		451.91			68364.45	3,960.00 J		3253.89	2,230.00		1971.04	< 0.50		< 9.13	1,040.00 J		775.58
BREOT-N31+25 (0-6")	10/10/2007						272.98			59.07			2113.74			50092.22			9996.43			6606.73			< 16.35			10115.01

Notes:

mg/kg - Milligrams per kilogram
Blank - No data
< - Parameter not detected at or above the laboratory practical quantitation limit
XRF Field - XRF measurements recorded from ground surface in field.
XRF 10 M - XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab - Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
B - Method blank shows evidence of contamination.
M% - Matrix spike recoveries exceed acceptable limits. Number represents percent recovery value.
J - The associated value is an estimated quantity.
- Value meets or exceeds one or more screening level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00)..

BR - Blackfoot River
EOT - Edge of tailings
N - North side of river
S - South side of river

Aluminum was not analyzed in 2007.

BREOT-S47-999 is located 65 feet south of river.

Table 29a

Blackfoot River - River Floodplain Sediment Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)			Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M
DEQ Action Level/RSLs/UBMC BTVs		77,000 [a]			40 [b]			70 [a]			3,100 [a]			58,270 [c]			1,109 [c]			4,893 [c]			23 [a]			23,000 [a]		
BREOT-N31+50 (0-6")	7/9/2008					23.67						355.89			44,333.04			117.89			1,302.33			< 7.74			303.76	
BREOT-N31+75 (0-6")	7/9/2008	17,800				57.14	< 12.2	0.70				187.32	217		51,642.29	44071.7		181.44	75.4		1,729.28	828		< 8.50			234.52	198
BREOT-N31-0 (0-6")	10/10/2007						108.22			< 23.54			1288.16			24929.29			4140.92			3405.17			< 10.03			6523.66
BREOT-N31-12.5 (0-6")	10/11/2007						136.72			< 25.93			318.38			80870.24			3254.74			< 209.62			< 9.74			586.17
BREOT-N32+25 (0-6")	10/10/2007						< 18.07			< 24.44			265.02			45392.96			108.72			1169.61			< 9.06			148.97
BREOT-N32-0 (0-6")	10/10/2007						140.66			< 24.07			530.65			27664.14			1715.24			1551.78			< 9.02			2598.36
BREOT-N32-12.5 (0-6")	10/10/2007						303.37			< 29.94			212.73			149286.45			1178.34			< 270.23			< 11.6			1062.19
BREOT-N33+25 (0-6")	10/10/2007						< 17.43			< 27.23			382.97			60427.34			75.04			859.55			< 8.61			107.14
BREOT-N33-0 (0-6")	10/10/2007						16.44			< 25.52			199.69			48983.8			62.3			958.27			< 8.93			137
BREOT-N33-12.5 (0-6")	10/11/2007				240.00		289.71	1.29		< 28.25	328.00		236.9			101199.68	3,680.00 JM10		3438.68	368.00		401.88	< 0.50		< 11.19	462.00		356
BREOT-N34+25 (0-6")	10/10/2007						< 19.7			< 27			361.3			64589.9			114.56			762.62			< 9.57			138.64
BREOT-N34-0 (0-6")	10/10/2007						24.88			< 26.93			490.06			68467.45			164.66			1465.33			< 9			346.9
BREOT-N35+25 (0-6")	10/11/2007						22.74			< 25.43			285.74			56158.4			84.55			907.94			< 7.65			156.6
BREOT-N35-0 (0-6")	10/11/2007						24.73			< 24.69			266.22			47771.95			103.98			806.61			< 8.44			123.46
BREOT-N35-12.5 (0-6")	10/11/2007						79.02			< 20.52			186.74			38321.18			597.07			< 129.95			< 6.37			476.49
BREOT-N36+100 (0-6")	7/9/2008					34.02	16.2					177.18	158		61,566.23	44666.1		171.49	170.6		1,284.76	922		< 9.14			258.08	225.8
BREOT-N36+100-2 (0-6	7/9/2008					< 31.62						139.78			57,926.45			384.84			752.81			< 10.91			132.83	
BREOT-N36+25 (0-6")	10/11/2007						187.92			< 29.01			544.9			68878.15			2018			7537.71			< 12.06			2366.87
BREOT-N36+50 (0-6")	7/9/2008					34.06						206.73			29,331.02			379.98			1,929.26			< 7.06			678.79	
BREOT-N36+75 (0-6")	7/9/2008					50.35						182.55			44,157.66			182.37			1,463.54			< 8.07			206.73	
BREOT-N36-0 (0-6")	10/11/2007						215.91			< 30.56			433.34			71036.03			2266.23			8443.04			< 12			2974.94
BREOT-N36-12.5 (0-6")	10/11/2007						154.38			< 25.97			305.05			76050.57			1626.17			3261.49			< 9.39			618.89
BREOT-N37+25 (0-6")	10/11/2007				23.90 JM74		< 18.09	0.57		< 25.74	260.00		178.49			38813.73	147.00 JM10		104.43	514.00		372.98	< 0.50		< 8.63	91.90		78.59
BREOT-N37-0 (0-6")	10/11/2007				62.40 JM74		85.01	2.52		< 26.42	230.00		181.04			53648.51	540.00 JM10		506.1	784.00		1385.83	< 0.50		< 9.86	363.00		414.47
BREOT-N37-12.5 (0-6")	10/11/2007						221.2			< 27.02			184.16			73274.38			1529			329.81			< 10.16			202.79
BREOT-N38+25 (0-6")	10/11/2007						24.25			< 27.5			428.73			68977.8			150.78			649.96			< 10.44			84.05
BREOT-N38-0 (0-6")	10/11/2007						18.25			< 24.29			194.6			40787.42			105.17			734.58			< 8.34			125.41
BREOT-N38-12.5 (0-6")	10/11/2007						102.3			< 23.48			208.15			60094.91			795.42			665.14			< 8.49			220.84
BREOT-N39+25 (0-6")	10/10/2007						21.93			< 24.76			157.89			41060.57			146.12			534.25			< 8.49			115.07
BREOT-N39-0 (0-6")	10/11/2007						19.86			< 24.39			64.36			29067.37			87.85			865.03			< 7.38			212.89
BREOT-N39-12.5 (0-6")	10/11/2007						250			< 27.06			303.46			83919.88			2831.75			989.39			< 11.34			1094.73
BREOT-N40+25 (0-6")	10/11/2007						31.94			< 24.86			230.15			55347.01			150.55			567.06			< 7.94			64.9
BREOT-N40-0 (0-6")	10/11/2007						41.93			< 26.35			239.16			51858.83			212.19			930.4			< 8.82			169.12
BREOT-N40-12.5 (0-6")	10/11/2007						151.87			< 26.97			404.03			56771.73			1895.94			4630.16			< 9.49			1356.23
BREOT-N41+25 (0-6")	10/11/2007						< 17.57			< 24.38			90.99			29291.76			99.38			377.7			< 8.17			115.25
BREOT-N41-0 (0-6")	10/10/2007						29.39			< 24.38			154.53			37170.14			136.8			488.76			< 8.07			96.8
BREOT-N41-12.5 (0-6")	10/11/2007				69.60		< 56.25	5.11		< 27.3	328.00		300.08			49479.66	1,170.00		1163.4	1,680.00		3408.44	< 0.50		< 9.71	1,060.00		1034.53
BREOT-N42+25 (0-6")	10/11/2007						< 9.65			< 17.77			55.82			11476.02			45			138.43			< 5.22			57.58
BREOT-N42-0 (0-6")	10/11/2007						10.18			< 15.94			66.41			7855.8			27.2			139.9			< 4.45			41.49

Notes:

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Blank - No data
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XRF Field - XRF measurements recorded from ground surface in field.
XRF 10 M - XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab - Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
B - Method blank shows evidence of contamination.
M% - Matrix spike recoveries exceed acceptable limits. Number represents percent recovery value.
J - The associated value is an estimated quantity.
- Value meets or exceeds one or more screening level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
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BR - Blackfoot River
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Aluminum was not analyzed in 2007.

BREOT-S47-999 is located 65 feet south of river.

Table 29a

Blackfoot River - River Floodplain Sediment Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)			Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M
DEQ Action Level/RSLs/UBMC BTVs		77,000 [a]			40 [b]			70 [a]			3,100 [a]			58,270 [c]			1,109 [c]			4,893 [c]			23 [a]			23,000 [a]		
BREOT-N42-35 (0-6")	10/11/2007						118.57			< 24.86			244.28			63977.57			1852.91			785.1			< 9.45			205.76
BREOT-N43+40 (0-6")	10/11/2007						< 16.41			< 21.04			79.7			22566.37			116.88			749.77			< 6.52			220.66
BREOT-N43-0 (0-6")	10/12/2007						35.12			< 22.01			126.88			24593.81			185.15			619.91			< 6.84			201.76
BREOT-N43-12.5 (0-6")	10/11/2007						168.9			< 27.7			460.3			63722.77			2116.98			10092.37			< 11.23			2591.03
BREOT-N43-12.5 (0-6")	10/11/2007						39.41			< 23.22			152.41			27624.15			262.17			744.08			< 7.68			278.97
BREOT-N44+55 (0-6")	10/11/2007						30.56			< 24.25			186.36			35040.17			154.1			664.38			< 8.28			225.63
BREOT-N44-0 (0-6")	10/12/2007						65.22			< 24.64			240.88			39439.38			561.97			1375.09			< 7.81			419.4
BREOT-N44-30 (0-6")	10/12/2007						116.27			< 23.26			188.08			51528.87			979.68			791.45			< 7.16			482.21
BREOT-N45+25 (0-6")	10/15/2007						< 15.94			< 21			85.87			17653.03			110.4			650.14			< 5.91			230.88
BREOT-N45+25 (0-6")	10/11/2007						34.68			< 22.18			443.81			26209.8			143.04			829.09			< 6.58			349.68
BREOT-N45-0 (0-6")	10/11/2007						< 19.73			< 22.71			378.29			26499.3			160.56			967.41			< 6.58			338.5
BREOT-N45-12.5 (0-6")	10/11/2007						164.64			< 23.74			316.49			55685.36			1084.65			957.48			< 8.14			237.58
BREOT-N46+25 (0-6")	10/11/2007						42.1			< 24.69			336.04			34951.38			157.99			966.97			< 8.18			517.75
BREOT-N46-0 (0-6")	10/12/2007						< 19.12			< 23.82			264.13			36413.82			137.76			684.82			< 7.95			444.26
BREOT-N46-12.5 (0-6")	10/12/2007						66.02			< 22.42			123.11			43609.91			778.34			367.4			< 6.97			127.57
BREOT-N47+25 (0-6")	10/12/2007						< 19.23			< 25.25			253.31			28949.03			128.7			779.19			< 8.31			344.27
BREOT-N47-0 (0-6")	10/12/2007						< 17.5			< 19.7			644.26			15667.58			175.15			852.65			< 5.4			723
BREOT-N47-12.5 (0-6")	10/12/2007				121.00		96.64	1.40		< 25.02	310.00		277.83			61110	1,260.00		1281.62	789.00		703.76	< 0.50		< 8.51	346.00		251.86
BREOT-N48+25 (0-6")	10/12/2007						< 15.73			< 22.38			79.64			23391.16			109.67			617.4			< 6.56			132.85
BREOT-N48-0 (0-6")	10/12/2007						< 22.52			< 21.17			143.69			20458.82			243.67			557.77			< 6.07			282.63
BREOT-N49+25 (0-6")	10/12/2007						58.18			< 20.99			103.48			27520.57			407.9			925.79			< 6.41			341.71
BREOT-N49-0 (0-6")	10/12/2007						30.22			< 22.53			171.43			25614.16			386.57			1011.7			< 6.65			1061.15
BREOT-N51+25 (0-6")	10/12/2007						23.36			< 21.54			91.5			17734.45			94.58			783.81			< 6.83			166.35
BREOT-N51-0 (0-6")	10/12/2007						56.88			< 22.79			121.56			33096.13			422.52			1673.95			< 7.82			336.24
BREOT-N52+25 (0-6")	10/12/2007						46.68			< 19.76			114.98			16895.21			214.54			324.11			< 5.08			167.71
BREOT-N52-0 (0-6")	10/15/2007						< 14.43			< 19.92			123.1			49508.59			98.82			< 123.73			< 6.07			< 21.6
BREOT-N52-60 (0-6")	10/15/2007						213.9			< 27.03			212.06			75558.52			2822.18			256.45			< 10.25			419.74
BREOT-N53+25 (0-6")	10/12/2007						< 13.24			< 20.08			111.55			13868.28			81.51			293.99			< 5.49			166.57
BREOT-N53-0 (0-6")	10/12/2007						< 19.7			< 19.63			128.43			17175.37			213.65			563.22			< 5.76			261.47
BREOT-N54-0 (0-6")	10/15/2007						< 21.41			< 21.91			122.22			20644.7			215.54			679.13			< 6.19			298.71
BREOT-N55+25 (0-6")	10/15/2007						19.83			< 23.95			62.02			23843.7			80.28			713.58			< 7.94			146.57
BREOT-N55-0 (0-6")	10/15/2007						< 17.72			< 23.46			103.02			23830.6			124.06			1031.58			< 7.48			229.41
BREOT-N55-12.5 (0-6")	10/12/2007						186.67			< 26.73			433.85			66138.01			2379.34			3749.33			< 10.67			2394.16
BREOT-N56+25 (0-6")	10/15/2007						< 18.22			< 24.89			79.29			28418.2			110.55			698.72			< 7.64			144.72
BREOT-N56-0 (0-6")	10/12/2007				76.80		83.77	1.46		< 24.01	141.00		92.85			37077.14	668.00		565.16	922.00		655.3	< 0.50		< 8.37	348.00		249.69
BREOT-N56-12.5 (0-6")	10/12/2007				143.00		126.72	4.35		< 25.34	423.00		321.29			63445.57	2,560.00		2220.21	1,670.00		1788.13	< 0.50		< 9.71	1,000.00		689.53
BREOT-N57+25 (0-6")	10/15/2007						< 15.8			< 22.26			57.24			20377.93			97.96			736.05			< 6.85			124.54
BREOT-N57-0 (0-6")	10/15/2007						< 21.49			< 20.93			121.52			18790.34			245.15			930.83			< 6.14			178.39
BREOT-N57-12.5 (0-6")	10/15/2007						123.09			< 25.33			236.03			61727.19			1365.89			1193.93			< 9.56			291.39

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		Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M
DEQ Action Level/RSLs/UBMC BTVs		77,000 [a]			40 [b]			70 [a]			3,100 [a]			58,270 [c]			1,109 [c]			4,893 [c]			23 [a]			23,000 [a]		
BREOT-N58+25 (0-6")	10/15/2007						23.11			< 22.67			81.26			24228.55			92.8			973.28			< 6.93			212.21
BREOT-N58-0 (0-6")	10/15/2007						20.79			< 22.07			119.19			21845.12			165.6			980.99			< 6.08			217.35
BREOT-N58-12.5 (0-6")	10/12/2007						52.5			< 23.53			153.3			31112.26			327.95			2056.66			< 7.17			328.9
BREOT-N59+25 (0-6")	10/16/2007						53.61			< 21.01			111.1			26555.77			427.76			1535.26			< 6.54			351.54
BREOT-N59-0 (0-6")	10/16/2007						34.78			< 21.41			52.26			19382.28			100.13			883.13			< 6.51			244.14
BREOT-N59-18 (0-6")	10/16/2007						91.84			< 23.36			105.58			48845.83			919.82			704.95			< 8.05			224.4
BREOT-N60+25 (0-6")	10/16/2007				21.10		24.62	1.07		< 22.37	65.80		55.59			22494.97	111.00		91.64	596.00		523.7	< 0.50		< 6.75	223.00		235.93
BREOT-N60-0 (0-6")	10/16/2007				19.00		19.72	2.39		< 21.18	73.40		53.21			19977.27	106.00		80.31	538.00		360.09	< 0.50		< 6.21	246.00		226.75
BREOT-N60-12.5 (0-6")	10/16/2007						25.98			< 21.28			76.28			23291.22			266.35			1203.67			< 5.76			315.5
BREOT-N62+25 (0-6")	10/16/2007						< 18.48			< 21.42			107.19			21179.54			156.97			870.74			< 6.15			261.02
BREOT-N62-0 (0-6")	10/16/2007						18.29			< 21.09			83.17			18335.55			129.01			929.38			< 6.3			251.83
BREOT-N62-12.5 (0-6")	10/16/2007						< 18.1			< 28.02			87.44			30568.15			96.79			620.79			< 8.7			121.08
BREOT-N63+25 (0-6")	10/16/2007						73.74			< 20.9			264.04			19579.67			547.67			1368.57			< 5.91			274.29
BREOT-N63-0 (0-6")	10/16/2007				28.80		55.7	2.96		< 22.45	123.00		156.25			25799.36	361.00		340.33	969.00		1137.09	< 0.50		< 7.03	422.00		464.62
BREOT-N64 (0-6")	10/16/2007						< 17.39			< 22.58			86.72			21186.73			132.95			431.4			< 7.1			292.59
BREOT-N64+25 (0-6")	10/16/2007						20.85			< 22.4			99.16			22455.02			128.1			480.19			< 6.98			307.4
BREOT-N64-12.5 (0-6")	10/16/2007						39.56			< 22.84			94.63			27682.9			323.9			1097.41			< 6.5			286.37
BREOT-N64-20 (0-6")	10/16/2007						48.88			< 24.67			114.74			34442.65			270.37			1064.53			< 7.57			214.43
BREOT-N65-12.5 (0-6")	10/16/2007						28.1			< 22.81			122.79			27177.63			179.45			944.07			< 7.56			312.19
BREOT-N66+25 (0-6")	10/16/2007						29.85			< 22.85			69.6			26705.24			100.81			745.62			< 5.71			248.03
BREOT-N66-0 (0-6")	10/16/2007						37.04			< 23.56			76.55			30119.97			176.39			947.49			< 7.15			256.9
BREOT-N66-5 (0-6")	10/15/2007						98.58			< 23.83			134.63			52233.98			688.86			533.21			< 8.34			189.89
BREOT-N67+100 (0-6")	7/9/2008					148.81						190.51			50,861.47			1,980.01			349.23			< 8.09			273.40	
BREOT-N67+125 (0-6")	7/9/2008	12,200				20.98	53.2	2.80				72.24	148		4,373.44	21258.5		325.12	423.9		56.64	386		< 4.81			177.26	363
BREOT-N67+25 (0-6")	10/16/2007						104.37			< 25.63			176.25			62248.19			1541.1			904.75			< 9.01			377.36
BREOT-N67+50 (0-6")	7/9/2008					225.64						269.53			100,801.91			1,808.79			618.03			< 10.14			324.76	
BREOT-N67+75 (0-6")	7/9/2008					104.03						154.30			30,404.56			906.07			361.93			< 6.48			260.12	
BREOT-N67-0 (0-6")	10/16/2007						85.03			< 24.18			669			50871.08			1858.91			7989.94			< 8.46			3379.49
BREOT-N67-12.5 (0-6")	10/16/2007						97.45			< 27.7			563.05			45639.89			1119.02			10544.95			< 10.82			3099.17
BREOT-S0+25 (0-6")	10/8/2007						37.48			< 23.42			89.44			28511.05			257.98			957.27			< 7.57			349.15
BREOT-S0-0 (0-6")	10/8/2007						78.73			< 23.25			120.1			35555.62			468.4			762.32			< 8.49			456.04
BREOT-S0-12.5 (0-6")	10/8/2007						127.73			< 24.66			138.44			44278.66			888.73			174.97			< 8.64			247.57
BREOT-S1+25 (0-6")	10/8/2007						< 19.61			< 23.45			144.72			27218.23			141.8			1384.26			< 8.28			448.39
BREOT-S1-0 (0-6")	10/8/2007						238.91			< 26.09			210.69			87134.03			2278.72			846.69			< 10.84			263.49
BREOT-S1-12.5 (0-6")	10/8/2007						92.49			< 20.6			108.7			35319.9			809.31			551.72			< 6.7			166.3
BREOT-S2+95 (0-6")	10/8/2007						22.81			< 26.57			338.04			62240.47			58.49			893.68			< 8.36			147.4
BREOT-S2-0 (0-6")	10/9/2007						68.12			< 28.55			299.17			122263.52			666.2			2259.84			< 10.02			290.36
BREOT-S2-12.5 (0-6")	10/8/2007						259.46			< 31.67			731.57			100932.77			1944.58			3911.45			< 13.02			2539.69
BREOT-S3+6 (0-6")	10/8/2007						< 20.9			< 24.34			163.42			29293.48			165.03			554.86			< 8.45			193.15

Notes:

mg/kg - Milligrams per kilogram
Blank - No data
< - Parameter not detected at or above the laboratory practical quantitation limit
XRF Field - XRF measurements recorded from ground surface in field.
XRF 10 M - XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab - Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
B - Method blank shows evidence of contamination.
M% - Matrix spike recoveries exceed acceptable limits. Number represents percent recovery value.
J - The associated value is an estimated quantity.
- Value meets or exceeds one or more screening level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00)..

BR - Blackfoot River
EOT - Edge of tailings
N - North side of river
S - South side of river

Aluminum was not analyzed in 2007.

BREOT-S47-999 is located 65 feet south of river.

Table 29a

Blackfoot River - River Floodplain Sediment Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)			Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M
DEQ Action Level/RSLs/UBMC BTVs		77,000 [a]			40 [b]			70 [a]			3,100 [a]			58,270 [c]			1,109 [c]			4,893 [c]			23 [a]			23,000 [a]		
BREOT-S3-0 (0-6")	10/8/2007						266.89			< 26.97			362.11			71193.38			1479.3			5701.72			< 11.4			1653.52
BREOT-S4+10 (0-6")	10/8/2007						20.4			< 22.89			81.12			22399.66			92.25			1067.54			< 7.41			228.36
BREOT-S6+25 (0-6")	10/8/2007						28.97			< 23.16			153.22			33191.55			253.53			843.42			< 6.84			250.72
BREOT-S6-0 (0-6")	10/8/2007						290.69			< 30.82			327.21			144128.05			1700.3			< 270.57			< 12.15			1042.04
BREOT-S6-12.5 (0-6")	10/8/2007						199.13			< 25.74			243.71			77697.92			1550.47			277.25			< 10.62			382.85
BREOT-S7-0 (0-6")	10/8/2007						173.78			< 26.05			189.93			71543.39			1014.57			273.97			< 9.56			479.35
BREOT-S7-25 (0-6")	10/8/2007						< 23.95			< 27.26			191.75			61361.74			170.67			1375.17			< 9.16			233.17
BREOT-S8+25 (0-6")	10/8/2007						34.73			< 25.13			171.11			36663.54			262.03			862.7			< 8.25			285.77
BREOT-S8-0 (0-6")	10/8/2007						51.98			< 23.36			168.83			33545.93			373.4			1166.95			< 7.83			321.27
BREOT-S8-12.5 (0-6")	10/8/2007						105.74			< 25.82			161.45			54828.24			648.55			625.82			< 9.06			144.55
BREOT-S9 (0-6")	10/8/2007						119.03			< 25.67			150.86			56933.51			804.79			236.91			< 8.92			207.97
BREOT-S9-12.5 (0-6")	10/9/2007						100.86			< 24.68			216.48			51049.03			678.76			785.02			< 8.24			331.12
BREOT-S11+63 (0-6")	10/8/2007				96.20			2.20			330.00 J						2,760.00 J			616.00			< 0.50			504.00		
BREOT-S11-0 (0-6")	10/8/2007						100.94			< 25.96			230.95			33520.24			1003.33			1994.3			< 8.48			1300.42
BREOT-S11-12 (0-6")	10/8/2007						281.43			41.89			1096.87			36649.07			6520.09			3300.97			< 12.09			7092.27
BREOT-S11-63 (0-6")	10/8/2007						145.93			< 25.33			252.21			53906.48			2051.33			376.49			< 9.06			400.17
BREOT-S12+25 (0-6")	10/9/2007						254.28			< 28.09			1378.14			41091.56			8704.79			3164.87			< 15.57			6452.66
BREOT-S12+60 (0-6")	10/9/2007						85.14			< 24.93			204.49			45699.88			1092.25			748.7			< 9.5			628.49
BREOT-S12-0 (0-6")	10/9/2007						110.32			< 26.16			590.9			50498.09			3188.48			2987.2			< 9.68			1705.48
BREOT-S12-12.5 (0-6")	10/9/2007						110.79			26.8			521.31			23682.3			3367.38			1880.21			< 9.83			2904.55
BREOT-S13+25 (0-6")	10/9/2007						185.17			37.93			609			32571.46			3104.82			2222.53			< 10.47			2886.53
BREOT-S13+65 (0-6")	10/9/2007						103.45			< 25.2			302.61			34014.22			1090.75			1191.08			< 8.66			949.73
BREOT-S13-0 (0-6")	10/9/2007						< 36.27			< 23.94			140.11			21649.11			619.85			865.35			< 7.88			2858.17
BREOT-S13-12.5 (0-6")	10/9/2007						239.13			< 26.03			1006.99			32597.78			5023.64			2611.95			< 11.94			5154.71
BREOT-S14+25 (0-6")	10/9/2007						698.6			< 26.82			1644.49			47422.37			12764.57			3069.52			< 15.36			4443.9
BREOT-S14+59 (0-6")	10/9/2007						100.48			< 26.61			194.01			56084.38			792.86			337.61			< 8.2			337.83
BREOT-S14-0 (0-6")	10/9/2007						729.53			42.31			2678.15			49313.34			13398.91			5748.56			< 18.3			11068.35
BREOT-S14-0 (0-6")	10/9/2007						708.36			69.5			3260.98			68591.92			15428.96			9152.85			< 20.06			15980.91
BREOT-S14-12.5 (0-6")	10/9/2007						67.39			< 25.96			409.08			26143.47			1393			1351.62			< 8.49			2558.11
BREOT-S15-12.5 (0-6")	10/9/2007				252.00		374.23	3.40		< 28.82	541.00 J		315.66			102702.27	3,260.00 J		2577.77	204.00		293.49	< 0.50		< 9.85	820.00		350.03
BREOT-S16+20 (0-6")	7/8/2008					94.47						307.81			35,485.02			1,257.96			438.00			< 9.14			350.16	
BREOT-S16+20 (0-6")	10/9/2007						157.5			< 23.33			798.23			27166.68			2988.56			2725.66			< 8.61			3869.97
BREOT-S16+49 (0-6")	7/8/2008					56.26						216.52			38,497.57			605.97			742.88			< 8.97			284.67	
BREOT-S16+65 (0-6")	7/8/2008					40.44						349.75			53,075.70			485.02			1,202.65			< 10.25			212.99	
BREOT-S16+75 (0-6")	7/8/2008	18,600				39.46	26.7	0.70				102.01	128		22,192.25	36202.1		333.43	432.6		1,096.73	598		< 7.40			456.21	456.2
BREOT-S16+75-2 (0-6"	7/8/2008					< 25.28						104.96			16,889.68			282.00			1,661.76			< 8.11			402.67	
BREOT-S16-0 (0-6")	10/9/2007						32.41			< 24.99			180.52			31121.22			334.02			1075.94			< 8.23			243.62
BREOT-S16-12.5 (0-6")	10/9/2007						147.9			< 26.26			153.7			54600.13			1917.22			246.91			< 9.3			177.87
BREOT-S17-0 (0-6")	10/10/2007						219.61			< 26.3			309.09			67231.92			3357.1			509.89			< 10.77			420.72

Notes:

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- Value meets or exceeds one or more screening level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00)..

BR - Blackfoot River
EOT - Edge of tailings
N - North side of river
S - South side of river

Aluminum was not analyzed in 2007.

BREOT-S47-999 is located 65 feet south of river.

Table 29a

Blackfoot River - River Floodplain Sediment Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)			Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M
DEQ Action Level/RSLs/UBMC BTVs		77,000 [a]			40 [b]			70 [a]			3,100 [a]			58,270 [c]			1,109 [c]			4,893 [c]			23 [a]			23,000 [a]		
BREOT-S17-12.5 (0-6")	10/9/2007						67.01			< 25.78			136.95			44367.87			703.41			384.72			< 8.15			153.28
BREOT-S17-25 (0-6")	10/10/2007						55.91			< 24.35			98.83			34920.95			546.41			990.56			< 8.39			233.77
BREOT-S18+25 (0-6")	10/9/2007						47.95			< 25.34			156.29			37797.98			629.2			315.97			< 8.9			202.4
BREOT-S18-0 (0-6")	10/9/2007						495.81			< 445.76			< 4187.75			10966813			< 72.98			406627.25			< 304.51			< 1446.94
BREOT-S18-12.5 (0-6")	10/9/2007						104.9			< 26			219.99			47076.09			822.27			1509.92			< 9.31			571.01
BREOT-S19+25 (0-6")	10/9/2007						416.48			787.21			5996.67			13283400			< 99.78			475483.56			< 349.74			< 1730.97
BREOT-S19+50 (0-6")	7/8/2008					23.67						120.99			19,550.33			187.34			499.62			< 8.70			327.98	
BREOT-S19+75 (0-6")	7/8/2008					< 33.69						218.98			33,107.88			459.53			835.35			< 8.46			168.09	
BREOT-S19+85 (0-6")	7/8/2008	19,500				32.86	< 31.4	0.60				202.12	239		47,044.12	57716.9		354.13	630.8		592.18	728		< 8.64			133.39	150.7
BREOT-S19-0 (0-6")	10/10/2007						60.32			< 25.43			128.58			34036.61			453.14			1258.18			< 8.31			272.85
BREOT-S19-12.5 (0-6")	10/10/2007						75			< 26.58			256.17			42343.3			1014.27			2865.56			< 9.66			1589.57
BREOT-S20+25 (0-6")	10/9/2007						592.19			1199.55			< 6568.07			17635634			< 109.78			676552			< 452.88			< 2316.01
BREOT-S20+50 (0-6")	7/8/2008					64.88						218.09			29,311.15			929.18			1,081.30			< 9.03			396.00	
BREOT-S20+75 (0-6")	7/8/2008	10,600			26.80	26.85	12.3	1.09			69.60	78.41	64	16900	27,015.49	17033.8	123.00	119.57	101.2	832.00	807.46	763	< 0.50	< 8.77		219.00	184.73	218
BREOT-S20-0 (0-6")	10/10/2007						53.75			< 25.19			136.1			39474.94			622.51			797.15			< 9.48			191.21
BREOT-S21+25 (0-6")	10/9/2007				80.20		356.03	1.44		547.82	188.00 J		8807.04			8847863	1,220.00 J		52.9	178.00		335362.81	< 0.50		< 238.69	320.00		< 1064.38
BREOT-S21-0 (0-6")	10/9/2007						184.37			< 26.99			231.1			82178.23			1731.16			339.04			< 10.72			386.01
BREOT-S22+25 (0-6")	10/10/2007						91.95			< 26.37			193.5			44766.59			1069.84			1652.02			< 8.73			352.11
BREOT-S22-0 (0-6")	10/10/2007						185.8			< 27.3			183.05			76967.59			1751.65			< 202.87			< 11.27			552.33
BREOT-S23+25 (0-6")	10/10/2007						105.05			< 21.97			348.81			19687.3			1259.1			1244.66			< 8.17			1763.01
BREOT-S23+37.5 (0-6")	7/8/2008					38.60	27.3					99.28	127		7,468.36	19589		445.31	107.9		202.87	974		< 5.65			449.23	465.7
BREOT-S23+55 (0-6")	7/8/2008					< 6.46						29.15			590.35			14.99			< 55.16			< 4.49			42.08	
BREOT-S23-0 (0-6")	10/10/2007						235.8			< 27.74			321.5			83235.52			2666.37			1660.51			< 10.48			789.37
BREOT-S23-12.5 (0-6")	10/10/2007						113.58			40.59			795.07			73567.61			1722.93			15887.5			< 12.39			8416.19
BREOT-S24+25 (0-6")	10/10/2007						82.75			< 24.85			187.87			51495.34			926.92			1837.59			< 9.16			427.43
BREOT-S24-0 (0-6")	10/10/2007						146.72			50.3			947.46			74522.2			1498.74			24125.57			< 13.29			10498.43
BREOT-S24-12.5 (0-6")	10/10/2007						141.25			< 28.77			677.22			79611.2			1779.36			16270.3			< 12.37			6368.59
BREOT-S25+25 (0-6")	10/10/2007						57.22			< 24.05			173.54			33975.06			542.98			1073.24			< 6.95			298.39
BREOT-S25-0 (0-6")	10/10/2007						129.23			< 27.29			669.92			50861.95			3485.39			5785.47			< 11.09			2583.7
BREOT-S25-12.5 (0-6")	10/10/2007						159.78			< 29.85			388.96			80024.82			1570.29			5808.09			< 10.96			1322.52
BREOT-S25-40 (0-6")	10/10/2007						94.27			< 26.22			215.85			54333.76			2395.38			728.68			< 10.25			326.4
BREOT-S25-40 (0-6")	10/10/2007						120.74			< 26.4			167.8			57010.96			2001.59			202.9			< 10.02			204.68
BREOT-S26+37 (0-6")	10/10/2007						22.62			< 22.94			84.16			25495.27			209.14			838.78			< 7.63			248.41
BREOT-S26-0 (0-6")	10/10/2007						140.56			< 27.78			342.52			59219			1593.55			3128.2			< 10.97			870.32
BREOT-S26-12.5 (0-6")	10/10/2007						101.91			< 26.19			120.02			41166.38			1146.16			2378.49			< 8.74			269.12
BREOT-S26-40 (0-6")	10/10/2007						146.87			< 27.73			408.45			53163.46			1421.68			7172.72			< 11.11			3621.86
BREOT-S27+25 (0-6")	10/10/2007						35.23			< 24.98			193.97			42314.22			396.16			776.07			< 7.59			196.68
BREOT-S27-0 (0-6")	10/10/2007				204.00		209.06	1.51		< 25.3	286.00 J		227.84			75408.95	3,390.00 J		2775.6	2,610.00		3541.93	< 0.50		< 9.23	381.00 J		214.66
BREOT-S27-12.5 (0-6")	10/10/2007						128.14			< 23.01			315.63			49146.76			2396.22			1518.19			< 8.16			367.11

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[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00)..

BR - Blackfoot River
EOT - Edge of tailings
N - North side of river
S - South side of river

Aluminum was not analyzed in 2007.

BREOT-S47-999 is located 65 feet south of river.

Table 29a

Blackfoot River - River Floodplain Sediment Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)			Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M
DEQ Action Level/RSLs/UBMC BTVs		77,000 [a]			40 [b]			70 [a]			3,100 [a]			58,270 [c]			1,109 [c]			4,893 [c]			23 [a]			23,000 [a]		
BREOT-S28+25 (0-6")	10/10/2007						96.07			< 24.64			189.31			43815.69			776.21			422.44			< 7.65			220.08
BREOT-S28-0 (0-6")	10/10/2007						115.53			< 26.01			165.31			61201.55			1164.15			< 185.43			< 8.94			239.41
BREOT-S28-12.5 (0-6")	10/10/2007						79.51			< 28.04			428.71			53148.98			1077.29			8379.43			< 10			2980.96
BREOT-S29+25 (0-6")	10/10/2007				34.60		< 42.32	1.57		< 24.64	276.00 J		203.33			52850.21	666.00 J		704.65	688.00		893.57	< 0.50		< 8.85	276.00 J		180.92
BREOT-S29-0 (0-6")	10/10/2007						< 33.93			< 24.5			176.57			44441.57			481.52			733.98			< 7.99			230.37
BREOT-S29-12.5 (0-6")	10/10/2007						152.09			< 28.41			402.02			96506.27			1322.57			7069.93			< 9.72			916.43
BREOT-S30+25 (0-6")	10/10/2007						< 35.65			< 24.63			186.1			39720.71			518.46			878.7			< 8.9			307.76
BREOT-S30-0 (0-6")	10/10/2007				10.80		< 24.78	0.35		< 24.68	178.00 J		129.78			41721.08	291.00 J		235.4	298.00		188.55	< 0.50		< 9.24	72.10 J		86.3
BREOT-S30-12.5 (0-6")	10/11/2007						147.02			< 28.91			312.86			89466.93			1544			4859.08			< 10.25			1205.32
BREOT-S31+25 (0-6")	10/10/2007						< 18.1			< 21.03			83.74			18021.14			175.19			639.52			< 6.72			282.28
BREOT-S31-0 (0-6")	10/11/2007						< 22.74			< 22.38			107.24			24924.88			226.95			264.37			< 7.18			405.19
BREOT-S31-25 (0-6")	10/10/2007				73.20		83.17	2.59		< 26.24	286.00 J		197.51			47769.66	1,000.00 J		888.6	2,560.00		3918.11	< 0.50		< 8.5	499.00 J		412.5
BREOT-S31-5 (0-6")	10/11/2007						169.13			< 26.04			296.71			68289.68			1132.07			6384.85			< 9.42			1113.37
BREOT-S32+100 (0-6")	7/8/2008					49.11						940.62			39,494.88			188.27			3,401.82			< 8.32			969.33	
BREOT-S32+100-2 (0-6	7/8/2008					35.97						998.56			33,928.83			130.50			3,514.25			< 7.72			967.57	
BREOT-S32+120 (0-6")	7/8/2008					94.62						409.45			52,379.93			806.27			2,333.18			< 10.46			610.98	
BREOT-S32+180 (0-6")	7/8/2008					131.63						568.73			46,706.72			1,236.62			1,009.67			< 8.91			291.57	
BREOT-S32+220 (0-6")	7/8/2008					86.89						261.24			37,992.17			620.32			191.36			< 8.95			195.69	
BREOT-S32+25 (0-6")	10/10/2007						135.46			< 24.9			403.7			43068.36			1198.64			1655.49			< 8.03			406.65
BREOT-S32+250 (0-6")	7/8/2008					102.57						389.75			59,803.52			1,332.49			350.06			< 10.33			234.93	
BREOT-S32+300 (0-6")	7/8/2008	25,500				96.15	62.4	1.40				707.71	791		66,476.70	66392.2		966.80	376.4		233.97	2487		< 9.47			110.62	522.3
BREOT-S32+50 (0-6")	7/8/2008					68.50						246.86			35,692.34			719.22			641.71			< 8.68			354.55	
BREOT-S32+75 (0-6")	7/8/2008					96.91						447.95			39,419.96			554.41			336.66			< 8.28			493.69	
BREOT-S32-0 (0-6")	10/10/2007						87.86			< 23.58			517.26			47612.28			1987.72			1214.87			< 8.53			428.19
BREOT-S32-6 (0-6")	10/10/2007						177.21			< 26.22			211.29			80680.65			1146.52			1381.49			< 9.4			206.88
BREOT-S33+25 (0-6")	10/10/2007						33.99			< 20.9			890.17			41228.91			137.86			3990.06			< 6.75			1188.03
BREOT-S33-0 (0-6")	10/10/2007						83.73			< 21.2			491.31			36752.48			474.77			1831.87			< 7.03			697.13
BREOT-S33-12.5 (0-6")	10/11/2007						< 29.19			< 21.57			579.88			32411.52			430.07			2695.65			< 6.85			543.12
BREOT-S34+25 (0-6")	10/10/2007						51.42			< 23.17			407.88			50573.15			370.9			1227.23			< 7.35			239.82
BREOT-S34-0 (0-6")	10/10/2007						113.78			< 22.94			596.7			44028			2309.28			1421.25			< 7.94			1904.06
BREOT-S34-0 (0-6")	10/11/2007						138.67			< 29.77			479.57			68439.65			1156.78			7236.47			< 10.99			3059.99
BREOT-S35+25 (0-6")	10/11/2007						32.42			< 21.92			870.37			47480.16			135.8			4167.08			< 6.48			1060.8
BREOT-S35-0 (0-6")	10/11/2007						109.63			< 23.97			443.04			73179.26			803.74			1238.99			< 7.82			443.98
BREOT-S35-12.5 (0-6")	10/11/2007						187.43			< 30.55			452.95			89411.81			1553.67			8469.79			< 11.15			2205.73
BREOT-S36+25 (0-6")	10/11/2007						35.51			< 24.11			801.71			70525.73			224.4			3822.52			< 7.42			899.24
BREOT-S36-0 (0-6")	10/11/2007						160.32			< 29.3			477.14			70477.28			1605.16			6368.11			< 10.9			2619.57
BREOT-S36-12.5 (0-6")	10/11/2007						148.62			< 25.69			201.96			66800.68			1548.78			1127.85			< 9.09			470.67
BREOT-S37+25 (0-6")	10/11/2007				36.40 JM74		29.11	5.35		< 23.48	1,280.00		1103.69			60048.89	175.00 JM10		125.6	5,340.00		5145.65	< 0.50		< 8.23	1,220.00		1021.98
BREOT-S37-0 (0-6")	10/11/2007						151.09			< 29.62			532.53			79544.09			1781.14			8125.24			< 12.1			2958.26

Notes:

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Blank - No data
< - Parameter not detected at or above the laboratory practical quantitation limit
XRF Field - XRF measurements recorded from ground surface in field.
XRF 10 M - XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab - Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
B - Method blank shows evidence of contamination.
M% - Matrix spike recoveries exceed acceptable limits. Number represents percent recovery value.
J - The associated value is an estimated quantity.
- Value meets or exceeds one or more screening level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00)..

BR - Blackfoot River
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S - South side of river

Aluminum was not analyzed in 2007.

BREOT-S47-999 is located 65 feet south of river.

Table 29a

Blackfoot River - River Floodplain Sediment Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)			Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M
DEQ Action Level/RSLs/UBMC BTVs		77,000 [a]			40 [b]			70 [a]			3,100 [a]			58,270 [c]			1,109 [c]			4,893 [c]			23 [a]			23,000 [a]		
BREOT-S37-12.5 (0-6")	10/11/2007						107.14			< 26.74			295.95			55784.01			779.69			1332.18			< 7.59			520.65
BREOT-S38+25 (0-6")	10/11/2007				32.10 JM74		28.14	5.95		< 24.16	1,220.00		1049.79			65462.8	180.00 JM10		153.02	5,580.00		4916.1	< 0.50		< 7.51	1,400.00		1190.89
BREOT-S38-0 (0-6")	10/11/2007						31.14			< 22.21			840.99			48776.36			208.02			4670.15			< 7.18			1130.16
BREOT-S38-12.5 (0-6")	10/11/2007				215.00 JM74		201.66	15.70		< 30.93	889.00		695.84			88026	1,420.00 JM10		1290.14	6,890.00		11757.94	< 0.50		< 12.03	2,180.00		1917.93
BREOT-S39+25 (0-6")	10/11/2007						47.38			< 22.53			878.21			48877.88			165.41			3743.47			< 7.4			1186.81
BREOT-S39-12.5 (0-6")	10/11/2007						158.2			< 27.74			520.88			69904.97			1528.85			4606.88			< 10.53			1330.47
BREOT-S4-0 (0-6")	10/8/2007						242.38			< 28.47			405.04			85966.1			1758.45			6686.6			< 11.56			1987.07
BREOT-S40+25 (0-6")	10/11/2007						38.78			< 22.93			817.06			48145.24			130.98			3533			< 7.04			1060.65
BREOT-S40-0 (0-6")	10/11/2007						169.82			< 30.96			563			89409.3			1377.1			8684.76			< 13.32			2125.03
BREOT-S40-14 (0-6")	10/11/2007						263.91			< 31.38			494.66			129872.28			1365.01			4276.43			< 12.41			1422.26
BREOT-S41+25 (0-6")	10/11/2007						64.92			< 21.08			316.05			35429.17			539.44			2255.26			< 7.26			784.54
BREOT-S41-0 (0-6")	10/11/2007						207.57			< 32.17			551.62			89447.77			1365.07			9280.42			< 13.44			2296.9
BREOT-S41-12.5 (0-6")	10/11/2007				389.00 JM74		330.71	9.99		< 33.82	683.00		451.4			182321.33	1,710.00 JM10		1686.75	5,350.00		4277.16	< 0.50		< 15.92	2,230.00		1302.05
BREOT-S42+25 (0-6")	10/11/2007						< 16.9			< 22.17			482.26			28696.16			121.33			1968.2			< 7.14			1138.94
BREOT-S42-0 (0-6")	10/11/2007						216.16			< 31.05			822.74			82466.02			2840.91			10554.89			< 11.86			4359.58
BREOT-S42-25 (0-6")	10/11/2007						198.28			< 23.75			268.63			53785.61			2287			1659.77			< 9.54			325.03
BREOT-S43+25 (0-6")	10/12/2007						14.25			< 20.33			196.91			19142.46			73.67			949.76			< 5.54			441.68
BREOT-S43-0 (0-6")	10/12/2007						20.06			< 19.75			130.35			16652.27			121.18			983.84			< 5.43			408.51
BREOT-S43-12.5 (0-6")	10/12/2007						162.43			< 26.94			244.68			79193.29			1284.48			2218.08			< 8.74			476.75
BREOT-S44+25 (0-6")	10/11/2007						22.15			< 18.89			37			12138.93			71.73			1258.55			< 5.64			327.27
BREOT-S44-0 (0-6")	10/12/2007						< 14.6			< 21.2			126.87			20772.21			88.93			1163.37			< 6.16			350.64
BREOT-S44-12.5 (0-6")	10/12/2007						139.83			< 25.89			428.06			80147.04			2715.97			7438.63			< 10.47			669.67
BREOT-S45+25 (0-6")	10/12/2007						< 11.83			< 20.45			45.78			15854.9			54.77			303.28			< 5.84			458.52
BREOT-S45-0 (0-6")	10/11/2007						24.1			< 21.36			106.17			18733.2			189.66			658.11			< 6.6			399.37
BREOT-S45-6 (0-6")	10/11/2007						131.54			< 25.6			304.59			67815.13			3020.51			1277.86			< 9.74			379.02
BREOT-S46+25 (0-6")	10/11/2007						< 10.9			< 20.44			153.24			8916.89			50.48			< 90.74			< 6.03			346
BREOT-S46-0 (0-6")	10/11/2007						45.54			< 18.29			98.56			21297.1			1081.13			803.11			< 5.13			168.75
BREOT-S46-12.5 (0-6")	10/12/2007						64.02			< 20.23			152.16			36768.56			1425.48			365.37			< 6.91			368.02
BREOT-S46-40 (0-6")	10/12/2007						93.82			< 23.46			296.99			61203.77			2997.69			559.43			< 9.47			551.67
BREOT-S47+25 (0-6")	10/11/2007						20.76			< 21.27			65.9			16412.08			36.7			261.53			< 6.23			105.83
BREOT-S47-0 (0-6")	10/11/2007						20.3			< 21.41			36.16			16753.8			37.56			241.35			< 6.12			114.45
BREOT-S47-999 (0-6")	10/11/2007						152.47			< 25.23			411.98			61126.34			4007.74			747.31			< 9.74			400.31
BREOT-S48+25 (0-6")	10/15/2007				105.00		41.54	0.17		< 24.99	184.00 JM73		87.68			29205.6	165.00		138.65	83.60 JM21		< 127.82	< 0.50		< 9.17	28.50 JM7		< 27.29
BREOT-S48-0 (0-6")	10/15/2007						64.12			< 24.96			90.06			32316.83			191.56			< 135.61			< 8.24			< 31.35
BREOT-S48-12.5 (0-6")	10/12/2007						46.54			< 23.57			98.87			29617.83			122.44			< 137.39			< 8.07			< 28.74
BREOT-S49+25 (0-6")	10/15/2007						< 18.8			< 23.19			71.3			19865.55			138.22			< 114.89			< 7.54			< 28.5
BREOT-S49-0 (0-6")	10/15/2007						< 16.97			< 22.01			41.26			16804.48			120			< 108.89			< 6.59			28.19
BREOT-S49-2.5 (0-6")	10/12/2007						55.27			< 24.46			129.89			29888.81			115.09			< 133.55			< 8.38			< 31.2
BREOT-S50+25 (0-6")	10/12/2007				33.10			0.16			85.40 JM73						51.00			82.30 JM21			< 0.50			27.80 JM7		

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		Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M
DEQ Action Level/RSLs/UBMC BTVs		77,000 [a]			40 [b]			70 [a]			3,100 [a]			58,270 [c]			1,109 [c]			4,893 [c]			23 [a]			23,000 [a]		
BREOT-S50-0 (0-6")	10/15/2007						25.18			< 24.65			105.6			24543.47			105.61			147.43			< 7.39			< 29.64
BREOT-S50-12.5 (0-6")	10/15/2007						< 34.57			< 20.86			231.47			20437.26			667.41			< 99.41			< 6.53			52.21
BREOT-S50-25 (0-6")	10/15/2007						26.05			< 21.95			50.18			16859.22			45.17			< 110.04			< 6.4			< 26.22
BREOT-S51+25 (0-6")	10/15/2007						29.97			< 21.05			31.18			14400.74			29.73			130.21			< 5.92			133.95
BREOT-S51-0 (0-6")	10/15/2007						24.6			< 16.19			770.96			8558.08			148.88			< 75.38			< 4.83			190.66
BREOT-S52+25 (0-6")	10/15/2007						26.17			< 23.35			78.5			23607.73			61.93			< 113.84			< 7.87			< 28.47
BREOT-S52-0 (0-6")	10/15/2007						< 14.12			< 22.55			92.86			17709.87			76.26			< 111.56			< 7.53			< 23.87
BREOT-S52-12.5 (0-6")	10/15/2007						96.65			< 27.68			1100.35			81026.39			61.47			< 196.48			< 12.08			59.9
BREOT-S53+25 (0-6")	10/15/2007						< 17.87			< 23.94			73.96			19913.61			113.09			< 115.11			< 7.58			< 28.78
BREOT-S53-0 (0-6")	10/15/2007						17.49			< 23.15			86.2			18701.46			79.05			< 105.12			< 7.83			< 26.9
BREOT-S53-12.5 (0-6")	10/15/2007						28.69			< 18.72			255.75			12249.98			185.4			< 83.71			< 6.57			94.89
BREOT-S54+25 (0-6")	10/15/2007						13.8			< 20.65			64.4			15038.88			64.42			< 97.87			< 6.66			39.77
BREOT-S54-0 (0-6")	10/15/2007				30.50		< 15.87	0.30		< 23.04	118.00 JM73		82.02			21616.49	80.40		96.56	86.10 JM21		< 127.99	< 0.50		< 7.35	29.20 JM7		< 28.81
BREOT-S54-12.5 (0-6")	10/15/2007						21.09			< 20.57			160.48			15508.6			88.08			< 111.71			< 6.59			105.75
BREOT-S55+25 (0-6")	10/15/2007						< 13.49			< 21.21			88.46			15563.15			69.48			< 98.06			< 6.77			34.66
BREOT-S55-0 (0-6")	10/15/2007						< 17.92			< 24.59			143.72			28264.25			108.12			220.71			< 8.61			67.73
BREOT-S55-12.5 (0-6")	10/15/2007				47.80		64.85	1.08		< 23.54	188.00 JM73		172.93			32609.67	498.00		638.13	842.00 JM21		1546.7	< 0.50		< 8.19	284.00 JM7		210.09
BREOT-S56+25 (0-6")	10/15/2007						22.72			< 23.79			201.37			36326.56			90.88			< 139.56			< 8.16			< 33.43
BREOT-S56-12.5 (0-6")	10/15/2007						27.44			< 20.54			149.27			21042.32			205.82			951.66			< 6.39			349.43
BREOT-S57+25 (0-6")	10/15/2007						34.53			< 25.57			140.78			47362.05			97.18			2445.48			< 9.46			203.95
BREOT-S57-0 (0-6")	10/15/2007						39.4			< 23.09			179.88			26871.76			183.29			936.08			< 6.48			369.05
BREOT-S57-12.5 (0-6")	10/15/2007						72.02			< 23.37			173.02			42644			621.75			1242.41			< 7.51			289.3
BREOT-S58+25 (0-6")	10/15/2007						< 18.48			< 24.16			155.7			31493.15			125.25			286.63			< 7.92			89.96
BREOT-S58-0 (0-6")	10/15/2007						24.05			< 23.5			162.15			28926.1			133.1			5159.58			< 7.06			346.46
BREOT-S58-12 (0-6")	10/15/2007						82.66			< 24.48			257.25			64314.1			522.97			1286.58			< 9.24			757.68
BREOT-S60+25 (0-6")	10/15/2007						26.68			< 28.09			200.87			99666.63			77			< 226.06			< 10.76			< 44.25
BREOT-S60-0 (0-6")	10/15/2007						81.3			< 28.35			225.98			77145.36			518.02			2662.86			< 9.7			612.29
BREOT-S60-12.5 (0-6")	10/15/2007						79.5			< 22.14			187.98			45381.7			1113.98			184.33			< 7.16			591.3
BREOT-S61+25 (0-6")	10/15/2007						< 15.75			< 25.72			162.11			60343.97			60.92			223.32			< 8.99			39.91
BREOT-S61-0 (0-6")	10/15/2007						< 18.04			< 26.25			159.29			70564.99			82.3			< 202.94			< 9.43			< 39.21
BREOT-S61-12.5 (0-6")	10/15/2007						44.74			< 22.28			258.12			27334.15			890.89			6387.23			< 8.02			2339.82
BREOT-S62+25 (0-6")	10/15/2007						< 10.14			< 22.49			77.29			22599.25			34.38			< 128.81			< 6.94			115.55
BREOT-S62-0 (0-6")	10/15/2007						< 18.7			< 26.41			156.06			54933.39			100.58			275.11			< 9.09			95.21
BREOT-S62-12.5 (0-6")	10/15/2007						102.1			< 28			349.33			61227.13			1549.38			7601.47			< 12.32			2259.2
BREOT-S63+25 (0-6")	10/15/2007						< 10.74			< 21.57			97.85			24818.13			35.19			243.81			< 6.53			193.9
BREOT-S63-0 (0-6")	10/15/2007						29.41			< 22.82			132.12			36235.25			214.14			1289.07			< 7.01			330.92
BREOT-S63-12.5 (0-6")	10/15/2007						62.85			< 26.55			141.21			63082.65			390.83			1089.45			< 9.07			294.21
BREOT-S64+25 (0-6")	10/16/2007						25.5			< 35.94			289.43			201202.58			87.66			< 379.16			< 14.36			< 50.83
BREOT-S64-0 (0-6")	10/16/2007						< 21.57			< 30.74			289.59			163908.13			97.19			< 305.55			< 11.12			< 47.68

Notes:

mg/kg - Milligrams per kilogram
Blank - No data
< - Parameter not detected at or above the laboratory practical quantitation limit
XRF Field - XRF measurements recorded from ground surface in field.
XRF 10 M - XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab - Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
B - Method blank shows evidence of contamination.
M% - Matrix spike recoveries exceed acceptable limits. Number represents percent recovery value.
J - The associated value is an estimated quantity.
- Value meets or exceeds one or more screening level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00)..

BR - Blackfoot River
EOT - Edge of tailings
N - North side of river
S - South side of river

Aluminum was not analyzed in 2007.

BREOT-S47-999 is located 65 feet south of river.

Table 29a

Blackfoot River - River Floodplain Sediment Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)			Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M
DEQ Action Level/RSLs/UBMC BTVs		77,000 [a]			40 [b]			70 [a]			3,100 [a]			58,270 [c]			1,109 [c]			4,893 [c]			23 [a]			23,000 [a]		
BREOT-S64-12.5 (0-6")	10/16/2007						62.53			< 24.55			167.69			41793.28			648.58			364.06			< 7.78			193.53
BREOT-S65+25 (0-6")	10/15/2007						< 19.41			< 28.58			268.75			119327.99			73.28			< 249.19			< 9.56			< 42.31
BREOT-S65-12.5 (0-6")	10/16/2007						121.13			< 24.25			181.44			49113.25			1764.44			171.9			< 8.73			228.17
BREOT-S66+25 (0-6")	10/15/2007						38.85			< 26.55			267.49			101300.84			66.29			< 239.23			< 9.48			74.23
BREOT-S66-0 (0-6")	10/15/2007						18.46			< 22.79			177.18			27306.43			92.65			1181.81			< 7.18			381.27
BREOT-S66-12.5 (0-6")	10/16/2007						69.46			< 25.64			147.83			44801.41			608.81			905.62			< 8.02			230.09
BREOT-S67+25 (0-6")	10/16/2007						26.15			< 28.58			305.18			117652.57			85.63			< 229.4			< 10.15			< 42.86
BREOT-S67-0 (0-6")	10/16/2007						< 15.8			< 24.18			99.42			28895.46			79.68			589.71			< 7.59			186.01
BREOT-S67-12.5 (0-6")	10/16/2007						< 25.34			< 25.56			66.6			35829.04			244.51			588.38			< 8.28			134.47

Notes:

mg/kg	- Milligrams per kilogram
Blank	- No data
<	- Parameter not detected at or above the laboratory practical quantitation limit
XRF Field	- XRF measurements recorded from ground surface in field.
XRF 10 M	- XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab	- Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
B	- Method blank shows evidence of contamination.
M%	- Matrix spike recoveries exceed acceptable limits. Number represents percent recovery value.
J	- The associated value is an estimated quantity.
	- Value meets or exceeds one or more screening level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).

[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).

[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00)..

BR	- Blackfoot River
EOT	- Edge of tailings
N	- North side of river
S	- South side of river

Aluminum was not analyzed in 2007.

BREOT-S47-999 is located 65 feet south of river.

Table 29b
Blackfoot River - River Floodplain Sediment ABA and SPLP Analytical Results

Sample ID	Date Collected	Specific Conductance (µmhos/cm)	pH (s.u.)	TOC (%)	Acid - Base Accounting								Synthetic Precipitation Leaching Procedure							
					Sulfur, Hot Water Extractable (%)	Total Sulfur (%)	Sulfur Sulfate (%)	Sulfur Pyritic (%)	Sulfur Organic (%)	Neutral Potential (t/kt)	Acid Potential (t/kt)	Acid/Base Potential (t/kt)	Arsenic (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Zinc (mg/L)
Floodplain SPLP		--	--	--	--	--	--	--	--	--	--	--	**0.08**	**0.04**	**10.4**	**88**	**0.12**	**2.56**	**0.016**	**16**
BREOT-N11+25 (0-6")	10/8/2007	0.14	5.2	1.15	0.01	0.02	< 0.01	0.01	< 0.01	6	0.32	6	< 0.1	< 0.01	0.5 JM1		0.3	2 JM141	< 0.0001	< 0.5
BREOT-N12-12.5 (0-6")	10/8/2007	2.53	2.7	0.15	0.88	1.08	0.23	0.79	0.07	0 BJ	25	-24	< 0.1	< 0.01	0.4 JM1		3.7	3 JM141	< 0.0001	1.1
BREOT-N21+25 (0-6")	10/9/2007	0.49	3.1	2.05																
BREOT-N23+115 (0-6")	7/8/2008																			
BREOT-N23-0 (0-6")	10/9/2007	10.40	4.2	0.50	10.4	10.5	0.1	9.9	0.5	-5	310	-310	< 0.1	0.11 JM13	< 0.1		< 0.1	35 JM141	0.0002 JM8	5.8
BREOT-N26-0 (0-6")	10/9/2007	4.39	3.0	1.80																
BREOT-N27-75 (0-6")	10/9/2007	0.52	6.2	3.02																
BREOT-N28+25 (0-6")	10/9/2007	0.48	5.7	1.95	0.04	0.07	< 0.01	0.06	0.01	8	1.7	6	< 0.1	< 0.01	< 0.1		< 0.1	0.4 JM141	< 0.0001	< 0.5
BREOT-N30-12.5 (0-6")	10/10/2007	1.47	3.3	3.12	0.77	0.82	0.4	0.39	0.04	1 BJ	12	-11	< 0.1	< 0.01	< 0.1		< 0.1	2.8 JM141	< 0.0001	0.6
BREOT-N31+75 (0-6")	7/8/2008																			
BREOT-N33-12.5 (0-6")	10/10/2007	4.54	2.1	2.88																
BREOT-N37+25 (0-6")	10/10/2007	0.39	4.6	1.38	0.04	0.05	0.02	0.03	< 0.01	7	0.78	6	< 0.1	< 0.01	0.1 JM1		< 0.1	0.2 JM141	< 0.0001	< 0.5
BREOT-N37-0 (0-6")	10/10/2007	3.77	3.3	2.41																
BREOT-N41-12.5 (0-6")	10/10/2007	2.77	3.5	0.28																
BREOT-N47-12.5 (0-6")	10/11/2007	1.37	2.9	3.44	0.28	0.37	0.25	0.1	0.02	-3	3.1	-6	< 0.1	< 0.01	0.3		0.2	2.4	< 0.0001	0.7 JM62
BREOT-N56-0 (0-6")	10/12/2007	2.85	3.3	5.36																
BREOT-N56-12.5 (0-6")	10/12/2007	4.32	2.7	3.20	1.99	2.61	0.55	1.98	0.08	-2	62	-63	< 0.1	0.03	0.8		3.4	13	< 0.0001	4.9 JM62
BREOT-N60+25 (0-6")	10/15/2007	0.32	5.0	5.82	0.06	0.07	0.02	0.04	0.01	7	1.3	6	< 0.1	< 0.01	< 0.1		< 0.1	0.2	< 0.0001	< 0.5
BREOT-N60-0 (0-6")	10/15/2007	0.19	5.6	4.76																
BREOT-N63-0 (0-6")	10/15/2007	0.35	5.1	4.52	0.07	0.07	0.01	0.05	< 0.01	7	1.6	5	< 0.1	< 0.01	< 0.1		0.2	0.4	< 0.0001	< 0.5
BREOT-N67+125 (0-6")	7/9/2008																			
BREOT-S1+25 (0-6")	10/8/2007	0.17	5.1	2.43	0.02	0.04	0.03	0.01	< 0.01	5	0.39	5	< 0.1	< 0.01	< 0.1		< 0.1	0.8 JM141	< 0.0001	< 0.5
BREOT-S11+63 (0-6")	10/8/2007	0.54	3.1	1.04																
BREOT-S15-12.5 (0-6")	10/8/2007	7.55	2.0	0.55																
BREOT-S16+75 (0-6")	7/8/2008																			
BREOT-S19+85 (0-6")	7/8/2008																			
BREOT-S20+75 (0-6")	7/8/2008	0.60	5.3	6.60	0.02	0.02	< 0.01	0.02	< 0.01	8	0.54	8	0.012	0.0002	0.024	5.7	0.032	0.15	< 0.0001	0.07
BREOT-S21+25 (0-6")	10/9/2007	0.44	3.3	0.86	0.51	0.57	0.23	0.33	0.01	-1	10	-11	< 0.1	< 0.01	< 0.1		< 0.1	0.1	< 0.0001	< 0.5
BREOT-S27-0 (0-6")	10/9/2007	1.61	2.6	5.59	0.67	0.89	0.51	0.36	0.02		11	-12	< 0.1	< 0.01	0.3 JM1		2.8	3.4 JM141	< 0.0001	< 0.5
BREOT-S29+25 (0-6")	10/10/2007	0.94	3.6	0.91	0.37	0.38	0.04	0.32	0.02	0 BJ	10	-9	< 0.1	< 0.01	< 0.1		< 0.1	0.4 JM141	0.00013 JM8	< 0.5
BREOT-S30-0 (0-6")	10/10/2007	0.21	5.3	0.72																
BREOT-S31-25 (0-6")	10/10/2007	1.77	3.1	0.23																
BREOT-S32+300 (0-6")	7/8/2008																			
BREOT-S37+25 (0-6")	10/10/2007	0.28	5.5	5.55	0.17	0.18	< 0.01	0.14	0.03	8	4.3	4	< 0.1	< 0.01	< 0.1		< 0.1	0.3 JM141	< 0.0001	< 0.5
BREOT-S38+25 (0-6")	10/10/2007	0.44	5.6	5.15																

Notes:

µmhos/cm - Micromhos per liter
s.u. - Standard units
% - Percent
t/kt - Tons per thousand tons
mg/L - Milligrams per liter
-- - No standard/screening level
Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
M% - Matrix spike recoveries exceed acceptable limits. Number represents recovery value.
J - The associated value is an estimated quantity.
TOC - Total organic carbon

BR - Blackfoot River
EOT - Edge of tailings
N - North side of river
S - South side of river

Classification	Criteria for Classification [b]
Potentially Acid Generating	NP:AP[a] < 1 and NNP < -20 tons/kton
Uncertain Acid Generation Potential	NP:AP between 1 and 3 and/or NNP between -20 and +20 tons/kton
Unlikely to Generate Acid	NP:AP > 3 and NNP < +20 tons/kton

AP - Acidification Potential
NP - Neutralization Potential
NNP - Net Neutralization Potential

: - ratio
< - less than
> - greater than

[a] NP = Neutralization Potenital, AP = Acidification Potential, NNP = Net Neutralization Potential.

[b] From BLM (1996) and EPA (1994).

BREOT-S47-999 is located 65 feet south of the river.

*Iron and manganese SPLP Leachate Criterion for soil were calculated based on a DAF 8 and their respective EPA Tap Water standards. The SPLP Leachate Criterion for Soil for the remaining metals were calculated based on a DAF 8 and their respective DEQ-7 water quality standards (see Section 4 of RI report).

Table 29b
Blackfoot River - River Floodplain Sediment ABA and SPLP Analytical Results

Sample ID	Date Collected	Specific Conductance (µmhos/cm)	pH (s.u.)	TOC (%)	Acid - Base Accounting								Synthetic Precipitation Leaching Procedure							
					Sulfur, Hot Water Extractable (%)	Total Sulfur (%)	Sulfur Sulfate (%)	Sulfur Pyritic (%)	Sulfur Organic (%)	Neutral Potential (t/kt)	Acid Potential (t/kt)	Acid/Base Potential (t/kt)	Arsenic (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Zinc (mg/L)
Floodplain SPLP		--	--	--	--	--	--	--	--	--	--	--	**0.08**	**0.04**	**10.4**	**88**	**0.12**	**2.56**	**0.016**	**16**
BREOT-S38-12.5 (0-6")	10/10/2007	8.34	5.0	1.14	9.34	9.34	< 0.01	8.88	0.46	59	280	-220	< 0.1	0.06 JM13	< 0.1		< 0.1	31 JM141	< 0.0001	1.8
BREOT-S41-12.5 (0-6")	10/10/2007	7.80	5.0	0.96	13.8	13.8	< 0.01	12.8	1.02	43	400	-360	< 0.1	0.03 JM13	< 0.1		< 0.1	39 JM141	0.0001	0.8
BREOT-S48+25 (0-6")	10/12/2007	0.11	5.1	0.38	0.14	0.14	< 0.01	0.11	0.02	3	3.5	0	< 0.1	< 0.01	< 0.1		< 0.1	0.1	< 0.0001	< 0.5
BREOT-S50+25 (0-6")	10/12/2007	0.17	4.8	1.33	0.13	0.15	0.01	0.12	0.02	1	3.6	-2	< 0.1	< 0.01	< 0.1		< 0.1	0.1	< 0.0001	< 0.5
BREOT-S54-0 (0-6")	10/15/2007	0.12	4.1	1.00	0.08	0.08	< 0.01	0.07	0.01	1	2.1	0	< 0.1	< 0.01	< 0.1		< 0.1	0.1	< 0.0001	< 0.5
BREOT-S55-12.5 (0-6")	10/15/2007	0.15	4.2	1.68	0.07	0.08	0.04	0.03	< 0.01	2	1	0	< 0.1	< 0.01	0.1		0.2	0.2	< 0.0001	< 0.5

Notes:

µmhos/cm	- Micromhos per liter
s.u.	- Standard units
%	- Percent
t/kt	- Tons per thousand tons
mg/L	- Milligrams per liter
--	- No standard/screening level
Blank	- No data/not analyzed
<	- Parameter not detected at or above the laboratory practical quantitation limit
M%	- Matrix spike recoveries exceed acceptable limits. Number represents recovery value.
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Classification	Criteria for Classification [b]
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Unlikely to Generate Acid	NP:AP > 3 and NNP < +20 tons/kton

AP	- Acidification Potential	:	- ratio
NP	- Neutralization Potential	<	- less than
NNP	- Net Neutralization Potential	>	- greater than

[a] NP = Neutralization Potenital, AP = Acidification Potential, NNP = Net Neutralization Potential.

[b] From BLM (1996) and EPA (1994).

BREOT-S47-999 is located 65 feet south of the river.

*Iron and manganese SPLP Leachate Criterion for soil were calculated based on a DAF 8 and their respective EPA Tap Water standards. The SPLP Leachate Criterion for Soil for the remaining metals were calculated based on a DAF 8 and their respective DEQ-7 water quality standards (see Section 4 of RI report).

TABLE 3
Summary of Regulated Facilities in the Site Vicinity

MSD (Radius)	Data Source	Databases Searched	# of Facilities Identified
	Federal Records		
1.0 mile	EPA National Priorities List (NPL) http://www.epa.gov/superfund/sites/cursites/	EPA Superfund Information System	1 – UBMC
0.5 mile	EPA De-Listed NPL facility list http://www.epa.gov/superfund/sites/cursites/	EPA Superfund Information System	1 - UBMC
0.5 mile	EPA Comprehensive Emergency Response and Cleanup Liability Information System (CERCLIS) and CERCLIS No Further Remedial Action Planned (NFRAP) http://www.epa.gov/enviro/	EPA's EnviroFacts (EnviroFacts)	1 - UBMC
1.0 mile	EPA Resource Conservation and Recovery Act (RCRA) facilities under Corrective Action (CORRACTS) http://www.epa.gov/enviro/	EnviroFacts	0
0.5 mile	EPA RCRA Non-CORRACTS for Treatment, Storage, and Disposal (TSD) facilities http://www.epa.gov/enviro/	EnviroFacts	0
0.25 mile	EPA RCRA database for Generator and Transporter Facilities http://www.epa.gov/enviro/	EnviroFacts	0
0.5	EPA Toxic Release	EnviroFacts	1
Property	Federal Institutional Control/Engineering Control Registry web sites http://www.epa.gov/swerffrr/documents/fi-icops_106.htm and http://www.epa.gov/superfund/action/ic/	EPA Institutional Controls and Federal Facilities Restoration and Reuse	0
Property	EPA Emergency Response Notification System (ERNS) http://www.nrc.uscg.mil/nrchp.html	National Response Center	0
	State Databases		
1.0 mile	State Equivalent NPL http://nris.state.mt.us/	NRIS Remediation Response Sites list, MDEQ CECRA, Response Action, & CALA lists	0
1.0 mile	State Equivalent CERCLIS [MDEQ Comprehensive Environmental Cleanup and Responsibility Act (CECRA)] http://nris.state.mt.us/	NRIS Remediation Response Sites list, MDEQ CECRA, Response Action, & CALA lists	2 - UBMC
0.5 mile	State Voluntary Cleanup Program Sites [MDEQ Voluntary Cleanup and Redevelopment Act (VCRA) and Controlled Allocation of Liability Act (CALA) lists] http://nris.state.mt.us/	NRIS Remediation Response Sites	2 - UBMC
0.5 mile	State MDEQ Brownfield Registry http://nris.state.mt.us/	NRIS Remediation Response Sites	0
0.5 mile	MDEQ Water Quality Act (WQA) database http://nris.state.mt.us/	NRIS Remediation Response Sites	0
0.5 mile	State Landfill and/or Solid Waste Disposal Facility List [MDEQ Solid Waste Registration (landfills)] http://nris.state.mt.us/	NRIS Remediation Response Sites	0
0.5 mile	State Leaking Underground Storage Tank (LUST) [MDEQ LUST List) http://nris.state.mt.us/	NRIS LUST list	0
Property & Adjoining	State Registered Storage Tank List [MDEQ Underground Storage Tank (UST) list] http://nris.state.mt.us/	NRIS UST list	0
Property	State Institutional Control/Engineering Control Registries http://www.deq.state.mt.us/StateSuperfund/vcra.asp	MDEQ CECRA, VCRA, Response Action Lists	0

Table 30a

Beartrap Creek - Floodplain Sediment Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)			Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M
DEQ Action Level/RSLs/UBMC BTVs		77,000[a]			40 [b]			70 [a]			3,100[a]			58,270[c]			1,109[c]			4,893[c]			23 [a]			23,000[a]		
BCEOT-E0+25 (0-6")	10/16/2007						91.31			< 24.39			87.14			51333.98			390.91			926.77			< 8.08			204.68
BCEOT-E0-0 (0-6")	10/16/2007						143.09			< 24.94			203.29			67570.32			738.2			3056.56			< 9.23			272.94
BCEOT-E0-12.5 (0-6")	10/16/2007						125.57			< 23.8			121.43			54864.84			572.41			1523.05			< 7.72			182.73
BCEOT-E1+25 (0-6")	10/16/2007						108.03			< 23.97			182.7			53125.52			558.21			4559.02			< 8.23			428.46
BCEOT-E1-0 (0-6")	10/16/2007						20.81			< 22.23			50.32			21380.38			83.77			2640.12			< 6.93			185.27
BCEOT-E1-12.5 (0-6")	10/16/2007						116.94			< 25.32			162.51			49231.89			467.5			3387.32			< 8.46			275.4
BCEOT-E2+25 (0-6")	10/16/2007						88.95			< 24.65			95.48			42639.45			349.09			556.43			< 7.66			174.98
BCEOT-E2-0 (0-6")	10/16/2007						156.81			< 25.46			271.86			72695.1			914.37			2245.72			< 9.47			509.31
BCEOT-E2-8 (0-6")	10/16/2007						129.22			< 23.79			102.88			57661.5			448.48			1750.41			< 8.34			136.3
BCEOT-E3+25 (0-6")	10/16/2007						27.47			< 23.15			53.06			24621.22			108.36			1047.23			< 8.2			110.34
BCEOT-E3-0 (0-6")	10/16/2007						49.1			< 23.74			61.49			31869.19			183.33			791.95			< 7.51			124.13
BCEOT-E3-8 (0-6")	10/16/2007						65.52			< 24.71			152.2			47012.07			376.17			1765.56			< 8.46			236.91
BCEOT-E4+25 (0-6")	10/16/2007						50.48			< 23.62			107.16			31312.04			156.44			2685.31			< 7.71			159.8
BCEOT-E4-0 (0-6")	10/17/2007						< 18			< 22.59			60.14			22847.17			136.07			1444.2			< 7.17			176.15
BCEOT-E4-12.5 (0-6")	10/16/2007						105.56			< 25.58			100.01			45950.93			404.78			1052.99			< 8.44			162.11
BCEOT-E5+25 (0-6")	10/17/2007						94.09			< 23.39			126.81			43375.42			388.55			2321.07			< 8.03			421.24
BCEOT-E5-0 (0-6")	10/16/2007						99.59			< 25.23			184.01			59132.21			546.65			1187.2			< 9.2			237.08
BCEOT-E5-25 (0-6")	10/17/2007						25.92			< 22.73			76.43			26905.13			131.57			582.51			< 7.31			95.61
BCEOT-E6+25 (0-6")	10/16/2007						66.67			< 24.49			79.19			41439.54			370.19			574.12			< 8.1			152.49
BCEOT-E6-0 (0-6")	10/16/2007						59.55			< 25.82			71.83			37562.78			294.85			846.08			< 8.28			169.47
BCEOT-E6-12.5 (0-6")	10/16/2007						72.75			< 24.73			126.39			37434.11			350.82			1224.39			< 8.25			192.82
BCEOT-E7+25 (0-6")	10/16/2007						28.94			< 24.44			107.57			29951.51			124.64			2436			< 7.72			145.7
BCEOT-E7-0 (0-6")	10/17/2007						83.49			< 25.73			141.84			52812.38			428.74			1215.76			< 7.5			169.39
BCEOT-E7-12.5 (0-6")	10/17/2007						45.77			< 23.06			42.9			29726.96			120.56			1260.65			< 7.12			111.46
BCEOT-E9+25 (0-6")	10/17/2007						102.42			< 25.37			148.7			47514.91			517.71			1967.01			< 8.66			255.9
BCEOT-E9-0 (0-6")	10/16/2007						49.5			< 24.17			74.43			31409.43			279.75			3156.97			< 7.07			226.64
BCEOT-E9-12.5 (0-6")	10/17/2007						161.92			< 24.07			160.23			57759.93			715.5			582.99			< 7.45			260.64
BCEOT-E10+25 (0-6")	10/16/2007						24.35			< 26.63			386.59			62569.89			41.08			2285.62			< 8.41			158.18
BCEOT-E10-0 (0-6")	10/16/2007						48.87			< 28.99			440.34			84571.55			105.29			5843.56			< 10.27			322.14
BCEOT-E10-12.5 (0-6")	10/18/2007						40.85			< 27.41			418.05			73687.42			92.01			3723.44			< 7.87			253.9
BCEOT-E11+25 (0-6")	10/17/2007						94.44			< 23.73			104.29			40810.6			366.65			947.43			< 7.61			205.29
BCEOT-E11-0 (0-6")	10/16/2007						24.33			< 25.51			100.27			25104.77			53.68			2860.96			< 7.78			144.15
BCEOT-E11-12.5 (0-6")	10/17/2007						98.54			< 22.9			103.21			43360.46			349.39			426.3			< 7.72			165.36
BCEOT-E12+25 (0-6")	10/17/2007						54.88			< 25.18			235.41			52902.05			241.86			986.15			< 7.39			147.55
BCEOT-E12-0 (0-6")	10/17/2007						46.13			< 23.28			202.39			47455.69			191.56			1472.17			< 7.48			161.4
BCEOT-E12-12.5 (0-6")	10/17/2007						61.31			< 24.86			201.9			52710.64			237.81			1205.75			< 7.58			125.89
BCEOT-E13+25 (0-6")	10/17/2007						91.72			< 25.55			233.65			58631.36			369.12			877.13			< 8.4			155.88
BCEOT-E13-0 (0-6")	10/17/2007						24.51			< 23.27			105.41			30836.86			49.1			1130.53			< 7.22			134.9
BCEOT-E13-12.5 (0-6")	10/17/2007						113.49			< 22.58			154.61			57267.21			619.34			610.4			< 6.69			220.05
BCEOT-E14+25 (0-6")	10/17/2007						19.06			< 23.82			124.73			31829.09			100.58			1235.68			< 8.01			94.45

Notes:

mg/kg - Milligrams per kilogram
Blank - No data
< - Parameter not detected at or above the laboratory practical quantitation limit
XRF Field - XRF measurements recorded from ground surface in field.
XRF 10 M - XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab - Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
B - Method blank shows evidence of contamination.
M% - Matrix spike recoveries exceed acceptable limits. Number represents percent recovery value.
J - The associated value is an estimated quantity.
- Value meets or exceeds one or more screening level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

BC - Beartrap Creek
EOT - Edge of river floodplain sediments
E - East side of creek
W - West side of creek
SD - Sediment

Aluminum was not analyzed in 2007 or 2008. The XRF was not set up to run cadmium in 2008. The two 2008 samples do not have cadmium results.

2011 Samples collected by Pioneer Technical Services, Inc.

Table 30a

Beartrap Creek - Floodplain Sediment Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)			Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M
DEQ Action Level/RSLs/UBMC BTVs		77,000[a]			40 [b]			70 [a]			3,100[a]			58,270[c]			1,109[c]			4,893[c]			23 [a]			23,000[a]		
BCEOT-E14-0 (0-6")	10/17/2007						32.36			< 25			108.12			38070.58			142.6			1120.3			< 7.87			123.38
BCEOT-E15+25 (0-6")	10/17/2007						38.03			< 23.3			198.11			35962.86			220.29			1545.64			< 8.18			258.99
BCEOT-E15-0 (0-6")	10/17/2007						< 22.23			< 22.82			158			31651.29			221.13			1265.96			< 6.77			262.78
BCEOT-E15-8 (0-6")	10/17/2007						76.38			< 25.54			199.51			58400.83			554.77			889.72			< 8.96			227.59
BCEOT-E16+25 (0-6")	10/17/2007						19.24			< 23.43			82.76			24942.28			75.53			964.23			< 6.37			198.52
BCEOT-E16-0 (0-6")	10/18/2007						20.98			< 22.88			107.55			27579.9			132.38			1416.96			< 7.65			182.62
BCEOT-E16-12.5 (0-6")	10/17/2007						274.12			< 32.61			484.55			133862.8			3352.9			716.34			< 13.03			3861.7
BCEOT-E17+25 (0-6")	10/17/2007						28.14			< 23.28			123.76			30421.48			178.04			1219.22			< 8.05			377.79
BCEOT-E17-0 (0-6")	10/17/2007						98.37			< 24.31			190.58			42790.96			550.68			1931.81			< 9.09			644.42
BCEOT-E17-12.5 (0-6")	10/17/2007						732.62			74.97			2694.94			72545.72			17431.72			8381.56			< 23.23			16182.16
BCEOT-E18+12.5 (0-6")	10/18/2007						683.17			65.35			2180.04			86709.16			15717.3			7882.2			< 20.77			13646.53
BCEOT-E18+25 (0-6")	10/17/2007				31.20		33.5	1.91		< 23.57	134.00		111.63			30774.54	84.40		103.11	1,180.00 JM21		1276.15	< 0.50		< 7.61	281.00		287.34
BCEOT-E18-0 (0-6")	10/17/2007						41.92			< 22.11			115.59			28889.3			231.15			1717.24			< 6.23			379.82
BCEOT-E19+25 (0-6")	10/17/2007						30.43			< 23.16			97.46			27137.82			76.01			1245.4			< 6.86			250.49
BCEOT-E19-0 (0-6")	10/17/2007						24.31			< 19.23			65.22			13689.03			96.37			1037.84			< 5.79			265.16
BCEOT-E19-12.5 (0-6")	10/18/2007				161.00		107.98	6.36		< 24.95	348.00 J		218.19			49771.83	1,730.00 J		1175.78	2,260.00		1794.27	< 0.50		< 8.98	1,270.00		934.08
BCEOT-E20+25 (0-6")	10/17/2007				22.90		22.15	1.04		< 21.22	67.80		44.12			19334.04	47.50		33.66	1,340.00 JM21		1058.27	< 0.50		< 6.1	175.00		163.93
BCEOT-E20-0 (0-6")	10/18/2007						22.7			< 22.12			45.42			21333.01			29.24			363.37			< 7			132.38
BCEOT-E20-12.5 (0-6")	10/17/2007						163.28			< 28.11			236.55			92746.97			1719.88			2274.27			< 10.47			571.98
BCEOT-E21+25 (0-6")	10/17/2007						24.55			< 18.28			40.15			10216.34			129.7			517.56			< 4.81			188.45
BCEOT-E21-0 (0-6")	10/17/2007						76.13			< 19.57			169.34			26529.48			705.03			1420.23			< 5.82			267.27
BCEOT-E21-12.5 (0-6")	10/17/2007				169.00		178.7	1.19		< 23.17	214.00 J		200.23			65768.58	2,160.00 J		1595.97	2,000.00		2288.87	< 0.50		< 8.33	383.00		248.93
BCEOT-E22+25 (0-6")	10/17/2007						148.3			< 23.03			128			56862.43			1354.53			2456.98			< 7.96			201.37
BCEOT-E22+37.5 (0-6")	7/8/2008					52.14						112.13			12,824.52			610.55			1,680.52			< 6.44			837.51	
BCEOT-E22+70 (0-6")	7/8/2008	11500				19.42	32.63	1.60				69.56	46.98		22,103.34	15544.6		94.31	249.95		651.83	698.25		8.18	< 5.74		158.96	307.45
BCEOT-E22-0 (0-6")	10/17/2007						47.9			< 21.62			73.01			27289.46			300.11			852.89			< 6.68			124.65
BCEOT-E22-12.5 (0-6")	10/17/2007						265.08			< 30.76			355.77			99276.98			2044.37			7488.88			< 11.56			1238.19
BCEOT-E23+25 (0-6")	10/17/2007						20.62			< 20.88			43.41			16411.5			49.41			423.25			< 5.5			102.17
BCEOT-E23-0 (0-6")	10/17/2007						< 13.07			< 24.02			46.33			25656.97			45.42			470.07			< 7.32			90.17
BCEOT-E23-15 (0-6")	10/17/2007						45.16			< 21.31			93.92			23203.53			287.47			1375.86			< 6.28			272.74
BCEOT-E24+25 (0-6")	10/17/2007						14.85			< 20.56			62.36			16952.04			21.18			346.78			< 5.86			58.77
BCEOT-E24-0 (0-6")	10/18/2007						33.28			< 24.75			56.3			25134.29			112.09			537.89			< 8.06			146.3
BCEOT-E24-12.5 (0-6")	10/17/2007						25.24			< 22.33			57.97			26349.43			125.41			364.76			< 7.03			106.86
BCEOT-E25+20 (0-6")	10/17/2007						18.02			< 24.01			81.53			23765.67			38.97			434.46			< 7.27			108.57
BCEOT-E25-0 (0-6")	10/17/2007						42.05			< 22.67			55.1			26492.17			170.32			711.29			< 6.91			171.8
BCEOT-E25-12.5 (0-6")	10/17/2007						192.09			< 27.39			301.66			80668.34			1442.36			1108.58			< 9.9			567.2
BCEOT-E26+25 (0-6")	10/17/2007						88.51			< 23.4			126.08			42132.7			524.5			241.18			< 8.09			124.29
BCEOT-E26-0 (0-6")	10/18/2007						27.15			< 23.86			75.2			24485.89			253.65			1283.02			< 7.14			329.61
BCEOT-E26-12.5 (0-6")	10/18/2007						104.26			< 24.16			71.8			48905.18			657.8			600.57			< 7.57			198.62
BCEOT-W4+25 (0-6")	10/17/2007						53.81			< 23.76			104.87			30320.33			186.09			672.51			< 8.4			145.73

Notes:

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XRF Field	- XRF measurements recorded from ground surface in field.
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[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

BC	- Beartrap Creek
EOT	- Edge of river floodplain sediments
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Aluminum was not analyzed in 2007 or 2008. The XRF was not set up to run cadmium in 2008. The two 2008 samples do not have cadmium results.

2011 Samples collected by Pioneer Technical Services, Inc.

Table 30a

Beartrap Creek - Floodplain Sediment Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)			Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M
DEQ Action Level/RSLs/UBMC BTVs		77,000[a]			40 [b]			70 [a]			3,100[a]			58,270[c]			1,109[c]			4,893[c]			23 [a]			23,000[a]		
BCEOT-W4-0 (0-6")	10/17/2007						37.39			< 23.52			62.37			26094.18			96.38			761.24			< 7.69			88.45
BCEOT-W4-12.5 (0-6")	10/17/2007						89.56			< 26.37			139.43			45642.52			423.63			1164.97			< 8.19			236.16
BCEOT-W5+25 (0-6")	10/17/2007						123.16			< 24.78			82.31			51837.71			487.49			714.13			< 8.27			171.18
BCEOT-W5-00 (0-6")	10/18/2007						125.19			< 24.54			89.51			47735.83			615.22			526.09			< 8.68			192.81
BCEOT-W5-12.5 (0-6")	10/18/2007						301.99			< 30.48			402.98			118436.83			1644.8			2825.82			< 12.18			1160.83
BCEOT-W6+25 (0-6")	10/17/2007						18.68			< 22.82			66.1			21929.84			78.68			297.22			< 6.33			85.46
BCEOT-W6-00 (0-6")	10/17/2007						29.97			< 23.65			93.69			26069.71			109.84			1108.51			< 6.73			108.82
BCEOT-W6-12.5 (0-6")	10/17/2007						38.04			< 23.71			44.21			27379.43			113.16			1046.31			< 7.57			81.91
BCEOT-W7+25 (0-6")	10/17/2007						< 11.5			< 23.75			< 30.5			19428.75			40.68			832.67			< 7.47			123.05
BCEOT-W7-00 (0-6")	10/18/2007						54.2			< 19.22			72.75			37678.27			230.79			423.17			< 5.9			< 24.67
BCEOT-W7-12.5 (0-6")	10/18/2007						120.08			< 20.69			174.61			42394.62			619.63			608.51			< 6.04			142.6
BCEOT-W8+25 (0-6")	10/17/2007						37.89			< 24.73			75.35			30678.96			158.01			505.85			< 8.38			160.57
BCEOT-W8-00 (0-6")	10/17/2007						< 12.61			< 24.54			< 30.62			20831.33			45.97			413.71			< 7.36			65.93
BCEOT-W8-12.5 (0-6")	10/17/2007						202.38			< 29.52			225.45			81865.24			2308.39			< 230.16			< 11.92			379.64
BCEOT-W9+25 (0-6")	10/17/2007						20.89			< 22.53			42.75			20761.57			101.18			2122.58			< 7.49			234.88
BCEOT-W9-0 (0-6")	10/17/2007						< 11.77			< 24.04			36.77			18341.62			34.78			467.13			< 7.13			68.12
BCEOT-W9-12.5 (0-6")	10/17/2007						300.35			< 28.28			386.31			120304.84			842.65			< 247.79			< 11.44			2800.76
BCEOT-W10+25 (0-6")	10/17/2007				11.10		16.44	0.28		< 24.48	16.60		< 33.18			20749.73	31.50		32.09	392.00 JM21		380.04	< 0.50		< 7.19	91.60		81.03
BCEOT-W10-0 (0-6")	10/17/2007						< 13.38			< 23.38			46.01			22288.56			55.59			440.87			< 7.34			71.02
BCEOT-W10-12.5 (0-6")	10/17/2007						169.72			< 31.08			136.1			74934.24			1010.95			712.48			< 10.16			240.7
BCEOT-W11+25 (0-6")	10/17/2007						45.38			< 22.95			69.15			27638.09			177.18			633.61			< 7.38			86.4
BCEOT-W11-0 (0-6")	10/17/2007						110.62			< 23.53			161.21			47984.83			630.75			1395.96			< 7.82			322.53
BCEOT-W11-12.5 (0-6")	10/17/2007						198.93			< 29.45			425.87			114786			713.77			600.09			< 9.53			1811.31
BCEOT-W12+25 (0-6")	10/17/2007						< 10.08			< 23.1			< 28			17163.22			23.8			1108.69			< 7.79			170.69
BCEOT-W12-0 (0-6")	10/17/2007						23.01			< 22.99			54.85			22883.27			76			814.76			< 6.63			76.66
BCEOT-W12-12.5 (0-6")	10/17/2007						242.83			< 26.83			288.51			79983.55			2067.82			2650.92			< 10.21			1080.42
BCEOT-W13-0 (0-6")	10/17/2007				17.80		16.51	0.41		< 23.99	26.90		< 32.34			21473.86	62.20		83.45	832.00 JM21		958.52	< 0.50		< 7.42	134.00		153.77
BCEOT-W13-12.5 (0-6")	10/17/2007						251.5			< 28.82			172.62			95024.49			2111.73			323.42			< 10.58			576.55
BCEOT-W13-25 (0-6")	10/17/2007						14.87			< 22.34			34.39			20377			54.35			572.07			< 6.73			82
BCEOT-W14+25 (0-6")	10/17/2007						14.23			< 22.5			35.95			21507.43			40.21			1754.65			< 6.91			171.91
BCEOT-W14-0 (0-6")	10/17/2007						52.17			< 22.63			102.66			24136.99			395.72			3746.14			< 7.44			735.46
BCEOT-W14-12.5 (0-6")	10/17/2007						64.22			< 23.06			84			39316.82			286.92			2737.45			< 7			387.97
BCEOT-W15+25 (0-6")	10/17/2007						55.47			< 22.64			137.4			30944.81			188.5			2742.72			< 6.69			266.1
BCEOT-W15-0 (0-6")	10/17/2007						76.1			< 18.52			159.58			27817.7			525.76			3541.57			< 5.48			771.56
BCEOT-W15-12.5 (0-6")	10/17/2007						192.7			< 28.25			208.02			101373.51			1261.63			< 244.09			< 9.21			391.75
BCEOT-W16+25 (0-6")	10/17/2007						11.42			< 22.54			< 27.76			15852.35			28.35			610.89			< 7.24			152.05
BCEOT-W16-0 (0-6")	10/17/2007						< 15.82			< 22.58			< 29.6			19159.74			102.34			825.62			< 6.75			219.51
BCEOT-W16-12.5 (0-6")	10/17/2007						239.15			< 32.74			556.93			137186.19			1260.14			2318.06			< 11.71			1067.98
BCEOT-W17+25 (0-6")	10/17/2007				39.90		18.68	0.71		< 22.28	103.00		74.85			20915.66	126.00		99.92	722.00 JM21		597.4	< 0.50		< 6.21	164.00		124.11
BCEOT-W17-0 (0-6")	10/17/2007						49.31			< 24.22			112.92			32973.79			278.16			1236.93			< 7.48			230.91

Notes:

mg/kg - Milligrams per kilogram
Blank - No data
< - Parameter not detected at or above the laboratory practical quantitation limit
XRF Field - XRF measurements recorded from ground surface in field.
XRF 10 M - XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab - Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
B - Method blank shows evidence of contamination.
M% - Matrix spike recoveries exceed acceptable limits. Number represents percent recovery value.
J - The associated value is an estimated quantity.
- Value meets or exceeds one or more screening level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

BC - Beartrap Creek
EOT - Edge of river floodplain sediments
E - East side of creek
W - West side of creek
SD - Sediment

Aluminum was not analyzed in 2007 or 2008. The XRF was not set up to run cadmium in 2008. The two 2008 samples do not have cadmium results.

2011 Samples collected by Pioneer Technical Services, Inc.

Table 30a

Beartrap Creek - Floodplain Sediment Metals Analytical Results

Sample ID	Sample Date	Total Aluminum (mg/kg)			Total Arsenic (mg/kg)			Total Cadmium (mg/kg)			Total Copper (mg/kg)			Total Iron (mg/kg)			Total Lead (mg/kg)			Total Manganese (mg/kg)			Total Mercury (mg/kg)			Total Zinc (mg/kg)		
		Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M	Lab	XRF Field	XRF 10M
DEQ Action Level/RSLs/UBMC BTVs		77,000[a]			40 [b]			70 [a]			3,100[a]			58,270[c]			1,109[c]			4,893[c]			23 [a]			23,000[a]		
BCEOT-W17-12.5 (0-6")	10/17/2007						99.53			< 25.1			117.32			47338.83			660.73			1149.22			< 8.36			504.59
BCEOT-W18+25 (0-6")	10/17/2007						26.25			< 21.01			70.91			20325.29			87.65			1310.76			< 6.17			205.98
BCEOT-W18-0 (0-6")	10/17/2007						32.07			< 24.15			82.85			25955.24			70.55			1245.11			< 7.36			273.22
BCEOT-W18-12.5 (0-6")	10/17/2007						220.88			< 26.13			296.71			54152.09			2309.56			< 167.2			< 10.41			387.94
BCEOT-W19+25 (0-6")	10/17/2007						< 14.6			< 23.47			54.82			19412.76			73.53			279.86			< 6.45			124.35
BCEOT-W19-0 (0-6")	10/18/2007						38.18			< 20.33			65.06			18006.07			157.33			2636.95			< 5.81			298.3
BCEOT-W19-12.5 (0-6")	10/17/2007						69.33			< 23.05			82.19			34847.13			339.83			1122.67			< 7.47			339.96
BCEOT-W20+25 (0-6")	10/17/2007						< 14.45			< 23.05			105.11			24709.39			77.15			795.99			< 6.42			197.69
BCEOT-W20-0 (0-6")	10/17/2007						< 14.81			< 21.6			65.55			24215.44			82.57			1032.89			< 6.44			271.21
BCEOT-W20-12.5 (0-6")	10/17/2007						295.86			< 36.5			708.82			119489.67			1576.27			10365.25			< 14.78			3627.62
BCEOT-W21+25 (0-6")	10/17/2007						< 16.08			< 22.93			155.62			27582.33			91.16			713.99			< 7.55			174.68
BCEOT-W21-0 (0-6")	10/18/2007						26.27			< 20.52			129.42			20492.28			134.14			1172.24			< 6.35			308.57
BCEOT-W21-12.5 (0-6")	10/17/2007						150.65			< 26.9			186.9			94568.86			1111			352.72			< 9.93			345.9
BCEOT-W22+25 (0-6")	10/17/2007						20.77			< 24.24			132.78			34364.66			71.29			312.99			< 7.58			160.14
BCEOT-W22-0 (0-6")	10/17/2007						33.19			< 25.37			172.47			48751.21			127.24			636.87			< 8.27			240.94
BCEOT-W22-12.5 (0-6")	10/17/2007				199.00		165.57	72.20		62.5	2,000.00		1958.04			89161.79	5,560.00		3486.92	23,700.00 JM21		41403.96	< 0.50		< 14.79	13,700.00		14604.84
BCEOT-W23+25 (0-6")	10/17/2007				31.60		19.16	0.55		< 24.38	134.00		134.42			30831.41	153.00		106.83	634.00 JM21		592.16	< 0.50		< 7.66	223.00		192.38
BCEOT-W23-0 (0-6")	10/17/2007						< 17.83			< 22.57			107.05			27021.65			119.46			553.77			< 7			404.11
BCEOT-W23-12.5 (0-6")	10/17/2007						281.19			< 38.09			954.34			152093.95			2363.8			10297.96			< 14.32			3665.7
BCEOT-W24+25 (0-6")	10/17/2007						< 22.03			< 24.09			117.61			23333.28			200.06			550.48			< 8.16			309.9
BCEOT-W24-0 (0-6")	10/17/2007						< 23.09			< 22.9			144.79			25110.83			221.06			1173.13			< 6.8			247.41
BCEOT-W24-12.5 (0-6")	10/17/2007						205.16			< 34.22			593.23			112047.25			1615.5			9137.23			< 14.07			2809.17
BCEOT-W25+25 (0-6")	10/17/2007						< 20.81			< 24.81			66.45			20220.56			164.16			302.6			< 8.76			269.71
BCEOT-W25-0 (0-6")	10/17/2007						< 28.79			< 26.28			150.5			36792.84			297.22			1691.84			< 8.11			283.58
BCEOT-W25-12.5 (0-6")	10/17/2007				308.00		176.9	18.10		< 33.64	903.00 J		607.17			105175.15	1,620.00 J		1276.87	9,080.00		10653.23	< 0.50		< 12.96	3,040.00		1923.13
BCEOT-W26+25 (0-6")	10/17/2007						82.51			< 25.41			295.03			92029.69			135.2			5038.19			< 7.09			281.45
BCEOT-W26-0 (0-6")	10/17/2007				18.20		< 22.15	1.62		< 23.89	103.00 J		70.96			25247.27	380.00 J		187.5	2,820.00		1253.9	< 0.50		< 7.72	340.00		233.62
BCEOT-W26-12.5 (0-6")	10/17/2007						108.69			< 23.2			226			61153.48			1033.36			< 167.06			< 7.8			309.06
BCEOT-W27+25 (0-6")	10/17/2007						27.71			< 22.81			91.9			21149.1			144.43			1140.68			< 6.84			262.77
BCEOT-W27-0 (0-6")	10/17/2007						< 23.35			< 23.11			98.01			22877.41			232.82			1004.09			< 7.54			269.48
BCEOT-W27-12.5 (0-6")	10/17/2007						152.02			< 28.74			389.55			69411.09			1222.4			7999.06			< 10.92			1735.69
BCSD-201	11/1/2011	2480			307.00			3.40			631.00			75400			2,060.00			509.00			< 0.50			822.00		
BCSD-202	11/1/2011	2740			491.00			33.80			1,280.00			199000			2,400.00			6,730.00			< 0.50			5,170.00		
BCSD-203	11/1/2011	5580			253.00			1.20			149.00			44500			1,600.00			397.00			< 0.50			339.00		
BCSD-204	11/1/2011	3450			277.00			6.10			375.00			64300			2,510.00			298.00			< 0.50			1,230.00		

Notes:

mg/kg	- Milligrams per kilogram
Blank	- No data
<	- Parameter not detected at or above the laboratory practical quantitation limit
XRF Field	- XRF measurements recorded from ground surface in field.
XRF 10 M	- XRF measurements recorded following drying and screening soil using 10-mesh screen.
Lab	- Laboratory analysis of soil after drying and 10-mesh screening by Tetra Tach.
B	- Method blank shows evidence of contamination.
M%	- Matrix spike recoveries exceed acceptable limits. Number represents percent recovery value.
J	- The associated value is an estimated quantity.
	- Value meets or exceeds one or more screening level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).

[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).

[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

BC	- Beartrap Creek
EOT	- Edge of river floodplain sediments
E	- East side of creek
W	- West side of creek
SD	- Sediment

Aluminum was not analyzed in 2007 or 2008. The XRF was not set up to run cadmium in 2008. The two 2008 samples do not have cadmium results.

2011 Samples collected by Pioneer Technical Services, Inc.

Table 30b
Beartrap Creek - Floodplain Sediment ABA and SPLP Analytical Results

Sample ID	Date Collected	Specific Conductance (µmhos/cm)	pH (s.u.)	TOC (%)	Acid - Base Accounting								Synthetic Precipitation Leaching Procedure								
					Sulfur, Hot Water Extractable (%)	Total Sulfur (%)	Sulfur Sulfate (%)	Sulfur Pyritic (%)	Sulfur Organic (%)	Neutral Potential (t/kt)	Acid Potential (t/kt)	Acid/Base Potential (t/kt)	Aluminum (mg/L)	Arsenic (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Zinc (mg/L)
Floodplain SPLP		--	--	--	--	--	--	--	--	--	--	--	--	**0.08**	**0.04**	**10.4**	**88**	**0.12**	**2.56**	**0.016**	**16**
BCEOT-E3-8 (0-6")	10/16/2007	420	5.9	2.28																	
BCEOT-E4-12.5 (0-6")	10/16/2007	480	3.6	3.94																	
BCEOT-E5+25 (0-6")	10/16/2007	3010	3.7	9.48	0.66	0.95	0.46	0.46	0.03	2 J	14	-12		< 0.1	< 0.01	< 0.1		< 0.1	13	< 0.0001	1.1 JM328,30
BCEOT-E18+25 (0-6")	10/16/2007	210	5.3	4.13																	
BCEOT-E19-12.5 (0-6")	10/16/2007	3360	3.6	4.7	5.28	5.8	0.52	4.92	0.36	12	150	-140		< 0.1	< 0.01	< 0.1		< 0.1	7.2 JM10	< 0.0001	1 JM492
BCEOT-E20+25 (0-6")	10/16/2007	150	5	6.85																	
BCEOT-E21-12.5 (0-6")	10/17/2007	480	3.6	12.7																	
BCEOT-W8-0 (0-6")	10/17/2007	220	5	0.29																	
BCEOT-W10+25 (0-6")	10/17/2007	2090	4	1.29																	
BCEOT-W13-0 (0-6")	10/16/2007	800	5.8	1.82	0.16	0.28	0.18	0.1	< 0.01	9	3.1	6		< 0.1	< 0.01	< 0.1		< 0.1	0.3	< 0.0001	< 0.5
BCEOT-W17+25 (0-6")	10/16/2007	210	4.4	3.04	0.17	0.17	0.01	0.15	< 0.01	3	4.7	-1		< 0.1	< 0.01	< 0.1		< 0.1	0.3	< 0.0001	< 0.5
BCEOT-W22-12.5 (0-6"	10/17/2007	2320	6.2	1.76	5.79	5.79	0.17	5	0.62	39	160	-120		< 0.1	< 0.01	< 0.1		< 0.1	0.1	< 0.0001	1.5 JM328,30
BCEOT-W23+25 (0-6")	10/17/2007	140	5.4	1.54	0.02	0.02	< 0.01	0.01	< 0.01	5	0.45	5		< 0.1	< 0.01	< 0.1		< 0.1	0.2	< 0.0001	< 0.5
BCEOT-W25-12.5 (0-6"	10/17/2007	6060	5.7	2.49	14	14	0.6	11.8	1.65	14	370	-350		< 0.1	< 0.01	< 0.1		< 0.1	4.3 JM10	< 0.0001	< 0.5
BCEOT-W26-0 (0-6")	10/17/2007	260	4.7	1																	
BCSD-201	11/1/2011	13900	2.1	0.33	0.5	7.8		5		-7	240	-250	3.8	0.004	0.028	1.7	10	0.029	13	< 0.00001	5.5
BCSD-202	11/1/2011	7290	5.3	0.28	< 0.01	23		8.8		78	730	-660	< 0.03	< 0.003	0.02	0.013	< 0.05	< 0.001	3.7	< 0.00001	2.1
BCSD-203	11/1/2011	750	2.8	5.58	0.06	1.2		0.73		-2	38	-40	< 0.03	< 0.003	0.0009	0.062	< 0.05	0.0055	0.1	< 0.00001	0.1
BCSD-204	11/1/2011	3500	2.7	0.52	< 0.01	2.1		1.3		0	67	-68	< 0.03	< 0.003	0.0034	0.096	< 0.05	0.007	0.48	< 0.00001	0.38
BCEOT-E22+70 (0-6")	7/18/2008																				

Notes:

µmhos/cm	- Micromhos per liter
s.u.	- Standard units
%	- Percent
t/kt	- Tons per thousand tons
mg/L	- Milligrams per liter
--	- No standard/screening level
Blank	- No data/not analyzed
<	- Parameter not detected at or above the laboratory practical quantitation limit
M%	- Matrix spike recoveries exceed acceptable limits.
J	- The associated value is an estimated quantity.
TOC	- Total organic carbon

Classification	Criteria for Classification [a]
Potentially Acid Generating	NP:AP[a] < 1 and NNP < -20 tons/kton
Uncertain Acid Generation Potential	NP:AP between 1 and 3 and/or NNP between -20 and +20 tons/kton
Unlikely to Generate Acid	NP:AP > 3 and NNP < +20 tons/kton

AP	- Acidification Potential	:	- ratio
NP	- Neutralization Potential	<	- less than
NNP	- Net Neutralization Potential	>	- greater than

BC	- Beartrap Creek
EOT	- Edge of tailings
E	- East side of creek
W	- West side of creek
SD	- Sediment

[a] NP = Neutralization Potenital, AP = Acidification Potential, NNP = Net Neutralization Potential.

[b] From BLM (1996) and EPA (1994).

*Iron and manganese SPLP Leachate Criterion for soil were calculated based on a DAF 8 and their respective EPA Tap Water standards. The SPLP Leachate Criterion for Soil for the remaining metals were calculated based on a DAF 8 and their respective DEQ-7 water quality standards (see Section 4 of RI report).

Table 31a

Discrete Streamside Mine Waste Deposit Metals Analytical Results

Sample ID	Sample Date	Total Arsenic (mg/kg)		Total Cadmium (mg/kg)		Total Copper (mg/kg)		Total Iron (mg/kg)		Total Lead (mg/kg)		Total Manganese (mg/kg)		Total Mercury (mg/kg)		Total Zinc (mg/kg)	
		Lab	XRF	Lab	XRF	Lab	XRF	Lab	XRF	Lab	XRF	Lab	XRF	Lab	XRF	Lab	XRF
DEQ Action Level/RSLs/UBMC BTVs		40 [b]		70 [a]		3,100 [a]		58,270 [c]		1,109 [c]		4,893 [c]		23 [a]		23,000 [a]	
UBDT-TP-1 (0-2")	10/17/2007	169	394.4	65.4	55.11	1560	980.56	39742.54	39742.54	11800	7654.77	7100	5549.95	< 0.5	< 16.06	14200	8949.42
UBDT-TP-1 (2-12")	10/17/2007	201	687.03	66.4 JM270, 30	85.84	2260 JM31	2011.28	46643.68	46643.68	14400	9854.05	5690	5524.94	0.77	< 17.41	17800	9631.58
UBDT-TP-1 (12-24")	10/17/2007	188	216.68	52.3	76.96	2480	1818.93	38144.63	38144.63	16500	9202.52	5790	5673.38	< 0.5	< 17.78	9470	9081.28
UBDT-TP-1 (24-36")	10/17/2007	35.9	165.57	27.5	61.07	831	1343.83	29473.19	29473.19	1900	2864.2	3390	7547.27	< 0.5	< 10.95	3620	6177.7
UBDT-TP-1 (36-48")	10/17/2007	13.4	< 23.51	10.4	< 27.24	284	291.5	20886.81	20886.81	331	174.44	838	1199.94	< 0.5	< 9.2	1490	1916.2
UBDT-TP-1 (48-60")	10/17/2007	8.6	< 25.17	2.71	< 27.36	145	183.67	21508.7	21508.7	147	208.34	642	1493.68	< 0.5	< 8.72	524	637.55
UBDT-TP-2 (0-2")	10/17/2007	124	220.46	19	< 29.64	562	448.18	63676.61	63676.61	2510	1186.5	3440	5475.99	< 0.5	< 11.83	3500	3207.29
UBDT-TP-2 (2-12")	10/17/2007	72	110.24	12.8 JM270, 30	< 28.55	437 JM31	448.83	53726.84	53726.84	931	875.37	2940	7208.15	< 0.5	< 10.26	2330	1996.64
UBDT-TP-2 (12-24")	10/17/2007	109	< 61.23	17.2	< 29.57	333	306.95	42887.16	42887.16	2490	1256.05	3620	5435.65	< 0.5	< 11.05	3350	1712.09
UBDT-TP-2 (24-36")	10/17/2007	23.8	64.17	6.05 JM270, 30	< 25.72	184 JM31	186.57	27609.64	27609.64	975	746.88	1620	2760.12	< 0.5	< 7.8	1150	1450.98
UBDT-TP-2 (36-48")	10/17/2007	26.6	70.54	5.4	< 28.35	233	245.71	34213.92	34213.92	1110	1226.09	1270	2786.87	< 0.5	< 9.04	1060	1525.51
UBDT-TP-3 (0-2")	10/17/2007	140	170.32	1.82 JM270, 30	< 29.99	250 JM31	283.03	68468.97	68468.97	1640	1344.02	586	798.38	< 0.5	< 10.68	461	446.55
UBDT-TP-3 (2-12")	10/17/2007	110	164.22	2.28 JM270, 30	< 27.9	239 JM31	190.65	73860.81	73860.81	1670	1815.82	270	< 204.08	< 0.5	< 9.29	534	292.8
UBDT-TP-3 (12-24")	10/17/2007	82.8	152.33	0.714 JM270, 30	< 28.58	217 JM31	208.28	66365.09	66365.09	964	1247.74	276	301.2	< 0.5	< 9.08	264	228.4
UBDT-TP-3 (24-36")	10/17/2007	83.1	136.12	2.14	< 28	233	224.3	62510.35	62510.35	1400	1575.09	307	360.15	< 0.5	< 9.42	518	366.31
UBDT-TP-3 (36-48")	10/17/2007	82.2	223.35	5.45 JM270, 30	32.06	474 JM31	350.14	49740.54	49740.54	4220	1744.85	2380	5541.67	< 0.5	< 9.88	1120	563.29
UBDT-TP-3 (48-60")	10/17/2007	16.5	46.26	2.54 JM270, 30	29.33	155 JM31	184.12	32534.89	32534.89	371	356.85	1160	2627.23	< 0.5	< 8.3	701	790.23
UBDT-TP-4 (0-2")	10/16/2007	104	175.85	18.2 JM270, 30	< 28.66	434 JM31	344.97	56993.54	56993.54	3080	1297.49	2610	6145.04	< 0.5	< 10.61	2910	2380.9
UBDT-TP-4 (2-12")	10/16/2007	32.8	118.65	3.57 JM270, 30	< 27.76	245 JM31	314.91	48562.27	48562.27	1060	1222.98	1580	3891.51	< 0.5	< 10	988	1430.22
UBDT-TP-4 (12-24")	10/16/2007	15.1	104.55	3.15 JM270, 30	< 28.12	127 JM31	303.75	34993.17	34993.17	338	826.25	585	1909.73	< 0.5	< 8.18	655	781.86
UBDT-TP-4 (24-36")	10/16/2007	26.4	63.82	4.79 JM270, 30	< 26.09	624 JM31	165.67	30609.99	30609.99	900	670.83	884	1777.84	< 0.5	< 8.87	1020	1126.52
UBDT-TP-5 (0-2")	10/17/2007	203	95.18	10.1 JM270, 30	< 27.77	638 JM31	410.7	45447.53	45447.53	1680	962.22	2210	4632.92	< 0.5	< 10.42	1980	2627.39
UBDT-TP-5 (2-12")	10/17/2007	25.7	92.46	5.74 JM270, 30	< 28.26	249 JM31	325.44	40904.21	40904.21	716	1022.96	1290	3870.41	< 0.5	< 10.86	1200	1741.41
UBDT-TP-5 (12-24")	10/17/2007	33.3	71.97	7.55	< 27.32	300	344.96	38158.26	38158.26	822	1042.02	1750	3529.29	< 0.5	< 10.23	1520	1550.77
UBDT-TP-6 (0-2")	10/16/2007	388	704.66	98.7 JM270, 30	82.98	3010 JM31	2506.14	80416.69	80416.69	27700	15558.62	6550	7051.66	0.73	< 21.65	24000	19805.25
UBDT-TP-6 (2-12")	10/16/2007	382	637	28.7 JM270, 30	52.58	2520 JM31	1969.72	74386.13	74386.13	25400	11870.99	6410	5489.22	1.2	< 19.46	8640	12294.37
UBDT-TP-6 (12-24")	10/16/2007	170	515.72	161 JM270, 30	51.22	2070 JM31	3721.5	56552.43	56552.43	14400	6640.5	3600	7270.97	0.57	< 17.11	26000	12541.27
UBDT-TP-6 (24-36")	10/16/2007	56.2	122.67	9.75 JM270, 30	< 27.34	510 JM31	215.21	47928.5	47928.5	862 JM10	533.32	2320	2805.1	< 0.5	< 8.85	1290	915.09
UBDT-TP-6 (36-48")	10/16/2007	24.3	180.03	13.7 JM270, 30	40.26	652 JM31	1578.28	30566.06	30566.06	890	1202.79	3200	7680.17	< 0.5	< 10.07	1490	2486.44
UBDT-TP-6 (48-60")	10/16/2007	27.5	59.88	10.5 JM270, 30	< 29.33	776 JM31	912.53	23105.52	23105.52	531	547.29	1990	4663.84	< 0.5	< 10.14	1190	1901.9

Notes:

mg/kg - Milligrams per kilogram
Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
XRF - Field x-ray fluorescence result
Lab - Laboratory analytical result
M% - Matrix spike recoveries exceed acceptable limits.
J - The associated value is an estimated quantity.
- Value meets or exceeds one or more soil screening level.

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

Aluminum was not analyzed in 2007.

Table 31b
Discrete Streamside Mine Waste Deposit ABA and SPLP Analytical Results

Sample ID	Date Collected	Specific Conductance (µmhos/cm)	pH (s.u.)	TOC (%)	Acid - Base Accounting								Synthetic Precipitation Leaching Procedure							
					Sulfur, Hot Water Extractable(%)	Total Sulfur (%)	Sulfur Sulfate (%)	Sulfur Pyritic (%)	Sulfur Organic (%)	Neutral Potential (t/kt)	Acid Potential (t/kt)	Acid/Base Potential (t/kt)	Arsenic (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Zinc (mg/L)
Floodplain SPLP		--	--	--	--	--	--	--	--	--	--	--	**0.08**	**0.04**	**10.4**	**88**	**0.12**	**2.56**	**0.016**	**16**
UBDT-TP-1 (0-2")	10/17/2007	0.53	7.0	2.93																
UBDT-TP-1 (2-12")	10/17/2007	1.29	6.2	2.33	10.8	10.8	0.5	6.79	3.51	14	210	-200	< 0.1	0.01	0.1		< 0.1	0.8	< 0.0001	< 0.5
UBDT-TP-1 (12-24")	10/17/2007	2.02	6.5	2.80																
UBDT-TP-1 (24-36")	10/17/2007	1.02	6.1	0.52																
UBDT-TP-1 (36-48")	10/17/2007	0.88	6.2	0.30																
UBDT-TP-1 (48-60")	10/17/2007	1.06	4.6	0.09																
UBDT-TP-2 (0-2")	10/17/2007	1.73	6.8	0.77																
UBDT-TP-2 (2-12")	10/17/2007	3.02	6.4	0.69	5.86	5.86	0.3	5.19	0.37	47	160	-120	< 0.1	< 0.01	0.1		< 0.1	0.1	< 0.0001	< 0.5
UBDT-TP-2 (12-24")	10/17/2007	1.75	7.1	1.19																
UBDT-TP-2 (24-36")	10/17/2007	2.13	5.5	0.12																
UBDT-TP-2 (36-48")	10/17/2007	1.59	5.4	0.17																
UBDT-TP-3 (0-2")	10/17/2007	6.12	2.3	0.23																
UBDT-TP-3 (2-12")	10/17/2007	4.65	1.9	0.15																
UBDT-TP-3 (12-24")	10/17/2007	6.97	2.3	0.12																
UBDT-TP-3 (24-36")	10/17/2007	6.12	2.5	0.21																
UBDT-TP-3 (36-48")	10/17/2007	6.95	3.2	0.21	0.55	0.9	0.55	0.31	0.05	16	9.6	6	< 0.1	0.03	1		1.8	9.6	< 0.0001	5.7
UBDT-TP-3 (48-60")	10/17/2007	2.68	5.4	0.10																
UBDT-TP-4 (0-2")	10/16/2007	1.16	7.0	0.50	5.87	5.87	< 0.01	5.54	0.33	24	170	-150	< 0.1	< 0.01	0.1		0.3	0.3	< 0.0001	< 0.5
UBDT-TP-4 (2-12")	10/16/2007	3.68	3.7	0.07																
UBDT-TP-4 (12-24")	10/16/2007	1.00	6.5	0.13																
UBDT-TP-4 (24-36")	10/16/2007	1.14	6.4	0.32																
UBDT-TP-5 (0-2")	10/17/2007	1.17	6.3	0.36	4.25	4.25	0.31	3.66	0.28	14	110	-100	< 0.1	< 0.01	0.1		0.1	0.1	< 0.0001	< 0.5
UBDT-TP-5 (2-12")	10/17/2007	1.26	6.2	0.24																
UBDT-TP-5 (12-24")	10/17/2007	1.23	6.0	0.28																
UBDT-TP-6 (0-2")	10/16/2007	0.74	6.4	1.62	8.27	8.27	1.07	4.75	2.45	25	150	-120	< 0.1	< 0.01	0.1		< 0.1	0.2	< 0.0001	< 0.5
UBDT-TP-6 (2-12")	10/16/2007	0.99	6.4	1.33																
UBDT-TP-6 (12-24")	10/16/2007	17.70	4.3	0.65																
UBDT-TP-6 (24-36")	10/16/2007	12.80	4.1	0.43																
UBDT-TP-6 (36-48")	10/16/2007	2.25	4.9	0.07																
UBDT-TP-6 (48-60")	10/16/2007	2.98	4.3	0.22																

Notes:

TOC	- Total organic carbon
%	- Percent
t/kt	- Tons per thousand tons
s.u.	- Standard units
µmhos/cm	- Micromhos per liter
mg/L	- Milligrams per liter
Blank	- No data/not analyzed
--	- No standard/screening level
<	- Parameter not detected at or above the laboratory practical quantitation limit

Classification	Criteria for Classification [b]
Potentially Acid Generating	NP:AP [a] < 1 and NNP < -20 tons/kton
Uncertain Acid Generation Potential	NP:AP between 1 and 3 and/or NNP between -20 and +20 tons/kton
Unlikely to Generate Acid	NP:AP > 3 and NNP < +20 tons/kton

[a] NP = Neutralization Potenital, AP = Acidification Potential, NNP = Net Neutralization Potential.

[b] From BLM (1996) and EPA (1994).

*Iron and manganese SPLP Leachate Criterion for soil were calculated based on a DAF 8 and their respective EPA Tap Water standards. The SPLP Leachate Criterion for Soil for the remaining metals were calculated based on a DAF 8 and their respective DEQ-7 water quality standards (see Section 4 of RI report).

Table 32
Reclamation Cover Soil Analytical Results

Sample ID	Sample Date	SC (µmhos/cm)	pH (s.u.)	TOC (%)	Potassium (mg/kg)	Phosphorus (mg/kg)	Nitrogen (mg/kg)	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)	Total Cadmium (mg/kg)	Total Copper (mg/kg)	Total Iron (mg/kg)	Total Lead (mg/kg)	Total Manganese (mg/kg)	Total Mercury (mg/kg)	Total Zinc (mg/kg)
DEQ Action Level/RSLs/UBMC BTVs		--	--	--	--	--	--	77,000[a]	40[b]	70[a]	3,100[a]	56,470[c]	400[c]	6,946[c]	23[a]	23,000[a]
CONM-RF-RV1	7/15/08	0.17	4.7	1.9	188	9.2	2.6	23100	14.5	3.73	579	73700	968	321	<0.5	163
CONM-RV1	7/15/08	0.19	4.7	0.8	117	6.6	3.3	16900	382	5.29	370	59000	2880	968	<0.5	479
CONM-RV2	7/15/08	0.28	6.1	0.9	160	6.8	3.6	19200	446	2.77	350	53200	1190	1180	<0.5	407
EEA1-RV1	7/15/08	0.32	6.0	2.2	116	10	5.6	10100	14.0	0.922	83.6	21600	101	514	<0.5	167
EEA2-RV1	7/15/08	0.24	6.0	1.6	117	10	5.6	8910	8.71	<0.5	75.0	15200	82.7	366	<0.5	73.5
MHTS-RV1	7/16/08	0.15	3.9	1.5	115	9.4	3.2	6930	76.9	<0.5	124	25600	2880	5270	<0.5	1370
PMR-RV1	7/15/08	0.45	6.4	1.1	189	8.8	3.2	18800	33.7	0.776	480	63200	1310	310	<0.5	152
PMR-RV2	7/15/08	0.19	4.9	1.0	135	5.6	6.2	22200	20.4	0.660	549	72100	726	257	<0.5	122
PMWA2-RV1	7/15/08	0.85	5.3	0.6	121	5.8	3.2	16200	20.3	0.698	359	43000	510	268	<0.5	107
UAW-RV1	7/16/08	0.58	3.1	1.8	96	10	3.8	8770	46.2	1.77	86.0	36500	437	579	<0.5	216
UAW-RV2	7/16/08	0.21	6.0	2.4	193	14	3.4	10700	23.8	1.61	172	39500	1040	1070	<0.5	541
UMH-RV1	7/16/08	0.15	5.2	0.6	160	6.4	4.2	19500	28.9	0.798	517	56200	1010	390	<0.5	139
UMH-RV2	7/16/08	0.53	6.8	1.2	173	47	3.6	10800	431	7.63	1590	54800	26700	1360	1.1	1350
UMH-RV3	7/16/08	0.19	4.4	0.5	107	3.1	3.2	6710	405	24.0	2310	55600	35200	811	1.3	4060
UMH-RV4	7/16/08	0.38	7.0	1.8	164	65	3.0	6770	154	14.5	740	33900	11000	4090	<0.5	1750
UMH-RV5	7/16/08	2.22	6.5	0.7	133	7.4	5.7	11200	114	4.34	793	39800	2480	920	<0.5	495
UMH-RV6	7/16/08	0.16	5.5	0.4	98	4.9	4.4	25300	21.9	0.686	564	77500	1010	343	<0.5	172
UMH-RV7	7/16/08	0.34	6.6	0.7	135	25	2.9	6290	64.8	6.69	129	22600	2560	4810	<0.5	1110
WEA-RV1	7/15/08	0.14	4.0	2.4	116	7.9	4.7	13300	31.8	<0.5	197	38000	271	969	<0.5	269

Notes:

SC - Specific conductance
µmhos/cm - Micromhos per centimeter
s.u. - Standard units
% - Percent
mg/Kg - Milligrams per kilogram
-- - No standard/screening level
< - Parameter not detected at or above the laboratory practical quantitation limit
- Value meets or exceeds one or more screening levl
Blank - No data
RF - Denotes reference site

[a] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[b] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[c] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

CONM - Consolation Mine
EEA - East Edith Area
MHTS - Mike Horse Town Site
PMR - Paymaster Mine Repository
PMW2 - Paymaster Mine Waste Area
UAW - Upper Anaconda Waste
UMH - Upper Mike Horse
WEA - West Edith Area

Table 33
Marsh and Terrestrial Vegetation Analytical Results

Sample ID	Date Collected	Metals								
		Aluminum (mg/kg)	Arsenic[b] (mg/kg)	Cadmium [c] (mg/kg)	Copper [d] (mg/kg)	Iron (mg/kg)	Lead [e] (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)
Soil Screening Levels	ECO-SSL Plants	--	18	32	70	--	120	--	--	--
	ORNL Plants [a]	50	10	4	100	--	50	500	0.3	50
ANTREF01	7/25/2008	13.0	< 0.7	< 0.05	10.8	69.0	0.82	42.2	< 0.003	39.0
ANTREF02	7/25/2008	18.1	< 0.7	< 0.05	5.71	56.1	< 0.25	18.8	< 0.003	22.3
ANTREF03	7/25/2008	11.4	< 0.7	0.25	5.06	45.8	< 0.25	60.7	< 0.003	35.9
BCVE01	7/26/2008	222	3.1	0.31	6.39	729	14.7	2060	< 0.003	64.3
BCVE02	7/23/2008	157	< 0.7	0.32	5.42	104	1.89	3230	< 0.003	75.0
BCVE03	7/26/2008	64.6	< 0.7	1.05	4.56	125	2.16	521	< 0.003	84.4
BRVE01	7/25/2008	19.2	< 0.7	0.82	9.10	101	3.39	171	< 0.003	210
BRVE02	7/25/2008	13.0	< 0.7	0.66	8.66	54.9	< 0.25	91.8	< 0.003	88.6
BRVE03	7/25/2008	14.4	< 0.7	1.05	9.82	64.5	1.45	21.2	< 0.003	225
PGREFVE01	7/24/2008	40.6	< 0.7	< 0.05	5.32	168	< 0.25	236	< 0.003	33.7
PGREFVE02	7/24/2008	35.8	< 0.7	1.49	4.88	95.6	< 0.25	59.5	< 0.003	66.9
PGREFVE03	7/24/2008	27.1	< 0.7	< 0.05	5.68	74.6	< 0.25	64.0	< 0.003	26.4
UMT1VE01	7/25/2008	18.3	< 0.7	0.74	7.02	87.5	3.18	249	< 0.003	188
UMT1VE02	7/25/2008	106	< 0.7	1.91	16.7	416	24.3	419	< 0.003	251
UMT1VE03	7/25/2008	102	< 0.7	5.21	20.0	386	20.9	389	< 0.003	661
UMT2VE01	7/24/2008	23.5	< 0.7	0.63	7.11	118	5.01	255	< 0.003	245
UMT2VE02	7/24/2008	15.0	< 0.7	0.24	3.84	354	1.02	341	< 0.003	70.3
UMT2VE03	7/24/2008	25.6	< 0.7	0.25	4.34	631	0.85	298	< 0.003	55.6

Notes:

mg/Kg - Milligrams per kilogram
-- - No standard/screening level
< - Parameter not detected at or above the laboratory practical quantitation limit
Blank - No data

[a] Efroymson, R.A., M.E. Will, G.W. Suter II, A.C. Wooten. 1997b. "Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision." November.

[b] US EPA. 2005. "Ecological Soil Screening Levels for Arsenic, Interim Final." March.

[c] US EPA. 2005. "Ecological Soil Screening Levels for Cadmium, Interim Final." March.

[d] US EPA. 2007. "Ecological Soil Screening Levels for Copper, Interim Final.". February (Revised from July 2006).

[e] US EPA. 2005. "Ecological Soil Screening Levels for Lead, Interim Final." March.

ANTREF - Reference transect (outside the river floodplain sediments) on Anaconda Creek.
BC - Transect within the river floodplain sediments along Beartrap Creek (moderate to low risk).
BR - Transect within the river floodplain sediments along Blackfoot River (high risk).
PGREF - Reference transect on Pass Creek Marsh.
UMT2 - Transect on western edge to middle of the Upper Marsh of the Blackfoot River (moderate to low risk).
UMT1 - Transect on eastern portion of the Upper Marsh of the Blackfoot River (high risk).

Table 33
Marsh and Terrestrial Vegetation Analytical Results

Sample ID	Date Collected	Metals								
		Aluminum (mg/kg)	Arsenic[b] (mg/kg)	Cadmium [c] (mg/kg)	Copper [d] (mg/kg)	Iron (mg/kg)	Lead [e] (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)
Soil Screening Levels	ECO-SSL Plants	--	18	32	70	--	120	--	--	--
	ORNL Plants [a]	50	10	4	100	--	50	500	0.3	50

Notes:

mg/Kg - Milligrams per kilogram
-- - No standard/screening level
< - Parameter not detected at or above the laboratory practical quantitation limit
Blank - No data

[a] Efroymson, R.A., M.E. Will, G.W. Suter II, A.C. Wooten. 1997b. "Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision." November.

[b] US EPA. 2005. "Ecological Soil Screening Levels for Arsenic, Interim Final." March.

[c] US EPA. 2005. "Ecological Soil Screening Levels for Cadmium, Interim Final." March.

[d] US EPA. 2007. "Ecological Soil Screening Levels for Copper, Interim Final.". February (Revised from July 2006).

[e] US EPA. 2005. "Ecological Soil Screening Levels for Lead, Interim Final." March.

ANTREF - Reference transect (outside the river floodplain sediments) on Anaconda Creek.
BC - Transect within the river floodplain sediments along Beartrap Creek (moderate to low risk).
BR - Transect within the river floodplain sediments along Blackfoot River (high risk).
PGREF - Reference transect on Pass Creek Marsh.
UMT2 - Transect on western edge to middle of the Upper Marsh of the Blackfoot River (moderate to low risk).
UMT1 - Transect on eastern portion of the Upper Marsh of the Blackfoot River (high risk).

Table 33a
Marsh and Terrestrial Plant Tissue Analytical Results

Sample ID	Date Collected	Metals								
		Aluminum (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)
Reference Plant Tissue Concentration	**Minimum RC**	**27.1**	**<0.7**	**<0.05**	**4.88**	**74.6**	**<0.25**	**59.5**	**<0.033**	**26.4**
	Maximum RC	**40.6**	**<0.7**	**1.49**	**5.68**	**168**	**<0.25**	**236**	**<0.033**	**66.9**
Pass Creek Marsh Reference Site										
PGREFVE03	7/24/2008	27.1	< 0.7	< 0.05	5.68	74.6	< 0.25	64.0	< 0.003	26.4
PGREFVE02	7/24/2008	35.8	< 0.7	1.49	4.88	95.6	< 0.25	59.5	< 0.003	66.9
PGREFVE01	7/24/2008	40.6	< 0.7	< 0.05	5.32	168	< 0.25	236	< 0.003	33.7
Eastern Upper Marsh Transect										
UMT1VE03	7/25/2008	102	< 0.7	5.21	20.0	386	20.9	389	< 0.003	661
UMT1VE02	7/25/2008	106	< 0.7	1.91	16.7	416	24.3	419	< 0.003	251
UMT1VE01	7/25/2008	18.3	< 0.7	0.74	7.02	87.5	3.18	249	< 0.003	188
Western Upper Marsh Transect										
UMT2VE03	7/24/2008	25.6	< 0.7	0.25	4.34	631	0.85	298	< 0.003	55.6
UMT2VE02	7/24/2008	15.0	< 0.7	0.24	3.84	354	1.02	341	< 0.003	70.3
UMT2VE01	7/24/2008	23.5	< 0.7	0.63	7.11	118	5.01	255	< 0.003	245

Notes:

mg/Kg - Milligrams per kilogram
< - Parameter not detected at or above the laboratory practical quantitation limit
Blank - No data
RC - Reference Concentration

PGREF - Reference transect on Pass Creek Marsh.
UMT2 - Transect on western edge to middle of the Upper Marsh of the Blackfoot River (moderate to low risk).
UMT1 - Transect on eastern portion of the Upper Marsh of the Blackfoot River (high risk).

Table 33b

Floodplain and Terrestrial Plant Tissue Analytical Results

Sample ID	Date Collected	Metals								
		Aluminum (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)
Reference Plant Tissue Concentration	**Minimum RC**	**11.4**	**<0.7**	**<0.05**	**5.06**	**45.8**	**<0.25**	**18.8**	**<0.003**	**22.3**
	Maximum RC	**18.1**	**<0.7**	**0.25**	**10.8**	**69**	**0.82**	**60.7**	**<0.003**	**39**
Anaconda Creek Reference Transect										
ANTREF03	7/25/2008	11.4	< 0.7	0.25	5.06	45.8	< 0.25	60.7	< 0.003	35.9
ANTREF02	7/25/2008	18.1	< 0.7	< 0.05	5.71	56.1	< 0.25	18.8	< 0.003	22.3
ANTREF01	7/25/2008	13.0	< 0.7	< 0.05	10.8	69.0	0.82	42.2	< 0.003	39.0
Blackfoot River Transect										
BRVE03	7/25/2008	14.4	< 0.7	1.05	9.82	64.5	1.45	21.2	< 0.003	225
BRVE02	7/25/2008	13.0	< 0.7	0.66	8.66	54.9	< 0.25	91.8	< 0.003	88.6
BRVE01	7/25/2008	19.2	< 0.7	0.82	9.10	101	3.39	171	< 0.003	210
Beartrap Creek Transect										
BCVE03	7/26/2008	64.6	< 0.7	1.05	4.56	125	2.16	521	< 0.003	84.4
BCVE02	7/23/2008	157	< 0.7	0.32	5.42	104	1.89	3230	< 0.003	75.0
BCVE01	7/26/2008	222	3.1	0.31	6.39	729	14.7	2060	< 0.003	64.3

Notes:

mg/Kg - Milligrams per kilogram
< - Parameter not detected at or above the laboratory practical quantitation limit
Blank - No data
RC - Reference Concentration

ANTREF - Reference transect (outside the river floodplain sediments) on Anaconda Creek.
BC - Transect within the river floodplain sediments along Beartrap Creek (moderate to low risk).
BR - Transect within the river floodplain sediments along Blackfoot River (high risk).

Table 34
Marsh and Terrestrial Small Mammal Analytical Results

Sample ID	Date Collected	Aluminum (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)
Soil Screening Levels	**ECO-SSL Mammal**	**--**	**46 [a]**	**0.36 [b]**	**49 [c]**	**--**	**56 [d]**	**--**	**--**	**--**
ANTREFMA01	7/25/2008	11.3	< 2.5	< 0.2	2.32	93.9	< 0.75	1.07	< 0.033	141
ANTREFMA02	7/25/2008	28.5	< 2.5	< 0.2	3.83	B 157	< 0.75	6.95	< 0.033	351
ANTREFMA03	7/28/2008	24.5	< 2.5	< 0.2	5.34	B 115	< 0.75	5.08	< 0.033	33.5
BCMAO1	7/26/2008	< 8	< 2.5	< 0.2	3.18	B 104	< 0.75	1.56	< 0.033	30.8
BCMAO2	7/27/2008	17.7	< 2.5	< 0.2	3.33	B 168	1.34	6.28	< 0.033	164
BCMAO3	7/27/2008	< 8	< 2.5	< 0.2	1.92	B 77.8	7.66	3.59	< 0.033	63
BRMA01	7/26/2008	8	3.7	< 0.2	5.53	B 95.5	2.83	1.99	< 0.033	376
BRMAO2	7/26/2008	17.1	< 2.5	< 0.2	3.62	B 148	5.17	4.92	< 0.033	59.3
BRMAO3	7/27/2008	17.4	3	< 0.2	4.68	B 123	4.54	4.81	< 0.033	64.8
PGREFMA01	7/26/2008	11.3	< 2.5	< 0.2	3.97	B 128	< 0.75	7.23	< 0.033	158
PGREFMA02	7/27/2008	29.4	< 2.5	< 0.2	2.54	B 115	< 0.75	4.46	< 0.033	23.9
PGREFMA03	7/28/2008	27.6	< 2.5	< 0.2	3.77	B 139	1.2	4.75	< 0.033	26.4
PGREFMA04	7/28/2008	29.2	< 2.5	< 0.2	3.04	B 112	0.81	2.53	< 0.033	25.4
PGREFMA05	7/28/2008	16.4	< 2.5	< 0.2	2.55	B 123	< 0.75	6.66	< 0.033	91.6
UMT1MA01	7/25/2008	53.3	2.5	0.98	11.7	B 958	25.9	80	< 0.033	69.3
UMT1MA02	7/27/2008	< 8	< 2.5	< 0.2	1.48	46.8	< 0.75	1.77	< 0.033	44.8
UMT1MA03	7/27/2008	42.2	< 2.5	0.47	8.78	B 216	8.56	49.2	< 0.033	537

Notes:
Results reported in dry weight.
mg/kg - Milligrams per kilogram
B - value was qualified as estimated by the laboratory
-- - No soil screening level
< - Parameter not detected at or above the laboratory practical quantitation limit

ANTREF - Reference transect (outside the river floodplain sediments) on Anaconda Creek.
BC - Transect within the river floodplain sediments along Beartrap Creek (moderate to low risk).
BR - Transect within the river floodplain sediments along Blackfoot River (high risk).
PGREF - Reference transect on Pass Creek Marsh.
UMT2 - Transect on western edge to middle of the Upper Marsh of the Blackfoot River (moderate to low risk).
UMT1 - Transect on eastern portion of the Upper Marsh of the Blackfoot River (high risk).

[a] US EPA. 2005. "Ecological Soil Screening Levels for Arsenic, Interim Final." March.
[b] US EPA. 2005. "Ecological Soil Screening Levels for Cadmium, Interim Final." March.
[c] US EPA. 2007. "Ecological Soil Screening Levels for Copper, Interim Final.". February (Revised from July 2006).
[d] US EPA. 2005. "Ecological Soil Screening Levels for Lead, Interim Final." March.

Table 34a

Marsh and Terrestrial Small Mammal Tissue Analytical Results

Sample ID	Date Collected	Aluminum (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)
Reference Mammal Tissue Concentration	**Minimum RC**	**11.3**	**<2.5**	**<0.2**	**2.54**	**112**	**<0.75**	**<0.033**	**<0.033**	**23.9**
	Maximum RC	**29.4**	**<2.5**	**<0.2**	**3.97**	**139**	**1.2**	**<0.033**	**<0.033**	**158**
Pass Creek Marsh Reference Site										
PGREFMA01	7/26/2008	11.3	< 2.5	< 0.2	3.97	B 128	< 0.75	7.23	< 0.033	158
PGREFMA02	7/27/2008	29.4	< 2.5	< 0.2	2.54	B 115	< 0.75	4.46	< 0.033	23.9
PGREFMA03	7/28/2008	27.6	< 2.5	< 0.2	3.77	B 139	1.2	4.75	< 0.033	26.4
PGREFMA04	7/28/2008	29.2	< 2.5	< 0.2	3.04	B 112	0.81	2.53	< 0.033	25.4
PGREFMA05	7/28/2008	16.4	< 2.5	< 0.2	2.55	B 123	< 0.75	6.66	< 0.033	91.6
Eastern Upper Marsh Transect										
UMT1MA01	7/25/2008	53.3	2.5	0.98	11.7	B 958	25.9	80	< 0.033	69.3
UMT1MA02	7/27/2008	< 8	< 2.5	< 0.2	1.48	46.8	< 0.75	1.77	< 0.033	44.8
UMT1MA03	7/27/2008	42.2	< 2.5	0.47	8.78	B 216	8.56	49.2	< 0.033	537

Notes:

Results reported in dry weight.

mg/kg - Milligrams per kilogram

B - value was qualified as estimated by the laboratory

< - Parameter not detected at or above the laboratory practical quantitation limit

RC - Reference Concentration

PGREF - Reference transect on Pass Creek Marsh.

UMT2 - Transect on western edge to middle of the Upper Marsh of the Blackfoot River (moderate to low risk).

UMT1 - Transect on eastern portion of the Upper Marsh of the Blackfoot River (high risk).

Table 34b

Floodplain and Terrestrial Small Mammal Tissue Analytical Results

Sample ID	Date Collected	Aluminum (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)
Reference Mammal Tissue Concentration	**Minimum RC**	**11.3**	**<2.5**	**<0.2**	**2.32**	**93.9**	**<0.75**	**1.07**	**<0.033**	**33.5**
	Maximum RC	**28.5**	**<2.5**	**<0.2**	**5.34**	**157**	**<0.75**	**6.95**	**<0.033**	**351**
Anaconda Creek Reference Transect										
ANTREFMA01	7/25/2008	11.3	< 2.5	< 0.2	2.32	93.9	< 0.75	1.07	< 0.033	141
ANTREFMA02	7/25/2008	28.5	< 2.5	< 0.2	3.83	B 157	< 0.75	6.95	< 0.033	351
ANTREFMA03	7/28/2008	24.5	< 2.5	< 0.2	5.34	B 115	< 0.75	5.08	< 0.033	33.5
Beartrap Creek Transect										
BCMAO1	7/26/2008	< 8	< 2.5	< 0.2	3.18	B 104	< 0.75	1.56	< 0.033	30.8
BCMAO2	7/27/2008	17.7	< 2.5	< 0.2	3.33	B 168	1.34	6.28	< 0.033	164
BCMAO3	7/27/2008	< 8	< 2.5	< 0.2	1.92	B 77.8	7.66	3.59	< 0.033	63
Blackfoot River Transect										
BRMA01	7/26/2008	8	3.7	< 0.2	5.53	B 95.5	2.83	1.99	< 0.033	376
BRMAO2	7/26/2008	17.1	< 2.5	< 0.2	3.62	B 148	5.17	4.92	< 0.033	59.3
BRMAO3	7/27/2008	17.4	3	< 0.2	4.68	B 123	4.54	4.81	< 0.033	64.8

Notes:

Results reported in dry weight.

mg/kg - Milligrams per kilogram

B - value was qualified as estimated by the laboratory

< - Parameter not detected at or above the laboratory practical quantitation limit

RC - Reference Concentration

ANTREF - Reference transect (outside the river floodplain sediments) on Anaconda Creek.

BC - Transect within the river floodplain sediments along Beartrap Creek (moderate to low risk).

BR - Transect within the river floodplain sediments along Blackfoot River (high risk).

Table 35
Terrestrial and Marsh Invertebrate Analytical Results

Sample ID	Date Collected	Metals								
		Aluminum (mg/kg)	Arsenic [c] (mg/kg)	Cadmium[d] (mg/kg)	Copper [e] (mg/kg)	Iron (mg/kg)	Lead [f] (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)
Soil Screening Levels	**ECO-SSL Inverts**	**--**	**--**	**140**	**80**	**--**	**1,700**	**--**	**--**	**--**
	ORNL Inverts [a]	**--**	**60**	**20**	**50**	**--**	**500**	**--**	**0.1**	**100 [b]**
ANT REF T1 01	7/25/08	21.9	1.87	1.04	41.5	117	0.997	63.2	< 0.1	197
ANT REF T1 02	7/25/08	37.0	0.616	0.990	46.4	98.3	0.508	40.0	< 0.1	156
ANT REF T1 03	7/25/08	304	9.73	0.760	34.9	373	2.02	103	< 0.1	166
BC T1 01	7/26/08	214	41.9	0.456	20.9	774	16.0	173	< 0.1	163
BC T1 03	7/26/08	196	50.2	1.46	38.6	465	4.91	117	< 0.1	224
BR T1 02	7/25/08	96.0	8.19	2.01	38.3	336	9.24	80.0	< 0.1	230
BR T1 03	7/25/08	40.4	24.3	9.46	27.9	590	13.5	263	< 0.1	196
BR TI 01	7/25/08	415	16.3	3.68	68.0	5570	102	636	< 0.1	386
PG REF T1 01	7/26/08	3060	6.56	4.29	116	5660	34.1	532	< 0.1	222
PG REF T1 02	7/26/08	114	2.63	0.865	23.3	288	1.17	78.9	< 0.1	204
PG REF T1 03	7/26/08	418	1.26	3.40	34.8	454	3.82	52.6	< 0.1	236
UMT1 TI 01	7/26/08	1660	21.9	14.7	227	9000	364	1790	< 0.1	1440
UMT1 TI 02	7/26/08	1370	26.2	13.1	200	9580	440	1310	< 0.1	2080
UMT1 TI 03	7/26/08	749	10.2	11.2	137	3590	163	697	< 0.1	798
UMT2 TI 01	7/26/08	1120	8.73	12.9	137	3900	152	1100	< 0.1	939
UMT2 TI 02	7/26/08	2770	6.84	4.81	57.3	7200	76.9	377	< 0.1	377
UMT2 TI 03	7/26/08	1170	2.76	1.90	29.2	5840	27.6	183	< 0.1	210

Notes:

mg/kg - Milligrams per kilogram
-- - No standard/screening level available
Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
M% - Matrix spike recoveries exceed acceptable limits.
J - The associated value is an estimated quantity.

ANTREF - Reference transect (outside the river floodplain sediments) on Anaconda Creek.
BC - Transect within the river floodplain sediments along Beartrap Creek (moderate to low risk).
BR - Transect within the river floodplain sediments along Blackfoot River (high risk).
PGREF - Reference transect on Pass Creek Marsh.
UMT2 - Transect on western edge to middle of the Upper Marsh of the Blackfoot River (moderate to low risk).
UMT1 - Transect on eastern portion of the Upper Marsh of the Blackfoot River (high risk).

[a] Efroymson, R.A., M.E. Will, G.W. Suter II. 1997. "Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision." November.

[b] The online Risk Assessment Information System database (http://rais.ornl.gov/cgi-bin/eco/ECO_select), accessed October 3, 2007, shows an ORNL Plants Screening Benchmark value of 100 mg/kg, while Efroymson et al 1997 shows a value of 200 mg/kg.

[c] US EPA. 2005. "Ecological Soil Screening Levels for Arsenic, Interim Final." March.

[d] US EPA. 2005. "Ecological Soil Screening Levels for Cadmium, Interim Final." March.

[e] US EPA. 2007. "Ecological Soil Screening Levels for Copper, Interim Final.". February (Revised from July 2006

[f] US EPA. 2005. "Ecological Soil Screening Levels for Lead, Interim Final." March.

Table 35a
Terrestrial and Marsh Invertebrate Tissue Analytical Results

Sample ID	Date Collected	Metals								
		Aluminum (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)
Reference Invertebrate Tissue Concentration	**Minimum RC**	**114**	**1.26**	**0.865**	**23.3**	**288**	**1.17**	**52.6**	**<0.1**	**204**
	Maximum RC	**3060**	**6.56**	**4.29**	**116**	**5660**	**34.1**	**532**	**<0.1**	**236**
Pass Creek Marsh Reference Site										
PG REF T1 01	7/26/08	3060	6.56	4.29	116	5660	34.1	532	< 0.1	222
PG REF T1 02	7/26/08	114	2.63	0.865	23.3	288	1.17	78.9	< 0.1	204
PG REF T1 03	7/26/08	418	1.26	3.40	34.8	454	3.82	52.6	< 0.1	236
Eastern Upper Marsh Transect										
UMT1 TI 01	7/26/08	1660	21.9	14.7	227	9000	364	1790	< 0.1	1440
UMT1 TI 02	7/26/08	1370	26.2	13.1	200	9580	440	1310	< 0.1	2080
UMT1 TI 03	7/26/08	749	10.2	11.2	137	3590	163	697	< 0.1	798
UMT2 TI 01	7/26/08	1120	8.73	12.9	137	3900	152	1100	< 0.1	939
UMT2 TI 02	7/26/08	2770	6.84	4.81	57.3	7200	76.9	377	< 0.1	377
UMT2 TI 03	7/26/08	1170	2.76	1.90	29.2	5840	27.6	183	< 0.1	210

Notes:

mg/kg - Milligrams per kilogram
Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
M% - Matrix spike recoveries exceed acceptable limits.
J - The associated value is an estimated quantity.

PGREF - Reference transect on Pass Creek Marsh.
UMT2 - Transect on western edge to middle of the Upper Marsh of the Blackfoot River (moderate to low risk).
UMT1 - Transect on eastern portion of the Upper Marsh of the Blackfoot River (high risk).

Table 35b
Terrestrial and Marsh Invertebrate Tissue Analytical Results

Sample ID	Date Collected	Metals								
		Aluminum (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)
Reference Invertebrate Tissue Concentration	**Minimum RC**	**21.9**	**.616**	**.76**	**34.9**	**98.3**	**0.508**	**40**	**<0.1**	**156**
	Maximum RC	**304**	**9.73**	**1.04**	**46.4**	**373**	**2.02**	**103**	**<0.1**	**197**
Anaconda Creek Reference Transect										
ANT REF T1 01	7/25/08	21.9	1.87	1.04	41.5	117	0.997	63.2	< 0.1	197
ANT REF T1 02	7/25/08	37.0	0.616	0.990	46.4	98.3	0.508	40.0	< 0.1	156
ANT REF T1 03	7/25/08	304	9.73	0.760	34.9	373	2.02	103	< 0.1	166
Beartrap Creek Transect										
BC T1 01	7/26/08	214	41.9	0.456	20.9	774	16.0	173	< 0.1	163
BC T1 03	7/26/08	196	50.2	1.46	38.6	465	4.91	117	< 0.1	224
Blackfoot River Transect										
BR T1 02	7/25/08	96.0	8.19	2.01	38.3	336	9.24	80.0	< 0.1	230
BR T1 03	7/25/08	40.4	24.3	9.46	27.9	590	13.5	263	< 0.1	196
BR TI 01	7/25/08	415	16.3	3.68	68.0	5570	102	636	< 0.1	386

Notes:

mg/kg - Milligrams per kilogram
Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
M% - Matrix spike recoveries exceed acceptable limits.
J - The associated value is an estimated quantity.

ANTREF - Reference transect (outside the river floodplain sediments) on Anaconda Creek.
BC - Transect within the river floodplain sediments along Beartrap Creek (moderate to low risk).
BR - Transect within the river floodplain sediments along Blackfoot River (high risk).
PGREF - Reference transect on Pass Creek Marsh.
UMT2 - Transect on western edge to middle of the Upper Marsh of the Blackfoot River (moderate to low risk).
UMT1 - Transect on eastern portion of the Upper Marsh of the Blackfoot River (high risk).

Table 36
Terrestrial Transect Soil Analytical Results

Sample ID	Date Collected	Metals								
		Aluminum (mg/kg)	Arsenic[d] (mg/kg)	Cadmium[e] (mg/kg)	Copper[f] (mg/kg)	Iron (mg/kg)	Lead[g] (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)
Soil Screening Levels	ECO-SSL Inverts	--	--	140	80	--	1,700	--	--	--
	ECO-SSL Mammals	--	46	0.36	49	--	56	--	--	--
	ECO-SSL Plants	--	18	32	70	--	120	--	--	--
	ORNL Inverts[a]	--	60	20	50	--	500	--	0.1	100[c]
	ORNL Plants[b]	50	10	4	100	--	50	500	0.3	50
DEQ Action Level/RSLs/UBMC BTVs		77,000[h]	40[i]	70[h]	3,100[h]	58,270[j]	1,109[j]	4,893[j]	23[h]	23,000[h]
ANT REF TS 01	7/25/08	11700	14.8	0.917	42.4	15800	81.3	436	< 0.5	106
ANT REF TS 02	7/25/08	11200	15.2	0.847	40.4	15800	24.8	428	< 0.5	67.3
ANT REF TS 03	7/25/08	12700	12.3	0.738	31.6	14400	23.7	564	< 0.5	64.4
BC TS 01	7/25/08	17800	8.20	0.786	13.9	15700	37.2	673	< 0.5	124
BC TS 02	7/25/08	12600	7.57	0.618	10.3	12900	25.8	701	< 0.5	81.4
BC TS 03	7/25/08	17200	35.2	1.45	99.6	23200	264	1150	< 0.5	165
BR TS 01	7/26/08	10600	23.9	8.62	126	18800	212	1390	< 0.5	582
BR TS 02	7/26/08	11600	31.9	1.33	59.8	18000	68.1	720	< 0.5	174
BR TS 03	7/26/08	7670	101	4.36	264	44100	1840	785	< 0.5	764

Notes:

mg/kg - Milligrams per kilogram
ECO-SSL - Ecological Soil Screening Levels
ORNL - Oak Ridge National Laboratory
-- - No standard/screening level available
Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit

ANTREF - Reference transect outside the river floodplain sediments on Anaconda Creek.
BC - within the edge of river floodplain sediments along Beartrap Creek (moderate to low risk).
BR - within the edge of river floodplain sediments along Blackfoot River (high risk).

[a] Efroymson, R.A., M.E. Will, G.W. Suter II. 1997. "Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision." November.

[b] Efroymson, R.A., M.E. Will, G.W. Suter II, A.C. Wooten. 1997b. "Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision." November.

[c] The online Risk Assessment Information System database (http://rais.ornl.gov/cgi-bin/eco/ECO_select), accessed October 3, 2007, shows an ORNL Plants Screening Benchmark value of 100 mg/kg, while Efroymson et al 1997 shows a value of 200 mg/kg.

[d] US EPA. 2005. "Ecological Soil Screening Levels for Arsenic, Interim Final." March.

[e] US EPA. 2005. "Ecological Soil Screening Levels for Cadmium, Interim Final." March.

[f] US EPA. 2007. "Ecological Soil Screening Levels for Copper, Interim Final.". February (Revised from July 2006

[g] US EPA. 2005. "Ecological Soil Screening Levels for Lead, Interim Final." March.

[h] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).

[i] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).

[j] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

Table 37a
Marsh Surface Transect Sediment Metals Analytical Results

Sample ID	Date Collected	Metals								
		Aluminum (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)
Screening Levels	TEL [abfq]	--	5.9	0.596	35.7	--	35	--	0.174	123
	PAET [cbdfg]	--	19	97.5	340	--	240	1,400	0.16	500
	SEL [ebfg]	--	33	10	110	--	250	1,100	2	820
DEQ Action Level/RSLs/UBMC BTVs		77,000[h]	40 [i]	70[h]	3,100 [h]	58,270 [j]	1,109 [j]	4,893[j]	23 [h]	23,000[h]
Marsh Sediment RVs[k]		8,030	32.3	1.84	67.4	14,500	174	696	0.5	275
PGREFTS01 0-2	7/24/08	11700	10.8	1.25	46.2	13100	86.0	218	< 0.5	198
PGREFTS01 2-6	7/24/08	13300	13.9	1.53	49.8	14500	76.8	207	< 0.5	200
PGREFTS01 6-12	7/24/08	13000	15.2	1.35	48.4	14900	82.4	200	< 0.5	204
PGREFTS02 0-2	7/24/08	8750	15.4	1.58	40.0	11500	52.9	494	< 0.5	159
PGREFTS02 2-6	7/24/08	6460	10.3	1.53	25.8	9470	38.8	186	< 0.5	130
PGREFTS02 6-12	7/24/08	4990	12.3	0.886	12.8	9750	31.2	156	< 0.5	101
PGREFTS03 0-2	7/24/08	10600	17.4	1.34	38.9	14200	74.2	708	< 0.5	216
PGREFTS03 2-6	7/24/08	9890	14.6	1.05	30.9	13500	66.2	727	< 0.5	183
PGREFTS03 6-12	7/24/08	6120	7.06	0.522	14.3	10300	36.6	452	< 0.5	108
UMT1TS01 0-2	7/25/08	11200	17.0	1.97	89.1	15100	117	530	< 0.5	352
UMT1TS01 2-6	7/25/08	10800	17.5	1.34	94.9	14300	103	400	< 0.5	418
UMT1TS01 6-12	7/25/08	9060	13.0	1.36	79.0	12000	61.9	256	< 0.5	301
UMT1TS02 0-2	7/25/08	5160	128	14.1	450	42500	2250	4200	< 0.5	2040

Notes:

mg/kg - Milligrams per kilogram
-- - No standard/screening level available
Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
- Value meets or exceeds one or more screening level.

PGREF - Reference transect on Pass Creek Marsh.
UMT2 - Transect on western edge to middle of the Upper Marsh of the Blackfoot River (moderate to low risk).
UMT1 - Transect on eastern portion of the Upper Marsh of the Blackfoot River (high risk).

[a] The TEL is calculated as the geometric mean of the 15th percentile concentration of the toxic effects data set and the median of the no-effect data set. As such it represents the concentration below which adverse effects are expected to occur only rarely. Freshwater TELs are based on benthic community metrics and toxicity texts results. Adverse biological effects rarely seen below TEL.

[b] Cubbage, James, David Batts, Scott Breidenback. 1997. "Creation and Analysis of Freshwater Sediment Quality Values in Washington State". July. http://www.ecy.wa.gov/pubs/97323a.pdf

[c] The PAET is defined as the 95th percentile of values with no significant biological effects and concentrations greater than the lowest "hit" level. It is designed as an alternative value to the Apparent Effect Threshold to reduce the effects of random error.

[d] Entry is lowest, reliable value among a compilation of PAET levels for; H – Hyalella azteca bioassay or M – Microtox bioassay.

[e] The SEL is defined as the 90th-95th percentile screening level concentration based on in-situ benthic community structure. Contaminant concentration above the SEL is likely detrimental to the majority of benthic species.

[f] SAIC and Avocet Consulting. 2002. "Phase I Report: Development of Freshwater Sediment Quality Values for Use in Washington State." September. – Prioritizing Areas for Attention – Areas exceeding the SEL are considered the highest-priority areas for biological testing. Areas between the PAET and the SEL are considered medium priority for attention, and areas between the TEL and the PAET are considered low priority. Areas below the TEL are screened out entirely. http://www.ecy.wa.gov/pubs/0209050.pdf

[g] SAIC and Avocet Consulting. 2003. "Phase II Report: Development and recommendation of SQVs for Freshwater Sediments in Washington State." September. – Recommendations for Screening – Report recommends SQVs as defined in the Phase I report be used (see note f above). http://www.ecy.wa.gov/pubs/0309088.pdf

[h] Site-specific sediment screening level for protection of groundwater (calculated using lab data).
[i] Site-speciific background soil screening level value (calculated using ProUCL v4.1.00).
[h] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[i] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[j] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).
[k] Marsh Sediment Reference Values are Sediment Background Threshold Value (Sediment BTV - calculated using ProUCL v4.1.00).

Table 37a
Marsh Surface Transect Sediment Metals Analytical Results

Sample ID	Date Collected	Metals								
		Aluminum (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)
Screening Levels	TEL [abfq]	--	5.9	0.596	35.7	--	35	--	0.174	123
	PAET [cbdfg]	--	19	97.5	340	--	240	1,400	0.16	500
	SEL [ebfg]	--	33	10	110	--	250	1,100	2	820
DEQ Action Level/RSLs/UBMC BTVs		77,000[h]	40 [i]	70[h]	3,100 [h]	58,270 [j]	1,109 [j]	4,893[j]	23 [h]	23,000[h]
Marsh Sediment RVs[k]		8,030	32.3	1.84	67.4	14,500	174	696	0.5	275
UMT1TS02 2-6	7/25/08	5560	110	18.4	573	36200	2440	4910	< 0.5	2830
UMT1TS02 6-12	7/25/08	5700	55.8	19.2	662	18200	2200	2890	< 0.5	2740
UMT1TS03 0-2	7/25/08	4940	82.6	13.9	570	31100	1780	2840	< 0.5	2060
UMT1TS03 2-6	7/25/08	4420	46.2	9.49	413	16400	1130	1500	< 0.5	1710
UMT1TS03 6-12	7/25/08	5680	33.3	10.1	263	16700	656	1210	< 0.5	1520
UMTT2TS01 0-2	7/24/08	8910	54.2	2.16	249	18700	1030	330	< 0.5	264
UMTT2TS01 2-6	7/24/08	11000	42.4	8.93	162	10500	163	314	< 0.5	585
UMTT2TS01 6-12	7/24/08	12200	18.7	2.27	109	14900	87.9	202	< 0.5	380
UMTT2TS02 0-2	7/24/08	12700	26.5	2.92	84.2	19200	125	1370	< 0.5	420
UMTT2TS02 2-6	7/24/08	13200	21.8	0.948	99.3	22800	93.0	1260	< 0.5	214
UMTT2TS02 6-12	7/24/08	10800	17.5	0.761	97.7	22400	91.8	1390	< 0.5	207
UMTT2TS03 0-2	7/24/08	8840	14.3	1.09	59.2	42800	45.2	241	< 0.5	174
UMTT2TS03 2-6	7/24/08	12500	11.3	1.36	77.8	24800	62.5	158	< 0.5	184

Notes:

mg/kg - Milligrams per kilogram
-- - No standard/screening level available
Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
- Value meets or exceeds one or more screening level.

PGREF - Reference transect on Pass Creek Marsh.
UMT2 - Transect on western edge to middle of the Upper Marsh of the Blackfoot River (moderate to low risk).
UMT1 - Transect on eastern portion of the Upper Marsh of the Blackfoot River (high risk).

[a] The TEL is calculated as the geometric mean of the 15th percentile concentration of the toxic effects data set and the median of the no-effect data set. As such it represents the concentration below which adverse effects are expected to occur only rarely. Freshwater TELs are based on benthic community metrics and toxicity texts results. Adverse biological effects rarely seen below TEL.

[b] Cubbage, James, David Batts, Scott Breidenback. 1997. "Creation and Analysis of Freshwater Sediment Quality Values in Washington State". July. http://www.ecy.wa.gov/pubs/97323a.pdf

[c] The PAET is defined as the 95th percentile of values with no significant biological effects and concentrations greater than the lowest "hit" level. It is designed as an alternative value to the Apparent Effect Threshold to reduce the effects of random error.

[d] Entry is lowest, reliable value among a compilation of PAET levels for; H – Hyalella azteca bioassay or M – Microtox bioassay.

[e] The SEL is defined as the 90th-95th percentile screening level concentration based on in-situ benthic community structure. Contaminant concentration above the SEL is likely detrimental to the majority of benthic species.

[f] SAIC and Avocet Consulting. 2002. "Phase I Report: Development of Freshwater Sediment Quality Values for Use in Washington State." September. – Prioritizing Areas for Attention – Areas exceeding the SEL are considered the highest-priority areas for biological testing. Areas between the PAET and the SEL are considered medium priority for attention, and areas between the TEL and the PAET are considered low priority. Areas below the TEL are screened out entirely. http://www.ecy.wa.gov/pubs/0209050.pdf

[g] SAIC and Avocet Consulting. 2003. "Phase II Report: Development and recommendation of SQVs for Freshwater Sediments in Washington State." September. – Recommendations for Screening – Report recommends SQVs as defined in the Phase I report be used (see note f above). http://www.ecy.wa.gov/pubs/0309088.pdf

[h] Site-specific sediment screening level for protection of groundwater (calculated using lab data).

[i] Site-speciific background soil screening level value (calculated using ProUCL v4.1.00).

[h] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).

[i] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).

[j] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).

[k] Marsh Sediment Reference Values are Sediment Background Threshold Value (Sediment BTV - calculated using ProUCL v4.1.00).

Table 37a
Marsh Surface Transect Sediment Metals Analytical Results

Sample ID	Date Collected	Metals								
		Aluminum (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)
Screening Levels	TEL [abfq]	--	5.9	0.596	35.7	--	35	--	0.174	123
	PAET [cbdfg]	--	19	97.5	340	--	240	1,400	0.16	500
	SEL [ebfg]	--	33	10	110	--	250	1,100	2	820
DEQ Action Level/RSLs/UBMC BTVs		77,000[h]	40 [i]	70[h]	3,100 [h]	58,270 [j]	1,109 [j]	4,893[j]	23 [h]	23,000[h]
Marsh Sediment RVs[k]		8,030	32.3	1.84	67.4	14,500	174	696	0.5	275
UMTT2TS03 6-12	7/24/08	10800	17.2	0.341	112	35400	51.8	300	< 0.5	186

Notes:

mg/kg - Milligrams per kilogram
-- - No standard/screening level available
Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
- Value meets or exceeds one or more screening level.

PGREF - Reference transect on Pass Creek Marsh.
UMT2 - Transect on western edge to middle of the Upper Marsh of the Blackfoot River (moderate to low risk).
UMT1 - Transect on eastern portion of the Upper Marsh of the Blackfoot River (high risk).

[a] The TEL is calculated as the geometric mean of the 15th percentile concentration of the toxic effects data set and the median of the no-effect data set. As such it represents the concentration below which adverse effects are expected to occur only rarely. Freshwater TELs are based on benthic community metrics and toxicity texts results. Adverse biological effects rarely seen below TEL.

[b] Cubbage, James, David Batts, Scott Breidenback. 1997. "Creation and Analysis of Freshwater Sediment Quality Values in Washington State". July. http://www.ecy.wa.gov/pubs/97323a.pdf

[c] The PAET is defined as the 95th percentile of values with no significant biological effects and concentrations greater than the lowest "hit" level. It is designed as an alternative value to the Apparent Effect Threshold to reduce the effects of random error.

[d] Entry is lowest, reliable value among a compilation of PAET levels for; H – Hyalella azteca bioassay or M – Microtox bioassay.

[e] The SEL is defined as the 90th-95th percentile screening level concentration based on in-situ benthic community structure. Contaminant concentration above the SEL is likely detrimental to the majority of benthic species.

[f] SAIC and Avocet Consulting. 2002. "Phase I Report: Development of Freshwater Sediment Quality Values for Use in Washington State." September. – Prioritizing Areas for Attention – Areas exceeding the SEL are considered the highest-priority areas for biological testing. Areas between the PAET and the SEL are considered medium priority for attention, and areas between the TEL and the PAET are considered low priority. Areas below the TEL are screened out entirely. http://www.ecy.wa.gov/pubs/0209050.pdf

[g] SAIC and Avocet Consulting. 2003. "Phase II Report: Development and recommendation of SQVs for Freshwater Sediments in Washington State." September. – Recommendations for Screening – Report recommends SQVs as defined in the Phase I report be used (see note f above). http://www.ecy.wa.gov/pubs/0309088.pdf

[h] Site-specific sediment screening level for protection of groundwater (calculated using lab data).
[i] Site-speciific background soil screening level value (calculated using ProUCL v4.1.00).
[h] EPA Region 9 Regional Screening Level (RSL) for residential soil (November 2012).
[i] DEQ Action Level for Arsenic in Surface Soil (DEQ Remediation Division, 2005).
[j] Soil Background Threshold Value (Soil BTV - calculated using ProUCL v4.1.00).
[k] Marsh Sediment Reference Values are Sediment Background Threshold Value (Sediment BTV - calculated using ProUCL v4.1.00).

Table 37b
Marsh Surface Transect Sediment ABA and SPLP Analytical Results

Sample ID	Date Collected	Specific Conductance (µmhos/cm)	pH (s.u.)	TOC (%)	Acid - Base Accounting								Synthetic Precipitation Leaching Procedure								
					Sulfur, Hot Water Extractable (%)	Total Sulfur (%)	Sulfur Sulfate (%)	Sulfur Pyritic (%)	Sulfur Organic (%)	Neutral Potential (t/kt)	Acid Potential (t/kt)	Acid/Base Potential (t/kt)	Aluminum (mg/L)	Arsenic (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Zinc (mg/L)
Marsh SPLP		--	--	--	--	--	--	--	--	--	--	--	--	**0.01**	**0.005**	**1.3**	**11**	**0.015**	**0.32**	**0.002**	**2.0**
PGREFTS01 0-2	7/24/08	0.34	6.2	3.4	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	10	< 0.01	10	7.1	0.008	0.0004	0.023	4.8	0.031	0.035	< 0.0001	0.11
PGREFTS01 2-6	7/24/08	0.24	6.0	3.1																	
PGREFTS01 6-12	7/24/08	0.26	6.0	3.2	< 0.01	0.02	0.02	< 0.01	< 0.01	9	0.62	9	7.7	0.016	0.00061	0.020	9.6	0.058	0.041	< 0.0001	0.09
PGREFTS02 0-2	7/24/08	0.46	6.1	7.8																	
PGREFTS02 2-6	7/24/08	0.39	6.1	7.5	0.04	0.04	< 0.01	0.03	< 0.01	13	1.4	11	6.5	0.023	0.00021	0.024	8.0	0.038	0.061	< 0.0001	0.07
PGREFTS02 6-12	7/24/08	0.30	6.5	5.8																	
PGREFTS03 0-2	7/24/08	0.24	6.6	4.4	0.01	0.06	0.05	< 0.01	< 0.01	12	0.97	11	5.8	0.014	< 0.0003	0.015	7.2	0.12	0.14	< 0.0001	0.08
PGREFTS03 2-6	7/24/08	0.22	6.7	4.0																	
PGREFTS03 6-12	7/24/08	0.24	6.0	4.9	0.01	0.05	0.03	0.01	< 0.01	10	1.3	8	8.2	0.014	< 0.0004	0.013	8.5	0.054	0.23	< 0.0001	0.10
UMT1TS01 0-2	7/25/08	0.52	5.3	4.4																	
UMT1TS01 2-6	7/25/08	0.48	5.4	3.5	0.04	0.14	< 0.01	0.10	< 0.01	6	3.0	3	13	0.026	< 0.0006	0.087	11	0.057	0.13	0.00019	0.22
UMT1TS01 6-12	7/25/08	0.46	5.5	3.4																	
UMT1TS02 0-2	7/25/08	1.50	6.4	3.9	1.4	7.3	< 0.01	5.5	0.41	93	230	-140	2.8	0.027	0.0012	0.10	3.1	0.56	0.28	0.00022	0.20
UMT1TS02 2-6	7/25/08	1.58	6.2	4.0																	
UMT1TS02 6-12	7/25/08	1.65	6.2	4.6	< 0.01	3.0	< 0.01	2.6	0.41	32	93	-60	2.5	0.055	0.0042	0.17	2.9	1.3	0.042	0.00014	0.63
UMT1TS03 0-2	7/25/08	0.53	6.8	2.9																	
UMT1TS03 2-6	7/25/08	0.46	6.8	4.2	3.35	3.35	< 0.01	3.24	.11	38	100	-67	2.6	0.007	0.0014	0.18	2.1	0.17	0.038	< 0.0001	0.40
UMT1TS03 6-12	7/25/08	0.37	6.8	3.7																	
UMTT2TS01 0-2	7/24/08	0.41	3.7	4.2																	
UMTT2TS01 2-6	7/24/08	0.38	4.4	3.5	< 0.01	0.02	< 0.01	< 0.01	< 0.01	3	0.57	2	5.0	0.004	< 0.0002	0.029	2.3	0.022	0.040	< 0.0001	0.11
UMTT2TS01 6-12	7/24/08	0.48	4.5	2.6																	
UMTT2TS02 0-2	7/24/08	0.29	5.3	3.7	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	6	0.15	6	18	0.028	< 0.0007	0.071	19	0.095	0.52	< 0.0001	0.32
UMTT2TS02 2-6	7/24/08	0.36	5.7	2.5																	
UMTT2TS02 6-12	7/24/08	0.61	4.9	2.8	0.03	0.03	< 0.01	< 0.01	< 0.01	8	0.33	8	16	0.020	< 0.0004	0.093	25	0.071	0.56	< 0.0001	0.23
UMTT2TS03 0-2	7/24/08	0.42	5.3	4.9																	
UMTT2TS03 2-6	7/24/08	0.49	5.2	3.6	0.06	0.31	< 0.01	0.20	0.04	6	7.3	-2	12	0.016	< 0.0006	0.096	25	0.068	0.13	< 0.0001	0.19
UMTT2TS03 6-12	7/24/08	0.39	5.1	3.1																	

Notes:

µmhos/cm - Micromho per liter
s.u. - Standard units
% - Percent
t/kt - Tons per thousand tons
mg/kg - Milligrams per kilogram
mg/L - Milligrams per liter
-- - No standard/screening level available
Blank - No data/not analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
M% - Matrix spike recoveries exceed acceptable limits.
J - The associated value is an estimated quantity.

Classification	Criteria for Classification [b]
Potentially Acid Generating	NP:AP [a] < 1 and NNP < -20 tons/kton
Uncertain Acid Generation Potential	NP:AP between 1 and 3 and/or NNP between -20 and +20 tons/kton
Unlikely to Generate Acid	NP:AP > 3 and NNP < +20 tons/kton

PGREF - Reference transect on Pass Creek Marsh.
UMT2 - Transect on western edge to middle of the Upper Marsh of the Blackfoot River (moderate to low risk).
UMT1 - Transect on eastern portion of the Upper Marsh of the Blackfoot River (high risk).

[a] NP = Neutralization Potenital, AP = Acidification Potential, NNP = Net Neutralization Potential.

[b] From BLM (1996) and EPA (1994).

Aluminum and iron were not sampled in 2007.

*Iron and manganese SPLP Leachate Criterion for soil were calculated based on a DAF 1 and their respective EPA Tap Water standards. The SPLP Leachate Criterion for Soil for the remaining metals were calculated based on a DAF 1 and their respective DEQ-7 water quality standards (see Section 4 of RI report).

Table 38a - 2007 Macroinvertebrate Taxonomic Community Analysis Data

ASL ID	EcoA ID	Site ID	Matrix	Analyte	ReportResult	Units	Detect Limit	Analysis Method
E0703095	5127-1	BRSW-101	Solid - Wet Weight	Chlorophyll A	53.3	µg	0.1	EPA 446.0
E0703095	5127-1	BRSW-101	Solid - Wet Weight	Chlorophyll B	18.9	µg	0.1	EPA 446.0
E0703095	5127-1	BRSW-101	Solid - Wet Weight	Chlorophyll C	12.5	µg	0.1	EPA 446.0
E0703095	5127-1	BRSW-101	Solid - Wet Weight	Pheophytin	11.8	µg	0.1	EPA 446.0
E0703096	5127-2	BRSW-17	Solid - Wet Weight	Chlorophyll A	24.0	µg	0.1	EPA 446.0
E0703096	5127-2	BRSW-17	Solid - Wet Weight	Chlorophyll B	5.7	µg	0.1	EPA 446.0
E0703096	5127-2	BRSW-17	Solid - Wet Weight	Chlorophyll C	3.9	µg	0.1	EPA 446.0
E0703096	5127-2	BRSW-17	Solid - Wet Weight	Pheophytin	7.6	µg	0.1	EPA 446.0
E0703097	5127-3	BRSW-16	Solid - Wet Weight	Chlorophyll A	25.6	µg	0.1	EPA 446.0
E0703097	5127-3	BRSW-16	Solid - Wet Weight	Chlorophyll B	6.5	µg	0.1	EPA 446.0
E0703097	5127-3	BRSW-16	Solid - Wet Weight	Chlorophyll C	5.8	µg	0.1	EPA 446.0
E0703097	5127-3	BRSW-16	Solid - Wet Weight	Pheophytin	4.6	µg	0.1	EPA 446.0
E0703098	5127-4	BRSW-106	Solid - Wet Weight	Chlorophyll A	5.2	µg	0.1	EPA 446.0
E0703098	5127-4	BRSW-106	Solid - Wet Weight	Chlorophyll B	0.5	µg	0.1	EPA 446.0
E0703098	5127-4	BRSW-106	Solid - Wet Weight	Chlorophyll C	0.1	µg	0.1	EPA 446.0
E0703098	5127-4	BRSW-106	Solid - Wet Weight	Pheophytin	1.0	µg	0.1	EPA 446.0
E0703099	5127-5	BRSW-109	Solid - Wet Weight	Chlorophyll A	15.6	µg	0.1	EPA 446.0
E0703099	5127-5	BRSW-109	Solid - Wet Weight	Chlorophyll B	2.9	µg	0.1	EPA 446.0
E0703099	5127-5	BRSW-109	Solid - Wet Weight	Chlorophyll C	2.2	µg	0.1	EPA 446.0
E0703099	5127-5	BRSW-109	Solid - Wet Weight	Pheophytin	< 0.1	µg	0.1	EPA 446.0
E0703100	5127-6	BRSW-6	Solid - Wet Weight	Chlorophyll A	10.4	µg	0.1	EPA 446.0
E0703100	5127-6	BRSW-6	Solid - Wet Weight	Chlorophyll B	1.5	µg	0.1	EPA 446.0
E0703100	5127-6	BRSW-6	Solid - Wet Weight	Chlorophyll C	< 0.1	µg	0.1	EPA 446.0
E0703100	5127-6	BRSW-6	Solid - Wet Weight	Pheophytin	0.5	µg	0.1	EPA 446.0
E0703101	5127-7	BRSW-108	Solid - Wet Weight	Chlorophyll A	3.6	µg	0.1	EPA 446.0
E0703101	5127-7	BRSW-108	Solid - Wet Weight	Chlorophyll B	0.4	µg	0.1	EPA 446.0
E0703101	5127-7	BRSW-108	Solid - Wet Weight	Chlorophyll C	< 0.1	µg	0.1	EPA 446.0
E0703101	5127-7	BRSW-108	Solid - Wet Weight	Pheophytin	0.3	µg	0.1	EPA 446.0
E0703102	5127-8	BRSW-33	Solid - Wet Weight	Chlorophyll A	24.0	µg	0.1	EPA 446.0
E0703102	5127-8	BRSW-33	Solid - Wet Weight	Chlorophyll B	2.1	µg	0.1	EPA 446.0
E0703102	5127-8	BRSW-33	Solid - Wet Weight	Chlorophyll C	0.8	µg	0.1	EPA 446.0
E0703102	5127-8	BRSW-33	Solid - Wet Weight	Pheophytin	< 0.1	µg	0.1	EPA 446.0

Table 38a - 2007 Macroinvertebrate Taxonomic Community Analysis Data

ASL ID	EcoA ID	Site ID	Matrix	Analyte	ReportResult	Units	Detect Limit	Analysis Method
E0703103	5127-9	BRSW-12	Solid - Wet Weight	Chlorophyll A	58.5	µg	0.1	EPA 446.0
E0703103	5127-9	BRSW-12	Solid - Wet Weight	Chlorophyll B	4.5	µg	0.1	EPA 446.0
E0703103	5127-9	BRSW-12	Solid - Wet Weight	Chlorophyll C	3.2	µg	0.1	EPA 446.0
E0703103	5127-9	BRSW-12	Solid - Wet Weight	Pheophytin	< 0.1	µg	0.1	EPA 446.0

Table 38b - 2007 Macroinvertebrate Taxonomic Community Analysis Data

ASL ID	EcoA ID	Site ID	Matrix	Analyte	ReportResult	Units	MDL	Analysis Method
E0703104	5127-1	BRSW-101	Solid - Wet Weight	Sample Analyzed	119	mL		Combustion/Gravimetric
E0703104	5127-1	BRSW-101	Solid - Wet Weight	Weight - Dry Material	1.43	grams		Combustion/Gravimetric
E0703104	5127-1	BRSW-101	Solid - Wet Weight	Ash-Free Dry Weight	0.325	grams	0.001	Combustion/Gravimetric
E0703105	5127-2	BRSW-17	Solid - Wet Weight	Sample Analyzed	91.1	mL		Combustion/Gravimetric
E0703105	5127-2	BRSW-17	Solid - Wet Weight	Weight - Dry Material	0.473	grams		Combustion/Gravimetric
E0703105	5127-2	BRSW-17	Solid - Wet Weight	Ash-Free Dry Weight	0.121	grams	0.001	Combustion/Gravimetric
E0703106	5127-3	BRSW-16	Solid - Wet Weight	Sample Analyzed	85.3	mL		Combustion/Gravimetric
E0703106	5127-3	BRSW-16	Solid - Wet Weight	Weight - Dry Material	1.17	grams		Combustion/Gravimetric
E0703106	5127-3	BRSW-16	Solid - Wet Weight	Ash-Free Dry Weight	0.172	grams	0.001	Combustion/Gravimetric
E0703107	5127-4	BRSW-106	Solid - Wet Weight	Sample Analyzed	82.9	mL		Combustion/Gravimetric
E0703107	5127-4	BRSW-106	Solid - Wet Weight	Weight - Dry Material	0.302	grams		Combustion/Gravimetric
E0703107	5127-4	BRSW-106	Solid - Wet Weight	Ash-Free Dry Weight	0.051	grams	0.001	Combustion/Gravimetric
E0703108	5127-5	BRSW-109	Solid - Wet Weight	Sample Analyzed	91.3	mL		Combustion/Gravimetric
E0703108	5127-5	BRSW-109	Solid - Wet Weight	Weight - Dry Material	0.274	grams		Combustion/Gravimetric
E0703108	5127-5	BRSW-109	Solid - Wet Weight	Ash-Free Dry Weight	0.118	grams	0.001	Combustion/Gravimetric
E0703109	5127-6	BRSW-6	Solid - Wet Weight	Sample Analyzed	118	mL		Combustion/Gravimetric
E0703109	5127-6	BRSW-6	Solid - Wet Weight	Weight - Dry Material	0.113	grams		Combustion/Gravimetric
E0703109	5127-6	BRSW-6	Solid - Wet Weight	Ash-Free Dry Weight	0.052	grams	0.001	Combustion/Gravimetric
E0703110	5127-7	BRSW-108	Solid - Wet Weight	Sample Analyzed	102	mL		Combustion/Gravimetric
E0703110	5127-7	BRSW-108	Solid - Wet Weight	Weight - Dry Material	0.37	grams		Combustion/Gravimetric
E0703110	5127-7	BRSW-108	Solid - Wet Weight	Ash-Free Dry Weight	0.056	grams	0.001	Combustion/Gravimetric
E0703111	5127-8	BRSW-33	Solid - Wet Weight	Sample Analyzed	93.5	mL		Combustion/Gravimetric
E0703111	5127-8	BRSW-33	Solid - Wet Weight	Weight - Dry Material	0.11	grams		Combustion/Gravimetric
E0703111	5127-8	BRSW-33	Solid - Wet Weight	Ash-Free Dry Weight	0.052	grams	0.001	Combustion/Gravimetric
E0703112	5127-9	BRSW-12	Solid - Wet Weight	Sample Analyzed	125	mL		Combustion/Gravimetric
E0703112	5127-9	BRSW-12	Solid - Wet Weight	Weight - Dry Material	0.636	grams		Combustion/Gravimetric
E0703112	5127-9	BRSW-12	Solid - Wet Weight	Ash-Free Dry Weight	0.206	grams	0.001	Combustion/Gravimetric

Table 38c - 2007 Macroinvertebrate Taxonomic Community Analysis Data

	Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
	Site	BRSW-101	BRSW-101	BRSW-101	BRSW-102	BRSW-102	BRSW-102	BRSW-17	BRSW-17	BRSW-17	BRSW-16	BRSW-16	BRSW-16	BRSW-106
	Rep	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1
	Date	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007
	Percent Subsampled	40.65	43.67	78.13	60.24	60.24	100.00	100.00	23.98	93.46	100.00	100.00	100.00	100.00
	Habitat	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
	EcoAnalysts Sample ID	5126.1-1	5126.1-2	5126.1-3	5126.1-4	5126.1-5	5126.1-6	5126.1-7	5126.1-8	5126.1-9	5126.1-10	5126.1-11	5126.1-12	5126.1-13
Ephemeroptera	Ameletus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Baetis tricaudatus	6	4	5	2	3	2	2	1	6	15	12	2	0
	Cinygmula sp.	3	1	1	1	0	0	0	0	0	0	0	0	0
	Diphetor hageni	12	15	0	15	2	1	2	2	0	0	0	0	0
	Drunella doddsi	0	0	0	0	0	0	0	0	0	0	0	0	0
	Drunella spinifera	0	0	0	0	0	0	0	0	0	0	0	0	0
	Epeorus grandis	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemerella inermis/infrequens	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemerella sp.	0	0	1	0	0	0	0	0	0	0	0	0	0
	Ephemerellidae	0	0	0	1	0	0	0	0	1	0	0	0	0
	Rhithrogena sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
Plecoptera	Calineuria californica	0	0	0	2	0	0	0	0	0	0	0	0	0
	Capniidae	27	17	3	12	7	1	5	2	1	102	45	31	1
	Chloroperlidae	0	0	0	0	0	0	0	0	0	0	0	0	0
	Claassenia sabulosa	0	1	2	1	1	2	0	0	0	0	0	0	0
	Cultus sp.	0	0	0	0	7	0	0	0	0	0	0	0	0
	Doroneuria sp.	2	0	0	0	0	0	0	0	0	0	0	0	1
	Hesperoperla pacifica	0	1	1	1	0	0	0	1	1	0	0	0	0
	Isoperla sp.	1	0	0	0	0	0	0	0	0	0	0	0	0
	Malenka sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Megarcys sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Paraleuctra sp.	1	0	4	1	0	0	0	0	2	0	0	0	0
	Perlodidae	5	1	9	3	0	2	0	3	5	0	2	1	1
	Skwala sp.	1	0	0	2	0	1	0	0	0	0	0	0	0
	Sweltsa sp.	9	34	15	49	16	9	62	8	4	24	17	31	34
	Taeniopterygidae	0	0	0	0	0	0	0	0	0	0	0	0	0
	Yoraperla sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Zapada cinctipes	11	18	57	4	18	2	0	33	2	9	8	9	15
	Zapada columbiana	0	0	0	0	0	0	0	0	0	0	0	0	0
	Zapada frigida	0	0	0	0	0	0	0	0	0	0	0	0	0
	Zapada oregonensis gr.	0	0	0	0	0	0	0	0	0	0	0	0	0
Coleoptera	Cleptelmis addenda	0	0	0	0	0	0	0	0	1	0	0	0	0
	Heterlimnius corpulentus	3	1	0	0	0	0	0	0	0	0	0	0	0
	Heterlimnius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Narpus sp.	3	0	2	0	0	0	0	0	0	0	0	0	0
	Optioservus quadrimaculatus	0	0	1	0	0	0	1	0	0	1	0	0	0
	Oreodytes sp.	0	0	0	0	0	1	0	0	0	0	0	0	0
	Zaitzevia parvula	0	0	0	0	0	0	0	0	0	0	0	0	0
	Zaitzevia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
Diptera-Chironomidae	Brillia sp.	0	1	0	0	0	0	0	0	0	1	0	0	0
	Chaetocladius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Corynoneura sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cricotopus (Nostoc.) nostocicola	0	0	0	0	0	0	1	30	33	0	0	0	0
	Cricotopus bicinctus gr.	0	0	0	0	0	0	0	0	0	0	1	0	0
	Cricotopus sp.	0	0	2	0	0	0	0	0	1	0	0	0	0
	Diamesa sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Eukiefferiella brehmi gr.	0	0	0	0	0	0	0	9	0	0	0	0	0
	Eukiefferiella claripennis gr.	0	0	0	0	0	0	0	0	0	0	0	1	1
	Eukiefferiella devonica gr.	2	0	0	0	0	0	0	0	0	0	0	0	0
	Eukiefferiella gracei gr.	0	0	0	0	0	0	0	3	4	0	0	0	0
	Eukiefferiella pseudomontana gr.	0	0	0	0	3	0	0	0	0	0	0	0	0
	Eukiefferiella sp.	3	2	0	0	0	1	0	0	7	0	1	0	0
	Heleniella sp.	1	0	0	0	0	0	0	0	0	0	0	0	0
	Heterotrissocladius marcidus gr.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hydrobaenus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Krenosmittia sp.	1	0	0	0	0	0	0	0	0	0	0	0	0

Table 38c - 2007 Macroinvertebrate Taxonomic Community Analysis Data

	Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
	Site	BRSW-101	BRSW-101	BRSW-101	BRSW-102	BRSW-102	BRSW-102	BRSW-17	BRSW-17	BRSW-17	BRSW-16	BRSW-16	BRSW-16	BRSW-106
	Rep	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1
	Date	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007
	Percent Subsampled	40.65	43.67	78.13	60.24	60.24	100.00	100.00	23.98	93.46	100.00	100.00	100.00	100.00
	Habitat	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
	EcoAnalysts Sample ID	5126.1-1	5126.1-2	5126.1-3	5126.1-4	5126.1-5	5126.1-6	5126.1-7	5126.1-8	5126.1-9	5126.1-10	5126.1-11	5126.1-12	5126.1-13
	Larsia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Limnophyes sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Micropsectra sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Micropsectra/Tanytarsus sp.	0	1	0	0	0	0	0	0	1	0	1	0	0
	Microtendipes rydalensis gr.	5	0	1	0	3	0	27	23	19	0	0	0	0
	Natarsia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Orthocladiinae	0	0	0	0	0	0	0	0	0	0	0	0	0
	Orthocladius (Euorthocladius) sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Orthocladius Complex	68	50	0	45	10	11	28	29	28	2	24	8	0
	Orthocladius sp.	0	0	0	0	2	0	0	2	0	3	14	3	1
	Pagastia sp.	8	13	0	9	7	2	4	6	2	3	25	0	0
	Paracricotopus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Parakiefferiella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Parametriocnemus sp.	9	6	0	4	2	0	5	5	0	0	0	0	1
	Paraphaenocladius "n. sp."	0	0	0	0	0	0	0	0	0	0	0	0	0
	Parorthocladius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Polypedilum sp.	33	61	4	99	94	4	7	5	1	0	4	1	0
	Psectrocladius sp.	0	0	0	0	0	0	0	0	0	1	0	0	0
	Pseudosmittia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rheocricotopus sp.	0	0	0	1	1	0	0	0	0	0	0	0	0
	Rheotanytarsus sp.	15	7	12	49	101	24	1	14	2	0	0	0	0
	Stempellinella sp.	4	7	0	0	0	0	0	1	0	0	0	0	0
	Thienemanniella sp.	2	1	0	0	5	0	0	2	0	0	2	1	0
	Thienemannimyia gr. sp.	4	34	4	5	3	1	5	3	0	3	0	1	0
	Tokunagaia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tvetenia bavarica gr.	3	1	1	0	1	1	2	0	0	0	0	0	0
	Tvetenia discoloripes gr.	0	0	0	0	0	0	0	0	0	0	0	0	0
Diptera	Antocha sp.	8	4	20	0	3	2	2	16	64	1	4	1	0
	Bezzia/Palpomyia sp.	0	1	1	1	1	1	11	1	8	0	0	0	0
	Clinocera sp.	0	0	1	0	0	0	0	2	3	0	0	0	0
	Cryptolabis sp.	6	1	8	0	0	0	0	0	0	0	0	0	0
	Dicranota sp.	0	0	1	1	0	0	0	1	0	0	0	0	0
	Glutops sp.	0	0	2	0	0	0	0	0	0	0	0	0	0
	Hexatoma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Limnophila sp.	0	1	0	0	0	0	0	0	0	0	0	0	0
	Neoplasta sp.	0	4	1	0	3	0	1	3	2	1	1	0	1
	Oreogeton sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Oreoleptis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pericoma/Telmatoscopus sp.	0	4	1	1	0	0	3	2	1	0	0	0	0
	Simulium sp.	0	0	0	2	4	0	0	5	1	0	0	0	6
	Tipula sp.	0	0	0	0	0	0	1	0	0	0	0	0	0
	Wiedemannia sp.	1	0	0	0	2	0	0	0	0	0	0	0	0
Trichoptera	Agraylea sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Anagapetus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Arctopsyche grandis	1	3	3	2	3	0	0	4	0	0	0	0	0
	Brachycentrus americanus	5	5	16	1	2	1	2	9	8	0	0	0	0
	Ecclisomyia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glossosoma sp.	6	0	12	0	0	0	1	0	1	0	0	0	0
	Hydropsyche sp.	16	8	60	1	24	2	43	22	44	0	1	1	0
	Hydroptila sp.	0	0	0	0	0	0	1	0	0	0	3	1	0
	Lepidostoma sp.	30	4	54	5	1	4	2	1	0	0	0	0	0
	Micrasema sp.	3	0	5	0	0	0	6	55	65	0	14	1	0
	Oecetis disjuncta	2	2	0	1	2	1	0	0	0	0	0	0	0
	Parapsyche almota	0	0	0	0	0	0	0	0	0	0	0	0	0
	Parapsyche elsis	0	0	0	0	0	0	0	0	0	0	0	0	0
	Polycentropus sp.	0	0	0	0	0	0	0	0	0	0	1	0	0

Table 38c - 2007 Macroinvertebrate Taxonomic Community Analysis Data

	Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
	Site	BRSW-101	BRSW-101	BRSW-101	BRSW-102	BRSW-102	BRSW-102	BRSW-17	BRSW-17	BRSW-17	BRSW-16	BRSW-16	BRSW-16	BRSW-106
	Rep	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1
	Date	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007
	Percent Subsampled	40.65	43.67	78.13	60.24	60.24	100.00	100.00	23.98	93.46	100.00	100.00	100.00	100.00
	Habitat	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
	EcoAnalysts Sample ID	5126.1-1	5126.1-2	5126.1-3	5126.1-4	5126.1-5	5126.1-6	5126.1-7	5126.1-8	5126.1-9	5126.1-10	5126.1-11	5126.1-12	5126.1-13
	Psychoglypha sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rhyacophila betteni gr.	0	0	2	1	0	0	0	0	0	0	0	0	0
	Rhyacophila brunnea gr.	0	0	0	0	0	0	0	1	0	0	0	0	0
	Rhyacophila narvae	0	0	0	0	0	0	0	1	0	0	0	0	0
	Rhyacophila sp.	0	0	0	1	1	0	0	0	0	1	0	0	0
Annelida	Enchytraeidae	0	1	0	0	1	0	0	0	0	0	0	0	0
	Lumbriculidae	0	0	0	0	0	0	0	0	0	0	0	0	0
	Naididae	0	0	0	0	0	0	0	2	0	0	0	0	0
	Spirosperma nikolskyi	0	0	0	0	0	0	0	0	0	0	0	0	0
Acari	Acari	1	0	0	0	0	0	0	0	0	0	0	0	0
	Aturus sp.	1	0	0	1	0	0	0	0	0	0	0	0	0
	Estelloxus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hygrobates sp.	0	0	0	0	0	0	0	1	0	0	0	0	0
	Lebertia sp.	2	0	0	3	0	0	0	1	2	0	1	0	0
	Oribatei	0	0	0	0	0	0	0	0	0	0	0	0	0
	Protzia sp.	3	0	13	1	1	1	0	14	7	0	0	0	1
	Sperchon sp.	0	0	1	0	1	0	2	1	0	0	0	0	1
	Stygothrombium sp.	0	1	0	3	0	0	2	1	1	0	0	0	0
	Testudacarus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Torrenticola sp.	1	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Ostracoda	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Organisms	Nematoda	0	0	1	0	0	0	0	3	0	0	0	1	0
	Polycelis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	**328**	**316**	**327**	**331**	**335**	**77**	**229**	**328**	**328**	**167**	**181**	**94**	**64**

Table 38c - 2007 Macroinvertebrate Taxonomic Community Analysis Data

	Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
	Site	BRSW-106	BRSW-106	BRSW-21	BRSW-21	BRSW-21	BRSW-13	BRSW-13	BRSW-13	BRSW-109	BRSW-109	BRSW-109	BRSW-6	BRSW-6
	Rep	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2
	Date	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-05-2007	10-05-2007
	Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	25.00	30.96
	Habitat	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
	EcoAnalysts Sample ID	5126.1-14	5126.1-15	5126.1-16	5126.1-17	5126.1-18	5126.1-19	5126.1-20	5126.1-21	5126.1-22	5126.1-23	5126.1-24	5126.1-25	5126.1-26
Ephemeroptera	Ameletus sp.	0	0	0	0	0	0	0	0	0	0	0	1	0
	Baetis tricaudatus	0	2	1	0	0	0	0	0	0	0	0	21	4
	Cinygmula sp.	0	1	0	0	0	0	0	0	0	0	0	12	27
	Diphetor hageni	0	0	0	0	0	0	0	0	0	0	0	23	29
	Drunella doddsi	0	0	0	0	0	0	0	0	0	0	0	0	0
	Drunella spinifera	0	0	0	0	0	0	0	0	0	0	0	0	1
	Epeorus grandis	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemerella inermis/infrequens	0	0	0	0	0	0	0	0	0	0	0	21	17
	Ephemerella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemerellidae	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rhithrogena sp.	0	0	0	0	0	0	0	0	0	0	0	2	0
Plecoptera	Calineuria californica	0	0	0	0	0	0	0	0	0	0	0	0	0
	Capniidae	3	16	1	0	0	0	1	0	0	1	0	0	0
	Chloroperlidae	0	0	0	0	0	0	0	0	0	0	0	0	0
	Claassenia sabulosa	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cultus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Doroneuria sp.	0	1	0	0	0	0	0	0	0	0	0	5	0
	Hesperoperla pacifica	0	1	0	0	0	0	0	0	0	0	0	0	0
	Isoperla sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Malenka sp.	0	0	38	42	1	1	0	4	0	0	0	0	0
	Megarcys sp.	0	0	0	0	0	0	0	0	0	0	0	0	1
	Paraleuctra sp.	0	0	3	0	0	0	0	0	0	2	0	2	0
	Perlodidae	0	3	0	0	0	0	0	0	0	0	0	0	0
	Skwala sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sweltsa sp.	20	74	0	0	0	0	0	0	3	8	3	44	35
	Taeniopterygidae	0	0	0	0	0	0	0	0	0	0	0	0	0
	Yoraperla sp.	0	0	0	0	0	0	0	0	0	0	0	2	4
	Zapada cinctipes	7	62	0	0	0	1	0	0	0	0	0	14	16
	Zapada columbiana	0	0	0	0	0	0	0	0	0	0	0	1	2
	Zapada frigida	0	5	0	0	0	0	0	0	0	0	0	0	0
	Zapada oregonensis gr.	0	0	0	0	0	0	0	0	0	0	0	1	0
Coleoptera	Cleptelmis addenda	0	0	0	0	0	0	0	0	0	0	0	0	0
	Heterlimnius corpulentus	0	0	0	0	0	0	0	0	0	0	0	0	0
	Heterlimnius sp.	0	0	0	0	0	0	0	0	0	0	0	1	2
	Narpus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Optioservus quadrimaculatus	0	0	0	0	0	0	0	0	0	0	0	1	0
	Oreodytes sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Zaitzevia parvula	0	0	0	0	0	0	0	0	0	0	0	0	0
	Zaitzevia sp.	0	1	0	0	0	0	0	0	0	0	0	0	0
Diptera-Chironomidae	Brillia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chaetocladius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Corynoneura sp.	0	0	0	0	0	0	0	0	0	0	0	0	1
	Cricotopus (Nostoc.) nostocicola	0	0	0	0	0	0	0	0	0	0	0	45	14
	Cricotopus bicinctus gr.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cricotopus sp.	0	0	0	0	0	0	0	0	0	0	0	0	1
	Diamesa sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Eukiefferiella brehmi gr.	0	0	0	0	0	0	0	0	0	0	0	1	1
	Eukiefferiella claripennis gr.	0	6	0	0	0	0	0	0	0	0	0	0	0
	Eukiefferiella devonica gr.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Eukiefferiella gracei gr.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Eukiefferiella pseudomontana gr.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Eukiefferiella sp.	0	1	0	0	0	0	0	0	0	0	0	1	0
	Heleniella sp.	0	0	0	0	0	0	0	0	0	0	0	1	5
	Heterotrissocladius marcidus gr.	0	0	6	3	1	0	0	0	0	0	0	0	0
	Hydrobaenus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Krenosmittia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 38c - 2007 Macroinvertebrate Taxonomic Community Analysis Data

	Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
	Site	BRSW-106	BRSW-106	BRSW-21	BRSW-21	BRSW-21	BRSW-13	BRSW-13	BRSW-13	BRSW-109	BRSW-109	BRSW-109	BRSW-6	BRSW-6
	Rep	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2
	Date	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-05-2007	10-05-2007
	Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	25.00	30.96
	Habitat	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
	EcoAnalysts Sample ID	5126.1-14	5126.1-15	5126.1-16	5126.1-17	5126.1-18	5126.1-19	5126.1-20	5126.1-21	5126.1-22	5126.1-23	5126.1-24	5126.1-25	5126.1-26
	Larsia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Limnophyes sp.	0	0	1	1	0	1	1	0	0	0	0	0	0
	Micropsectra sp.	0	0	0	0	0	0	0	0	0	0	0	11	39
	Micropsectra/Tanytarsus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Microtendipes rydalensis gr.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Natarsia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Orthocladiinae	0	0	0	0	0	0	0	0	0	0	0	0	0
	Orthocladius (Euorthocladius) sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Orthocladius Complex	0	5	0	0	0	0	0	0	0	0	1	6	19
	Orthocladius sp.	0	1	0	0	0	0	0	0	0	0	0	2	1
	Pagastia sp.	0	1	0	0	0	0	0	0	2	2	2	8	22
	Paracricotopus sp.	0	0	0	0	0	0	0	0	0	0	0	0	5
	Parakiefferiella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Parametriocnemus sp.	0	0	0	0	0	0	0	0	0	0	0	19	14
	Paraphaenocladius "n. sp."	0	0	0	0	0	0	0	0	0	0	0	0	1
	Parorthocladius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Polypedilum sp.	0	2	12	2	3	0	0	11	0	0	0	0	0
	Psectrocladius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pseudosmittia sp.	0	0	0	1	0	2	0	1	0	0	0	0	0
	Rheocricotopus sp.	0	0	0	0	0	0	0	0	0	0	0	2	4
	Rheotanytarsus sp.	0	0	0	0	0	0	0	0	0	0	0	0	1
	Stempellinella sp.	0	1	0	0	0	0	0	0	0	0	0	0	0
	Thienemanniella sp.	0	0	0	0	0	0	0	0	0	0	0	2	0
	Thienemannimyia gr. sp.	0	4	0	0	0	0	0	0	0	0	0	0	2
	Tokunagaia sp.	0	0	0	0	0	0	0	0	0	0	0	2	14
	Tvetenia bavarica gr.	0	0	0	0	0	0	0	0	0	0	0	0	25
	Tvetenia discoloripes gr.	0	0	0	0	0	0	0	0	0	0	0	18	0
Diptera	Antocha sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bezzia/Palpomyia sp.	0	0	0	0	0	0	0	0	0	1	2	0	0
	Clinocera sp.	0	0	0	0	0	0	0	1	0	0	0	0	0
	Cryptolabis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Dicranota sp.	0	0	0	0	0	0	0	0	0	0	0	0	1
	Glutops sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hexatoma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Limnophila sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Neoplasta sp.	0	1	0	0	0	0	1	0	0	0	0	0	0
	Oreogeton sp.	0	0	1	0	0	0	0	0	0	0	0	0	0
	Oreoleptis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pericoma/Telmatoscopus sp.	0	0	0	0	0	0	0	0	0	0	0	4	1
	Simulium sp.	2	0	0	0	0	0	0	0	0	0	0	0	0
	Tipula sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Wiedemannia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichoptera	Agraylea sp.	0	0	0	0	0	0	0	0	0	0	0	0	2
	Anagapetus sp.	0	0	0	0	0	0	0	0	0	0	0	1	0
	Arctopsyche grandis	1	0	0	0	0	0	0	0	0	0	0	0	0
	Brachycentrus americanus	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ecclisomyia sp.	0	0	0	0	0	0	0	0	0	0	0	0	1
	Glossosoma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hydropsyche sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hydroptila sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lepidostoma sp.	0	0	0	0	0	0	0	0	0	0	0	1	0
	Micrasema sp.	0	0	0	0	0	0	0	0	0	0	0	1	1
	Oecetis disjuncta	0	0	0	0	0	0	0	0	0	0	0	0	0
	Parapsyche almota	0	0	0	0	0	0	0	0	0	0	0	0	0
	Parapsyche elsis	0	0	0	0	0	0	0	0	0	0	0	0	0
	Polycentropus sp.	0	2	0	0	0	0	0	0	0	0	0	0	0

Table 38c - 2007 Macroinvertebrate Taxonomic Community Analysis Data

	Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
	Site	BRSW-106	BRSW-106	BRSW-21	BRSW-21	BRSW-21	BRSW-13	BRSW-13	BRSW-13	BRSW-109	BRSW-109	BRSW-109	BRSW-6	BRSW-6
	Rep	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2
	Date	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-05-2007	10-05-2007
	Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	25.00	30.96
	Habitat	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
	EcoAnalysts Sample ID	5126.1-14	5126.1-15	5126.1-16	5126.1-17	5126.1-18	5126.1-19	5126.1-20	5126.1-21	5126.1-22	5126.1-23	5126.1-24	5126.1-25	5126.1-26
	Psychoglypha sp.	0	0	4	0	0	0	0	0	0	0	0	0	0
	Rhyacophila betteni gr.	0	0	0	0	0	0	0	0	0	0	0	0	3
	Rhyacophila brunnea gr.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rhyacophila narvae	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rhyacophila sp.	0	0	0	0	0	0	0	0	1	0	0	1	1
Annelida	Enchytraeidae	0	0	0	0	0	0	0	0	0	0	0	1	3
	Lumbriculidae	0	1	0	0	0	0	0	0	0	0	0	0	0
	Naididae	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spirosperma nikolskyi	0	0	0	0	0	0	0	0	0	0	0	0	1
Acari	Acari	0	0	0	0	0	0	0	0	0	0	0	0	0
	Aturus sp.	0	0	0	0	0	0	0	0	0	0	0	1	0
	Estelloxus sp.	0	0	0	0	0	0	0	0	0	0	0	0	1
	Hygrobates sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lebertia sp.	0	0	0	0	0	0	0	0	0	0	0	1	3
	Oribatei	0	0	0	1	0	0	0	0	0	0	0	0	0
	Protzia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperchon sp.	0	0	0	0	0	0	0	1	0	1	0	2	0
	Stygothrombium sp.	0	8	0	0	0	0	0	0	0	0	0	0	0
	Testudacarus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Torrenticola sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Ostracoda	0	0	0	0	0	0	0	0	0	0	0	16	15
Other Organisms	Nematoda	0	0	0	0	0	2	0	0	0	0	0	5	1
	Polycelis sp.	0	0	0	0	0	0	0	0	0	0	0	0	4
	TOTAL	**33**	**199**	**67**	**50**	**5**	**7**	**3**	**18**	**6**	**15**	**8**	**303**	**345**

Table 38c - 2007 Macroinvertebrate Taxonomic Community Analysis Data

	Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
	Site	BRSW-6	BRSW-108	BRSW-108	BRSW-108	BRSW-33	BRSW-33	BRSW-33	BRSW-12	BRSW-12	BRSW-12
	Rep	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
	Date	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007
	Percent Subsampled	16.67	100.00	100.00	100.00	43.67	46.95	50.00	100.00	100.00	100.00
	Habitat	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
	EcoAnalysts Sample ID	5126.1-27	5126.1-28	5126.1-29	5126.1-30	5126.1-31	5126.1-32	5126.1-33	5126.1-34	5126.1-35	5126.1-36
Ephemeroptera	Ameletus sp.	1	0	0	0	0	0	0	0	0	0
	Baetis tricaudatus	5	2	0	0	0	0	0	0	0	0
	Cinygmula sp.	1	0	0	0	3	0	2	0	0	0
	Diphetor hageni	21	1	0	1	0	0	0	0	0	0
	Drunella doddsi	0	0	0	0	0	0	1	0	0	0
	Drunella spinifera	1	0	0	0	0	0	0	0	0	0
	Epeorus grandis	0	0	0	0	0	0	1	0	0	0
	Ephemerella inermis/infrequens	14	0	0	0	0	0	0	0	0	0
	Ephemerella sp.	0	0	0	0	0	0	1	0	0	0
	Ephemerellidae	0	0	0	0	0	0	0	0	0	0
	Rhithrogena sp.	0	0	0	0	0	0	0	0	0	0
Plecoptera	Calineuria californica	0	0	0	0	0	0	0	0	0	0
	Capniidae	3	13	3	18	76	101	106	101	45	82
	Chloroperlidae	0	0	0	0	0	0	1	0	0	0
	Claassenia sabulosa	0	0	0	0	0	0	0	0	0	0
	Cultus sp.	0	0	0	0	0	0	0	0	0	0
	Doroneuria sp.	1	1	0	0	3	0	2	1	0	0
	Hesperoperla pacifica	0	0	0	0	0	0	0	0	0	0
	Isoperla sp.	0	0	0	0	0	0	0	0	0	0
	Malenka sp.	0	0	0	0	0	0	0	0	0	0
	Megarcys sp.	1	0	0	0	0	0	0	0	0	0
	Paraleuctra sp.	0	0	0	0	0	0	0	0	0	0
	Perlodidae	0	0	0	0	0	0	0	0	0	0
	Skwala sp.	0	0	0	0	0	0	0	0	0	0
	Sweltsa sp.	42	9	3	2	39	37	28	70	69	76
	Taeniopterygidae	0	0	0	0	0	0	3	1	1	0
	Yoraperla sp.	0	0	0	0	0	0	0	0	0	0
	Zapada cinctipes	6	0	0	0	18	8	19	1	1	0
	Zapada columbiana	0	0	0	0	0	0	0	0	0	0
	Zapada frigida	0	0	0	0	0	0	0	0	0	0
	Zapada oregonensis gr.	1	0	0	0	0	0	0	0	0	0
Coleoptera	Cleptelmis addenda	0	0	0	0	0	0	0	0	0	0
	Heterlimnius corpulentus	1	1	0	0	0	0	0	0	1	0
	Heterlimnius sp.	0	0	0	0	0	0	0	0	0	0
	Narpus sp.	0	0	0	0	0	0	0	0	0	0
	Optioservus quadrimaculatus	0	0	0	0	0	0	0	0	0	0
	Oreodytes sp.	0	0	0	0	0	0	0	0	0	0
	Zaitzevia parvula	0	0	0	0	0	0	1	0	0	0
	Zaitzevia sp.	0	0	0	0	0	0	0	0	0	0
Diptera-Chironomidae	Brillia sp.	0	0	0	0	2	1	0	0	0	0
	Chaetocladius sp.	0	0	0	0	0	0	0	0	2	1
	Corynoneura sp.	0	0	0	0	0	0	0	0	0	0
	Cricotopus (Nostoc.) nostocicola	56	0	0	0	0	0	0	0	0	0
	Cricotopus bicinctus gr.	0	0	0	0	0	0	0	0	0	0
	Cricotopus sp.	0	0	0	0	0	0	0	0	1	0
	Diamesa sp.	0	0	0	0	5	10	7	14	5	0
	Eukiefferiella brehmi gr.	1	0	0	0	0	0	0	2	0	0
	Eukiefferiella claripennis gr.	0	0	0	0	3	8	8	3	1	0
	Eukiefferiella devonica gr.	1	0	0	0	0	0	0	0	0	0
	Eukiefferiella gracei gr.	0	0	0	0	5	4	0	3	0	0
	Eukiefferiella pseudomontana gr.	0	0	0	0	0	0	0	0	0	0
	Eukiefferiella sp.	0	0	0	0	0	0	0	0	0	0
	Heleniella sp.	1	0	0	0	0	0	0	0	0	0
	Heterotrissocladius marcidus gr.	0	0	0	0	0	0	0	0	0	0
	Hydrobaenus sp.	1	0	0	0	0	0	0	0	0	0
	Krenosmittia sp.	0	0	0	0	0	0	0	0	0	0

Table 38c - 2007 Macroinvertebrate Taxonomic Community Analysis Data

	Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
	Site	BRSW-6	BRSW-108	BRSW-108	BRSW-108	BRSW-33	BRSW-33	BRSW-33	BRSW-12	BRSW-12	BRSW-12
	Rep	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
	Date	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007
	Percent Subsampled	16.67	100.00	100.00	100.00	43.67	46.95	50.00	100.00	100.00	100.00
	Habitat	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
	EcoAnalysts Sample ID	5126.1-27	5126.1-28	5126.1-29	5126.1-30	5126.1-31	5126.1-32	5126.1-33	5126.1-34	5126.1-35	5126.1-36
	Larsia sp.	1	0	0	0	0	0	0	0	0	0
	Limnophyes sp.	0	0	0	0	0	0	0	0	0	0
	Micropsectra sp.	27	0	0	0	0	0	0	0	0	0
	Micropsectra/Tanytarsus sp.	0	0	0	0	0	0	0	0	0	0
	Microtendipes rydalensis gr.	0	0	0	0	0	0	0	0	0	0
	Natarsia sp.	0	0	0	0	0	0	0	0	0	2
	Orthocladiinae	0	0	0	1	0	0	0	0	0	0
	Orthocladius (Euorthocladius) sp.	0	0	0	0	0	0	1	0	0	0
	Orthocladius Complex	12	0	0	0	0	0	0	0	0	0
	Orthocladius sp.	3	0	0	0	133	128	119	15	12	43
	Pagastia sp.	13	0	1	0	22	17	18	3	7	2
	Paracricotopus sp.	0	0	0	0	0	0	0	0	0	0
	Parakiefferiella sp.	1	0	0	0	0	5	2	2	0	43
	Parametriocnemus sp.	27	2	0	0	0	0	0	0	0	0
	Paraphaenocladius "n. sp."	2	0	0	0	0	0	0	0	0	0
	Parorthocladius sp.	0	0	0	0	0	0	1	0	0	0
	Polypedilum sp.	3	0	0	0	0	0	0	0	0	0
	Psectrocladius sp.	0	1	0	0	0	0	0	0	0	0
	Pseudosmittia sp.	0	0	0	0	0	0	0	0	0	0
	Rheocricotopus sp.	7	0	0	2	0	0	0	0	0	0
	Rheotanytarsus sp.	0	0	0	0	0	0	0	0	0	0
	Stempellinella sp.	2	0	0	0	0	0	0	0	0	0
	Thienemanniella sp.	2	0	0	0	0	5	6	1	0	0
	Thienemannimyia gr. sp.	1	1	0	2	0	0	0	0	0	1
	Tokunagaia sp.	3	0	0	0	0	0	0	0	1	0
	Tvetenia bavarica gr.	6	0	0	0	0	0	0	0	0	0
	Tvetenia discoloripes gr.	0	1	0	0	0	0	0	0	0	0
Diptera	Antocha sp.	0	0	0	0	0	0	0	0	0	0
	Bezzia/Palpomyia sp.	0	1	0	1	1	3	1	4	5	10
	Clinocera sp.	0	0	0	0	0	0	0	0	0	0
	Cryptolabis sp.	0	0	0	0	0	0	0	0	0	0
	Dicranota sp.	0	0	0	0	0	0	0	0	0	2
	Glutops sp.	1	0	0	0	0	0	0	0	0	0
	Hexatoma sp.	0	0	0	0	0	1	0	0	0	0
	Limnophila sp.	0	0	0	0	0	0	0	0	0	0
	Neoplasta sp.	0	0	0	0	8	4	1	2	9	2
	Oreogeton sp.	0	0	0	0	0	0	0	0	0	0
	Oreoleptis sp.	0	0	0	0	1	0	0	0	0	0
	Pericoma/Telmatoscopus sp.	5	0	0	0	0	0	0	0	0	0
	Simulium sp.	0	0	0	0	0	0	0	4	0	0
	Tipula sp.	0	0	0	0	0	0	0	0	0	0
	Wiedemannia sp.	0	0	0	0	0	0	0	0	0	0
Trichoptera	Agraylea sp.	0	0	0	0	0	0	0	0	0	0
	Anagapetus sp.	0	0	0	0	0	0	0	0	0	0
	Arctopsyche grandis	0	0	0	0	0	0	0	0	0	0
	Brachycentrus americanus	0	1	0	0	0	1	1	0	0	0
	Ecclisomyia sp.	3	0	0	0	0	0	0	0	0	0
	Glossosoma sp.	0	0	0	0	0	0	0	0	0	0
	Hydropsyche sp.	0	0	0	0	0	0	0	0	0	0
	Hydroptila sp.	0	0	0	0	0	0	0	0	0	0
	Lepidostoma sp.	0	0	0	0	0	0	0	0	0	0
	Micrasema sp.	0	0	0	0	0	0	0	0	0	0
	Oecetis disjuncta	0	0	0	0	0	0	0	0	0	0
	Parapsyche almota	0	0	0	0	0	0	0	1	1	0
	Parapsyche elsis	0	0	0	0	0	0	0	0	0	1
	Polycentropus sp.	0	0	0	0	0	0	0	0	0	0

Table 38c - 2007 Macroinvertebrate Taxonomic Community Analysis Data

	Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
	Site	BRSW-6	BRSW-108	BRSW-108	BRSW-108	BRSW-33	BRSW-33	BRSW-33	BRSW-12	BRSW-12	BRSW-12
	Rep	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
	Date	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007
	Percent Subsampled	16.67	100.00	100.00	100.00	43.67	46.95	50.00	100.00	100.00	100.00
	Habitat	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
	EcoAnalysts Sample ID	5126.1-27	5126.1-28	5126.1-29	5126.1-30	5126.1-31	5126.1-32	5126.1-33	5126.1-34	5126.1-35	5126.1-36
	Psychoglypha sp.	0	0	0	0	0	0	0	0	0	0
	Rhyacophila betteni gr.	0	0	0	0	1	1	0	0	4	0
	Rhyacophila brunnea gr.	0	0	0	0	1	2	1	0	1	2
	Rhyacophila narvae	1	0	0	0	0	0	0	0	0	0
	Rhyacophila sp.	0	0	0	0	0	0	0	0	0	0
Annelida	Enchytraeidae	4	0	0	0	0	0	0	0	0	0
	Lumbriculidae	0	0	0	0	0	0	0	0	0	0
	Naididae	0	0	0	0	0	0	0	0	0	0
	Spirosperma nikolskyi	0	0	0	0	0	0	0	0	0	0
Acari	Acari	0	0	0	0	0	0	0	0	0	0
	Aturus sp.	1	0	0	0	0	0	0	0	0	0
	Estelloxus sp.	0	0	0	0	0	0	0	0	0	0
	Hygrobates sp.	0	1	0	0	0	0	0	0	0	0
	Lebertia sp.	2	0	0	0	1	2	0	1	3	0
	Oribatei	0	0	0	0	0	0	0	0	0	0
	Protzia sp.	0	1	0	0	0	0	0	0	0	0
	Sperchon sp.	1	0	0	1	4	1	3	1	14	2
	Stygothrombium sp.	0	0	0	0	0	0	1	0	0	0
	Testudacarus sp.	0	0	0	0	0	0	0	0	1	0
	Torrenticola sp.	0	0	0	0	0	0	0	0	0	0
Crustacea	Ostracoda	32	0	0	0	0	0	0	0	0	0
Other Organisms	Nematoda	3	2	0	0	4	3	2	0	1	0
	Polycelis sp.	0	0	0	0	0	0	0	1	0	0
	TOTAL	**321**	**38**	**7**	**28**	**330**	**342**	**337**	**231**	**185**	**269**

Table 38d - 2007 Macroinverebrate Taxonomic Community Analysis Data

Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
Site	BRSW-101	BRSW-101	BRSW-101	BRSW-102	BRSW-102	BRSW-102	BRSW-17	BRSW-17	BRSW-17
Rep	R1	R2	R3	R1	R2	R3	R1	R2	R3
Date	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007
Percent Subsampled	40.65	43.67	78.13	60.24	60.24	100.00	100.00	23.98	93.46
Habitat	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
EcoAnalysts Sample ID	5126.1-1	5126.1-2	5126.1-3	5126.1-4	5126.1-5	5126.1-6	5126.1-7	5126.1-8	5126.1-9
Abundance Measures									
Corrected Abundance	806.88	723.64	418.56	549.46	556.10	77.00	229.00	1367.76	350.96
EPT Abundance	346.86	261.06	320.00	175.96	144.42	28.00	126.00	596.31	149.80
Dominance Measures									
Dominant Taxon	Orthocladius Complex	Polypedilum sp.	Hydropsyche sp.	Polypedilum sp.	Rheotanytarsus sp.	Rheotanytarsus sp.	Sweltsa sp.	Micrasema sp.	Micrasema sp.
Dominant Abundance	167.28	139.69	76.80	164.34	167.66	24.00	62.00	229.35	69.55
2nd Dominant Taxon	Polypedilum sp.	Orthocladius Complex	Zapada cinctipes	Sweltsa sp.	Polypedilum sp.	Orthocladius Complex	Hydropsyche sp.	Zapada cinctipes	Antocha sp.
2nd Dominant Abundance	81.18	114.50	72.96	81.34	156.04	11.00	43.00	137.61	68.48
3rd Dominant Taxon	Lepidostoma sp.	Sweltsa sp.	Lepidostoma sp.	Rheotanytarsus sp.	Hydropsyche sp.	Sweltsa sp.	Orthocladius Complex	Cricotopus (Nostoc.) nostocico	Hydropsyche sp.
3rd Dominant Abundance	73.80	77.86	69.12	81.34	39.84	9.00	28.00	125.10	47.08
% Dominant Taxon	20.73	19.30	18.35	29.91	30.15	31.17	27.07	16.77	19.82
% 2 Dominant Taxa	30.79	35.13	35.78	44.71	58.21	45.45	45.85	26.83	39.33
% 3 Dominant Taxa	39.94	45.89	52.29	59.52	65.37	57.14	58.08	35.98	52.74
Richness Measures									
Species Richness	42.00	35.00	36.00	35.00	33.00	23.00	27.00	41.00	32.00
EPT Richness	18.00	14.00	17.00	20.00	13.00	12.00	10.00	14.00	12.00
Ephemeroptera Richness	3.00	3.00	3.00	4.00	2.00	2.00	2.00	2.00	2.00
Plecoptera Richness	8.00	6.00	7.00	9.00	5.00	6.00	2.00	5.00	6.00
Trichoptera Richness	7.00	5.00	7.00	7.00	6.00	4.00	6.00	7.00	4.00
Chironomidae Richness	14.00	12.00	6.00	7.00	12.00	7.00	9.00	13.00	10.00
Oligochaeta Richness	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00
Non-Chiro. Non-Olig. Richness	28.00	22.00	30.00	28.00	20.00	16.00	18.00	27.00	22.00
Rhyacophila Richness	0.00	0.00	1.00	2.00	1.00	0.00	0.00	2.00	0.00
Community Composition									
% Ephemeroptera	6.40	6.33	2.14	5.74	1.49	3.90	1.75	0.91	2.13
% Plecoptera	17.38	22.78	27.83	22.66	14.63	22.08	29.26	14.33	4.57
% Trichoptera	19.21	6.96	46.48	3.63	9.85	10.39	24.02	28.35	35.98
% EPT	42.99	36.08	76.45	32.02	25.97	36.36	55.02	43.60	42.68
% Coleoptera	1.83	0.32	0.92	0.00	0.00	1.30	0.44	0.00	0.30
% Diptera	52.74	62.97	18.04	65.56	73.13	61.04	42.79	49.39	53.96
% Oligochaeta	0.00	0.32	0.00	0.00	0.30	0.00	0.00	0.61	0.00
% Baetidae	5.49	6.01	1.53	5.14	1.49	3.90	1.75	0.91	1.83
% Brachycentridae	2.44	1.58	6.42	0.30	0.60	1.30	3.49	19.51	22.26
% Chironomidae	48.17	58.23	7.34	64.05	69.25	57.14	34.93	40.24	29.88
% Ephemerellidae	0.00	0.00	0.31	0.30	0.00	0.00	0.00	0.00	0.30
% Hydropsychidae	5.18	3.48	19.27	0.91	8.06	2.60	18.78	7.93	13.41
% Odonata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Perlidae	0.61	0.63	0.92	1.21	0.30	2.60	0.00	0.30	0.30
% Pteronarcyidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Simuliidae	0.00	0.00	0.00	0.60	1.19	0.00	0.00	1.52	0.30
Functional Group Composition									
% Filterers	12.80	7.28	28.13	16.62	40.90	35.06	31.88	23.48	22.56
% Gatherers	40.55	34.81	9.17	23.56	11.94	25.97	20.96	24.39	35.06
% Predators	9.45	24.68	16.51	22.66	10.75	23.38	36.24	13.72	10.06
% Scrapers	2.74	0.32	4.28	0.30	0.00	0.00	0.87	0.00	0.30
% Shredders	33.84	32.28	41.90	36.56	35.82	14.29	9.61	38.41	32.01
% Piercer-Herbivores	0.00	0.00	0.00	0.00	0.00	0.00	0.44	0.00	0.00
% Unclassified	0.61	0.63	0.00	0.30	0.60	1.30	0.00	0.00	0.00
Filterer Richness	5.00	4.00	5.00	5.00	6.00	3.00	4.00	6.00	5.00
Gatherer Richness	15.00	14.00	6.00	8.00	12.00	7.00	8.00	13.00	10.00
Predator Richness	12.00	9.00	14.00	15.00	10.00	8.00	6.00	16.00	9.00
Scraper Richness	2.00	1.00	3.00	1.00	0.00	0.00	2.00	0.00	1.00
Shredder Richness	7.00	6.00	8.00	5.00	4.00	4.00	6.00	6.00	7.00
Piercer-Herbivore Richness	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
Unclassified	1.00	1.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00
Diversity/Evenness Measures									
Shannon-Weaver H' (log 10)	1.32	1.18	1.17	1.02	1.00	1.08	1.04	1.30	1.10
Shannon-Weaver H' (log 2)	4.38	3.94	3.89	3.39	3.33	3.58	3.46	4.33	3.65
Shannon-Weaver H' (log e)	3.03	2.73	2.69	2.35	2.31	2.48	2.40	3.00	2.53
Margalef's Richness	6.13	5.16	5.80	5.39	5.06	5.06	4.78	5.54	5.29
Pielou's J'	0.81	0.77	0.75	0.66	0.66	0.79	0.73	0.81	0.73
Simpson's Heterogeneity	0.92	0.90	0.90	0.84	0.82	0.87	0.86	0.93	0.88
Biotic Indices									
% Indiv. w/ HBI Value	95.43	97.15	92.66	96.98	97.61	96.10	93.01	93.29	93.90
Hilsenhoff Biotic Index	3.89	4.02	2.59	4.27	4.94	4.14	3.43	3.93	3.78
% Indiv. w/ MTI Value	66.77	67.72	84.10	67.37	87.46	67.53	41.92	69.82	75.00
Metals Tolerance Index	2.80	3.41	3.03	2.94	2.92	2.56	4.14	3.49	3.93
% Indiv. w/ FSBI Value	27.44	31.33	63.00	25.98	24.78	25.97	55.02	49.70	61.28

Table 38d - 2007 Macroinverebrate Taxonomic Community Analysis Data

Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
Site	BRSW-101	BRSW-101	BRSW-101	BRSW-102	BRSW-102	BRSW-102	BRSW-17	BRSW-17	BRSW-17
Rep	R1	R2	R3	R1	R2	R3	R1	R2	R3
Date	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007	10-03-2007
Percent Subsampled	40.65	43.67	78.13	60.24	60.24	100.00	100.00	23.98	93.46
Habitat	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
EcoAnalysts Sample ID	5126.1-1	5126.1-2	5126.1-3	5126.1-4	5126.1-5	5126.1-6	5126.1-7	5126.1-8	5126.1-9
Fine Sediment Biotic Index	82.00	67.00	96.00	80.00	57.00	39.00	57.00	76.00	62.00
FSBI - average	1.95	1.91	2.67	2.29	1.73	1.70	2.11	1.85	1.94
FSBI - weighted average	4.83	4.37	4.70	4.22	4.61	4.50	4.47	4.40	5.02
% Indiv. w/ TPM Value	92.07	96.20	89.60	95.47	94.63	90.91	79.91	83.84	87.50
Temp. Pref. Metric - average	4.14	4.03	3.69	3.43	3.21	3.35	3.41	3.78	4.06
TPM - weighted average	5.00	4.42	4.30	4.19	3.45	4.46	5.04	4.95	4.76
Karr BIBI Metrics									
Long-Lived Taxa Richness	7.00	5.00	8.00	6.00	3.00	2.00	4.00	4.00	5.00
Clinger Richness	25.00	17.00	24.00	22.00	18.00	14.00	14.00	19.00	20.00
% Clingers	54.88	57.91	73.09	75.83	87.46	70.13	70.74	63.11	70.73
Intolerant Taxa Richness	13.00	8.00	13.00	14.00	8.00	7.00	6.00	11.00	10.00
% Tolerant Individuals	0.00	0.14	0.00	0.00	0.18	0.00	0.00	0.00	0.00
% Tolerant Taxa	2.38	2.86	0.00	0.00	6.06	0.00	0.00	4.88	3.13
Coleoptera Richness	2.00	1.00	2.00	0.00	0.00	1.00	1.00	0.00	1.00
Montana DEQ Metrics									
MT Biotic Index	3.89	4.02	2.59	4.27	4.94	4.14	3.43	3.93	3.78
C-Gatherers + C- Filterers	53.35	42.09	37.31	40.18	52.84	61.04	52.84	47.87	57.62
% Scraper + %Shredder	36.59	32.59	46.18	36.86	35.82	14.29	10.48	38.41	32.32
% Univoltine	50.30	41.46	28.75	26.59	16.12	35.06	25.76	20.12	20.43
% Multivoltine	20.43	18.67	33.64	23.26	39.70	41.56	7.86	33.84	33.84
% Semivoltine	6.71	12.66	10.09	16.92	5.97	14.29	30.57	20.73	22.26
Community Tolerance Quotient	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00
% Hydropsychinae	4.88	2.53	18.35	0.30	7.16	2.60	18.78	6.71	13.41
Lake Metrics									
% Orthocladiinae	27.13	19.30	0.92	15.11	7.16	16.88	15.72	24.39	22.26
Orthocladiinae Richness	8.00	6.00	2.00	3.00	7.00	3.00	4.00	7.00	5.00
% Chironomini	11.59	19.30	1.53	29.91	28.96	5.19	14.85	8.54	6.10
Chironomini Richness	2.00	1.00	2.00	1.00	2.00	1.00	2.00	2.00	2.00
% Tanytarsini	5.79	4.75	3.67	14.80	30.15	31.17	0.44	4.57	0.91
% Chironomus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Tanytarsus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Dicrotendipes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Dicrotendipes + Chironomus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Corbicula	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Manayunkia speciosa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Intolerant	35.46	31.27	60.07	29.28	18.96	29.73	38.50	40.52	29.87
% Intolerant Taxa (S.CA)	33.84	30.38	55.66	28.40	18.51	28.57	35.81	37.80	28.05
% Individuals w/ CAHBI value	71.34	78.48	88.99	82.78	90.75	79.22	85.15	72.56	76.83
% Intolerant Taxa (CAHBI)	43.59	35.48	55.67	32.48	16.45	32.79	41.03	46.64	33.33
% Sensitive EPT (CAHBI)	39.74	30.24	55.67	29.20	14.14	29.51	38.97	44.12	32.54
% Non-Insect Individuals	2.44	0.63	4.59	2.42	0.90	1.30	1.75	7.01	3.05
% Non-Insect Taxa	11.90	5.71	8.33	11.43	9.09	4.35	7.41	17.07	9.38
% Crustacea + Mollusca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average Abundance (per taxon)	19.21	20.68	11.63	15.70	16.85	3.35	8.48	33.36	10.97

Table 38d - 2007 Macroinverebrate Taxonomic Community Analysis Data

Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
Site	BRSW-16	BRSW-16	BRSW-16	BRSW-106	BRSW-106	BRSW-106	BRSW-21	BRSW-21	BRSW-21
Rep	R1	R2	R3	R1	R2	R3	R1	R2	R3
Date	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007
Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Habitat	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
EcoAnalysts Sample ID	5126.1-10	5126.1-11	5126.1-12	5126.1-13	5126.1-14	5126.1-15	5126.1-16	5126.1-17	5126.1-18
Abundance Measures									
Corrected Abundance	167.00	181.00	94.00	64.00	33.00	199.00	67.00	50.00	5.00
EPT Abundance	151.00	103.00	77.00	52.00	31.00	167.00	47.00	42.00	1.00
Dominance Measures									
Dominant Taxon	Capniidae	Capniidae	Capniidae	Sweltsa sp.	Sweltsa sp.	Sweltsa sp.	Malenka sp.	Malenka sp.	Polypedilum sp.
Dominant Abundance	102.00	45.00	31.00	34.00	20.00	74.00	38.00	42.00	3.00
2nd Dominant Taxon	Sweltsa sp.	Pagastia sp.	Sweltsa sp.	Zapada cinctipes	Zapada cinctipes	Zapada cinctipes	Polypedilum sp.	Heterotrissocladius marcidus g	Malenka sp.
2nd Dominant Abundance	24.00	25.00	31.00	15.00	7.00	62.00	12.00	3.00	1.00
3rd Dominant Taxon	Baetis tricaudatus	Orthocladius Complex	Zapada cinctipes	Simulium sp.	Capniidae	Capniidae	Heterotrissocladius marcidus g	Polypedilum sp.	Heterotrissocladius marcidus g
3rd Dominant Abundance	15.00	24.00	9.00	6.00	3.00	16.00	6.00	2.00	1.00
% Dominant Taxon	61.08	24.86	32.98	53.13	60.61	37.19	56.72	84.00	60.00
% 2 Dominant Taxa	75.45	38.67	65.96	76.56	81.82	68.34	74.63	90.00	80.00
% 3 Dominant Taxa	84.43	51.93	75.53	85.94	90.91	76.38	83.58	94.00	100.00
Richness Measures									
Species Richness	14.00	20.00	16.00	12.00	5.00	22.00	9.00	6.00	3.00
EPT Richness	5.00	9.00	8.00	5.00	4.00	10.00	5.00	1.00	1.00
Ephemeroptera Richness	1.00	1.00	1.00	0.00	0.00	2.00	1.00	0.00	0.00
Plecoptera Richness	3.00	4.00	4.00	5.00	3.00	7.00	3.00	1.00	1.00
Trichoptera Richness	1.00	4.00	3.00	0.00	1.00	1.00	1.00	0.00	0.00
Chironomidae Richness	6.00	8.00	6.00	3.00	0.00	8.00	3.00	4.00	2.00
Oligochaeta Richness	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
Non-Chiro. Non-Olig. Richness	8.00	12.00	10.00	9.00	5.00	13.00	6.00	2.00	1.00
Rhyacophila Richness	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Community Composition									
% Ephemeroptera	8.98	6.63	2.13	0.00	0.00	1.51	1.49	0.00	0.00
% Plecoptera	80.84	39.78	76.60	81.25	90.91	81.41	62.69	84.00	20.00
% Trichoptera	0.60	10.50	3.19	0.00	3.03	1.01	5.97	0.00	0.00
% EPT	90.42	56.91	81.91	81.25	93.94	83.92	70.15	84.00	20.00
% Coleoptera	0.60	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00
% Diptera	8.98	42.54	17.02	15.63	6.06	11.06	29.85	14.00	80.00
% Oligochaeta	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00
% Baetidae	8.98	6.63	2.13	0.00	0.00	1.01	1.49	0.00	0.00
% Brachycentridae	0.00	7.73	1.06	0.00	0.00	0.00	0.00	0.00	0.00
% Chironomidae	7.78	39.78	15.96	4.69	0.00	10.55	28.36	14.00	80.00
% Ephemerellidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Hydropsychidae	0.00	0.55	1.06	0.00	3.03	0.00	0.00	0.00	0.00
% Odonata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Perlidae	0.00	0.00	0.00	1.56	0.00	1.01	0.00	0.00	0.00
% Pteronarcyidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Simuliidae	0.00	0.00	0.00	9.38	6.06	0.00	0.00	0.00	0.00
Functional Group Composition									
% Filterers	0.00	0.55	1.06	9.38	9.09	0.00	0.00	0.00	0.00
% Gatherers	14.97	45.86	17.02	4.69	0.00	9.55	17.91	10.00	20.00
% Predators	17.37	12.15	36.17	60.94	60.61	47.24	1.49	2.00	0.00
% Scrapers	0.60	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00
% Shredders	67.07	39.78	44.68	25.00	30.30	42.71	80.60	88.00	80.00
% Piercer-Herbivores	0.00	1.66	1.06	0.00	0.00	0.00	0.00	0.00	0.00
% Unclassified	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Filterer Richness	0.00	1.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00
Gatherer Richness	6.00	8.00	6.00	3.00	0.00	9.00	4.00	3.00	1.00
Predator Richness	4.00	5.00	4.00	6.00	1.00	8.00	1.00	1.00	0.00
Scraper Richness	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
Shredder Richness	3.00	5.00	4.00	2.00	2.00	4.00	4.00	2.00	2.00
Piercer-Herbivore Richness	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
Unclassified	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity/Evenness Measures									
Shannon-Weaver H' (log 10)	0.61	1.03	0.80	0.64	0.49	0.83	0.61	0.29	0.41
Shannon-Weaver H' (log 2)	2.03	3.41	2.66	2.14	1.62	2.74	2.03	0.98	1.37
Shannon-Weaver H' (log e)	1.41	2.36	1.84	1.48	1.13	1.90	1.40	0.68	0.95
Margalef's Richness	2.54	3.65	3.30	2.64	1.14	3.97	1.90	1.28	1.24
Pielou's J'	0.53	0.79	0.66	0.60	0.70	0.61	0.64	0.38	0.86
Simpson's Heterogeneity	0.60	0.88	0.77	0.66	0.59	0.76	0.64	0.29	0.70
Biotic Indices									
% Indiv. w/ HBI Value	99.40	98.90	100.00	95.31	100.00	95.48	100.00	98.00	100.00
Hilsenhoff Biotic Index	1.51	2.65	1.81	1.36	0.88	1.68	2.91	2.49	4.80
% Indiv. w/ MTI Value	83.23	74.59	56.38	39.06	39.39	47.74	89.55	88.00	80.00
Metals Tolerance Index	1.20	3.52	1.57	3.44	2.62	2.60	1.77	1.14	3.25
% Indiv. w/ FSBI Value	30.54	32.60	48.94	87.50	90.91	73.87	64.18	84.00	20.00

Table 38d - 2007 Macroinverebrate Taxonomic Community Analysis Data

Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
Site	BRSW-16	BRSW-16	BRSW-16	BRSW-106	BRSW-106	BRSW-106	BRSW-21	BRSW-21	BRSW-21
Rep	R1	R2	R3	R1	R2	R3	R1	R2	R3
Date	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007
Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Habitat	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
EcoAnalysts Sample ID	5126.1-10	5126.1-11	5126.1-12	5126.1-13	5126.1-14	5126.1-15	5126.1-16	5126.1-17	5126.1-18
Fine Sediment Biotic Index	26.00	32.00	32.00	17.00	18.00	41.00	10.00	2.00	2.00
FSBI - average	1.86	1.60	2.00	1.42	3.60	1.86	1.11	0.33	0.67
FSBI - weighted average	4.16	4.27	3.93	3.68	3.83	3.65	2.16	2.00	2.00
% Indiv. w/ TPM Value	96.41	90.61	95.74	93.75	100.00	93.47	79.10	88.00	80.00
Temp. Pref. Metric - average	3.57	3.75	4.25	4.25	5.60	4.36	3.00	1.17	2.33
TPM - weighted average	6.47	5.95	6.30	6.05	6.18	5.76	4.42	4.86	2.75
Karr BIBI Metrics									
Long-Lived Taxa Richness	2.00	2.00	2.00	2.00	2.00	4.00	1.00	0.00	0.00
Clinger Richness	7.00	12.00	10.00	6.00	5.00	12.00	5.00	2.00	2.00
% Clingers	91.62	61.88	84.04	90.63	100.00	85.43	82.09	88.00	80.00
Intolerant Taxa Richness	4.00	5.00	5.00	5.00	4.00	7.00	4.00	1.00	1.00
% Tolerant Individuals	0.00	0.00	0.00	0.00	0.00	0.53	0.00	0.00	0.00
% Tolerant Taxa	7.14	0.00	6.25	8.33	0.00	9.09	11.11	16.67	0.00
Coleoptera Richness	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
Montana DEQ Metrics									
MT Biotic Index	1.51	2.65	1.81	1.36	0.88	1.68	2.91	2.49	4.80
C-Gatherers + C- Filterers	14.97	46.41	18.09	14.06	9.09	9.55	17.91	10.00	20.00
% Scraper + %Shredder	67.66	39.78	44.68	25.00	30.30	43.22	80.60	88.00	80.00
% Univoltine	68.86	62.43	47.87	4.69	9.09	18.09	67.16	86.00	20.00
% Multivoltine	14.97	16.02	15.96	35.94	27.27	36.18	1.49	0.00	0.00
% Semivoltine	14.97	17.13	34.04	54.69	63.64	38.69	4.48	0.00	0.00
Community Tolerance Quotient	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00
% Hydropsychinae	0.00	0.55	1.06	0.00	0.00	0.00	0.00	0.00	0.00
Lake Metrics									
% Orthocladiinae	4.19	23.20	13.83	4.69	0.00	6.53	10.45	10.00	20.00
Orthocladiinae Richness	4.00	5.00	4.00	3.00	0.00	4.00	2.00	3.00	1.00
% Chironomini	0.00	2.21	1.06	0.00	0.00	1.01	17.91	4.00	60.00
Chironomini Richness	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00
% Tanytarsini	0.00	0.55	0.00	0.00	0.00	0.50	0.00	0.00	0.00
% Chironomus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Tanytarsus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Dicrotendipes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Dicrotendipes + Chironomus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Corbicula	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Manayunkia speciosa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Intolerant	83.73	62.01	77.66	85.25	93.94	85.79	68.66	85.71	20.00
% Intolerant Taxa (S.CA)	83.23	61.33	77.66	81.25	93.94	81.91	68.66	84.00	20.00
% Individuals w/ CAHBI value	95.81	77.90	87.23	95.31	96.97	85.93	94.03	96.00	100.00
% Intolerant Taxa (CAHBI)	86.88	78.72	89.02	83.61	93.75	91.81	76.19	93.75	40.00
% Sensitive EPT (CAHBI)	85.00	60.99	89.02	83.61	93.75	91.23	66.67	87.50	20.00
% Non-Insect Individuals	0.00	0.55	1.06	3.13	0.00	4.52	0.00	2.00	0.00
% Non-Insect Taxa	0.00	5.00	6.25	16.67	0.00	9.09	0.00	16.67	0.00
% Crustacea + Mollusca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average Abundance (per taxon)	11.93	9.05	5.88	5.33	6.60	9.05	7.44	8.33	1.67

Table 38d - 2007 Macroinverebrate Taxonomic Community Analysis Data

Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
Site	BRSW-13	BRSW-13	BRSW-13	BRSW-109	BRSW-109	BRSW-109	BRSW-6	BRSW-6	BRSW-6
Rep	R1	R2	R3	R1	R2	R3	R1	R2	R3
Date	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-05-2007	10-05-2007	10-05-2007
Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00	25.00	30.96	16.67
Habitat	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
EcoAnalysts Sample ID	5126.1-19	5126.1-20	5126.1-21	5126.1-22	5126.1-23	5126.1-24	5126.1-25	5126.1-26	5126.1-27
Abundance Measures									
Corrected Abundance	7.00	3.00	18.00	6.00	15.00	8.00	1212.00	1114.35	1926.00
EPT Abundance	2.00	1.00	4.00	4.00	11.00	3.00	612.00	465.12	606.00
Dominance Measures									
Dominant Taxon	Nematoda	Neoplasta sp.	Polypedilum sp.	Sweltsa sp.	Sweltsa sp.	Sweltsa sp.	Cricotopus (Nostoc.) nostocico	Micropsectra sp.	Cricotopus (Nostoc.) nostocico
Dominant Abundance	2.00	1.00	11.00	3.00	8.00	3.00	180.00	125.97	336.00
2nd Dominant Taxon	Pseudosmittia sp.	Capniidae	Malenka sp.	Pagastia sp.	Paraleuctra sp.	Bezzia/Palpomyia sp.	Sweltsa sp.	Sweltsa sp.	Sweltsa sp.
2nd Dominant Abundance	2.00	1.00	4.00	2.00	2.00	2.00	176.00	113.05	252.00
3rd Dominant Taxon	Malenka sp.	Limnophyes sp.	Sperchon sp.	Rhyacophila sp.	Pagastia sp.	Pagastia sp.	Diphetor hageni	Diphetor hageni	Ostracoda
3rd Dominant Abundance	1.00	1.00	1.00	1.00	2.00	2.00	92.00	93.67	192.00
% Dominant Taxon	28.57	33.33	61.11	50.00	53.33	37.50	14.85	11.30	17.45
% 2 Dominant Taxa	57.14	66.67	83.33	83.33	66.67	62.50	29.37	21.45	30.53
% 3 Dominant Taxa	71.43	100.00	88.89	100.00	80.00	87.50	36.96	29.86	40.50
Richness Measures									
Species Richness	5.00	3.00	5.00	3.00	6.00	4.00	39.00	42.00	43.00
EPT Richness	2.00	1.00	1.00	2.00	3.00	1.00	17.00	15.00	14.00
Ephemeroptera Richness	0.00	0.00	0.00	0.00	0.00	0.00	6.00	5.00	6.00
Plecoptera Richness	2.00	1.00	1.00	1.00	3.00	1.00	7.00	5.00	6.00
Trichoptera Richness	0.00	0.00	0.00	1.00	0.00	0.00	4.00	5.00	2.00
Chironomidae Richness	2.00	1.00	2.00	1.00	1.00	2.00	13.00	17.00	20.00
Oligochaeta Richness	0.00	0.00	0.00	0.00	0.00	0.00	1.00	2.00	1.00
Non-Chiro. Non-Olig. Richness	3.00	2.00	3.00	2.00	5.00	2.00	25.00	23.00	22.00
Rhyacophila Richness	0.00	0.00	0.00	1.00	0.00	0.00	1.00	2.00	1.00
Community Composition									
% Ephemeroptera	0.00	0.00	0.00	0.00	0.00	0.00	26.40	22.61	13.40
% Plecoptera	28.57	33.33	22.22	50.00	73.33	37.50	22.77	16.81	16.82
% Trichoptera	0.00	0.00	0.00	16.67	0.00	0.00	1.32	2.32	1.25
% EPT	28.57	33.33	22.22	66.67	73.33	37.50	50.50	41.74	31.46
% Coleoptera	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.58	0.31
% Diptera	42.86	66.67	72.22	33.33	20.00	62.50	40.26	49.57	54.83
% Oligochaeta	0.00	0.00	0.00	0.00	0.00	0.00	0.33	1.16	1.25
% Baetidae	0.00	0.00	0.00	0.00	0.00	0.00	14.52	9.57	8.10
% Brachycentridae	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.29	0.00
% Chironomidae	42.86	33.33	66.67	33.33	13.33	37.50	38.94	48.99	52.96
% Ephemerellidae	0.00	0.00	0.00	0.00	0.00	0.00	6.93	5.22	4.67
% Hydropsychidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Odonata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Perlidae	0.00	0.00	0.00	0.00	0.00	0.00	1.65	0.00	0.31
% Pteronarcyidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Simuliidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Functional Group Composition									
% Filterers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.00
% Gatherers	42.86	33.33	5.56	33.33	13.33	37.50	45.54	55.94	55.14
% Predators	28.57	33.33	11.11	66.67	66.67	62.50	19.47	14.78	17.13
% Scrapers	0.00	0.00	0.00	0.00	0.00	0.00	5.28	8.12	0.93
% Shredders	28.57	33.33	83.33	0.00	20.00	0.00	29.04	15.94	25.86
% Piercer-Herbivores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00
% Unclassified	0.00	0.00	0.00	0.00	0.00	0.00	0.66	4.35	0.93
Filterer Richness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
Gatherer Richness	2.00	1.00	1.00	1.00	1.00	2.00	18.00	20.00	22.00
Predator Richness	1.00	1.00	2.00	2.00	3.00	2.00	7.00	9.00	11.00
Scraper Richness	0.00	0.00	0.00	0.00	0.00	0.00	4.00	2.00	3.00
Shredder Richness	2.00	1.00	2.00	0.00	2.00	0.00	9.00	7.00	6.00
Piercer-Herbivore Richness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
Unclassified	0.00	0.00	0.00	0.00	0.00	0.00	1.00	2.00	1.00
Diversity/Evenness Measures									
Shannon-Weaver H' (log 10)	0.67	0.48	0.49	0.44	0.61	0.57	1.27	1.33	1.27
Shannon-Weaver H' (log 2)	2.24	1.58	1.61	1.46	2.04	1.91	4.23	4.43	4.20
Shannon-Weaver H' (log e)	1.55	1.10	1.12	1.01	1.41	1.32	2.93	3.07	2.91
Margalef's Richness	2.06	1.82	1.38	1.12	1.85	1.44	5.35	5.84	5.55
Pielou's J'	0.96	1.00	0.69	0.92	0.79	0.95	0.80	0.82	0.77
Simpson's Heterogeneity	0.90	1.00	0.60	0.73	0.71	0.82	0.92	0.94	0.92
Biotic Indices									
% Indiv. w/ HBI Value	100.00	66.67	94.44	100.00	86.67	75.00	98.02	94.49	97.20
Hilsenhoff Biotic Index	4.86	4.50	5.06	0.33	0.23	1.33	3.93	4.16	4.71
% Indiv. w/ MTI Value	57.14	33.33	88.89	50.00	33.33	25.00	75.58	69.86	67.91
Metals Tolerance Index	3.50	0.00	3.38	6.33	3.60	9.00	3.49	2.87	3.66
% Indiv. w/ FSBI Value	28.57	0.00	27.78	66.67	53.33	37.50	51.16	42.32	32.71

Table 38d - 2007 Macroinverebrate Taxonomic Community Analysis Data

Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
Site	BRSW-13	BRSW-13	BRSW-13	BRSW-109	BRSW-109	BRSW-109	BRSW-6	BRSW-6	BRSW-6
Rep	R1	R2	R3	R1	R2	R3	R1	R2	R3
Date	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-04-2007	10-05-2007	10-05-2007	10-05-2007
Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00	25.00	30.96	16.67
Habitat	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
EcoAnalysts Sample ID	5126.1-19	5126.1-20	5126.1-21	5126.1-22	5126.1-23	5126.1-24	5126.1-25	5126.1-26	5126.1-27
Fine Sediment Biotic Index	5.00	-99.00	7.00	9.00	4.00	4.00	79.00	84.00	84.00
FSBI - average	1.00	-99.00	1.40	3.00	0.67	1.00	2.03	2.00	1.95
FSBI - weighted average	2.50	-99.00	2.60	4.25	4.00	4.00	4.37	4.43	4.30
% Indiv. w/ TPM Value	28.57	33.33	88.89	83.33	73.33	75.00	78.88	64.64	70.40
Temp. Pref. Metric - average	1.80	2.33	2.60	4.33	3.33	4.75	4.31	3.55	4.12
TPM - weighted average	4.50	7.00	3.00	6.60	6.82	6.50	5.78	5.99	5.75
Karr BIBI Metrics									
Long-Lived Taxa Richness	0.00	0.00	0.00	1.00	2.00	1.00	8.00	6.00	4.00
Clinger Richness	2.00	1.00	3.00	2.00	3.00	1.00	18.00	17.00	16.00
% Clingers	28.57	33.33	88.89	66.67	73.33	37.50	47.52	48.70	36.76
Intolerant Taxa Richness	2.00	1.00	1.00	2.00	3.00	1.00	14.00	11.00	11.00
% Tolerant Individuals	0.00	0.00	0.00	0.00	0.00	0.00	1.43	1.99	1.92
% Tolerant Taxa	20.00	33.33	0.00	0.00	0.00	0.00	7.69	11.90	11.63
Coleoptera Richness	0.00	0.00	0.00	0.00	0.00	0.00	2.00	1.00	1.00
Montana DEQ Metrics									
MT Biotic Index	4.86	4.50	5.06	0.33	0.23	1.33	3.93	4.16	4.71
C-Gatherers + C- Filterers	42.86	33.33	5.56	33.33	13.33	37.50	45.54	56.23	55.14
% Scraper + %Shredder	28.57	33.33	83.33	0.00	20.00	0.00	34.32	24.06	26.79
% Univoltine	28.57	66.67	27.78	50.00	26.67	62.50	15.84	28.41	20.87
% Multivoltine	42.86	0.00	0.00	0.00	0.00	0.00	58.09	40.00	56.70
% Semivoltine	0.00	0.00	0.00	50.00	66.67	37.50	18.81	13.04	14.02
Community Tolerance Quotient	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00
% Hydropsychinae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lake Metrics									
% Orthocladiinae	42.86	33.33	5.56	0.00	0.00	12.50	32.67	30.43	38.32
Orthocladiinae Richness	2.00	1.00	1.00	0.00	0.00	1.00	11.00	13.00	14.00
% Chironomini	0.00	0.00	61.11	0.00	0.00	0.00	0.00	0.00	0.93
Chironomini Richness	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00
% Tanytarsini	0.00	0.00	0.00	0.00	0.00	0.00	3.63	11.59	9.03
% Chironomus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Tanytarsus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Dicrotendipes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Dicrotendipes + Chironomus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Corbicula	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Manayunkia speciosa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Intolerant	28.57	50.00	23.53	100.00	100.00	83.33	35.35	31.90	27.88
% Intolerant Taxa (S.CA)	28.57	33.33	22.22	100.00	86.67	62.50	34.65	30.14	27.10
% Individuals w/ CAHBI value	71.43	100.00	94.44	100.00	100.00	87.50	59.41	66.38	66.04
% Intolerant Taxa (CAHBI)	40.00	33.33	23.53	100.00	86.67	71.43	40.00	34.50	31.60
% Sensitive EPT (CAHBI)	40.00	33.33	23.53	66.67	73.33	42.86	35.56	24.89	25.47
% Non-Insect Individuals	28.57	0.00	5.56	0.00	6.67	0.00	8.58	8.12	13.40
% Non-Insect Taxa	20.00	0.00	20.00	0.00	16.67	0.00	15.38	16.67	13.95
% Crustacea + Mollusca	0.00	0.00	0.00	0.00	0.00	0.00	5.28	4.35	9.97
Average Abundance (per taxon)	1.40	1.00	3.60	2.00	2.50	2.00	31.08	26.53	44.79

Table 38d - 2007 Macroinverebrate Taxonomic Community Analysis Data

Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
Site	BRSW-108	BRSW-108	BRSW-108	BRSW-33	BRSW-33	BRSW-33	BRSW-12	BRSW-12	BRSW-12
Rep	R1	R2	R3	R1	R2	R3	R1	R2	R3
Date	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007
Percent Subsampled	100.00	100.00	100.00	43.67	46.95	50.00	100.00	100.00	100.00
Habitat	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
EcoAnalysts Sample ID	5126.1-28	5126.1-29	5126.1-30	5126.1-31	5126.1-32	5126.1-33	5126.1-34	5126.1-35	5126.1-36
Abundance Measures									
Corrected Abundance	38.00	7.00	28.00	755.70	728.46	674.00	231.00	185.00	269.00
EPT Abundance	27.00	6.00	21.00	322.89	319.50	332.00	175.00	122.00	161.00
Dominance Measures									
Dominant Taxon	Capniidae	Capniidae	Capniidae	Orthocladius sp.	Orthocladius sp.	Orthocladius sp.	Capniidae	Sweltsa sp.	Capniidae
Dominant Abundance	13.00	3.00	18.00	304.57	272.64	238.00	101.00	69.00	82.00
2nd Dominant Taxon	Sweltsa sp.	Sweltsa sp.	Sweltsa sp.	Capniidae	Capniidae	Capniidae	Sweltsa sp.	Capniidae	Sweltsa sp.
2nd Dominant Abundance	9.00	3.00	2.00	174.04	215.13	212.00	70.00	45.00	76.00
3rd Dominant Taxon	Baetis tricaudatus	Pagastia sp.	Thienemannimyia gr. sp.	Sweltsa sp.	Sweltsa sp.	Sweltsa sp.	Orthocladius sp.	Sperchon sp.	Orthocladius sp.
3rd Dominant Abundance	2.00	1.00	2.00	89.31	78.81	56.00	15.00	14.00	43.00
% Dominant Taxon	34.21	42.86	64.29	40.30	37.43	35.31	43.72	37.30	30.48
% 2 Dominant Taxa	57.89	85.71	71.43	63.33	66.96	66.77	74.03	61.62	58.74
% 3 Dominant Taxa	63.16	100.00	78.57	75.15	77.78	75.07	80.52	69.19	74.72
Richness Measures									
Species Richness	15.00	3.00	8.00	19.00	20.00	26.00	20.00	21.00	14.00
EPT Richness	6.00	2.00	3.00	7.00	6.00	12.00	6.00	7.00	4.00
Ephemeroptera Richness	2.00	0.00	1.00	1.00	0.00	4.00	0.00	0.00	0.00
Plecoptera Richness	3.00	2.00	2.00	4.00	3.00	6.00	5.00	4.00	2.00
Trichoptera Richness	1.00	0.00	0.00	2.00	3.00	2.00	1.00	3.00	2.00
Chironomidae Richness	4.00	1.00	3.00	6.00	8.00	8.00	8.00	7.00	6.00
Oligochaeta Richness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-Chiro. Non-Olig. Richness	11.00	2.00	5.00	13.00	12.00	18.00	12.00	14.00	8.00
Rhyacophila Richness	0.00	0.00	0.00	2.00	2.00	1.00	0.00	2.00	1.00
Community Composition									
% Ephemeroptera	7.89	0.00	3.57	0.91	0.00	1.48	0.00	0.00	0.00
% Plecoptera	60.53	85.71	71.43	41.21	42.69	47.18	75.32	62.70	58.74
% Trichoptera	2.63	0.00	0.00	0.61	1.17	0.59	0.43	3.24	1.12
% EPT	71.05	85.71	75.00	42.73	43.86	49.26	75.76	65.95	59.85
% Coleoptera	2.63	0.00	0.00	0.00	0.00	0.30	0.00	0.54	0.00
% Diptera	15.79	14.29	21.43	54.55	54.39	48.66	22.94	23.24	39.41
% Oligochaeta	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Baetidae	7.89	0.00	3.57	0.00	0.00	0.00	0.00	0.00	0.00
% Brachycentridae	2.63	0.00	0.00	0.00	0.29	0.30	0.00	0.00	0.00
% Chironomidae	13.16	14.29	17.86	51.52	52.05	48.07	18.61	15.68	34.20
% Ephemerellidae	0.00	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.00
% Hydropsychidae	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.54	0.37
% Odonata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Perlidae	2.63	0.00	0.00	0.91	0.00	0.59	0.43	0.00	0.00
% Pteronarcyidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Simuliidae	0.00	0.00	0.00	0.00	0.00	0.00	1.73	0.00	0.00
Functional Group Composition									
% Filterers	2.63	0.00	0.00	0.00	0.29	0.30	1.73	0.00	0.00
% Gatherers	21.05	14.29	14.29	50.91	51.75	48.66	18.61	15.14	33.09
% Predators	42.11	42.86	21.43	18.79	15.79	11.87	35.06	58.38	36.43
% Scrapers	0.00	0.00	0.00	0.91	0.00	1.19	0.00	0.00	0.00
% Shredders	34.21	42.86	64.29	29.09	32.16	37.98	44.59	25.95	30.48
% Piercer-Herbivores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Unclassified	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.54	0.00
Filterer Richness	1.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00
Gatherer Richness	6.00	1.00	3.00	5.00	7.00	10.00	8.00	6.00	4.00
Predator Richness	7.00	1.00	4.00	9.00	9.00	9.00	8.00	10.00	9.00
Scraper Richness	0.00	0.00	0.00	1.00	0.00	3.00	0.00	0.00	0.00
Shredder Richness	1.00	1.00	1.00	3.00	3.00	3.00	3.00	4.00	1.00
Piercer-Herbivore Richness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unclassified	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
Diversity/Evenness Measures									
Shannon-Weaver H' (log 10)	0.93	0.44	0.58	0.81	0.80	0.83	0.74	0.88	0.74
Shannon-Weaver H' (log 2)	3.07	1.45	1.91	2.69	2.67	2.76	2.44	2.93	2.47
Shannon-Weaver H' (log e)	2.13	1.00	1.33	1.87	1.85	1.91	1.69	2.03	1.71
Margalef's Richness	3.85	1.03	2.10	2.72	2.88	3.84	3.49	3.83	2.32
Pielou's J'	0.79	0.91	0.64	0.63	0.62	0.59	0.56	0.67	0.65
Simpson's Heterogeneity	0.83	0.71	0.59	0.76	0.76	0.76	0.71	0.79	0.78
Biotic Indices									
% Indiv. w/ HBI Value	92.11	100.00	92.86	95.45	97.08	98.22	96.54	82.16	94.80
Hilsenhoff Biotic Index	2.03	0.57	1.81	3.38	3.41	3.23	1.70	1.26	2.49
% Indiv. w/ MTI Value	65.79	57.14	82.14	81.21	81.29	84.57	61.04	42.70	49.44
Metals Tolerance Index	1.80	2.25	0.74	3.72	3.44	3.24	1.83	2.46	1.83
% Indiv. w/ FSBI Value	39.47	42.86	10.71	19.70	14.62	16.91	33.33	41.62	30.11

Table 38d - 2007 Macroinverebrate Taxonomic Community Analysis Data

Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
Site	BRSW-108	BRSW-108	BRSW-108	BRSW-33	BRSW-33	BRSW-33	BRSW-12	BRSW-12	BRSW-12
Rep	R1	R2	R3	R1	R2	R3	R1	R2	R3
Date	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007	10-05-2007
Percent Subsampled	100.00	100.00	100.00	43.67	46.95	50.00	100.00	100.00	100.00
Habitat	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
EcoAnalysts Sample ID	5126.1-28	5126.1-29	5126.1-30	5126.1-31	5126.1-32	5126.1-33	5126.1-34	5126.1-35	5126.1-36
Fine Sediment Biotic Index	32.00	4.00	8.00	31.00	28.00	56.00	21.00	27.00	15.00
FSBI - average	2.13	1.33	1.00	1.63	1.40	2.15	1.05	1.29	1.07
FSBI - weighted average	4.60	4.00	4.00	4.00	3.96	4.05	3.97	4.12	3.98
% Indiv. w/ TPM Value	81.58	100.00	82.14	53.94	57.31	61.13	88.31	73.51	60.97
Temp. Pref. Metric - average	3.33	6.67	2.38	4.26	4.15	4.46	3.95	3.62	2.71
TPM - weighted average	6.52	6.86	6.39	6.57	6.77	6.67	6.98	7.00	6.98
Karr BIBI Metrics									
Long-Lived Taxa Richness	3.00	1.00	1.00	2.00	1.00	3.00	3.00	3.00	2.00
Clinger Richness	7.00	2.00	3.00	7.00	6.00	12.00	7.00	9.00	4.00
% Clingers	73.68	85.71	75.00	42.73	43.86	49.26	77.49	67.03	59.85
Intolerant Taxa Richness	4.00	2.00	2.00	6.00	7.00	11.00	5.00	6.00	4.00
% Tolerant Individuals	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Tolerant Taxa	6.67	0.00	0.00	10.53	10.00	3.85	15.00	4.76	7.14
Coleoptera Richness	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00
Montana DEQ Metrics									
MT Biotic Index	2.03	0.57	1.81	3.38	3.41	3.23	1.70	1.26	2.49
C-Gatherers + C- Filterers	23.68	14.29	14.29	50.91	52.05	48.96	20.35	15.14	33.09
% Scraper + %Shredder	34.21	42.86	64.29	30.00	32.16	39.17	44.59	25.95	30.48
% Univoltine	44.74	57.14	78.57	73.94	81.29	79.23	62.34	43.24	68.77
% Multivoltine	21.05	0.00	3.57	7.58	5.56	8.61	3.46	2.16	0.00
% Semivoltine	28.95	42.86	7.14	12.73	10.82	9.20	31.17	38.38	28.62
Community Tolerance Quotient	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00
% Hydropsychinae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lake Metrics									
% Orthocladiinae	10.53	0.00	10.71	43.33	44.15	40.65	11.26	9.19	32.34
Orthocladiinae Richness	3.00	0.00	2.00	4.00	6.00	6.00	6.00	5.00	3.00
% Chironomini	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chironomini Richness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Tanytarsini	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Chironomus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Tanytarsus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Dicrotendipes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Dicrotendipes + Chironomus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Corbicula	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Manayunkia speciosa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Intolerant	68.57	100.00	76.92	50.79	50.60	54.98	79.37	84.21	63.92
% Intolerant Taxa (S.CA)	63.16	100.00	71.43	48.48	49.12	54.01	76.62	69.19	60.59
% Individuals w/ CAHBI value	84.21	100.00	100.00	53.64	54.09	55.19	81.82	87.57	66.91
% Intolerant Taxa (CAHBI)	68.75	100.00	71.43	88.70	89.73	93.01	92.59	78.40	90.00
% Sensitive EPT (CAHBI)	68.75	85.71	71.43	76.27	80.54	83.33	91.01	74.07	88.89
% Non-Insect Individuals	10.53	0.00	3.57	2.73	1.75	1.78	1.30	10.27	0.74
% Non-Insect Taxa	20.00	0.00	12.50	15.79	15.00	11.54	15.00	19.05	7.14
% Crustacea + Mollusca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average Abundance (per taxon)	2.53	2.33	3.50	39.77	36.42	25.92	11.55	8.81	19.21

Table 38e - 2007 Macroinvertebrate Taxonomic Community Analysis Data

	Stream	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**
	Site	**BRSW-101**	**BRSW-102**	**BRSW-106**	**BRSW-108**	**BRSW-109**	**BRSW-12**	**BRSW-13**	**BRSW-16**	**BRSW-17**	**BRSW-21**	**BRSW-33**	**BRSW-6**
	Rep	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**
	Date	**10-03-2007**	**10-03-2007**	**10-04-2007**	**10-05-2007**	**10-04-2007**	**10-05-2007**	**10-04-2004**	**10-04-2007**	**10-03-2007**	**10-04-2007**	**10-05-2007**	**10-05-2007**
	Percent Subsampled	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
	Habitat	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**
	EcoAnalysts Sample ID	*5126.1-37*	*5126.1-38*	*5126.1-39*	*5126.1-40*	*5126.1-41*	*5126.1-42*	*5126.1-43*	*5126.1-44*	*5126.1-45*	*5126.1-46*	*5126.1-47*	*5126.1-48*
Ephemeroptera	Baetis tricaudatus	4	3	2	2	0	0	0	20	5	1	0	6
	Cinygmula sp.	3	1	1	0	0	0	0	0	0	0	1	16
	Diphetor hageni	5	7	0	2	0	0	0	0	3	0	0	18
	Drunella spinifera	0	0	0	0	0	0	0	0	0	0	0	2
	Epeorus grandis	0	0	0	0	0	0	0	0	0	0	1	0
	Ephemerella sp.	0	0	0	0	0	0	0	0	0	0	0	16
	Ephemerellidae	0	1	0	0	0	0	0	0	0	0	0	0
Plecoptera	Calineuria californica	0	1	0	0	0	0	0	0	0	0	0	0
	Capniidae	14	3	20	34	1	107	1	121	1	1	88	1
	Claassenia sabulosa	2	2	0	0	0	0	0	0	0	0	0	0
	Cultus sp.	0	2	0	0	0	0	0	0	0	0	0	0
	Doroneuria sp.	0	0	2	1	0	0	0	0	0	0	2	4
	Hesperoperla pacifica	0	1	1	0	0	0	0	0	0	0	0	0
	Isoperla sp.	1	0	0	0	0	0	0	0	0	0	0	0
	Leuctridae	3	0	0	0	2	0	0	0	1	3	0	0
	Malenka sp.	0	0	0	0	0	0	5	0	0	81	0	0
	Perlodidae	4	0	4	0	0	0	0	3	4	0	0	0
	Skwala sp.	1	3	0	0	0	0	0	0	0	0	0	0
	Sweltsa sp.	18	26	128	14	14	89	0	42	32	0	25	36
	Taeniopterygidae	0	0	0	0	0	1	0	0	0	0	1	0
	Yoraperla sp.	0	0	0	0	0	0	0	0	0	0	0	2
	Zapada cinctipes	31	11	84	0	0	1	1	18	11	0	13	14
	Zapada frigida	0	0	5	0	0	0	0	0	0	0	0	0
	Zapada oregonensis gr.	0	0	0	0	0	0	0	0	0	0	0	2
Coleoptera	Cleptelmis sp.	0	0	0	0	0	0	0	0	1	0	0	0
	Heterlimnius sp.	1	0	0	1	0	0	0	0	0	0	0	2
	Narpus sp.	2	0	0	0	0	0	0	0	0	0	0	0
	Optioservus sp.	0	0	0	0	0	0	0	1	1	0	0	0
	Oreodytes sp.	0	1	0	0	0	0	0	0	0	0	0	0
	Zaitzevia sp.	0	0	1	0	0	0	0	0	0	0	1	0
Diptera-Chironomidae	Brillia sp.	0	0	0	0	0	0	0	1	0	0	2	0
	Chaetocladius sp.	0	0	0	0	0	2	0	0	0	0	0	0
	Cricotopus (Nostoc.) nostocicola	0	0	0	0	0	0	0	0	17	0	0	35
	Cricotopus sp.	0	0	0	0	0	0	0	0	0	0	0	1
	Diamesa sp.	0	0	0	0	0	2	0	0	0	0	10	0
	Eukiefferiella brehmi gr.	0	0	0	0	0	0	0	0	3	0	0	2
	Eukiefferiella claripennis gr.	0	0	7	0	0	2	0	1	0	0	6	0
	Eukiefferiella gracei gr.	0	0	0	0	0	1	0	0	2	0	3	0
	Eukiefferiella pseudomontana gr.	0	1	0	0	0	0	0	0	0	0	0	0
	Eukiefferiella sp.	1	1	1	0	0	0	0	1	3	0	0	0
	Heleniella sp.	0	0	0	0	0	0	0	0	0	0	0	2
	Heterotrissocladius marcidus gr.	0	0	0	0	0	0	0	0	0	10	0	0
	Hydrobaenus sp.	0	0	0	0	0	0	0	0	0	0	0	1
	Krenosmittia sp.	1	0	0	0	0	0	0	0	0	0	0	0
	Limnophyes sp.	0	0	0	0	0	0	2	0	0	2	0	0
	Micropsectra sp.	0	0	0	0	0	0	0	0	0	0	0	28
	Micropsectra/Tanytarsus sp.	1	0	0	0	0	0	0	1	0	0	0	0
	Microtendipes rydalensis gr.	2	1	0	0	0	0	0	0	23	0	0	0
	Orthocladiinae	0	0	0	1	0	0	0	0	0	0	0	0
	Orthocladius Complex	42	30	5	0	1	0	0	23	31	0	0	13
	Orthocladius sp.	0	1	2	0	0	27	0	15	1	0	106	4
	Pagastia sp.	6	8	1	1	6	5	0	20	2	0	18	15
	Parakiefferiella sp.	0	0	0	0	0	20	0	0	0	0	1	1
	Parametriocnemus sp.	3	1	1	2	0	0	0	0	4	0	0	14
	Polypedilum sp.	31	71	2	0	0	0	11	3	8	17	0	0
	Psectrocladius sp.	0	0	0	1	0	0	0	1	0	0	0	0
	Pseudosmittia sp.	0	0	0	0	0	0	3	0	0	1	0	0
	Rheocricotopus sp.	0	2	0	2	0	0	0	0	0	0	0	8
	Rheotanytarsus sp.	8	76	0	0	0	0	0	0	4	0	0	0
	Stempellinella sp.	3	0	1	0	0	0	0	0	0	0	0	1
	Thienemanniella sp.	1	3	0	0	0	1	0	3	0	0	5	1
	Thienemannimyia gr. sp.	10	4	4	3	0	1	0	4	1	0	0	2
	Tokunagaia sp.	0	0	0	0	0	1	0	0	0	0	0	4
	Tvetenia bavarica gr.	2	1	0	0	0	0	0	0	1	0	0	11

Table 38e - 2007 Macroinvertebrate Taxonomic Community Analysis Data

	Stream	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**
	Site	**BRSW-101**	**BRSW-102**	**BRSW-106**	**BRSW-108**	**BRSW-109**	**BRSW-12**	**BRSW-13**	**BRSW-16**	**BRSW-17**	**BRSW-21**	**BRSW-33**	**BRSW-6**
	Rep	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**
	Date	**10-03-2007**	**10-03-2007**	**10-04-2007**	**10-05-2007**	**10-04-2007**	**10-05-2007**	**10-04-2004**	**10-04-2007**	**10-03-2007**	**10-04-2007**	**10-05-2007**	**10-05-2007**
	Percent Subsampled	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
	Habitat	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**
	EcoAnalysts Sample ID	*5126.1-37*	*5126.1-38*	*5126.1-39*	*5126.1-40*	*5126.1-41*	*5126.1-42*	*5126.1-43*	*5126.1-44*	*5126.1-45*	*5126.1-46*	*5126.1-47*	*5126.1-48*
	Tvetenia discoloripes gr.	0	0	0	1	0	0	0	0	0	0	0	1
Diptera	Antocha sp.	9	3	0	0	0	0	0	4	23	0	0	0
	Ceratopogonidae	0	1	0	2	3	10	0	0	9	0	1	0
	Clinocera sp.	1	0	0	0	0	0	1	0	0	0	0	0
	Cryptolabis sp.	3	0	0	0	0	0	0	0	0	0	0	0
	Dicranota sp.	1	1	0	0	0	1	0	0	0	0	0	1
	Limnophila sp.	1	0	0	0	0	0	0	0	0	0	0	0
	Neoplasta sp.	1	1	2	0	0	8	1	2	2	0	5	0
	Oreogeton sp.	0	0	0	0	0	0	0	0	0	1	0	0
	Pericoma/Telmatoscopus sp.	3	0	0	0	0	0	0	0	2	0	0	2
	Simulium sp.	0	5	8	0	0	3	0	0	2	0	0	0
Trichoptera	Arctopsyche sp.	1	1	1	0	0	0	0	0	3	0	0	0
	Brachycentrus sp.	8	1	0	1	0	0	0	0	7	0	1	0
	Ecclisomyia sp.	0	0	0	0	0	0	0	0	0	0	0	4
	Glossosoma sp.	7	0	0	0	0	0	0	0	1	0	0	0
	Hydropsyche sp.	28	13	0	0	0	0	0	2	36	0	0	0
	Hydroptila sp.	0	0	0	0	0	0	0	3	1	0	0	0
	Lepidostoma sp.	31	3	0	0	0	0	0	0	2	0	0	0
	Micrasema sp.	2	0	0	0	0	0	0	9	42	0	0	0
	Oecetis sp.	0	3	0	0	0	0	0	0	0	0	0	0
	Parapsyche sp.	0	0	0	0	0	2	0	0	0	0	0	0
	Polycentropus sp.	0	0	2	0	0	0	0	1	0	0	0	0
	Psychoglypha sp.	0	0	0	0	0	0	0	0	0	4	0	0
	Rhyacophila betteni gr.	0	0	0	0	0	3	0	0	0	0	1	0
	Rhyacophila brunnea gr.	0	0	0	0	0	1	0	0	0	0	1	0
	Rhyacophila sp.	0	0	0	0	1	0	0	0	0	0	0	0
Annelida	Enchytraeidae	0	1	0	0	0	0	0	0	0	0	0	2
	Lumbriculidae	0	0	1	0	0	0	0	0	0	0	0	0
	Naididae	0	0	0	0	0	0	0	0	1	0	0	0
	Spirosperma nikolskyi	0	0	0	0	0	0	0	0	0	0	0	1
Acari	Sarcoptiformes	0	0	0	0	0	0	0	0	0	1	0	0
	Trombidiformes	4	5	10	3	1	10	1	0	9	0	5	2
Crustacea	Ostracoda	0	0	0	0	0	0	0	0	0	0	0	19
Other Organisms	Nematoda	0	0	0	2	0	1	2	1	1	0	3	3
	Turbellaria	0	0	0	0	0	1	0	0	0	0	0	3
	TOTAL	**300**	**300**	**296**	**73**	**29**	**300**	**28**	**300**	**300**	**122**	**300**	**300**

Table 38f - 2007 Macroinvertebrate Taxonomic Community Analysis Data

Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
Site	**BRSW-101**	**BRSW-102**	**BRSW-106**	**BRSW-108**	**BRSW-109**	**BRSW-12**	**BRSW-13**	**BRSW-16**
Rep	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**
Date	**10-03-2007**	**10-03-2007**	**10-04-2007**	**10-05-2007**	**10-04-2007**	**10-05-2007**	**10-04-2004**	**10-04-2007**
Percent Subsampled	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Habitat	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**
EcoAnalysts Sample ID	*5126.1-37*	*5126.1-38*	*5126.1-39*	*5126.1-40*	*5126.1-41*	*5126.1-42*	*5126.1-43*	*5126.1-44*
Abundance Measures								
Corrected Abundance	300.00	300.00	296.00	73.00	29.00	300.00	28.00	300.00
EPT Abundance	163.00	82.00	250.00	54.00	18.00	204.00	7.00	219.00
Dominance Measures								
Dominant Taxon	Orthocladius Complex	Rheotanytarsus sp.	Sweltsa sp.	Capniidae	Sweltsa sp.	Capniidae	Polypedilum sp.	Capniidae
Dominant Abundance	42.00	76.00	128.00	34.00	14.00	107.00	11.00	121.00
2nd Dominant Taxon	Zapada cinctipes	Polypedilum sp.	Zapada cinctipes	Sweltsa sp.	Pagastia sp.	Sweltsa sp.	Malenka sp.	Sweltsa sp.
2nd Dominant Abundance	31.00	71.00	84.00	14.00	6.00	89.00	5.00	42.00
3rd Dominant Taxon	Lepidostoma sp.	Orthocladius Complex	Capniidae	Thienemannimyia gr. sp.	Ceratopogonidae	Orthocladius sp.	Pseudosmittia sp.	Orthocladius Complex
3rd Dominant Abundance	31.00	30.00	20.00	3.00	3.00	27.00	3.00	23.00
% Dominant Taxon	14.00	25.33	43.24	46.58	48.28	35.67	39.29	40.33
% 2 Dominant Taxa	24.33	49.00	71.62	65.75	68.97	65.33	57.14	54.33
% 3 Dominant Taxa	34.67	59.00	78.38	69.86	79.31	74.33	67.86	62.00
Richness Measures								
Species Richness	40.00	38.00	25.00	17.00	8.00	24.00	10.00	24.00
EPT Richness	17.00	17.00	11.00	6.00	4.00	7.00	3.00	9.00
Ephemeroptera Richness	3.00	4.00	2.00	2.00	0.00	0.00	0.00	1.00
Plecoptera Richness	8.00	8.00	7.00	3.00	3.00	4.00	3.00	4.00
Trichoptera Richness	6.00	5.00	2.00	1.00	1.00	3.00	0.00	4.00
Chironomidae Richness	13.00	13.00	9.00	7.00	2.00	10.00	3.00	11.00
Oligochaeta Richness	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00
Non-Chiro. Non-Olig. Richness	27.00	24.00	15.00	10.00	6.00	14.00	7.00	13.00
Rhyacophila Richness	0.00	0.00	0.00	0.00	1.00	2.00	0.00	0.00
Community Composition								
% Ephemeroptera	4.00	4.00	1.01	5.48	0.00	0.00	0.00	6.67
% Plecoptera	24.67	16.33	82.43	67.12	58.62	66.00	25.00	61.33
% Trichoptera	25.67	7.00	1.01	1.37	3.45	2.00	0.00	5.00
% EPT	54.33	27.33	84.46	73.97	62.07	68.00	25.00	73.00
% Coleoptera	1.00	0.33	0.34	1.37	0.00	0.00	0.00	0.33
% Diptera	43.33	70.33	11.49	17.81	34.48	28.00	64.29	26.33
% Oligochaeta	0.00	0.33	0.34	0.00	0.00	0.00	0.00	0.00
% Baetidae	3.00	3.33	0.68	5.48	0.00	0.00	0.00	6.67
% Brachycentridae	3.33	0.33	0.00	1.37	0.00	0.00	0.00	3.00
% Chironomidae	37.00	66.67	8.11	15.07	24.14	20.67	57.14	24.33
% Ephemerellidae	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00
% Hydropsychidae	9.67	4.67	0.34	0.00	0.00	0.67	0.00	0.67
% Odonata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Perlidae	0.67	1.33	1.01	1.37	0.00	0.00	0.00	0.00
% Pteronarcyidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Simuliidae	0.00	1.67	2.70	0.00	0.00	1.00	0.00	0.00
Functional Group Composition								
% Filterers	15.67	32.33	3.04	1.37	0.00	1.00	0.00	0.67
% Gatherers	28.00	21.00	7.43	17.81	24.14	20.00	17.86	29.67
% Predators	13.33	15.33	48.31	30.14	62.07	39.00	14.29	17.67
% Scrapers	3.33	0.33	0.34	0.00	0.00	0.00	0.00	0.33
% Shredders	38.33	29.33	37.50	46.58	10.34	36.33	64.29	50.67
% Piercer-Herbivores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
% Unclassified	1.33	1.67	3.38	4.11	3.45	3.67	3.57	0.00
Filterer Richness	5.00	6.00	2.00	1.00	0.00	1.00	0.00	1.00
Gatherer Richness	15.00	14.00	10.00	9.00	2.00	8.00	2.00	10.00
Predator Richness	10.00	12.00	7.00	5.00	3.00	10.00	3.00	6.00
Scraper Richness	2.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00
Shredder Richness	7.00	4.00	4.00	1.00	2.00	3.00	4.00	5.00
Piercer-Herbivore Richness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
Unclassified	1.00	1.00	1.00	1.00	1.00	2.00	1.00	0.00
Diversity/Evenness Measures								
Shannon-Weaver H' (log 10)	1.30	1.09	0.80	0.84	0.68	0.84	0.82	0.93
Shannon-Weaver H' (log 2)	4.33	3.62	2.64	2.80	2.25	2.79	2.72	3.09
Shannon-Weaver H' (log e)	3.00	2.51	1.83	1.94	1.56	1.93	1.89	2.14

Table 38f - 2007 Macroinvertebrate Taxonomic Community Analysis Data

Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
Site	**BRSW-101**	**BRSW-102**	**BRSW-106**	**BRSW-108**	**BRSW-109**	**BRSW-12**	**BRSW-13**	**BRSW-16**
Rep	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**
Date	**10-03-2007**	**10-03-2007**	**10-04-2007**	**10-05-2007**	**10-04-2007**	**10-05-2007**	**10-04-2004**	**10-04-2007**
Percent Subsampled	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Habitat	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**
EcoAnalysts Sample ID	*5126.1-37*	*5126.1-38*	*5126.1-39*	*5126.1-40*	*5126.1-41*	*5126.1-42*	*5126.1-43*	*5126.1-44*
Margalef's Richness	6.84	6.49	4.22	3.73	2.08	4.03	2.70	4.03
Pielou's J'	0.81	0.69	0.57	0.68	0.75	0.61	0.82	0.67
Simpson's Heterogeneity	0.93	0.86	0.73	0.75	0.73	0.77	0.81	0.80
Biotic Indices								
% Indiv. w/ HBI Value	97.33	98.00	95.95	95.89	96.55	93.67	92.86	99.33
Hilsenhoff Biotic Index	3.43	4.76	1.52	1.91	1.11	1.94	4.96	2.16
% Indiv. w/ MTI Value	71.00	78.00	44.93	72.60	44.83	55.33	75.00	76.00
Metals Tolerance Index	2.97	2.99	2.76	1.45	5.38	1.75	3.24	2.31
% Indiv. w/ FSBI Value	42.00	26.00	78.38	28.77	51.72	33.33	25.00	33.00
Fine Sediment Biotic Index	80.00	68.00	44.00	31.00	9.00	27.00	10.00	35.00
FSBI - average	2.00	1.79	1.76	1.82	1.13	1.13	1.00	1.46
FSBI - weighted average	4.45	4.27	3.66	4.38	4.07	4.01	2.57	4.14
% Indiv. w/ TPM Value	94.33	93.00	93.92	83.56	82.76	73.00	67.86	93.33
Temp. Pref. Metric - average	4.20	3.24	4.32	3.29	4.25	3.83	2.40	3.79
TPM - weighted average	4.64	3.78	5.87	6.51	6.79	6.95	3.37	6.19
Karr BIBI Metrics								
Long-Lived Taxa Richness	6.00	4.00	4.00	3.00	2.00	2.00	0.00	3.00
Clinger Richness	23.00	21.00	14.00	7.00	4.00	8.00	5.00	12.00
% Clingers	62.00	78.33	88.18	75.34	62.07	69.00	67.86	75.67
Intolerant Taxa Richness	12.00	11.00	8.00	4.00	4.00	7.00	3.00	5.00
% Tolerant Individuals	0.00	1.36	0.35	0.00	0.00	0.00	0.00	0.00
% Tolerant Taxa	0.00	7.89	8.00	5.88	0.00	8.33	10.00	8.33
Coleoptera Richness	2.00	1.00	1.00	1.00	0.00	0.00	0.00	1.00
Montana DEQ Metrics								
MT Biotic Index	3.43	4.76	1.52	1.91	1.11	1.94	4.96	2.16
C-Gatherers + C- Filterers	43.67	53.33	10.47	19.18	24.14	21.00	17.86	30.33
% Scraper + %Shredder	41.67	29.67	37.84	46.58	10.34	36.33	64.29	51.00
% Univoltine	41.33	21.00	14.19	56.16	31.03	56.67	32.14	63.67
% Multivoltine	23.67	37.00	35.14	15.07	10.34	6.00	10.71	16.00
% Semivoltine	9.33	10.00	44.59	21.92	55.17	30.33	0.00	17.33
Community Tolerance Quotient	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00
% Hydropsychinae	9.33	4.33	0.00	0.00	0.00	0.00	0.00	0.67
Lake Metrics								
% Orthocladiinae	16.67	13.33	5.41	9.59	3.45	18.00	17.86	15.00
Orthocladiinae Richness	6.00	8.00	5.00	5.00	1.00	7.00	2.00	7.00
% Chironomini	11.00	24.00	0.68	0.00	0.00	0.00	39.29	1.00
Chironomini Richness	2.00	2.00	1.00	0.00	0.00	0.00	1.00	1.00
% Tanytarsini	4.00	25.33	0.34	0.00	0.00	0.00	0.00	0.33
% Chironomus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Tanytarsus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Dicrotendipes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Dicrotendipes + Chironomus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Corbicula	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Manayunkia speciosa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Intolerant	43.84	20.75	86.62	72.86	85.71	74.38	26.92	71.48
% Intolerant Taxa (S.CA)	42.67	20.33	83.11	69.86	82.76	69.67	25.00	71.00
% Individuals w/ CAHBI value	77.67	83.00	88.51	89.04	93.10	78.33	85.71	86.33
% Intolerant Taxa (CAHBI)	50.64	21.69	90.84	75.38	88.89	88.51	29.17	82.24
% Sensitive EPT (CAHBI)	47.64	18.47	90.46	73.85	66.67	86.38	29.17	74.52
% Non-Insect Individuals	1.33	2.00	3.72	6.85	3.45	4.00	10.71	0.33
% Non-Insect Taxa	2.50	5.26	8.00	11.76	12.50	12.50	20.00	4.17
% Crustacea + Mollusca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average Abundance (per taxon)	7.50	7.89	11.84	4.29	3.63	12.50	2.80	12.50

Table 38f - 2007 Macroinvertebrate Taxonomic Community Analysis Data

Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
Site	BRSW-17	BRSW-21	BRSW-33	BRSW-6
Rep	R1-R3 Pooled	R1-R3 Pooled	R1-R3 Pooled	R1-R3 Pooled
Date	10-03-2007	10-04-2007	10-05-2007	10-05-2007
Percent Subsampled	100.00	100.00	100.00	100.00
Habitat	Mountains	Mountains	Mountains	Mountains
EcoAnalysts Sample ID	*5126.1-45*	*5126.1-46*	*5126.1-47*	*5126.1-48*
Abundance Measures				
Corrected Abundance	300.00	122.00	300.00	300.00
EPT Abundance	149.00	90.00	134.00	121.00
Dominance Measures				
Dominant Taxon	Micrasema sp.	Malenka sp.	Orthocladius sp.	Sweltsa sp.
Dominant Abundance	42.00	81.00	106.00	36.00
2nd Dominant Taxon	Hydropsyche sp.	Polypedilum sp.	Capniidae	Cricotopus (Nostoc.) nostocico
2nd Dominant Abundance	36.00	17.00	88.00	35.00
3rd Dominant Taxon	Sweltsa sp.	Heterotrissocladius marcidus g	Sweltsa sp.	Micropsectra sp.
3rd Dominant Abundance	32.00	10.00	25.00	28.00
% Dominant Taxon	14.00	66.39	35.33	12.00
% 2 Dominant Taxa	26.00	80.33	64.67	23.67
% 3 Dominant Taxa	36.67	88.52	73.00	33.00
Richness Measures				
Species Richness	37.00	11.00	23.00	39.00
EPT Richness	14.00	5.00	10.00	12.00
Ephemeroptera Richness	2.00	1.00	2.00	5.00
Plecoptera Richness	5.00	3.00	5.00	6.00
Trichoptera Richness	7.00	1.00	3.00	1.00
Chironomidae Richness	13.00	4.00	8.00	18.00
Oligochaeta Richness	1.00	0.00	0.00	2.00
Non-Chiro. Non-Olig. Richness	23.00	7.00	15.00	19.00
Rhyacophila Richness	0.00	0.00	2.00	0.00
Community Composition				
% Ephemeroptera	2.67	0.82	0.67	19.33
% Plecoptera	16.33	69.67	43.00	19.67
% Trichoptera	30.67	3.28	1.00	1.33
% EPT	49.67	73.77	44.67	40.33
% Coleoptera	0.67	0.00	0.33	0.67
% Diptera	46.00	25.41	52.33	49.00
% Oligochaeta	0.33	0.00	0.00	1.00
% Baetidae	2.67	0.82	0.00	8.00
% Brachycentridae	16.33	0.00	0.33	0.00
% Chironomidae	33.33	24.59	50.33	48.00
% Ephemerellidae	0.00	0.00	0.00	6.00
% Hydropsychidae	13.00	0.00	0.00	0.00
% Odonata	0.00	0.00	0.00	0.00
% Perlidae	0.00	0.00	0.67	1.33
% Pteronarcyidae	0.00	0.00	0.00	0.00
% Simuliidae	0.67	0.00	0.00	0.00
Functional Group Composition				
% Filterers	25.00	0.00	0.33	0.00
% Gatherers	27.33	14.75	50.00	57.00
% Predators	16.33	1.64	12.67	16.33
% Scrapers	0.67	0.00	0.67	6.33
% Shredders	27.33	83.61	34.67	18.33
% Piercer-Herbivores	0.33	0.00	0.00	0.00
% Unclassified	3.00	0.00	1.67	2.00
Filterer Richness	6.00	0.00	1.00	0.00
Gatherer Richness	14.00	5.00	8.00	22.00
Predator Richness	6.00	2.00	7.00	6.00
Scraper Richness	2.00	0.00	2.00	3.00
Shredder Richness	7.00	4.00	4.00	6.00
Piercer-Herbivore Richness	1.00	0.00	0.00	0.00
Unclassified	1.00	0.00	1.00	2.00
Diversity/Evenness Measures				
Shannon-Weaver H' (log 10)	1.26	0.53	0.85	1.34
Shannon-Weaver H' (log 2)	4.20	1.76	2.84	4.44
Shannon-Weaver H' (log e)	2.91	1.22	1.97	3.08

Table 38f - 2007 Macroinvertebrate Taxonomic Community Analysis Data

Stream	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT	Lewis and Clark County, MT
Site	BRSW-17	BRSW-21	BRSW-33	BRSW-6
Rep	R1-R3 Pooled	R1-R3 Pooled	R1-R3 Pooled	R1-R3 Pooled
Date	10-03-2007	10-04-2007	10-05-2007	10-05-2007
Percent Subsampled	100.00	100.00	100.00	100.00
Habitat	Mountains	Mountains	Mountains	Mountains
EcoAnalysts Sample ID	*5126.1-45*	*5126.1-46*	*5126.1-47*	*5126.1-48*
Margalef's Richness	6.31	2.08	3.86	6.66
Pielou's J'	0.81	0.51	0.63	0.84
Simpson's Heterogeneity	0.93	0.54	0.78	0.94
Biotic Indices				
% Indiv. w/ HBI Value	96.33	99.18	96.67	98.00
Hilsenhoff Biotic Index	3.72	2.82	3.35	4.27
% Indiv. w/ MTI Value	62.00	88.52	83.67	67.33
Metals Tolerance Index	3.80	1.56	3.49	3.34
% Indiv. w/ FSBI Value	55.67	70.49	15.33	41.67
Fine Sediment Biotic Index	61.00	10.00	50.00	71.00
FSBI - average	1.65	0.91	2.17	1.82
FSBI - weighted average	4.54	2.08	4.11	4.53
% Indiv. w/ TPM Value	83.33	85.25	59.67	69.00
Temp. Pref. Metric - average	3.81	3.18	4.96	3.74
TPM - weighted average	4.95	4.64	6.68	5.98
Karr BIBI Metrics				
Long-Lived Taxa Richness	4.00	1.00	3.00	4.00
Clinger Richness	20.00	5.00	10.00	15.00
% Clingers	69.67	84.43	44.67	50.67
Intolerant Taxa Richness	10.00	4.00	9.00	9.00
% Tolerant Individuals	0.00	0.00	0.00	7.48
% Tolerant Taxa	5.41	9.09	8.70	12.82
Coleoptera Richness	2.00	0.00	1.00	1.00
Montana DEQ Metrics				
MT Biotic Index	3.72	2.82	3.35	4.27
C-Gatherers + C- Filterers	52.33	14.75	50.33	57.00
% Scraper + %Shredder	28.00	83.61	35.33	24.67
% Univoltine	18.33	72.95	78.33	20.00
% Multivoltine	27.67	0.82	7.67	48.00
% Semivoltine	25.33	2.46	9.33	14.67
Community Tolerance Quotient	-99.00	-99.00	-99.00	-99.00
% Hydropsychinae	12.00	0.00	0.00	0.00
Lake Metrics				
% Orthocladiinae	20.67	10.66	41.00	32.67
Orthocladiinae Richness	8.00	3.00	6.00	14.00
% Chironomini	10.33	13.93	0.00	0.00
Chironomini Richness	2.00	1.00	0.00	0.00
% Tanytarsini	1.33	0.00	0.00	9.67
% Chironomus	0.00	0.00	0.00	0.00
% Tanytarsus	0.00	0.00	0.00	0.00
% Dicrotendipes	0.00	0.00	0.00	0.00
% Dicrotendipes + Chironomus	0.00	0.00	0.00	0.00
% Corbicula	0.00	0.00	0.00	0.00
% Manayunkia speciosa	0.00	0.00	0.00	0.00
% Intolerant	36.68	73.55	52.07	32.65
% Intolerant Taxa (S.CA)	35.33	72.95	50.33	32.00
% Individuals w/ CAHBI value	75.00	95.08	54.33	61.33
% Intolerant Taxa (CAHBI)	42.67	81.90	89.57	36.96
% Sensitive EPT (CAHBI)	41.78	73.28	78.53	28.80
% Non-Insect Individuals	3.67	0.82	2.67	10.00
% Non-Insect Taxa	8.11	9.09	8.70	15.38
% Crustacea + Mollusca	0.00	0.00	0.00	6.33
Average Abundance (per taxon)	8.11	11.09	13.04	7.69

Table 38g - 2007 Macroinvertebrate Taxonomic Community Anlalysis Data

	Stream	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**	**Lewis and Clark County, MT**
	Site	**BRSW-101**	**BRSW-102**	**BRSW-106**	**BRSW-108**	**BRSW-109**	**BRSW-12**	**BRSW-13**	**BRSW-16**	**BRSW-17**	**BRSW-21**	**BRSW-33**	**BRSW-6**
	Rep	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**	**R1-R3 Pooled**
	Date	**10-03-2007**	**10-03-2007**	**10-04-2007**	**10-05-2007**	**10-04-2007**	**10-05-2007**	**10-04-2004**	**10-04-2007**	**10-03-2007**	**10-04-2007**	**10-05-2007**	**10-05-2007**
	Habitat	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**
	EcoAnalysts Sample ID	**5126.1-37**	**5126.1-38**	**5126.1-39**	**5126.1-40**	**5126.1-41**	**5126.1-42**	**5126.1-43**	**5126.1-44**	**5126.1-45**	**5126.1-46**	**5126.1-47**	**5126.1-48**
Metric Values	Ephemeroptera Richness	3	4	2	2	0	0	0	1	2	1	2	5
	Plecoptera Richness	8	8	7	3	3	4	3	4	5	3	5	6
	% EPT	54.33	27.33	84.46	73.97	62.07	68	25	73	49.67	73.77	44.67	40.33
	% Non-Insect Individuals	1.33	2	3.72	6.85	3.45	4	10.71	0.33	3.67	0.82	2.67	10
	% Predators	20.73578595	16.33333333	6.081081081	13.69863014	34.48275862	23.41137124	17.85714286	21.40468227	19.66666667	10.6557377	50	34.12162162
	Burrower Taxa %	9.756097561	7.5	3.703703704	5	0	7.692307692	7.692307692	12.5	5.128205128	0	7.692307692	9.756097561
	Biotic Index	3.578929766	5.059	1.606081081	1.979452055	1.548275862	2.320401338	5.057142857	2.227759197	3.732	1.864754098	3.836	3.354151625
Metric Scores	Ephemeroptera Richness	30	40	20	20	0	0	0	10	20	10	20	50
	Plecoptera Richness	100	100	100	42.85714286	42.85714286	57.14285714	42.85714286	57.14285714	71.42857143	42.85714286	71.42857143	85.71428571
	% EPT	60.36666667	30.36666667	93.84444444	82.18888889	68.96666667	75.55555556	27.77777778	81.11111111	55.18888889	81.96666667	49.63333333	44.81111111
	% Non-Insect Individuals	95.25	92.85714286	86.71428571	75.53571429	87.67857143	85.71428571	61.75	98.82142857	86.89285714	97.07142857	90.46428571	64.28571429
	% Predators	53.16868193	41.88034188	15.59251559	35.12469266	88.4173298	60.02915702	45.78754579	54.8838007	50.42735043	27.32240437	100	87.49133749
	Burrower Taxa %	100	100	100	100	100	100	100	99.29577465	100	100	100	100
	Biotic Index	65.35117057	40.68333333	98.23198198	92.00913242	99.1954023	86.32664437	40.71428571	87.87068004	62.8	93.92076503	61.06666667	69.09747292
	MMI Scores	**72.01950274**	**63.68392639**	**73.48331825**	**63.9593673**	**69.58787329**	**66.39549997**	**45.55525031**	**69.87509317**	**63.81966684**	**64.73405821**	**70.37040816**	**71.62856022**
	Impairment determination	**Unimpaired**	**Unimpaired**	**Unimpaired**	**Unimpaired**	**Unimpaired**	**Unimpaired**	**Moderate Impairment**	**Unimpaired**	**Unimpaired**	**Unimpaired**	**Unimpaired**	**Unimpaired**

Sites highlighted in yellow indicate that the samples did not reach the minimum target of 300 as required for the MMI calculation.

Table 38h - 2008 Macroinvertebrate Taxonomic Community Analysis Data

SITE	CollectDate	CollectTime	ASL ID	EcoA#	Matrix	Type	Analyte	ReportResult	Units	Detect Limit	Analysis Method	PrepMethod
BRSW-16	17-Jun-08	9:00 AM	E0801671	5192.2-1	Solid - Wet Weight	Periphyton	Chlorophyll A	1.6	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-16	17-Jun-08	9:00 AM	E0801671	5192.2-1	Solid - Wet Weight	Periphyton	Chlorophyll B	< 0.1	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-16	17-Jun-08	9:00 AM	E0801671	5192.2-1	Solid - Wet Weight	Periphyton	Chlorophyll C	0.5	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-16	17-Jun-08	9:00 AM	E0801671	5192.2-1	Solid - Wet Weight	Periphyton	Pheophytin	2.0	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-16	17-Jun-08	9:00 AM	E0801671	5192.1-1	Solid - Wet Weight	Periphyton	Sample Analyzed	25.4	grams	—	Combustion/Gravimetric	N/A
BRSW-16	17-Jun-08	9:00 AM	E0801671	5192.1-1	Solid - Wet Weight	Periphyton	Weight - Dry Material	0.0167	grams	—	Combustion/Gravimetric	N/A
BRSW-16	17-Jun-08	9:00 AM	E0801671	5192.1-1	Solid - Wet Weight	Periphyton	Ash-Free Dry Weight	0.00520	grams	0.001	Combustion/Gravimetric	N/A
BRSW-108	17-Jun-08	12:00 PM	E0801672	5192.2-2	Solid - Wet Weight	Periphyton	Chlorophyll A	0.4	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-108	17-Jun-08	12:00 PM	E0801672	5192.2-2	Solid - Wet Weight	Periphyton	Chlorophyll B	0.3	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-108	17-Jun-08	12:00 PM	E0801672	5192.2-2	Solid - Wet Weight	Periphyton	Chlorophyll C	0.1	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-108	17-Jun-08	12:00 PM	E0801672	5192.2-2	Solid - Wet Weight	Periphyton	Pheophytin	0.4	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-108	17-Jun-08	12:00 PM	E0801672	5192.1-2	Solid - Wet Weight	Periphyton	Sample Analyzed	9.59	grams	—	Combustion/Gravimetric	N/A
BRSW-108	17-Jun-08	12:00 PM	E0801672	5192.1-2	Solid - Wet Weight	Periphyton	Weight - Dry Material	0.00530	grams	—	Combustion/Gravimetric	N/A
BRSW-108	17-Jun-08	12:00 PM	E0801672	5192.1-2	Solid - Wet Weight	Periphyton	Ash-Free Dry Weight	0.00130	grams	0.001	Combustion/Gravimetric	N/A
BRSW-06	17-Jun-08	1:15 PM	E0801673	5192.2-3	Solid - Wet Weight	Periphyton	Chlorophyll A	2.0	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-06	17-Jun-08	1:15 PM	E0801673	5192.2-3	Solid - Wet Weight	Periphyton	Chlorophyll B	0.2	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-06	17-Jun-08	1:15 PM	E0801673	5192.2-3	Solid - Wet Weight	Periphyton	Chlorophyll C	0.4	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-06	17-Jun-08	1:15 PM	E0801673	5192.2-3	Solid - Wet Weight	Periphyton	Pheophytin	< 0.1	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-06	17-Jun-08	1:15 PM	E0801673	5192.1-3	Solid - Wet Weight	Periphyton	Sample Analyzed	34.4	grams	—	Combustion/Gravimetric	N/A
BRSW-06	17-Jun-08	1:15 PM	E0801673	5192.1-3	Solid - Wet Weight	Periphyton	Weight - Dry Material	0.0235	grams	—	Combustion/Gravimetric	N/A
BRSW-06	17-Jun-08	1:15 PM	E0801673	5192.1-3	Solid - Wet Weight	Periphyton	Ash-Free Dry Weight	0.00820	grams	0.001	Combustion/Gravimetric	N/A
BRSW-106	18-Jun-08	8:30 AM	E0801674	5192.2-4	Solid - Wet Weight	Periphyton	Chlorophyll A	1.2	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-106	18-Jun-08	8:30 AM	E0801674	5192.2-4	Solid - Wet Weight	Periphyton	Chlorophyll B	0.3	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-106	18-Jun-08	8:30 AM	E0801674	5192.2-4	Solid - Wet Weight	Periphyton	Chlorophyll C	< 0.1	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-106	18-Jun-08	8:30 AM	E0801674	5192.2-4	Solid - Wet Weight	Periphyton	Pheophytin	< 0.1	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-106	18-Jun-08	8:30 AM	E0801674	5192.1-4	Solid - Wet Weight	Periphyton	Sample Analyzed	24.3	grams	—	Combustion/Gravimetric	N/A
BRSW-106	18-Jun-08	8:30 AM	E0801674	5192.1-4	Solid - Wet Weight	Periphyton	Weight - Dry Material	0.0125	grams	—	Combustion/Gravimetric	N/A
BRSW-106	18-Jun-08	8:30 AM	E0801674	5192.1-4	Solid - Wet Weight	Periphyton	Ash-Free Dry Weight	0.00230	grams	0.001	Combustion/Gravimetric	N/A
BRSW-17	18-Jun-08	11:00 AM	E0801675	5192.2-5	Solid - Wet Weight	Periphyton	Chlorophyll A	1.2	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-17	18-Jun-08	11:00 AM	E0801675	5192.2-5	Solid - Wet Weight	Periphyton	Chlorophyll B	0.1	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-17	18-Jun-08	11:00 AM	E0801675	5192.2-5	Solid - Wet Weight	Periphyton	Chlorophyll C	< 0.1	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-17	18-Jun-08	11:00 AM	E0801675	5192.2-5	Solid - Wet Weight	Periphyton	Pheophytin	< 0.1	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-17	18-Jun-08	11:00 AM	E0801675	5192.1-5	Solid - Wet Weight	Periphyton	Sample Analyzed	28.7	grams	—	Combustion/Gravimetric	N/A
BRSW-17	18-Jun-08	11:00 AM	E0801675	5192.1-5	Solid - Wet Weight	Periphyton	Weight - Dry Material	0.0272	grams	—	Combustion/Gravimetric	N/A
BRSW-17	18-Jun-08	11:00 AM	E0801675	5192.1-5	Solid - Wet Weight	Periphyton	Ash-Free Dry Weight	0.00370	grams	0.001	Combustion/Gravimetric	N/A
BRSW-101	18-Jun-08	12:30 PM	E0801676	5192.2-6	Solid - Wet Weight	Periphyton	Chlorophyll A	0.4	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-101	18-Jun-08	12:30 PM	E0801676	5192.2-6	Solid - Wet Weight	Periphyton	Chlorophyll B	0.2	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-101	18-Jun-08	12:30 PM	E0801676	5192.2-6	Solid - Wet Weight	Periphyton	Chlorophyll C	0.8	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-101	18-Jun-08	12:30 PM	E0801676	5192.2-6	Solid - Wet Weight	Periphyton	Pheophytin	0.2	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-101	18-Jun-08	12:30 PM	E0801676	5192.1-6	Solid - Wet Weight	Periphyton	Sample Analyzed	27.8	grams	—	Combustion/Gravimetric	N/A
BRSW-101	18-Jun-08	12:30 PM	E0801676	5192.1-6	Solid - Wet Weight	Periphyton	Weight - Dry Material	0.0211	grams	—	Combustion/Gravimetric	N/A
BRSW-101	18-Jun-08	12:30 PM	E0801676	5192.1-6	Solid - Wet Weight	Periphyton	Ash-Free Dry Weight	0.00280	grams	0.001	Combustion/Gravimetric	N/A

Table 38i - 2008 Macroinvertebrate Taxonomic Community Analysis Data

SITE	CollectDate	CollectTime	ASL ID	EcoA#	Matrix	Type	Analyte	ReportResult	Units	Detect Limit	Analysis Method	PrepMethod
BRSW-16	17-Jun-08	9:00 AM	E0801671	5192.2-1	Solid - Wet Weight	Periphyton	Chlorophyll A	1.6	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-16	17-Jun-08	9:00 AM	E0801671	5192.2-1	Solid - Wet Weight	Periphyton	Chlorophyll B	< 0.1	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-16	17-Jun-08	9:00 AM	E0801671	5192.2-1	Solid - Wet Weight	Periphyton	Chlorophyll C	0.5	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-16	17-Jun-08	9:00 AM	E0801671	5192.2-1	Solid - Wet Weight	Periphyton	Pheophytin	2.0	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-16	17-Jun-08	9:00 AM	E0801671	5192.1-1	Solid - Wet Weight	Periphyton	Sample Analyzed	25.4	grams	—	Combustion/Gravimetric	N/A
BRSW-16	17-Jun-08	9:00 AM	E0801671	5192.1-1	Solid - Wet Weight	Periphyton	Weight - Dry Material	0.0167	grams	—	Combustion/Gravimetric	N/A
BRSW-16	17-Jun-08	9:00 AM	E0801671	5192.1-1	Solid - Wet Weight	Periphyton	Ash-Free Dry Weight	0.00520	grams	0.001	Combustion/Gravimetric	N/A
BRSW-108	17-Jun-08	12:00 PM	E0801672	5192.2-2	Solid - Wet Weight	Periphyton	Chlorophyll A	0.4	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-108	17-Jun-08	12:00 PM	E0801672	5192.2-2	Solid - Wet Weight	Periphyton	Chlorophyll B	0.3	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-108	17-Jun-08	12:00 PM	E0801672	5192.2-2	Solid - Wet Weight	Periphyton	Chlorophyll C	0.1	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-108	17-Jun-08	12:00 PM	E0801672	5192.2-2	Solid - Wet Weight	Periphyton	Pheophytin	0.4	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-108	17-Jun-08	12:00 PM	E0801672	5192.1-2	Solid - Wet Weight	Periphyton	Sample Analyzed	9.59	grams	—	Combustion/Gravimetric	N/A
BRSW-108	17-Jun-08	12:00 PM	E0801672	5192.1-2	Solid - Wet Weight	Periphyton	Weight - Dry Material	0.00530	grams	—	Combustion/Gravimetric	N/A
BRSW-108	17-Jun-08	12:00 PM	E0801672	5192.1-2	Solid - Wet Weight	Periphyton	Ash-Free Dry Weight	0.00130	grams	0.001	Combustion/Gravimetric	N/A
BRSW-06	17-Jun-08	1:15 PM	E0801673	5192.2-3	Solid - Wet Weight	Periphyton	Chlorophyll A	2.0	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-06	17-Jun-08	1:15 PM	E0801673	5192.2-3	Solid - Wet Weight	Periphyton	Chlorophyll B	0.2	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-06	17-Jun-08	1:15 PM	E0801673	5192.2-3	Solid - Wet Weight	Periphyton	Chlorophyll C	0.4	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-06	17-Jun-08	1:15 PM	E0801673	5192.2-3	Solid - Wet Weight	Periphyton	Pheophytin	< 0.1	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-06	17-Jun-08	1:15 PM	E0801673	5192.1-3	Solid - Wet Weight	Periphyton	Sample Analyzed	34.4	grams	—	Combustion/Gravimetric	N/A
BRSW-06	17-Jun-08	1:15 PM	E0801673	5192.1-3	Solid - Wet Weight	Periphyton	Weight - Dry Material	0.0235	grams	—	Combustion/Gravimetric	N/A
BRSW-06	17-Jun-08	1:15 PM	E0801673	5192.1-3	Solid - Wet Weight	Periphyton	Ash-Free Dry Weight	0.00820	grams	0.001	Combustion/Gravimetric	N/A
BRSW-106	18-Jun-08	8:30 AM	E0801674	5192.2-4	Solid - Wet Weight	Periphyton	Chlorophyll A	1.2	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-106	18-Jun-08	8:30 AM	E0801674	5192.2-4	Solid - Wet Weight	Periphyton	Chlorophyll B	0.3	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-106	18-Jun-08	8:30 AM	E0801674	5192.2-4	Solid - Wet Weight	Periphyton	Chlorophyll C	< 0.1	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-106	18-Jun-08	8:30 AM	E0801674	5192.2-4	Solid - Wet Weight	Periphyton	Pheophytin	< 0.1	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-106	18-Jun-08	8:30 AM	E0801674	5192.1-4	Solid - Wet Weight	Periphyton	Sample Analyzed	24.3	grams	—	Combustion/Gravimetric	N/A

Table 38i - 2008 Macroinvertebrate Taxonomic Community Analysis Data

SITE	CollectDate	CollectTime	ASL ID	EcoA#	Matrix	Type	Analyte	ReportResult	Units	Detect Limit	Analysis Method	PrepMethod
BRSW-106	18-Jun-08	8:30 AM	E0801674	5192.1-4	Solid - Wet Weight	Periphyton	Weight - Dry Material	0.0125	grams	—	Combustion/Gravimetric	N/A
BRSW-106	18-Jun-08	8:30 AM	E0801674	5192.1-4	Solid - Wet Weight	Periphyton	Ash-Free Dry Weight	0.00230	grams	0.001	Combustion/Gravimetric	N/A
BRSW-17	18-Jun-08	11:00 AM	E0801675	5192.2-5	Solid - Wet Weight	Periphyton	Chlorophyll A	1.2	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-17	18-Jun-08	11:00 AM	E0801675	5192.2-5	Solid - Wet Weight	Periphyton	Chlorophyll B	0.1	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-17	18-Jun-08	11:00 AM	E0801675	5192.2-5	Solid - Wet Weight	Periphyton	Chlorophyll C	< 0.1	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-17	18-Jun-08	11:00 AM	E0801675	5192.2-5	Solid - Wet Weight	Periphyton	Pheophytin	< 0.1	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-17	18-Jun-08	11:00 AM	E0801675	5192.1-5	Solid - Wet Weight	Periphyton	Sample Analyzed	28.7	grams	—	Combustion/Gravimetric	N/A
BRSW-17	18-Jun-08	11:00 AM	E0801675	5192.1-5	Solid - Wet Weight	Periphyton	Weight - Dry Material	0.0272	grams	—	Combustion/Gravimetric	N/A
BRSW-17	18-Jun-08	11:00 AM	E0801675	5192.1-5	Solid - Wet Weight	Periphyton	Ash-Free Dry Weight	0.00370	grams	0.001	Combustion/Gravimetric	N/A
BRSW-101	18-Jun-08	12:30 PM	E0801676	5192.2-6	Solid - Wet Weight	Periphyton	Chlorophyll A	0.4	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-101	18-Jun-08	12:30 PM	E0801676	5192.2-6	Solid - Wet Weight	Periphyton	Chlorophyll B	0.2	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-101	18-Jun-08	12:30 PM	E0801676	5192.2-6	Solid - Wet Weight	Periphyton	Chlorophyll C	0.8	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-101	18-Jun-08	12:30 PM	E0801676	5192.2-6	Solid - Wet Weight	Periphyton	Pheophytin	0.2	µg	0.1	EPA 446.0	Acetone Extraction
BRSW-101	18-Jun-08	12:30 PM	E0801676	5192.1-6	Solid - Wet Weight	Periphyton	Sample Analyzed	27.8	grams	—	Combustion/Gravimetric	N/A
BRSW-101	18-Jun-08	12:30 PM	E0801676	5192.1-6	Solid - Wet Weight	Periphyton	Weight - Dry Material	0.0211	grams	—	Combustion/Gravimetric	N/A
BRSW-101	18-Jun-08	12:30 PM	E0801676	5192.1-6	Solid - Wet Weight	Periphyton	Ash-Free Dry Weight	0.00280	grams	0.001	Combustion/Gravimetric	N/A

Table 38j - 2008 Macroinvertebrate Taxonomic Community Analysis Data

	Stream	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana
	Site	BRSW-16	BRSW-16	BRSW-16	BRSW-108	BRSW-108	BRSW-108	BRSW-06	BRSW-06	BRSW-06	BRSW-106	BRSW-106	BRSW-106	BRSW-17	BRSW-17	BRSW-17	BRSW-101	BRSW-101	BRSW-101
	Rep	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
	Date	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008
	Time	09:00	09:00	09:00	12:00	12:00	12:00	13:15	13:15	13:15	08:30	08:30	08:30	11:00	11:00	11:00	12:30	12:30	12:30
	Ecoregion	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
	Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	EcoAnalysts Sample ID	5191.1-1	5191.1-2	5191.1-3	5191.1-4	5191.1-5	5191.1-6	5191.1-7	5191.1-8	5191.1-9	5191.1-10	5191.1-11	5191.1-12	5191.1-13	5191.1-14	5191.1-15	5191.1-16	5191.1-17	5191.1-18
Ephemeroptera	Ameletus sp.	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0
	Baetis bicaudatus	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0
	Baetis sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	Baetis tricaudatus	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0	0	0
	Cinygmula sp.	0	0	0	0	0	0	22	6	2	1	0	0	0	0	0	0	0	0
	Diphetor hageni	0	0	0	0	0	0	3	1	14	1	0	0	2	8	5	6	3	0
	Drunella coloradensis/flavilinea	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0
	Epeorus albertae	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0
	Epeorus sp.	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0
	Ephemerella inermis/infrequens	0	0	0	0	0	0	0	1	3	0	0	0	0	1	0	0	0	0
	Rhithrogena sp.	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
	Serratella tibialis	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Plecoptera	Alloperla sp.	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
	Claassenia sabulosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Doroneuria sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Hesperoperla pacifica	0	0	0	0	0	0	0	0	0	0	0	0	6	3	0	0	0	0
	Isoperla sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	Kogotus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
	Lednia tumana	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Leuctridae	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
	Malenka sp.	0	0	0	0	0	3	0	0	0	0	0	1	0	0	2	0	0	0
	Nemouridae	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Paraleuctra sp.	0	0	0	3	1	3	6	1	2	0	0	0	0	0	0	1	0	0
	Paraperla sp.	0	0	0	0	0	0	7	1	0	0	0	0	0	0	0	0	0	0
	Perlidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
	Perlodidae	0	0	0	0	0	0	3	12	1	0	0	0	0	0	0	0	0	0
	Suwallia sp.	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0
	Sweltsa sp.	7	9	6	0	0	0	53	48	20	9	7	5	7	5	7	3	23	7
	Visoka cataractae	0	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0
	Yoraperla sp.	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0
	Zapada frigida	0	0	0	0	0	0	10	3	0	0	0	0	0	0	0	0	0	0
	Zapada oregonensis gr.	0	0	0	0	0	0	2	3	4	0	0	0	0	0	0	0	0	0
Coleoptera	Ametor sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	Heterlimnius sp.	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
	Oreodytes sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
	Zaitzevia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Diptera-Chironomidae	Chaetocladius sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Cricotopus (Nostoc.) nostocicola	0	0	0	0	0	0	1	6	5	0	0	0	0	0	0	0	0	0
	Diamesa sp.	2	1	0	0	0	0	0	2	1	1	0	0	0	0	0	0	0	0
	Eukiefferiella brehmi gr.	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
	Eukiefferiella coerulescens gr.	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Eukiefferiella devonica gr.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Eukiefferiella sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	Heleniella sp.	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
	Krenosmittia sp.	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Larsia sp.	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0
	Micropsectra sp.	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0
	Orthocladius Complex	0	0	0	0	0	0	0	1	8	0	0	0	0	0	0	0	0	0
	Orthocladius sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
	Pagastia sp.	0	0	0	0	0	0	14	8	10	0	0	0	0	0	0	0	0	0
	Parachaetocladius sp.	0	0	0	7	6	9	6	2	1	5	0	0	0	0	0	0	0	0
	Parametriocnemus sp.	0	0	0	0	0	0	16	8	1	1	0	0	0	2	0	2	4	3
	Paraphaenocladius sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	Paratanytarsus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
	Polypedilum sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1
	Pseudodiamesa sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	Reomyia sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Rheotanytarsus sp.	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
	Stempellinella sp.	0	0	0	0	0	0	1	0	3	0	0	0	1	0	0	0	1	0
	Stilocladius sp.	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0

Table 38j - 2008 Macroinvertebrate Taxonomic Community Analysis Data

	Stream	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana
	Site	BRSW-16	BRSW-16	BRSW-16	BRSW-108	BRSW-108	BRSW-108	BRSW-06	BRSW-06	BRSW-06	BRSW-106	BRSW-106	BRSW-106	BRSW-17	BRSW-17	BRSW-17	BRSW-101	BRSW-101	BRSW-101
	Rep	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
	Date	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008
	Time	09:00	09:00	09:00	12:00	12:00	12:00	13:15	13:15	13:15	08:30	08:30	08:30	11:00	11:00	11:00	12:30	12:30	12:30
	Ecoregion	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
	Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	EcoAnalysts Sample ID	5191.1-1	5191.1-2	5191.1-3	5191.1-4	5191.1-5	5191.1-6	5191.1-7	5191.1-8	5191.1-9	5191.1-10	5191.1-11	5191.1-12	5191.1-13	5191.1-14	5191.1-15	5191.1-16	5191.1-17	5191.1-18
	Tanytarsus sp.	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
	Thienemanniella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Thienemannimyia gr. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	Tvetenia bavarica gr.	0	0	0	0	0	0	3	1	0	0	1	0	0	0	0	0	0	0
Diptera	Antocha sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	Atrichopogon sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Bezzia/Palpomyia sp.	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0	0	0	0
	Cryptolabis sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	0
	Diptera	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Dolichopodidae	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Empididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Gonomyia sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
	Oreogeton sp.	0	0	0	2	4	1	0	0	0	0	0	0	0	0	0	0	0	0
	Pericoma/Telmatoscopus sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	Prosimulium sp.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	40
	Psychodidae	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
	Rhabdomastix fascigera gr.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	0	0
	Simulium sp.	0	0	0	0	0	0	0	0	0	0	0	0	68	186	12	2	1	14
	Tipula sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
	Twinnia sp.	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
	Wiedemannia sp.	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0
Trichoptera	Anagapetus sp.	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0
	Hesperophylax sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Hydropsyche sp.	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1	0	0	1
	Lepidostoma sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	1	0	0
	Limnephilidae	0	0	0	0	1	2	0	1	1	0	0	0	0	0	0	0	0	0
	Micrasema sp.	0	0	0	0	0	0	0	0	1	0	0	0	1	8	3	0	0	1
	Philopotamidae	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	Rhyacophila betteni gr.	0	0	0	0	0	0	5	3	2	0	0	0	0	0	0	0	0	0
	Rhyacophila brunnea gr.	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
	Rhyacophila sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rhyacophila verrula gr.	0	0	0	0	0	0	1	2	2	0	0	0	0	0	0	0	0	0
Bivalvia	Pisidium sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Annelida	Enchytraeidae	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
Acari	Hydryphantidae	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Hygrobates sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	Lebertia sp.	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0
	Oribatei	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Protzia sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	6	3	0	0	0
	Sperchon sp.	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0
	Torrenticola sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0
Crustacea	Ostracoda	0	0	0	0	0	0	6	4	5	0	0	0	0	0	0	0	0	0
Other Organisms	Nematoda	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
	Turbellaria	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
	TOTAL	**11**	**11**	**6**	**13**	**15**	**23**	**192**	**167**	**98**	**31**	**8**	**8**	**93**	**236**	**41**	**30**	**36**	**71**

Table 38k - 2008 Macroinvertebrate Taxonomic Community Analysis Data

Stream	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana
Site	BRSW-16	BRSW-16	BRSW-16	BRSW-108	BRSW-108	BRSW-108	BRSW-06	BRSW-06	BRSW-06	BRSW-106	BRSW-106	BRSW-106	BRSW-17	BRSW-17	BRSW-17	BRSW-101	BRSW-101	BRSW-101
Rep	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008
Time	09:00	09:00	09:00	12:00	12:00	12:00	13:15	13:15	13:15	08:30	08:30	08:30	11:00	11:00	11:00	12:30	12:30	12:30
Ecoregion	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
EcoAnalysts Sample ID	5191.1-1	5191.1-2	5191.1-3	5191.1-4	5191.1-5	5191.1-6	5191.1-7	5191.1-8	5191.1-9	5191.1-10	5191.1-11	5191.1-12	5191.1-13	5191.1-14	5191.1-15	5191.1-16	5191.1-17	5191.1-18
Abundance Measures																		
Corrected Abundance	11.00	11.00	6.00	13.00	15.00	23.00	192.00	167.00	98.00	31.00	8.00	8.00	93.00	236.00	41.00	30.00	36.00	71.00
EPT Abundance	8.00	10.00	6.00	3.00	2.00	9.00	131.00	106.00	57.00	13.00	7.00	7.00	22.00	32.00	21.00	14.00	26.00	10.00
Dominance Measures																		
Dominant Taxon	Sweltsa sp.	Sweltsa sp.	Sweltsa sp.	Parachaetocladius sp.	Parachaetocladius sp.	Parachaetocladius sp.	Sweltsa sp.	Sweltsa sp.	Sweltsa sp.	Sweltsa sp.	Sweltsa sp.	Sweltsa sp.	Simulium sp.	Simulium sp.	Simulium sp.	Diphetor hageni	Sweltsa sp.	Prosimulium sp.
Dominant Abundance	7.00	9.00	6.00	7.00	6.00	9.00	53.00	48.00	20.00	9.00	7.00	5.00	68.00	186.00	12.00	6.00	23.00	40.00
2nd Dominant Taxon	Diamesa sp.	Diamesa sp.		Paraleuctra sp.	Oreogeton sp.	Paraleuctra sp.	Cinygmula sp.	Perlodidae	Diphetor hageni	Parachaetocladius sp.	Tvetenia bavarica gr.	Heleniella sp.	Sweltsa sp.	Diphetor hageni	Sweltsa sp.	Sweltsa sp.	Parametriocnemus sp.	Simulium sp.
2nd Dominant Abundance	2.00	1.00	0.00	3.00	4.00	3.00	22.00	12.00	14.00	5.00	1.00	1.00	7.00	8.00	7.00	3.00	4.00	14.00
3rd Dominant Taxon	Nematoda	Rhyacophila sp.		Oreogeton sp.	Eukiefferiella coerulescens gr.	Malenka sp.	Parametriocnemus sp.	Micropsectra sp.	Pagastia sp.	Psychodidae		Malenka sp.	Hesperoperla pacifica	Micrasema sp.	Diphetor hageni	Rhabdomastix fascigera gr.	Diphetor hageni	Sweltsa sp.
3rd Dominant Abundance	1.00	1.00	0.00	2.00	1.00	3.00	16.00	9.00	10.00	3.00	0.00	1.00	6.00	8.00	5.00	3.00	3.00	7.00
% Dominant Taxon	63.64	81.82	100.00	53.85	40.00	39.13	27.60	28.74	20.41	29.03	87.50	62.50	73.12	78.81	29.27	20.00	63.89	56.34
% 2 Dominant Taxa	81.82	90.91	100.00	76.92	66.67	52.17	39.06	35.93	34.69	45.16	100.00	75.00	80.65	82.20	46.34	30.00	75.00	76.06
% 3 Dominant Taxa	90.91	100.00	100.00	92.31	73.33	65.22	47.40	41.32	44.90	54.84	100.00	87.50	87.10	85.59	58.54	40.00	83.33	85.92
Richness Measures																		
Species Richness	4.00	3.00	1.00	4.00	7.00	10.00	33.00	46.00	29.00	16.00	2.00	4.00	12.00	21.00	14.00	14.00	8.00	11.00
EPT Richness	2.00	2.00	1.00	1.00	2.00	4.00	18.00	23.00	15.00	5.00	1.00	3.00	8.00	9.00	7.00	6.00	2.00	4.00
Ephemeroptera Richness	0.00	0.00	0.00	0.00	0.00	0.00	6.00	6.00	6.00	3.00	0.00	0.00	2.00	3.00	2.00	2.00	1.00	0.00
Plecoptera Richness	2.00	1.00	1.00	1.00	1.00	2.00	10.00	11.00	5.00	2.00	1.00	3.00	3.00	3.00	2.00	3.00	1.00	2.00
Trichoptera Richness	0.00	1.00	0.00	0.00	1.00	2.00	2.00	6.00	4.00	0.00	0.00	0.00	3.00	3.00	3.00	1.00	0.00	2.00
Chironomidae Richness	1.00	1.00	0.00	2.00	2.00	3.00	13.00	15.00	9.00	4.00	1.00	1.00	1.00	2.00	2.00	2.00	3.00	3.00
Oligochaeta Richness	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
Non-Chiro. Non-Olig. Richness	3.00	2.00	1.00	2.00	4.00	7.00	20.00	31.00	20.00	12.00	1.00	3.00	11.00	18.00	12.00	12.00	5.00	8.00
Rhyacophila Richness	0.00	1.00	0.00	0.00	0.00	0.00	2.00	3.00	2.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
Community Composition																		
% Ephemeroptera	0.00	0.00	0.00	0.00	0.00	0.00	16.67	10.78	23.47	9.68	0.00	0.00	3.23	4.66	14.63	23.33	8.33	0.00
% Plecoptera	72.73	81.82	100.00	23.08	6.67	26.09	48.44	44.91	28.57	32.26	87.50	87.50	16.13	4.24	21.95	20.00	63.89	11.27
% Trichoptera	0.00	9.09	0.00	0.00	6.67	13.04	3.13	7.78	6.12	0.00	0.00	0.00	4.30	4.66	14.63	3.33	0.00	2.82
% EPT	72.73	90.91	100.00	23.08	13.33	39.13	68.23	63.47	58.16	41.94	87.50	87.50	23.66	13.56	51.22	46.67	72.22	14.08
% Coleoptera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20	0.00	0.00	0.00	0.00	0.00	0.42	2.44	3.33	2.78	1.41
% Diptera	18.18	9.09	0.00	76.92	80.00	56.52	28.13	29.94	33.67	58.06	12.50	12.50	75.27	81.36	36.59	50.00	19.44	84.51
% Oligochaeta	0.00	0.00	0.00	0.00	6.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.00
% Baetidae	0.00	0.00	0.00	0.00	0.00	0.00	2.08	1.80	14.29	6.45	0.00	0.00	3.23	4.24	14.63	20.00	8.33	0.00
% Brachycentridae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.02	0.00	0.00	0.00	1.08	3.39	7.32	0.00	0.00	1.41
% Chironomidae	18.18	9.09	0.00	61.54	46.67	47.83	28.13	26.95	31.63	25.81	12.50	12.50	1.08	1.27	4.88	13.33	16.67	7.04
% Ephemerellidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.19	4.08	0.00	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.00
% Hydropsychidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.15	0.85	2.44	0.00	0.00	1.41
% Odonata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Perlidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	6.45	1.27	0.00	6.67	0.00	1.41
% Pteronarcyidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Simuliidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.68	0.00	0.00	73.12	78.81	29.27	13.33	2.78	76.06
Functional Group Composition																		
% Filterers	0.00	0.00	0.00	0.00	0.00	0.00	3.13	0.60	1.02	9.68	0.00	0.00	76.34	80.51	31.71	13.33	2.78	77.46
% Gatherers	18.18	9.09	0.00	61.54	53.33	52.17	29.17	27.54	48.98	41.94	12.50	12.50	4.30	6.36	17.07	30.00	25.00	7.04
% Predators	72.73	90.91	100.00	15.38	26.67	8.70	38.54	46.11	28.57	38.71	87.50	62.50	18.28	8.47	31.71	30.00	72.22	11.27
% Scrapers	0.00	0.00	0.00	0.00	0.00	0.00	14.06	11.38	3.06	3.23	0.00	0.00	0.00	0.00	0.00	3.33	0.00	0.00
% Shredders	9.09	0.00	0.00	23.08	13.33	39.13	14.58	13.17	16.33	0.00	0.00	25.00	1.08	4.24	19.51	23.33	0.00	2.82
% Piercer-Herbivores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Unclassified	0.00	0.00	0.00	0.00	6.67	0.00	0.52	1.20	2.04	6.45	0.00	0.00	0.00	0.42	0.00	0.00	0.00	1.41
Filterer Richness	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	2.00	0.00	0.00	3.00	3.00	2.00	2.00	1.00	3.00
Gatherer Richness	1.00	1.00	0.00	2.00	3.00	4.00	14.00	16.00	12.00	7.00	1.00	1.00	3.00	6.00	3.00	3.00	4.00	3.00
Predator Richness	2.00	2.00	1.00	1.00	1.00	2.00	7.00	13.00	7.00	4.00	1.00	1.00	5.00	8.00	5.00	4.00	3.00	2.00
Scraper Richness	0.00	0.00	0.00	0.00	0.00	0.00	3.00	4.00	2.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
Shredder Richness	1.00	0.00	0.00	1.00	2.00	4.00	7.00	11.00	6.00	0.00	0.00	2.00	1.00	3.00	4.00	4.00	0.00	2.00
Piercer-Herbivore Richness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unclassified	0.00	0.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	2.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00
Diversity/Evenness Measures																		
Shannon-Weaver H' (log 10)	0.45	0.26	0.00	0.50	0.70	0.84	1.20	1.33	1.22	1.04	0.16	0.47	0.50	0.47	0.97	1.08	0.56	0.62
Shannon-Weaver H' (log 2)	1.49	0.87	0.00	1.67	2.34	2.78	3.98	4.41	4.07	3.44	0.54	1.55	1.65	1.56	3.22	3.58	1.87	2.06
Shannon-Weaver H' (log e)	1.03	0.60	0.00	1.16	1.62	1.93	2.76	3.06	2.82	2.39	0.38	1.07	1.14	1.08	2.23	2.48	1.30	1.43
Margalef's Richness	1.25	0.83	0.00	1.17	2.22	2.87	6.09	8.79	6.11	4.37	0.48	1.44	2.43	3.66	3.50	3.82	1.95	2.35
Pielou's J'	0.75	0.55	******.00	0.83	0.83	0.84	0.79	0.80	0.84	0.86	0.54	0.77	0.46	0.36	0.84	0.94	0.62	0.59
Simpson's Heterogeneity	0.60	0.35	0.00	0.68	0.80	0.83	0.89	0.90	0.92	0.89	0.25	0.64	0.46	0.38	0.87	0.93	0.58	0.64
Biotic Indices																		
% Indiv. w/ HBI Value	100.00	100.00	100.00	100.00	93.33	91.30	98.96	95.81	93.88	90.32	100.00	100.00	97.85	95.76	92.68	90.00	94.44	98.59
Hilsenhoff Biotic Index	1.55	0.45	0.00	4.23	5.57	4.24	2.31	2.47	3.05	3.68	0.63	1.25	4.15	4.64	3.39	3.41	1.59	3.30

Table 38k - **2008 Macroinvertebrate Taxonomic Community Analysis Data**

Stream	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana	Montana
Site	BRSW-16	BRSW-16	BRSW-16	BRSW-108	BRSW-108	BRSW-108	BRSW-06	BRSW-06	BRSW-06	BRSW-106	BRSW-106	BRSW-106	BRSW-17	BRSW-17	BRSW-17	BRSW-101	BRSW-101	BRSW-101
Rep	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-17-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008	06-18-2008
Time	09:00	09:00	09:00	12:00	12:00	12:00	13:15	13:15	13:15	08:30	08:30	08:30	11:00	11:00	11:00	12:30	12:30	12:30
Ecoregion	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
EcoAnalysts Sample ID	5191.1-1	5191.1-2	5191.1-3	5191.1-4	5191.1-5	5191.1-6	5191.1-7	5191.1-8	5191.1-9	5191.1-10	5191.1-11	5191.1-12	5191.1-13	5191.1-14	5191.1-15	5191.1-16	5191.1-17	5191.1-18
% Indiv. w/ MTI Value	27.27	18.18	0.00	38.46	40.00	30.43	51.56	46.71	53.06	25.81	12.50	12.50	86.02	92.80	75.61	70.00	25.00	87.32
Metals Tolerance Index	7.67	5.00	******.00	2.80	4.83	1.43	2.71	2.81	3.27	3.13	4.00	1.00	4.71	4.63	3.42	2.10	3.00	2.90
% Indiv. w/ FSBI Value	63.64	90.91	100.00	0.00	0.00	13.04	57.81	50.90	55.10	38.71	87.50	75.00	93.55	92.37	78.05	43.33	77.78	33.80
Fine Sediment Biotic Index	4.00	9.00	4.00	-99.00	-99.00	2.00	65.00	84.00	61.00	19.00	4.00	6.00	32.00	50.00	30.00	22.00	16.00	21.00
FSBI - average	1.00	3.00	4.00	-99.00	-99.00	0.20	1.97	1.83	2.10	1.19	2.00	1.50	2.67	2.38	2.14	1.57	2.00	1.91
FSBI - weighted average	4.00	4.10	4.00	-99.00	-99.00	2.00	4.69	4.71	4.37	4.25	4.00	3.67	3.46	3.22	3.53	4.08	4.00	3.50
% Indiv. w/ TPM Value	90.91	90.91	100.00	23.08	40.00	30.43	84.38	82.63	85.71	54.84	87.50	100.00	94.62	93.64	80.49	80.00	94.44	97.18
Temp. Pref. Metric - average	5.75	5.00	7.00	4.25	2.86	2.50	4.91	5.00	4.72	4.25	3.50	7.25	3.25	3.19	2.71	4.00	4.13	4.45
TPM - weighted average	7.30	7.10	7.00	8.33	7.33	5.86	7.06	7.27	6.06	7.29	7.00	7.13	5.07	5.05	5.12	5.42	6.29	8.12
Karr BIBI Metrics																		
Long-Lived Taxa Richness	1.00	1.00	1.00	1.00	1.00	1.00	5.00	7.00	3.00	1.00	1.00	1.00	3.00	5.00	3.00	3.00	2.00	4.00
Clinger Richness	2.00	2.00	1.00	1.00	1.00	2.00	16.00	19.00	11.00	6.00	1.00	3.00	8.00	11.00	7.00	9.00	4.00	8.00
% Clingers	72.73	90.91	100.00	23.08	6.67	26.09	65.63	64.07	51.02	48.39	87.50	87.50	94.62	92.80	75.61	66.67	77.78	92.96
Intolerant Taxa Richness	2.00	2.00	1.00	1.00	1.00	2.00	14.00	19.00	11.00	3.00	1.00	3.00	4.00	6.00	4.00	6.00	1.00	2.00
% Tolerant Individuals	0.00	0.00	0.00	0.00	7.14	0.00	3.16	2.50	5.43	10.71	0.00	0.00	0.00	0.44	0.00	0.00	0.00	0.00
% Tolerant Taxa	0.00	0.00	0.00	0.00	14.29	0.00	6.06	6.52	6.90	6.25	0.00	0.00	0.00	4.76	0.00	0.00	0.00	0.00
Coleoptera Richness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00
Montana DEQ Metrics																		
MT Biotic Index	1.55	0.45	0.00	4.23	5.57	4.24	2.31	2.47	3.05	3.68	0.63	1.25	4.15	4.64	3.39	3.41	1.59	3.30
C-Gatherers + C- Filterers	18.18	9.09	0.00	61.54	53.33	52.17	32.29	28.14	50.00	51.61	12.50	12.50	80.65	86.86	48.78	43.33	27.78	84.51
% Scraper + %Shredder	9.09	0.00	0.00	23.08	13.33	39.13	28.65	24.55	19.39	3.23	0.00	25.00	1.08	4.24	19.51	26.67	0.00	2.82
% Univoltine	27.27	18.18	0.00	23.08	46.67	39.13	27.08	35.93	35.71	29.03	12.50	37.50	1.08	2.97	12.20	23.33	2.78	59.15
% Multivoltine	9.09	0.00	0.00	0.00	0.00	0.00	14.06	18.56	27.55	16.13	0.00	0.00	76.34	84.32	51.22	33.33	22.22	23.94
% Semivoltine	63.64	81.82	100.00	23.08	6.67	13.04	35.42	34.13	23.47	29.03	87.50	62.50	15.05	7.20	26.83	16.67	66.67	14.08
Community Tolerance Quotient	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00	-99.00
% Hydropsychinae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.15	0.85	2.44	0.00	0.00	1.41
Lake Metrics																		
% Orthocladiinae	0.00	0.00	0.00	61.54	46.67	47.83	15.63	14.37	16.33	22.58	12.50	12.50	0.00	1.27	0.00	6.67	11.11	5.63
Orthocladiinae Richness	0.00	0.00	0.00	2.00	2.00	3.00	8.00	10.00	5.00	3.00	1.00	1.00	0.00	2.00	0.00	1.00	1.00	2.00
% Chironomini	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.67	0.00	1.41
Chironomini Richness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
% Tanytarsini	0.00	0.00	0.00	0.00	0.00	0.00	3.65	5.99	4.08	0.00	0.00	0.00	1.08	0.00	2.44	0.00	2.78	0.00
% Chironomus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Tanytarsus	0.00	0.00	0.00	0.00	0.00	0.00	3.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Dicrotendipes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Dicrotendipes + Chironomus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Corbicula	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Manayunkia speciosa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Intolerant	72.73	90.91	100.00	30.77	7.14	28.57	62.11	65.00	52.17	42.86	87.50	87.50	17.58	8.85	36.84	40.74	67.65	11.43
% Intolerant Taxa (S.CA)	72.73	90.91	100.00	30.77	6.67	26.09	61.46	62.28	48.98	38.71	87.50	87.50	17.20	8.47	34.15	36.67	63.89	11.27
% Individuals w/ CAHBI value	81.82	90.91	100.00	100.00	73.33	73.91	68.23	68.86	70.41	58.06	100.00	100.00	97.85	97.46	95.12	73.33	100.00	40.85
% Intolerant Taxa (CAHBI)	88.89	100.00	100.00	84.62	63.64	88.24	70.23	72.17	57.97	83.33	87.50	87.50	15.38	7.39	35.90	36.36	63.89	27.59
% Sensitive EPT (CAHBI)	88.89	100.00	100.00	23.08	9.09	35.29	54.96	63.48	42.03	50.00	87.50	87.50	16.48	7.39	35.90	36.36	63.89	27.59
% Non-Insect Individuals	9.09	0.00	0.00	0.00	6.67	4.35	3.65	5.39	8.16	0.00	0.00	0.00	1.08	4.66	9.76	0.00	5.56	0.00
% Non-Insect Taxa	25.00	0.00	0.00	0.00	14.29	10.00	6.06	10.87	10.34	0.00	0.00	0.00	8.33	23.81	14.29	0.00	12.50	0.00
% Crustacea + Mollusca	0.00	0.00	0.00	0.00	0.00	0.00	3.13	2.40	5.10	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.00
Average Abundance (per taxon)	2.75	3.67	6.00	3.25	2.14	2.30	5.82	3.63	3.38	1.94	4.00	2.00	7.75	11.24	2.93	2.14	4.50	6.45

Table 38I - 2008 Macroinvertebrate Taxonomic Community Analysis Data

	Stream	Montana	Montana	Montana	Montana	Montana	Montana
	Site	BRSW-06	BRSW-101	BRSW-106	BRSW-108	BRSW-16	BRSW-17
	Rep	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled
	Date	06-17-2008	06-18-2008	06-18-2008	06-17-2008	06-17-2008	06-18-2008
	Time	13:15	12:30	08:30	12:00	09:00	11:00
	Ecoregion	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
	Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00
	EcoAnalysts Sample ID	*5191.1-19*	*5191.1-20*	*5191.1-21*	*5191.1-22*	*5191.1-23*	*5191.1-24*
Ephemeroptera	Ameletus sp.	3	0	0	0	0	0
	Baetis bicaudatus	1	0	1	0	0	0
	Baetis sp.	1	0	0	0	0	0
	Baetis tricaudatus	0	0	0	0	0	1
	Cinygmula sp.	20	0	1	0	0	0
	Diphetor hageni	12	9	1	0	0	12
	Drunella coloradensis/flavilinea	3	0	0	0	0	0
	Epeorus albertae	2	0	0	0	0	0
	Epeorus sp.	2	1	0	0	0	0
	Ephemerella inermis/infrequens	2	0	0	0	0	0
	Rhithrogena sp.	1	0	0	0	0	0
	Serratella tibialis	1	0	0	0	0	0
Plecoptera	Alloperla sp.	0	0	0	0	0	2
	Claassenia sabulosa	0	1	0	0	0	0
	Hesperoperla pacifica	0	0	0	0	0	9
	Isoperla sp.	1	0	0	0	0	0
	Kogotus sp.	0	0	0	0	0	2
	Lednia tumana	0	0	1	0	0	0
	Leuctridae	1	0	0	0	0	0
	Malenka sp.	0	0	1	3	0	2
	Nemouridae	0	0	1	0	1	0
	Paraleuctra sp.	8	1	0	7	0	0
	Paraperla sp.	6	0	0	0	0	0
	Perlidae	0	2	0	0	0	0
	Perlodidae	11	0	0	0	0	0
	Suwallia sp.	2	0	0	0	0	0
	Sweltsa sp.	87	33	21	0	22	16
	Visoka cataractae	3	0	0	0	0	0
	Yoraperla sp.	4	0	0	0	0	0
	Zapada frigida	3	0	0	0	0	0
	Zapada oregonensis gr.	7	0	0	0	0	0
Coleoptera	Ametor sp.	0	0	0	0	0	1
	Oreodytes sp.	0	0	0	0	0	1
	Zaitzevia sp.	0	3	0	0	0	0
ptera-Chironomidae	Chaetocladius sp.	1	0	0	0	0	0
	Cricotopus (Nostoc.) nostocicola	7	0	0	0	0	0
	Diamesa sp.	3	0	1	0	3	0
	Eukiefferiella brehmi gr.	2	0	0	0	0	0
	Eukiefferiella coerulescens gr.	0	0	0	2	0	0
	Eukiefferiella sp.	1	0	0	0	0	0
	Heleniella sp.	0	0	1	0	0	0
	Krenosmittia sp.	0	0	1	1	0	0
	Larsia sp.	2	0	0	0	0	1
	Micropsectra sp.	7	0	0	0	0	0

Table 38I - 2008 Macroinvertebrate Taxonomic Community Analysis Data

	Stream	Montana	Montana	Montana	Montana	Montana	Montana
	Site	BRSW-06	BRSW-101	BRSW-106	BRSW-108	BRSW-16	BRSW-17
	Rep	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled
	Date	06-17-2008	06-18-2008	06-18-2008	06-17-2008	06-17-2008	06-18-2008
	Time	13:15	12:30	08:30	12:00	09:00	11:00
	Ecoregion	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
	Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00
	EcoAnalysts Sample ID	*5191.1-19*	*5191.1-20*	*5191.1-21*	*5191.1-22*	*5191.1-23*	*5191.1-24*
	Orthocladius Complex	6	0	0	0	0	0
	Orthocladius sp.	0	0	0	0	0	1
	Pagastia sp.	22	0	0	0	0	0
	Parachaetocladius sp.	5	0	5	22	0	0
	Parametriocnemus sp.	21	9	1	0	0	2
	Paraphaenocladius sp.	1	0	0	0	0	0
	Paratanytarsus sp.	0	0	0	0	0	1
	Polypedilum sp.	0	3	0	0	0	0
	Reomyia sp.	1	0	0	0	0	0
	Stempellinella sp.	4	1	0	0	0	1
	Stilocladius sp.	1	0	0	1	0	0
	Tanytarsus sp.	2	0	0	0	0	0
	Thienemanniella sp.	0	1	0	0	0	0
	Thienemannimyia gr. sp.	0	1	0	0	0	0
	Tvetenia bavarica gr.	4	0	1	0	0	0
Diptera	Antocha sp.	0	0	0	0	0	1
	Atrichopogon sp.	0	0	0	1	0	0
	Bezzia/Palpomyia sp.	0	0	1	0	0	0
	Cryptolabis sp.	0	3	0	0	0	0
	Diptera	0	0	1	0	0	0
	Dolichopodidae	0	0	1	0	0	0
	Empididae	0	1	0	0	0	0
	Gonomyia sp.	0	1	0	1	0	0
	Oreogeton sp.	0	0	0	7	0	0
	Prosimulium sp.	0	42	1	0	0	0
	Psychodidae	0	0	3	0	0	0
	Rhabdomastix fascigera gr.	0	3	1	0	0	0
	Simulium sp.	0	17	0	0	0	215
	Tipula sp.	0	0	0	0	0	2
	Twinnia sp.	0	0	2	0	0	0
	Wiedemannia sp.	2	0	0	0	0	0
Trichoptera	Anagapetus sp.	4	0	0	0	0	0
	Hesperophylax sp.	0	0	0	1	0	0
	Hydropsyche sp.	0	1	0	0	0	5
	Lepidostoma sp.	0	1	0	0	0	2
	Limnephilidae	1	0	0	3	0	0
	Micrasema sp.	1	1	0	0	0	9
	Philopotamidae	0	0	0	0	0	1
	Rhyacophila betteni gr.	6	0	0	0	0	0
	Rhyacophila brunnea gr.	1	0	0	0	0	1
	Rhyacophila sp.	0	0	0	0	1	0
	Rhyacophila verrula gr.	3	0	0	0	0	0
Bivalvia	Pisidium sp.	0	0	0	0	0	2
Annelida	Enchytraeidae	0	0	0	1	0	1

Table 38I - 2008 Macroinvertebrate Taxonomic Community Analysis Data

	Stream	Montana	Montana	Montana	Montana	Montana	Montana
	Site	BRSW-06	BRSW-101	BRSW-106	BRSW-108	BRSW-16	BRSW-17
	Rep	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled
	Date	06-17-2008	06-18-2008	06-18-2008	06-17-2008	06-17-2008	06-18-2008
	Time	13:15	12:30	08:30	12:00	09:00	11:00
	Ecoregion	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
	Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00
	EcoAnalysts Sample ID	*5191.1-19*	*5191.1-20*	*5191.1-21*	*5191.1-22*	*5191.1-23*	*5191.1-24*
Acari	Lebertia sp.	2	0	0	0	0	0
	Oribatei	0	0	0	1	0	0
	Protzia sp.	0	0	0	0	0	6
	Sperchon sp.	1	0	0	0	0	1
	Torrenticola sp.	0	2	0	0	0	1
Crustacea	Ostracoda	8	0	0	0	0	0
Other Organisms	Nematoda	0	0	0	0	1	1
	TOTAL	**300**	**137**	**47**	**51**	**28**	**300**

Table 38m - 2008 Macroinvertebrate Taxonomic Community Analysis Data

Stream	Montana	Montana	Montana	Montana	Montana	Montana
Site	BRSW-06	BRSW-101	BRSW-106	BRSW-108	BRSW-16	BRSW-17
Rep	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled
Date	06-17-2008	06-18-2008	06-18-2008	06-17-2008	06-17-2008	06-18-2008
Device	13:15	12:30	08:30	12:00	09:00	11:00
Ecoregion	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00
EcoAnalysts Sample ID	*5191.1-19*	*5191.1-20*	*5191.1-21*	*5191.1-22*	*5191.1-23*	*5191.1-24*
Abundance Measures						
Corrected Abundance	300.00	137.00	47.00	51.00	28.00	300.00
EPT Abundance	197.00	50.00	27.00	14.00	24.00	62.00
Dominance Measures						
Dominant Taxon	Sweltsa sp.	Prosimulium sp.	Sweltsa sp.	Parachaetocladius sp.	Sweltsa sp.	Simulium sp.
Dominant Abundance	87.00	42.00	21.00	22.00	22.00	215.00
2nd Dominant Taxon	Pagastia sp.	Sweltsa sp.	Parachaetocladius sp.	Paraleuctra sp.	Diamesa sp.	Sweltsa sp.
2nd Dominant Abundance	22.00	33.00	5.00	7.00	3.00	16.00
3rd Dominant Taxon	Parametriocnemus sp.	Simulium sp.	Psychodidae	Oreogeton sp.	Nematoda	Diphetor hageni
3rd Dominant Abundance	21.00	17.00	3.00	7.00	1.00	12.00
% Dominant Taxon	29.00	30.66	44.68	43.14	78.57	71.67
% 2 Dominant Taxa	36.33	54.74	55.32	57	89.29	77.00
% 3 Dominant Taxa	43.33	67.15	61.70	70.59	92.86	81.00
Richness Measures						
Species Richness	49.00	22.00	20.00	13.00	5.00	28.00
EPT Richness	28.00	9.00	7.00	4.00	3.00	12.00
Ephemeroptera Richness	11.00	2.00	3.00	0.00	0.00	2.00
Plecoptera Richness	11.00	4.00	4.00	2.00	2.00	5.00
Trichoptera Richness	6.00	3.00	0.00	2.00	1.00	5.00
Chironomidae Richness	17.00	5.00	6.00	4.00	1.00	5.00
Oligochaeta Richness	0.00	0.00	0.00	1.00	0.00	1.00
Non-Chiro. Non-Olig. Richness	32.00	17.00	14.00	8.00	4.00	22.00
Rhyacophila Richness	3.00	0.00	0.00	0.00	1.00	1.00
Community Composition						
% Ephemeroptera	16.00	7.30	6.38	0.00	0.00	4.33
% Plecoptera	44.33	27.01	51.06	19.61	82.14	10.33
% Trichoptera	5.33	2.19	0.00	7.84	3.57	6.00
% EPT	65.67	36.50	57.45	27.45	85.71	20.67
% Coleoptera	0.00	2.19	0.00	0.00	0.00	0.67
% Diptera	30.67	59.85	42.55	68.63	10.71	74.67
% Oligochaeta	0.00	0.00	0.00	1.96	0.00	0.33
% Baetidae	4.67	6.57	4.26	0.00	0.00	4.33
% Brachycentridae	0.33	0.73	0.00	0.00	0.00	3.00
% Chironomidae	30.00	10.95	21.28	50.98	10.71	2.00
% Ephemerellidae	2.00	0.00	0.00	0.00	0.00	0.00
% Hydropsychidae	0.00	0.73	0.00	0.00	0.00	1.67
% Odonata	0.00	0.00	0.00	0.00	0.00	0.00
% Perlidae	0.00	2.19	0.00	0.00	0.00	3.00
% Pteronarcyidae	0.00	0.00	0.00	0.00	0.00	0.00
% Simuliidae	0.00	43.07	6.38	0.00	0.00	71.67

Table 38m - 2008 Macroinvertebrate Taxonomic Community Analysis Data

Stream	Montana	Montana	Montana	Montana	Montana	Montana
Site	BRSW-06	BRSW-101	BRSW-106	BRSW-108	BRSW-16	BRSW-17
Rep	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled
Date	06-17-2008	06-18-2008	06-18-2008	06-17-2008	06-17-2008	06-18-2008
Device	13:15	12:30	08:30	12:00	09:00	11:00
Ecoregion	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00
EcoAnalysts Sample ID	*5191.1-19*	*5191.1-20*	*5191.1-21*	*5191.1-22*	*5191.1-23*	*5191.1-24*
Functional Group Composition						
% Filterers	0.67	43.80	6.38	0.00	0.00	74.33
% Gatherers	34.67	16.79	31.91	54.90	10.71	6.67
% Predators	40.67	31.39	51.06	15.69	85.71	13.67
% Scrapers	10.67	0.73	2.13	0.00	0.00	0.00
% Shredders	12.33	6.57	4.26	27.45	3.57	5.00
% Piercer-Herbivores	0.00	0.00	0.00	0.00	0.00	0.00
% Unclassified	1.00	0.73	4.26	1.96	0.00	0.33
Filterer Richness	1.00	3.00	2.00	0.00	0.00	4.00
Gatherer Richness	19.00	5.00	9.00	6.00	1.00	8.00
Predator Richness	12.00	7.00	4.00	2.00	3.00	11.00
Scraper Richness	6.00	1.00	1.00	0.00	0.00	0.00
Shredder Richness	10.00	5.00	2.00	4.00	1.00	4.00
Piercer-Herbivore Richness	0.00	0.00	0.00	0.00	0.00	0.00
Unclassified	1.00	1.00	2.00	1.00	0.00	1.00
Diversity/Evenness Measures						
Shannon-Weaver H' (log 10)	1.31	0.94	0.96	0.83	0.34	0.60
Shannon-Weaver H' (log 2)	4.36	3.14	3.20	2.75	1.13	1.99
Shannon-Weaver H' (log e)	3.02	2.18	2.22	1.91	0.79	1.38
Margalef's Richness	8.42	4.27	4.93	3.05	1.20	4.73
Pielou's J'	0.78	0.70	0.74	0.74	0.49	0.41
Simpson's Heterogeneity	0.89	0.83	0.79	0.78	0.38	0.48
Biotic Indices						
% Indiv. w/ HBI Value	97.67	95.62	93.62	94.12	100.00	97.00
Hilsenhoff Biotic Index	2.39	2.88	2.68	4.63	0.79	4.36
% Indiv. w/ MTI Value	51.33	67.15	21.28	35.29	17.86	89.67
Metals Tolerance Index	2.93	2.73	3.00	2.94	6.60	4.51
% Indiv. w/ FSBI Value	54.67	47.45	53.19	5.88	82.14	91.00
Fine Sediment Biotic Index	103.00	31.00	21.00	2.00	9.00	48.00
FSBI - average	2.10	1.41	1.05	0.15	1.80	1.71
FSBI - weighted average	4.59	3.83	4.04	2.00	4.04	3.32
% Indiv. w/ TPM Value	84.67	92.70	68.09	31.37	92.86	92.67
Temp. Pref. Metric - average	4.94	3.59	4.50	2.62	4.60	2.75
TPM - weighted average	6.96	7.12	7.19	6.88	7.15	5.06
Karr BIBI Metrics						
Long-Lived Taxa Richness	6.00	5.00	1.00	1.00	1.00	5.00
Clinger Richness	23.00	12.00	8.00	2.00	3.00	13.00
% Clingers	62.67	83.21	61.70	19.61	85.71	91.67
Intolerant Taxa Richness	23.00	7.00	5.00	2.00	3.00	8.00
% Tolerant Individuals	2.73	0.00	6.82	2.08	0.00	0.34

Table 38m - 2008 Macroinvertebrate Taxonomic Community Analysis Data

Stream	Montana	Montana	Montana	Montana	Montana	Montana
Site	BRSW-06	BRSW-101	BRSW-106	BRSW-108	BRSW-16	BRSW-17
Rep	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled	Reps1-3 Pooled
Date	06-17-2008	06-18-2008	06-18-2008	06-17-2008	06-17-2008	06-18-2008
Device	13:15	12:30	08:30	12:00	09:00	11:00
Ecoregion	Mountains	Mountains	Mountains	Mountains	Mountains	Mountains
Percent Subsampled	100.00	100.00	100.00	100.00	100.00	100.00
EcoAnalysts Sample ID	*5191.1-19*	*5191.1-20*	*5191.1-21*	*5191.1-22*	*5191.1-23*	*5191.1-24*
% Tolerant Taxa	4.08	0.00	5.00	7.69	0.00	3.57
Coleoptera Richness	0.00	1.00	0.00	0.00	0.00	2.00
Montana DEQ Metrics						
MT Biotic Index	2.39	2.88	2.68	4.63	0.79	4.36
C-Gatherers + C- Filterers	35.33	60.58	38.30	54.90	10.71	81.00
% Scraper + %Shredder	23.00	7.30	6.38	27.45	3.57	5.00
% Univoltine	30.00	36.50	27.66	37.25	17.86	3.33
% Multivoltine	18.67	25.55	10.64	0.00	3.57	78.00
% Semivoltine	34.67	28.47	44.68	13.73	78.57	12.00
Community Tolerance Quotient	N/A	N/A	N/A	N/A	N/A	N/A
% Hydropsychinae	0.00	0.73	0.00	0.00	0.00	1.67
Lake Metrics						
% Orthocladiinae	16.33	7.30	19.15	50.98	0.00	1.00
Orthocladiinae Richness	10.00	2.00	5.00	4.00	0.00	2.00
% Chironomini	0.00	2.19	0.00	0.00	0.00	0.00
Chironomini Richness	0.00	1.00	0.00	0.00	0.00	0.00
% Tanytarsini	4.33	0.73	0.00	0.00	0.00	0.67
% Chironomus	0.00	0.00	0.00	0.00	0.00	0.00
% Tanytarsus	0.67	0.00	0.00	0.00	0.00	0.00
% Dicrotendipes	0.00	0.00	0.00	0.00	0.00	0.00
% Dicrotendipes + Chironomus	0.00	0.00	0.00	0.00	0.00	0.00
% Corbicula	0.00	0.00	0.00	0.00	0.00	0.00
% Manayunkia speciosa	0.00	0.00	0.00	0.00	0.00	0.00
% Intolerant	62.12	32.06	59.09	22.92	85.71	14.78
% Intolerant Taxa (S.CA)	60.67	30.66	55.32	21.57	85.71	14.33
% Individuals w/ CAHBI value	72.67	63.50	72.34	80.39	89.29	97.33
% Intolerant Taxa (CAHBI)	69.27	44.83	85.29	80.49	96.00	13.36
% Sensitive EPT (CAHBI)	56.88	44.83	67.65	24.39	96.00	13.70
% Non-Insect Individuals	3.67	1.46	0.00	3.92	3.57	4.00
% Non-Insect Taxa	6.12	4.55	0.00	15.38	20.00	21.43
% Crustacea + Mollusca	2.67	0.00	0.00	0.00	0.00	0.67
Average Abundance (per taxon)	6.12	6.23	2.35	3.92	5.60	10.71

Table 38n - 2008 Macroinvertebrate Taxonomic Community Analysis Data

	Stream	**Montana**	**Montana**	**Montana**	**Montana**	**Montana**	**Montana**
	Site	**BRSW-06**	**BRSW-101**	**BRSW-106**	**BRSW-108**	**BRSW-16**	**BRSW-17**
	Rep	**Reps1-3 Pooled**	**Reps1-3 Pooled**	**Reps1-3 Pooled**	**Reps1-3 Pooled**	**Reps1-3 Pooled**	**Reps1-3 Pooled**
	Date	**06-17-2008**	**06-18-2008**	**06-18-2008**	**06-17-2008**	**06-17-2008**	**06-18-2008**
	Time	**13:15**	**12:30**	**08:30**	**12:00**	**09:00**	**11:00**
	Ecoregion	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**	**Mountains**
	Percent Subsampled	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
	EcoAnalysts Sample ID	***5191.1-19***	***5191.1-20***	***5191.1-21***	***5191.1-22***	***5191.1-23***	***5191.1-24***
Metric Values	Ephemeroptera Richness	11.00	2.00	3.00	0.00	0.00	2.00
	Plecoptera Richness	11.00	4.00	4.00	2.00	2.00	5.00
	% EPT	65.67	36.50	57.45	27.45	85.71	20.67
	% Non-Insect Individuals	3.67	1.46	0.00	3.92	3.57	4.00
	% Predators	40.67	31.39	51.06	15.69	85.71	13.67
	Burrower Taxa %	5.00	19.05	16.67	9.09	20.00	17.39
	Biotic Index	2.39	2.88	2.68	4.63	0.79	4.36
Metric Scores	Ephemeroptera Richness	100.00	20.00	30.00	0.00	0.00	20.00
	Plecoptera Richness	100.00	57.14	57.14	28.57	28.57	71.43
	% EPT	72.97	40.56	63.83	30.50	95.23	22.97
	% Non-Insect Individuals	86.89	94.79	100.00	86.00	87.25	85.71
	% Predators	100.00	80.49	100.00	40.23	100.00	35.05
	Burrower Taxa %	100.00	90.07	93.43	100.00	88.73	92.41
	Biotic Index	85.17	77.00	80.33	47.83	100.00	52.33
	MMI Scores	**92.15**	**65.72**	**74.96**	**47.59**	**71.40**	**54.27**
	Impairment determination	**Unimpaired**	**Unimpaired**	**Unimpaired**	**Impaired**	**Unimpaired**	**Impaired**

Sites highlighted in yellow indicate that the samples did not reach the minimum target of 300 as required for the MMI calculation.

Table 4
Summary of GWIC Database Information for Water Supply Wells

GWIC ID	Site Name	Location	TD	SWL	Yield	Aquifer Lithology
143631	Cox, Armond & Esther	T15N R6W S18	55	20	20	S/G, red shale, gravel
71500	Romain, Vera #1	T15N R6W S19	25	5	60	Alluvium
71499	Romain, Vera #2	T15N R6W S19	25	5	20	Alluvium
71501	Bordeleau, Denis	T15N R6W S19	37	13	25	clay, rock, coarse S/G
237352	Zuelke, Bob & Kathleen	T15N R6W S19	58	7	15	shale, gravel
71502	Jankuit, E.G.	T15N R6W S19	65	55	6	Alluvium
199512	Whittenberg, Bill	T15N R7W S23	110	75	12	clay, gravel
236272	Whittenberg, Bill	T15N R7W S23	143	73	12	clay, gravel
71507	MT Dept. of HWYS	T15N R7W S24	55	9.4	42	S/G, clay, bedrock
156567	Gilmore, Daniel	T15N R7W S24	72	30	12	gravel, shale
71508	The Anaconda Co.	T15N R7W S24	108	1.55	150	S/G, clay
176997	Eustance, Neil	T15N R7W S26	58	36	20	clay, gravel
243935	MT Dept of Trans.	T15N R7W S27	158.5			Bedrock – argilite
248670	MT Dept of Trans.	T15N R7W S27	60	15	50	clay, gravel
197046	Mcinnus, John	T15N R7W S34	60	18	12	clay, gravel, S/G, shale
190657	Grimes, Mike	T15N R7W S34	350	30	100	clay, gravel, shale
71511	Mcinnis, John	T15N R7W S34	80	40	20	clay, sand, gravel

Notes:
GWIC ID: MBMG Groundwater Information Center Identification No.
TD : Total depth of well in feet below ground surface
SWL : Static water level in feet below ground surface
Yield : Yield in gallons per minute
Aquifer Lithology : Type of rock and/or alluvial material that noted at and below measured water table
S/G : sand & gravel
Alluvium : alluvial material not defined

Table 5
Characteristics of Significant Streams in the UBMC

Stream	Drainage Area sq miles	Bankfull Elevation ft amsl[1]	Peak Flow from 100-yr Storm cfs[2]	Location	Range in Measured Flows 1991-2001 cfs[2]
Mike Horse Creek	0.41	5556.8	214	Lower Mike Horse Creek	0.02 – 2.6
Beartrap Creek	2.02	5311.5	496	At mouth	0.005 – 10.4
Above Tailings Dam	1.42	--	--	--	--
Anaconda Creek	2.91	5346.6	726	At mouth	0.05 – 16.8
Stevens Gulch	0.56	5241.8	187	At mouth	0.006 – 2.0
Shave Gulch	3.28	5218.8	715	At mouth	0.042 – 16.8
Paymaster Creek	0.61	5230.1	193	Lower Paymaster Ck	0.041 – 5.1
Pass Creek	2.34	5194.8	416	At mouth	0.02 – 1.2
Swamp Gulch	0.26	5182.2	105	Lower Swamp Gulch	0.002 – 0.50

Source: DEQ 2007
Notes:
-- Not applicable
[1]Elevations and flows from Envirocon 1993.
[2]cfs-cubic feet per second

Table 6
Surface Water Rights

Owner	Water Right Number	Well Location			Water Right Type	Year	Purpose
		Township and Range	Section	Quarter Section			
USFS	76F 52008 00	15N 6W	27	SESWNW	Statement Of Claim	1930	Mining
ASARCO Inc	76F 97609 00	15N 6W	28	NWNESE	Statement Of Claim	1916	Mining
ASARCO Inc	76F 97610 00	15N 6W	28	NWNESE	Statement Of Claim	1919	Mining
ASARCO Inc	76F 97611 00	15N 6W	28	NWNESE	Statement Of Claim	1941	Mining
ASARCO Inc	76F 97612 00	15N 6W	28	NWNESE	Statement Of Claim	1941	Mining
ASARCO Inc	76F 97613 00	15N 6W	20	S2NE	Statement Of Claim	1892	Mining
ASARCO Inc	76F 97614 00	15N 6W	20	S2NE	Statement Of Claim	1895	Mining
ASARCO Inc	76F 97615 00	15N 6W	28	NWNESE	Statement Of Claim	1945	Mining
ASARCO Inc	76F 97616 00	15N 6W	28	NWNESE	Statement Of Claim	1945	Mining
ASARCO Inc	76F 97622 00	15N 6W	21	SWNWNE	Statement Of Claim	1963	Mining
ASARCO Inc	76F 97623 00	15N 6W	20	SENWSE	Statement Of Claim	1902	Mining
Cartan, Gloria J,	76F 97850 00	15N 6W	16	NW	Statement Of Claim	1916	Mining
	76F 97850 00	15N 6W	16	SW			
	76F 97850 00	15N 6W	17	E2E2SE			
ASARCO Inc	76F 98318 00	15N 6W	20	SWSENW	Statement Of Claim	1943	Mining

Table 7 Water Wells and Ground Water Rights in UBMC Vicinity										
Well Location				Well Depth (ft)	Depth to Water (ft)	Year	Owner	Water Right Type	Water Right Number	Use
Quarter Section	Section	Township	Range							
SE¼ SE¼	18	15N	06W	55	20	1994	Cox, Amond and Gail	Ground Water Certificate	91569-00	Domestic
NE¼ SW¼	18	15N	06W	--	--	1937	Cox, Amond and Gail	Statement of Claim	127775	Domestic
NE¼ SE¼ SE¼	19	15N	06W	--	--	1959	USA (Dept of Agriculture Forest Service)	Statement of Claim	52005-00	Institutional
NW¼ NW¼ NE¼	19	15N	06W	--	--	1959	Zuelke, Robert and Kathleen	Statement of Claim	116746-00	Domestic
NW¼ SE¼ NE¼	19	15N	06W	58	7	2008	Zuelke, Robert and Kathleen	Ground Water Certificate	30044741	Domestic
SE¼ SE¼ NE¼	19	15N	06W	37	13	1982	Bordeleau, Denis	Ground Water Certificate	42722-00	Domestic
SE¼ NE¼	19	15N	06W	25	5	1965	Romain Vera	--	--	Domestic
SE¼ NE¼	19	15N	06W	25	5	1965	Romain Vera	--	--	Commercial
SE¼ SE¼ NE¼	19	15N	06W	65	55	1960	Janikuit, E.G	--	--	Domestic
--	20	15N	06W	23	--	2007	DEQ	--	--	Monitoring
NW¼ NE¼	20	15N	06W	67	10	2008	DEQ	--	--	Monitoring
NW¼ NE¼	20	15N	06W	20	9	2008	DEQ	--	--	Monitoring
NE¼ NW¼	20	15N	06W	20	8	2007	DEQ	--	--	Monitoring
SE¼ NW¼	20	15N	06W	7	--	2007	DEQ	--	--	Monitoring

Table 7 Water Wells and Ground Water Rights in UBMC Vicinity										
Well Location				Well Depth (ft)	Depth to Water (ft)	Year	Owner	Water Right Type	Water Right Number	Use
Quarter Section	Section	Township	Range							
NW¼ SW¼	20	15N	06W	85	8	2007	DEQ	--	--	Monitoring
NE¼ SE¼	20	15N	06W	90	7	2007	DEQ	--	--	Monitoring
NW¼ SE¼	20	15N	06W	30	10	2007	DEQ	--	--	Monitoring
NW¼ SE¼	20	15N	06W	90	11	2007	DEQ	--	--	Monitoring
NW¼ SE¼	20	15N	06W	60	14	2007	DEQ	--	--	Monitoring
NW¼ SE¼	20	15N	06W	25	11	2007	DEQ	--	--	Monitoring
NW¼ SE¼	20	15N	06W	18	8	1996	DEQ	--	--	Monitoring
--	21	15N	06W	31	15	2007	DEQ	--	--	Monitoring
SE¼ NW¼	21	15N	06W	20	9	2008	DEQ	--	--	Monitoring
SE¼ NW¼	21	15N	06W	72	10	2008	DEQ	--	--	Monitoring
SE¼ SW¼	21	15N	06W	70	29	2007	DEQ	--	--	Monitoring
SW¼ SE¼	21	15N	06W	43	12	2007	DEQ	--	--	Monitoring
NW¼ NW¼	27	15N	06W	85	70	2007	DEQ	--	--	Monitoring
NW¼ NW¼	27	15N	06W	129	102	2008	DEQ	--	--	Monitoring
SW¼ NW¼	27	15N	06W	60	51	2007	USFS	--	--	Monitoring

Table 7 Water Wells and Ground Water Rights in UBMC Vicinity										
Well Location				Well Depth (ft)	Depth to Water (ft)	Year	Owner	Water Right Type	Water Right Number	Use
Quarter Section	Section	Township	Range							
NE¼ SW¼	27	15N	06W	41	11	2008	USFS	--	--	Monitoring
NE¼ SW¼	27	15N	06W	15	11	2007	USFS	--	--	Monitoring
NW¼ SW¼	27	15N	06W	71	17	2007	USFS	--	--	Monitoring
NW¼ SW¼	27	15N	06W	64	30	2007	USFS	--	--	Monitoring
NE¼ SE¼	28	15N	06W	21	8	1989	Dept of State Lands	--	--	Monitoring
NE¼ SE¼	28	15N	06W	12	9	2007	DEQ	--	--	Monitoring
NE¼ SE¼	28	15N	06W	7	--	2007	DEQ	--	--	Monitoring
NE¼ SE¼	28	15N	06W	38	2	2007	DEQ	--	--	Monitoring
NE¼ SE¼	28	15N	06W	10	2	2007	DEQ	--	--	Monitoring
NW¼ SE¼ SE¼	28	15N	06W	37	18	1998	ASARCO	--	--	Monitoring
NW¼ SE¼ SE¼	28	15N	06W	55	15	1998	ASARCO	--	--	Monitoring
NE¼ SW¼	29	15N	06W	18	5	2007	DEQ	--	--	Monitoring
NE¼ SE¼	23	15N	7W	110	75	2008	Whittenburg, William and Jennifer	Ground Water Certificate	30044405	Stock
NE¼ SE¼	23	15N	7W	143	73	2007	Whittenburg, William and Jennifer	--	--	Domestic

Table 7 Water Wells and Ground Water Rights in UBMC Vicinity										
Well Location				Well Depth (ft)	Depth to Water (ft)	Year	Owner	Water Right Type	Water Right Number	Use
Quarter Section	Section	Township	Range							
NW¼	24	15N	7W	--	--	1970	Whittenburg, William and Jennifer	Statement of Claim	9760800	Mining
NE¼ NE¼	24	15N	7W	55	9.4	1973	MDT	--	--	Irrigation
NE¼ SW¼ NE¼	24	15N	7W	72	30	1996	Gilmore, Daniel and Juanita	Ground Water Certificate	9874800	Domestic
SE¼ NE¼ NE¼	24	15N	7W	--	--	1996	Gilmore, Daniel and Juanita	Exempt Right	8690500	Domestic
SE¼ NE¼ NE¼	24	15N	7W	--	--	1996	Gilmore, Daniel and Juanita	Exempt Right	8690400	Domestic
NW¼	24	15N	7W	108	1.55	1970	The Anaconda Co.	--	--	Industrial
NE¼ SW¼ NE¼	24	15N	7W	--	--	1999	Courtesy Land & Livestock Co. – Solvie, Adolph	Ground Water Certificate	10910400	Domestic
SW¼ NW¼	26	15N	7W	58	36	1999	Eustance, Neil and Babette	Ground Water Certificate	30027416	Domestic
--	27	15N	7W	158.5	--	1970	MDT	--	--	Unused
SE¼ SW¼ NW¼	27	15N	7W	60	15	2008	MDT	--	--	Domestic
SW¼ NE¼	34	15N	7W	60	18	2003	Mcinnus, John	Ground Water Certificate	30006050	Stock
NE¼ NE¼ SE¼	34	15N	7W	80	40	1980	Mcinnis, John	Ground Water Certificate	2909600	Domestic
SE¼ NE¼	34	15N	7W	350	30	2001	Grimes, Mike	--	--	Domestic

Sources: http://nris.mt.gov/dnrc/ water rights September 22, 2011 http://mbmggwic.mtech.edu September 22, 2011 DNRC, 2011

Table 8
Upper Blackfoot River Pre-Reclamation and Post-Reclamation Water Quality

	Water Quality Parameter								
	pH	Al (D)	As (T)	Cd (T)	Cu (T)	Fe (T)	Pb (T)	Mn (T)	Zn (T)
DEQ-7 HHS	A	N/A	0.01	0.005	1.3	0.3**	0.015	0.05**	2
DEQ-7 ALS	B	0.087***	0.15	0.000097*	0.00285*	1	0.000545*	N/A	0.037*
Site BRSW-9									
Pre-Reclamation Range (1991-1996)									
Minimum	6.9	<0.05	<0.002	0.003	0.013	<0.03	0.005	0.35	0.978
Maximum	8.1	0.209	<0.02	0.012	0.18	13.6	0.035	2.1	4.4
Post-Reclamation Range (1999-2004)									
Minimum	6.4	<0.05	<0.002	<0.0027	0.006	0.04	<0.003	0.16	0.4
Maximum	8.1	0.065	<0.005	0.0155	0.19	0.62	0.044	3.8	3.45
Site BRSW-12									
Pre-Reclamation Range (1991-1996)									
Minimum	7.2	<0.05	<0.002	0.002	0.008	0.042	<0.003	0.2	0.72
Maximum	8.0	0.317	<0.008	<0.01	0.06	0.507	0.073	0.96	2.5
Post-Reclamation Range (1999-2004)									
Minimum	6.2	<0.05	<0.002	<0.001	0.007	<0.02	<0.003	0.1	0.48
Maximum	7.8	0.13	<0.005	0.006	0.08	0.33	0.018	0.6	1.7

Notes: Al-Aluminum; As-Arsenic; Cd-Cadmium; Cu-Copper; Fe-Iron; Pb-Lead; Mn-Manganese, Zn-Zinc.
D=dissolved, T=total or total recoverable.
Metals and arsenic concentrations are mg/L; pH is field-measured in standard units.
½ the detection limit was used for "non-detects" to calculate averages.
Sampling locations shown in Figure 3-6.
Surface water standards are based on total recoverable metals, except aluminum (dissolved).
DEQ-7 HHS = Human Health Standards for surface water from Circular DEQ-7.
DEQ-7 ALS = Aquatic Life Standards (chronic standard) for surface water from Circular DEQ-7.
* = value based on 25 mg/L hardness – actual hardness not calculated; used for comparison purposes only
** = value provided is based on secondary maximum contaminant limits and is included in Circular DEQ-7.
*** = Aluminum standard is for pH range 6.5 - 9.0 only.
A = Narrative standard provided in ARM.
B = Standard based upon water use classification, see ARM.
N/A = no standard or guidance value is provided in DEQ-7.

Table 9
Pre-Reclamation and Post-Reclamation Water Quality in Swamp Gulch Downstream of the Carbonate Mine

	Water Quality Parameter								
	pH	Al (D)	As (T)	Cd (T)	Cu (T)	Fe (T)	Pb (T)	Mn (T)	Zn (T)
DEQ-7 HHS	A	N/A	0.01	0.005	1.3	0.3**	0.015	0.05**	2
DEQ-7 ALS	B	0.087***	0.15	0.000097*	0.00285*	1	0.000545*	N/A	0.037*
Pre-Reclamation Range (1991-1994)									
Minimum	2.6	<0.05	<0.002	<0.001	0.016	0.581	<0.005	0.323	0.145
Maximum	7.3	0.16	<0.02	0.042	1.35	64.7	0.253	6.8	3.73
Post-Reclamation Range (1995-1998)									
Minimum	7.5	<0.05	<0.002	<0.001	<0.005	0.054	<0.003	0.06	0.01
Maximum	8.0	<0.1	<0.005	<0.001	0.01	1.3	<0.01	0.33	0.065

Notes: Al-Aluminum; As-Arsenic; Cd-Cadmium; Cu-Copper; Fe-Iron; Pb-Lead; Mn-Manganese, Zn-Zinc.
D=dissolved, T=total or total recoverable.
Metals and arsenic concentrations are mg/L; pH is field-measured in standard units.
½ the detection limit was used for "non-detects" to calculate averages.
Sampling location BRSW-15 shown on Exhibit 1.
Surface water standards are based on total recoverable metals, except aluminum (dissolved).
DEQ-7 HHS = Human Health Standards for surface water from Circular DEQ-7.
DEQ-7 ALS = Aquatic Life Standards (chronic standard) for surface water from Circular DEQ-7.
* = value based on 25 mg/L hardness – actual hardness not calculated; used for comparison purposes only
** = value provided is based on secondary maximum contaminant limits and is included in Circular DEQ-7.
*** = Aluminum standard is for pH range 6.5 - 9.0 only.
A = Narrative standard provided in ARM.
B = Standard based upon water use classification, see ARM.
N/A = no standard or guidance value is provided in DEQ-7.