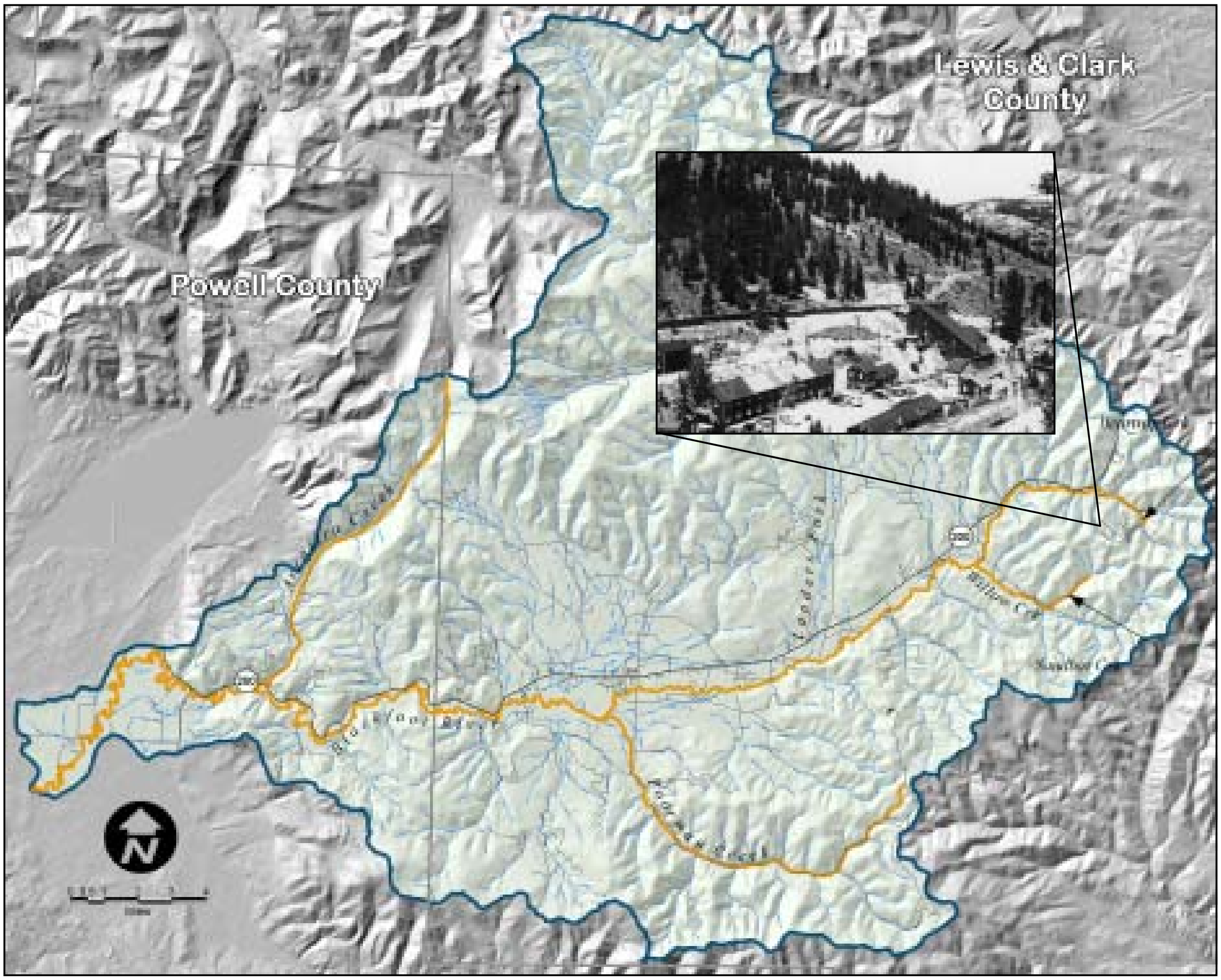
WATER QUALITY RESTORATION PLAN
FOR METALS IN THE
BLACKFOOT HEADWATERS TMDL PLANNING AREA



June 2003

Technical Lead:
Bob Anderson, Hydrometrics, Inc.

Dean Yashan, Montana Department of Environmental Quality

Significant Contributors:
Mark Walker, Hydrometrics, Inc.

Tina Bernd-Cohen, Blackfoot Challenge Inc.

Cover:
Blackfoot Headwaters TMDL Planning Area with Mike Horse Mine inset photo (circa 1940’s).

EXECUTIVE SUMMARY: WATER QUALITY RESTORATION PLAN FOR METALS IN THE BLACKFOOT HEADWATERS TMDL PLANNING AREA

Section 303(d) of the Federal Clean Water Act requires states to identify those water bodies within its boundaries that do not meet water quality standards, to prioritize the listed water bodies according to the severity of pollution and their intended beneficial uses, and to develop TMDLs for these water bodies. A Total Maximum Daily Load (TMDL) is a pollutant budget establishing the maximum amount of a pollutant that a water body can assimilate without exceeding water quality standards. This document is a water quality restoration plan that incorporates TMDLs for metals in the Blackfoot Headwaters TMDL Planning Area. The overall goal of this document is to identify an approach to improve water quality to the level where all beneficial uses are restored and protected. By fulfilling this goal, this document fulfills the requirements of Section 303(d) of the Federal Clean Water Act and Title 75, Chapter 5, Part 7 of the Montana Water Quality Act. Table E-1 contains a summary of this water quality restoration plan.

Table E-1. Water Quality Restoration Summary Information

Water Bodies & Pollutants of Concern	30 individual water body/pollutant combinations addressed as follows: - Blackfoot River above Landers Fork (pollutants: cadmium, copper, iron, lead, manganese, zinc) - Blackfoot River below Landers Fork (pollutants: aluminum, cadmium, iron, zinc) - Beartrap Creek (pollutants: cadmium, copper, iron, lead, manganese, zinc) - Mike Horse Creek (pollutants: aluminum, cadmium, copper, iron, lead, manganese, zinc) - Sandbar Creek (pollutants: aluminum, copper, iron, manganese) - Poorman Creek (pollutants: cadmium, copper, lead)
Impaired Beneficial Uses	- Blackfoot River above Landers Fork (impaired uses: aquatic life; cold water fish; drinking water supply) - Blackfoot River below Landers Fork (impaired uses: aquatic life; cold water fish) - Beartrap Creek (impaired uses: aquatic life; cold water fish; drinking water supply) - Mike Horse Creek (impaired uses: aquatic life; cold water fish; drinking water supply) - Sandbar Creek (impaired uses: aquatic life; cold water fish; drinking water supply) - Poorman Creek (impaired uses: aquatic life; cold water fish)
Pollutant Sources	- Metals: Mine disturbances, natural background
Target Development Strategies	- Numeric metals concentrations in water column for aquatic life/fishery and for drinking water/domestic use support; hardness adjustments to numeric targets must be incorporated - Elimination of objectionable deposits from metal precipitates - Metals in stream sediments may not impede beneficial uses - Biota (periphyton, macroinvertebrate) equal to or better than reference conditions
TMDLs	- Based on numeric concentration targets multiplied by stream flow (all metals, various flow conditions)

Table E-1. Water Quality Restoration Summary Information

Allocations	- Performance-based load allocations for mine disturbances in the Upper Blackfoot Mining Complex (UBMC) (applies to all metals TMDLs in Mike Horse and Beartrap Creeks and the Blackfoot River) - Performance based waste load allocation for discharge permit based on meeting water quality standards either within the discharge or within the mixing zone (applies to multiple metals from a wetlands treatment system permitted discharge within the UBMC) - Additional load allocations to tributary drainages where future monitoring identifies metals impairment conditions; (applies to specific metals associated with tributary impairment conditions and could result in additional load reductions for metals of concern in the Blackfoot River) - Load allocations to identified mining sources and natural background loads so that TMDL conditions are satisfied (applies to metals in Sandbar and Poorman Creek drainages)
Restoration Strategies	- UBMC restoration efforts currently underway for mine disturbances as identified within the temporary water quality standards (primary restoration approach for Mike Horse and Beartrap Creeks and the Blackfoot River) - Further characterization of identified mine disturbances in tributary drainages not covered by the UBMC (Sandbar Creek, Poorman Creek/Swansea Gulch) - Further characterization of Poorman Creek and Willow Creek to better define impairment conditions and/or loading sources - Monitoring or key tributary drainages to the Blackfoot River where impairment conditions have yet to be fully evaluated and subsequent identification and characterization of significant metals sources (Seven Up-Pete, Alice, Hogum, Hardscrabble Creeks, others) - Pursue restoration for significant mining and other metals sources within tributary drainages outside UBMC responsibilities (Poorman/Swansea, Sandbar Creek, other tributary streams where appropriate) - Adaptive management approach based on water quality monitoring and implementation of restoration activities (all water bodies)
Margin of Safety	- Metals targets apply during various flow conditions with considerations for changing hardness conditions - Adaptive management approach that commits to future monitoring and assessment - Built in margins of safety within existing numeric water quality standards - Application of most protective numeric standards, typically the chronic aquatic life standard - Addition of biota targets and sediment chemistry targets - Impairment determinations consider all relevant data and seasonality in a conservative manner - Significant monitoring efforts associated with metals related watershed characterization and restoration efforts
Seasonal Considerations	- Metals impairment and loading conditions evaluated at various flow conditions - Metals TMDLs incorporate stream flow as part of the TMDL equation - Metals targets apply during various flow conditions with considerations for changing hardness conditions - Existing and future monitoring addresses varying flow conditions

Blackfoot Headwaters Planning Area
The Blackfoot Headwaters Planning Area (Planning Area) includes the Blackfoot River watershed from its headwaters to the confluence of the Blackfoot River and Nevada Creek. The planning area includes approximately 318,000 acres within portions of Lewis and Clark County and Powell County in west-central Montana. The Blackfoot River has a mapped length of about 60 miles through the Planning Area. Major tributaries include Willow Creek, Alice Creek, Landers Fork, Poorman Creek, and Arrastra Creek. All surface waters within the Planning Area are classified as B-1 (ARM 17.30.607). B-1 classified waters are suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply (ARM 17.30.623).

The predominant source of metals-related water quality impairment in the Planning Area is historic mining activity. The most extensive mining occurred in an area near the Blackfoot River headwaters referred to as the Upper Blackfoot Mining Complex (UBMC) or Heddleston Mining District. The UBMC has been the focus of an extensive mine reclamation program initiated in 1993.

Metals-Related Water Quality Impairment
Montana's 2002 303(d) list represents the most current listing of impaired water bodies in need of TMDL development. As additional data is obtained within a watershed, new impairment conditions are sometimes identified, thus adding to TMDL development requirements that will be captured within future 303(d) lists. 303(d)-listed and other water bodies in need of TMDL development for metals in the Planning Area include portions of Sandbar Creek, Mike Horse Creek, Beartrap Creek, Poorman Creek, the Blackfoot River from its headwaters to the confluence with Landers Fork, and the Blackfoot River from Landers Fork to the confluence of Nevada Creek (Table E-2). The beneficial uses most commonly cited as "not fully supported" include aquatic life support, cold water fishery, and drinking water supply. The predominant metals of concern include aluminum, cadmium, copper, iron, lead, manganese and zinc. TMDL development and restoration planning for causes of impairment other than metals (i.e., sediment, habitat degradation) are addressed in a separate Water Quality and Habitat Restoration Plan/TMDL document for the Blackfoot Headwaters TMDL Planning Area.

Table E-2. Planning Area Water Bodies In Need Of TMDL And Restoration Plan For Metals.

Water Body	Stream Segment Number	Stream Miles	Beneficial Uses not Fully Supported	Pollutants of Concern[1]
Blackfoot River from Landers Fork to confluence of Nevada Creek	MT76F001-020	48.3	Aquatic life Cold water fishery	Aluminum, Cadmium, Iron, Zinc
Blackfoot River from headwaters to confluence with Landers Fork	MT76F001_010	16.4	Aquatic life Cold water fishery Drinking water supply	Cadmium, Copper, Iron, Lead, Manganese, Zinc
Beartrap Creek (Mike Horse Cr to mouth)	MT76F002-040	0.5	Aquatic life Cold water fishery Drinking water supply	Cadmium, Copper, Iron, Lead, Manganese, Zinc

Table E-2. Planning Area Water Bodies In Need Of TMDL And Restoration Plan For Metals.

Water Body	Stream Segment Number	Stream Miles	Beneficial Uses not Fully Supported	Pollutants of Concern[1]
Mike Horse Creek	Number not assigned yet	0.6	Aquatic life Cold water fishery Drinking water supply	Aluminum, Cadmium, Copper, Iron, Lead, Manganese, Zinc.
Sandbar Creek (from forks to mouth)	MT76F002-060	1.6	Aquatic life Cold water fishery Drinking water supply	Aluminum, Copper, Iron, Manganese
Poorman Creek (headwaters to mouth)	MT76F002-030	14.0	Aquatic life Cold water fishery	Cadmium, Copper, Lead

1- Based on recent (1996-2002) water and sediment chemistry data

Restoration Target/TMDL Development

This restoration plan summarizes available relevant water quality data, documents the magnitude of metals-related impairment, identifies specific metals loading sources, identifies water quality restoration targets, establishes TMDLs (acceptable pollution loads), and establishes load allocations for each of the water bodies listed as impaired for metals.

Water quality restoration targets are based primarily on the numeric water quality criteria included in the Montana water quality standards. The numeric criteria are intended to be protective of beneficial uses, such as aquatic life support, by establishing maximum allowable concentrations for metals based on toxic or carcinogenic characteristics. Restoration targets are also established to avoid development of metal-precipitate streambed coatings and toxic concentrations of metals in sediments, both of which can impede aquatic life support. As an additional measure of water quality restoration, biota targets associated with macroinvertebrate and periphyton communities also apply. These communities must show no impairment from metals as compared to a known reference condition.

The amount (or load) of a metal (in lb/day) that a water body can assimilate without exceeding the numeric water quality criteria (and thus the restoration targets) is a function of the streamflow rate (dilution capacity), and, for some metals, the water hardness. Therefore, the metals TMDLs (which establish the maximum allowable metal loads in each water body) must account for the full range of possible streamflow and water chemistry conditions. This is accomplished by basing the TMDL, in the form of an equation, on the requirement that applicable water quality standards be met and beneficial uses protected at all times, and under all streamflow and water chemistry conditions. The TMDL equation is as follows:

$$TMDL\ (lb/day) = X\ (\mu g/L)(Y\ cfs)(0.0054)$$

Where:

X= the numeric water quality criteria in micrograms per liter (parts per billion) for a specific metal adjusted for water hardness as necessary;
Y= streamflow rate in cubic feet per second;
0.0054 = conversion factor.

TMDLs are presented in this document for each water body based on typical high flow and low flow conditions as determined from existing hydrologic data. TMDLs can be determined for any streamflow and water hardness conditions encountered by using the equation listed above. In this fashion, implementation of the metals TMDLs should be protective of intended beneficial uses and water quality standards under all conditions and at all times.

Results

Sandbar Creek

Water quality data show that Sandbar Creek exceeds numeric water quality criteria for aluminum, iron, and copper. Biological data also indicate metals-related impairment, as do elevated metals concentrations in stream sediments. Iron and manganese concentrations also exceed guidance values for drinking water use support. Two historic mine waste dumps and a section of road containing apparent mine waste material are identified as probable sources of metals-related impairment in Sandbar Creek. Restoration strategies for Sandbar Creek include reclamation of the three probable metals-loading sources, and supplemental surface water and sediment sampling to support reclamation planning, and to determine if other potential metals loading sources may be present in the drainage.

Willow Creek

Water quality data for high and low flow conditions do not show any metals concentration exceeding numeric water quality criteria for Willow Creek. Elevated metals concentrations in stream sediments (primarily arsenic, copper, manganese, and iron) and biological data suggest the possibility of an impairment condition due to metals, although at this time Willow Creek is not identified as an impaired water body. Metals loading from Sandbar Creek is an identified source of metals to Willow Creek. Therefore, the restoration strategy for Willow Creek is focused on restoration work in Sandbar Creek and efforts to ensure that there are no significant metals sources in the remaining upper part of the Willow Creek drainage.

Poorman Creek

In Poorman Creek drainage, available water quality data indicate that mine waste rock, mill tailings, and possible discharges from one or more mine adits (mine tunnel) associated with the Swansea Mine are the primary sources of metals-related water quality impairment. Metals concentrations in a tributary draining the Swansea Mine area exceed water quality standards for the metals cadmium, copper and lead. Although available water quality data reveal no exceedences of numeric water quality criteria in the mainstem of Poorman Creek, degraded biotic populations documented through fishery and periphyton surveys, in conjunction with elevated metals concentrations in stream sediments, support the listing of Poorman Creek as impaired for metals. Restoration strategies for Poorman Creek include reclamation of the Swansea Mine area, and implementation of an environmental monitoring program designed to support reclamation planning, and to provide a more complete assessment of impairment conditions and possible metals loading sources throughout the drainage.

Beartrap Creek and Mike Horse Creek

The impaired portions of Beartrap Creek and Mike Horse Creek are significantly impacted by historic mining activities associated with the Upper Blackfoot Mining Complex (UBMC). Identified sources of metals-related impairment include seepage from a tailings impoundment, various mining related sources in Mike Horse Creek, and leaching of metals and acidity from floodplain tailings and waste rock piles. Existing water quality data show that metals concentrations in Beartrap Creek and Mike Horse Creek exceed numeric water quality criteria for cadmium, copper, lead and zinc. Metals concentrations in Mike Horse Creek also exceed numeric water quality criteria for aluminum, and metals concentrations in Beartrap Creek also exceed numeric water quality criteria for iron. Iron and manganese concentrations in both streams also exceed guidance values for drinking water use support. Biological data and elevated metals concentrations in stream sediments support the metals-impairment determination.

The UBMC, which includes the listed portion of Beartrap Creek in addition to Mike Horse Creek, is the focus of an extensive mine reclamation and water quality restoration program initiated in 1993. The reclamation program is currently being conducted under direction of the Montana Department of Environmental Quality, with future activities to occur under the Federal CERCLA program as well. Program requirements include identification and restoration of all human-caused sources of metals-related impairment, with the ultimate goal of attaining compliance with B-1 classification water quality standards by 2008, to the extent considered achievable. Based on these goals and requirements, it is presumed that the UBMC mine reclamation program will result in attainment of the TMDL water quality restoration targets in Beartrap Creek and Mike Horse Creek. In recognition of these water quality restoration commitments, a performance-based approach is adopted for load allocation and restoration planning in both streams. The performance-based approach relies on the current commitments and goals of the UBMC reclamation program for achievement of the goals and requirements of the TMDLs and the water quality restoration plan.

Blackfoot River

The segment of the Blackfoot River from the headwaters downstream to Landers Fork shows varying levels of metals-related impairment. Water quality data show that the upstream portion of this stream segment routinely exceeds numeric water quality criteria for the metals cadmium, copper, iron, lead, and zinc. Iron and manganese concentrations also exceed guidance values for drinking water use support. Metals concentrations decrease in a downstream direction to the point where exceedences of metals-related numeric water quality criteria typically occur during high flows only, and ultimately do not occur at all immediately upstream of Landers Fork. Water quality data for the segment of the Blackfoot River from Landers Fork to Nevada Creek occasionally exceeds numeric water quality criteria during high flows for cadmium, iron, aluminum, and zinc.

Identified sources of metals-related water quality impairment in the upper river segment are associated with the UBMC, and include inflow of metals-bearing surface water from two tributaries (Bear Trap Creek and Stevens Gulch), discharge from a water treatment system, and leaching of metals and acidity from mine waste situated along the floodplain. All of these sources are identified and addressed in the UBMC mine reclamation program. Therefore, load allocation and restoration planning in the upper river segment relies on the performance-based approach described above for Beartrap Creek and Mike Horse Creek. Sources of metals-related impairment in the lower river segments are not as well characterized as in the upper segment, although metal loads originating from the UBMC likely constitute the greatest impact to water quality in the downstream river segments as well. Therefore, completion of currently scheduled mine reclamation activities at the UBMC should also address most metals-related water quality impairments in the downstream segments of the Blackfoot River. Other possible metals loading source areas identified in this restoration plan in the downstream river segments include:

1. An extensive marsh system in the Blackfoot River drainage bottom through which loads of several metals in the Blackfoot River increase,
2. Tributary drainages included on the 303(d) list (Poorman Creek and Sandbar/Willow Creeks);
3. Tributary drainages (e.g. Alice Creek, Hogum Creek, Hardscrabble Creek, and Seven Up-Pete Creek) not included on the 303(d) list but available water quality data indicate that these streams may exceed water quality standards on a periodic basis.

The restoration strategy for the metals-listed segments of the Blackfoot River primarily relies on completion of the current water quality restoration commitments and scheduled reclamation activities at the UBMC. In addition, a surface water and sediment sampling program will be implemented to further delineate potential metals loading sources not included in the current reclamation program commitments, and to provide for more detailed load allocation and restoration planning on the metals-listed segment of the Blackfoot River.

TABLE OF CONTENTS

EXECUTIVE SUMMARY: WATER QUALITY RESTORATION PLAN FOR METALS IN THE BLACKFOOT HEADWATERS TMDL PLANNING AREA I
SECTION 1.0 INTRODUCTION 1
1.1 Planning Area Characterization 1
1.1.1 Location and Description of Watershed 1
1.1.2 Geologic Setting 2
1.1.3 Climate 3
1.1.4 Land Ownership and Use 3
1.1.5 Fisheries 3
1.2 Water Quality Standards 4
1.2.1 Water Body Classification and Beneficial Uses 4
1.2.2 Numeric and Narrative Standards 5
1.2.3 Stream Sediment Metals Criteria 6
1.3 303(d) Listing and Pollutants of Concern 7
1.3.1 Evidence of Metals-Related Impairment 8
1.4 Upper Blackfoot Mining Complex 10
1.4.1 Temporary Water Quality Standards 11
1.4.2 Status of UBMC Mine Reclamation Program 12
1.5 Seasonality and Margin of Safety 12
1.5.1 Seasonality 12
1.5.2 Margin of Safety 13
1.6 Restoration Plan Organization 13
SECTION 2.0 RESTORATION PLAN FOR SANDBAR CREEK AND WILLOW CREEK 15
2.1 Available Water Quality Data for Sandbar Creek 15
2.2 Sandbar Creek Drainage Impairment Conditions 16
2.2.1 Water Quality Data 16
2.2.2 Streambed Sediment Metals Concentrations 16
2.2.3 Impairment Determination for Sandbar Creek 18
2.3 Sandbar Creek Source Characterization 18
2.3.1 Metals Source Inventory 18
2.4 Sandbar Creek Restoration Targets, TMDLs and Load Allocations 19
2.4.1 Metals Restoration Targets 19
2.4.2 Metals TMDLs for Sandbar Creek 21
2.4.3 Sandbar Creek Load Allocations 23
2.5 Willow Creek Restoration Plan 24
2.5.1 Metals Data and Sources 24
2.5.2 Sampling and Restoration Planning for Willow Creek 25
SECTION 3.0 POORMAN CREEK DRAINAGE 27
3.1 Available Water Quality Data 27
3.2 Poorman Creek Drainage Impairment Conditions 27
3.2.1 Water Column Chemistry 27
3.2.2 Metals in Streambed Sediments 28
3.2.3 Impairment determinations for Poorman Creek 30
3.3 Source Characterization 31

3.3.1 Metals Source Inventory 31
3.4 Restoration Targets, TMDLs and Load Allocations 32
3.4.1 Metals Restoration Targets for Poorman Creek and Swansea Gulch 32
3.4.2 Poorman Creek Drainage Metals TMDL 33
3.4.3 Load Allocations 36
3.4.4 Future TMDL Development and Load Allocations 37
SECTION 4.0 RESTORATION PLAN FOR BEARTRAP/MIKE HORSE CREEKS 39
4.1 Available Water Quality Data 39
4.2 Beartrap Creek and Mike Horse Creek Impairment Conditions 40
4.3 Source Characterization 44
4.3.1 Beartrap Creek and Mike Horse Creek Metals Source Inventory 44
4.3.2 Metals Source Analysis 45
4.4 Restoration Targets, TMDLs and Load Allocations 46
4.4.1 Metals Restoration Targets 47
4.4.2 Beartrap Creek and Mike Horse Creek Metals TMDL 49
4.4.3 Beartrap Creek and Mike Horse Creek Load Allocations 53
SECTION 5.0 RESTORATION PLAN FOR THE BLACKFOOT RIVER 57
5.1 Available Water Quality Data for the Blackfoot River upstream of Landers Fork 57
5.2 Impairment Conditions for the Blackfoot River Upstream of Landers Fork 59
5.2.1 Water Quality Data 59
5.2.2 Streambed Sediment Metals Concentrations 63
5.2.3 Impairment Determination for the Blackfoot River 64
5.3 Source Characterization for the Blackfoot River Upstream of Landers Fork 64
5.3.1 Metals Source Inventory 64
5.3.2 Metals Source Analysis 65
5.4 Restoration Targets, TMDLs and Load Allocations for the Blackfoot River Upstream of Landers Fork 69
5.4.1 Metals Restoration Targets 69
5.4.2 Blackfoot River Metals TMDL 71
5.4.3 Blackfoot River Source Load Allocations 76
5.5 Blackfoot River from Landers Fork to Nevada Creek 82
SECTION 6.0 RESTORATION STRATEGY 85
6.1 Restoration Strategy for Sources Covered Under the UBMC Implementation Plan 85
6.2 Restoration Strategy for Sources Outside of the UBMC Implementation Plan Boundary 86
6.2.1 General Restoration Options 87
6.2.2 Funding Options 89
6.3 Monitoring Strategy 90
6.3.1 Existing UBMC Water Monitoring Requirements 90
6.3.2 Monitoring Strategy for the Remainder of the Blackfoot Headwaters Planning Area 92
6.4 Action Items 95
6.5 Adaptive Management Approach to Restoration 97
SECTION 7.0 PUBLIC AND STAKEHOLDER INVOLVEMENT 99
SECTION 8.0 REFERENCES 101

LIST OF TABLES

Table E-1. Water Quality Restoration Summary Information i
Table E-2. Planning Area Water Bodies In Need Of TMDL And Restoration Plan For Metals.. iii
Table 1-1 Blackfoot Headwaters TMDL Planning Area 1996, and 2002 303(d) List of Impaired Waters, Probable Causes and Sources, and Years Listed for Metals..................................9
Table 1-2 Water Bodies in Need of Restoration Plan for Metals. 10
Table 2-1 Summary of Current Available Water Quality Data from Sandbar Creek Drainage. ...15
Table 2-2 Sandbar Creek Drainage Seasonal Metals Impairment Summary. 17
Table 2-3 Stream Sediment Metals Concentrations from Sandbar Creek Sampling Site C02SNDBC01..18
Table 2-4 Water Quality Restoration Targets for Metals in Sandbar Creek.................................20
Table 2-5 Sandbar Creek TMDL and Load Reduction Requirement for Metals at Specified High and Low Flow Conditions – Monitoring Location SCSW-1. 22
Table 2-6 Preliminary Metals Load Allocations for Sandbar Creek Drainage.............................24
Table 2-7 Stream Sediment Metals Concentrations from Willow Creek Sampling Site..............25
Table 2-8 Willow Creek Impairment Determinations and Target Criteria for Metals. 26
Table 3-1 Summary of Current Available Water Quality Data from Poorman Creek Drainage...28
Table 3-2 Poorman Creek Drainage Metals Impairment Summary. 29
Table 3-3 Stream Sediment Metals Concentrations from Poorman Creek Main Channel. 30
Table 3-4 Metals and Sulfate Loading Trends in Poorman Creek Drainage for June 13, 1996. ...31
Table 3-5 Metals Water Quality Restoration Targets for Swansea Gulch and Poorman Creek Drainage. 34
Table 3-6 Poorman Creek TMDL and Load Reduction Requirements for Metals at Specified High Flow and Low Flow Conditions - Site PCSW-6 in Swansea Gulch. 35
Table 3-7 Preliminary Metals Load Allocations for Swansea Gulch Drainage............................37
Table 4-1 Summary of Current Water Quality Data from Beartrap and Mike Horse Creek Drainages. 40
Table 4-2 Beartrap Creek Drainage Seasonal Metals Impairment Summary for Monitoring Sites BRSW-23 and BRSW-38. 41
Table 4-3 Mike Horse Creek Drainage Seasonal Metals Impairment Summary for Monitoring Sites BRSW-4 and BRSW-22...42
Table 4-4 Mike Horse and Beartrap Creek Stream Sediment Metals Concentrations. 43
Table 4-5 Metals Loading Trends for Early Runoff, High Flow and Low Flow Conditions in Beartrap Creek. 45
Table 4-6 Water Quality Restoration Targets for Metals in Beartrap Creek and Mike Horse Creek. 48
Table 4-7 Beartrap Creek TMDLs and Required Load Reductions for Metals at Specified High Flow, Low Flow, and Early Runoff Conditions at Monitoring Location BRSW-23. 51
Table 4-8 Mike Horse Creek TMDLs and Required Load Reductions for Metals at Specified High Flow, Low Flow, and Early Runoff Conditions at Monitoring Location BRSW-22.52
Table 5-1 Summary of Current Blackfoot River Water Quality Data. 58
Table 5-2 Seasonal Metals Impairment Summary for Blackfoot River Upstream of Pass Creek. 60
Table 5-3 Blackfoot River Seasonal Metals Impairment Summary for Downstream River Segment Between Pass Creek and Landers Fork...61

Table 5-4 Percentage of Water Quality Measurements Exceeding Applicable Standards on a Seasonal Basis....63
Table 5-5 Blackfoot River Stream Sediment Metals Concentrations....64
Table 5-6 Water Quality Restoration Targets for Metals in the Blackfoot River Upstream and Downstream of Pass Creek....72
Table 5-7 TMDL and Load Reduction Examples for Metals at Documented High Flow, Low Flow and Early Runoff Conditions for Blackfoot River Above Pass Creek (Site BRSW-12)....74
Table 5-8 TMDL and Load Reduction Examples for Metals at Documented High Flow and Low Flow Conditions for Blackfoot River Between Pass Creek and Landers Fork (Monitoring Sites BRSW-31 and SP-SW-1.B)....75
Table 6-1 Monitoring Locations and Parameters to Evaluate Target Compliance....95

LIST OF FIGURES

Figure 1-1. Blackfoot Headwaters Planning Area General Location Map
Figure 1-2. Blackfoot Headwaters TMDL Planning Area
Figure 2-1. Sandbar Creek Drainage Showing Listed Stream Segment, Water Sampling Locations, and Other Relevant Features
Figure 3-1. Poorman Creek Drainage Showing Listed Stream Segment, Water Sampling Locations, and Other Relevant Features
Figure 4-1. Surface Water Monitoring Sites and Metals Loading Sources to the Impaired Segment of Beartrap Creek
Figure 4-2. 2001 Seasonal Metals Loading Trends in Mike Horse and Beartrap Creeks
Figure 5-1. Blackfoot River Drainage from Headwaters to the Confluence with Landers Fork
Figure 5-2. Historic Mining and Water Resource Features Within the Upper Blackfoot Mining Complex
Figure 5-3. Blackfoot River 2001 Loading Trends Upstream of Pass Creek
Figure 5-4. Blackfoot River Loading Trends Downstream of Pass Creek

LIST OF APPENDICES

Appendix A Total Maximum Daily Load (TMDL) Definition, Purpose, and Calculations
Appendix B Implementation Plan in Support of Petition for Adoption of Temporary Water Quality Standards Upper Blackfoot Mining Complex
Appendix C Water Quality Data From the Blackfoot Headwaters TMDL Planning Area
Appendix D Primary Cleanup/Restoration Options for Mine Operations or Other Sources of Metals Contamination
Appendix E Metals Source Analyses in Support of TMDL Development for Sandbar Creek and Poorman Creek Drainages
Appendix F Response to Public Comments

SECTION 1.0
INTRODUCTION

Under Montana law (MCA), an impaired water body is defined as a water body or stream segment for which sufficient credible data indicates non-compliance with applicable water quality standards (MCA 75-5-103). Section 303 of the Federal Clean Water Act requires states to submit a list of impaired water bodies or stream segments (known as a 303(d) list) to the U.S. Environmental Protection Agency (EPA) every two years. The Montana Water Quality Act further directs Montana Department of Environmental Quality (MDEQ) to develop Total Maximum Daily Loads (TMDLs) for all water bodies appearing on the 303(d) list as impaired or threatened (MCA 75-5-703).

A TMDL is a pollutant budget for a water body identifying the maximum amount of a particular parameter that a water body can assimilate without causing applicable water quality standards to be exceeded. TMDLs are often expressed in terms of an amount, or load, of a particular pollutant (expressed in units of mass per time such as pounds per day). TMDLs can also be expressed as the maximum allowable concentration of a parameter, as a required load reduction, or as specific mandates assuring the water quality standards are met (e.g., no toxic concentrations of sediment metals concentrations). TMDLs account for loads from point and nonpoint sources in addition to natural background sources, and are generally developed and presented as part of an overall water quality restoration plan (WQRP). The WQRP includes not only the actual TMDL, but also includes information that can be, or in some cases, is being used to effectively restore water quality.

This document is a Water Quality Restoration Plan (WQRP) and Total Maximum Daily Load (TMDL) for metals in the Blackfoot Headwaters TMDL Planning Area. The overall goal of this document is to identify an approach to improve metals-related water quality to a level where beneficial uses are fully supported for all impaired water bodies in the Planning Area, and to ensure that Montana water quality standards are not violated. Non-metals-related causes of water quality impairment in the Planning Area (e.g., siltation, habitat alterations) are addressed in a separate Water Quality and Habitat Restoration Plan/TMDL. Some of the habitat and sediment related issues addressed in this other plan are associated with UBMC historic metals mining impacts and impacts from the Mike Horse Dam failure, and are therefore linked to restoration efforts in this plan.

1.1 Planning Area Characterization

The following description of the Blackfoot Headwaters TMDL Planning Area is taken primarily from the Planning Area Phase I Assessment Report (Confluence Consulting et al., 2002).

1.1.1 Location and Description of Watershed

The Blackfoot Headwaters TMDL Planning Area is located northwest of Helena, Montana in portions of Lewis and Clark and Powell counties (Figure 1-1). The Planning Area extends from the continental divide on the east to the confluence of the Blackfoot River and Nevada Creek on the west, and encompasses approximately 495 square miles (318,000 acres). The physical geography of the Planning area varies from high elevation, steep glaciated mountain ranges in the north and lower non-glaciated mountains in the south, separated by the east-west trending Blackfoot Valley. Elevations range from approximately 4,250 feet above mean sea level near the confluence of the Blackfoot River and Nevada Creek, to over 8,500 feet in the northern portion of the Planning Area.

The Blackfoot River originates at the confluence of Beartrap and Anaconda Creeks, both of which flow westward from the continental divide. The main stem of the Blackfoot River has a mapped length of about 60 miles in the Planning Area and an average gradient of 0.98 percent. Major tributaries, in upstream to downstream order, include Alice Creek, Willow Creek, Landers Fork, Poorman Creek, and Arrastra Creek (Figure 1-2).

1.1.2 Geologic Setting

Bedrock within the Planning Area consists primarily of Proterozoic aged metasedimentary rocks of the Belt Supergroup. Predominant bedrock formations and lithologies include the Precambrian Newland Limestone, Spokane Shale, and Helena Limestone (Roberts, 1986). Surface exposures of these bedrock units cover about 55 percent of the area. Cambrian and Mississippian sedimentary rocks outcrop locally near the headwaters of Landers Fork.

Late Cretaceous and early Tertiary intrusive activity led to the formation of numerous metallic ore deposits in the Planning Area. Several gold, silver, lead, zinc, and copper ore deposits have been identified and developed since the late 1800s. Areas of significant historic mining activity include the Upper Blackfoot Mining Complex (UBMC) otherwise known as the Heddleston District or Mike Horse Mine, the Seven-Up Pete Mine area, and the Swansea Mine in Poorman Creek drainage although historic mining activity has occurred throughout the Planning Area (Figure 1-2). Historic mining development represents the primary source of metals-related water quality impairment in the Planning Area.

Approximately 40% of the Planning Area is mantled by unconsolidated glacial drift or alluvium. Alluvial deposits cover most drainage bottoms and reach depths of several hundred feet in portions of the Blackfoot Valley. Glacial drift covers much of the lower elevation uplands north of the Blackfoot River valley bottom, especially in the Landers Fork watershed. Glacial landforms, including glacial moraines and outwash plains, heavily influence the geomorphology of the Blackfoot River valley. For instance, glacial debris deposited in the drainage bottom has resulted in formation of an extensive marsh complex along the Blackfoot River throughout much of the Planning Area. This marsh system heavily influences metals transported through, and impairment conditions within, the Blackfoot River. Glacial meltwaters also deposited thick accumulations of coarse sediments (glacial outwash) in larger tributary drainages and on the Blackfoot Valley floor. Due to the highly permeable nature of these outwash sediments, streams generally lose water through infiltration, and often go dry, where they cross the outwash plains, such as the Blackfoot River between Landers Fork and the Town of Lincoln.

1.1.3 Climate

Climatic conditions vary significantly throughout the Planning Area due to considerable elevation change and geographic influences. Conditions are generally characterized by long, cold winters and short, moderately hot summers. Average monthly minimum and maximum temperatures as recorded at the Lincoln Ranger Station (near the town of Lincoln) for the period 1948 - 2000 range from 10.0° and 26.7°F in January, to 41.9° and 80.8°F in July.

Average annual precipitation ranges from less than 15 inches near the confluence of the Blackfoot River and Nevada Creek, to more than 50 inches near the headwaters of Copper Creek (Figure 1-2), with much of the precipitation occurring as snow. Based on a basin-wide average annual precipitation of 2.4 feet (White Horse Associates, 1996), the volume of annual precipitation in the Planning Area is approximately 760,000 acre-feet.

1.1.4 Land Ownership and Use

Approximately 64% of the Planning Area is under US Forest Service management including 13% USFS Wilderness. Private property holdings comprise approximately 30% of the Planning area (of which Plum Creek Timber owns about 6.5%), with subordinate amounts of land owned by the State of Montana (approximately 4.5%), the Bureau of Land Management (BLM), and the US Fish and Wildlife Service, (Confluence et al., 2002, MDEQ, 2001a). The dominant land uses in the watershed are livestock grazing, timber harvest, recreation, and minor dry land and irrigated agriculture.

1.1.5 Fisheries

The Blackfoot Headwaters Planning Area supports a largely native assemblage of fish comprised of eight species within four families (Confluence et al, 2002). Salmonids include the native bull trout, westslope cutthroat trout, mountain whitefish, and the introduced brook trout and brown trout. Two species of catostomid, longnose sucker and largescale sucker, occur in the upper Blackfoot watershed. The longnose dace is the sole member of the minnow family and the slimy sculpin is presumably the only member of the cottid family occurring in the upper Blackfoot River watershed.

The Planning Area is considered extremely important in the conservation and recovery of bull trout. Copper Creek and Landers Fork have been identified as bull trout core areas by the Montana Bull Trout Scientific Group (1995). As a result, these areas are the focus of restoration and monitoring activities in the management of this sensitive species. Factors contributing to the decline of bull trout throughout their range include siltation, increased water temperatures, introduced fish species, and passage barriers (culverts, diversions, etc) that can restrict the movements of this highly migratory species. The Blackfoot Headwaters Planning Area is a stronghold for westslope cutthroat trout; another species that has experienced marked declines.

A number of fish inventory studies have been conducted in the Blackfoot Headwaters Planning Area. The Montana Department of Fish, Wildlife and Parks performed fisheries inventories in the Upper Blackfoot River and select tributaries in the early 1970s, 1988, and 1999. Results of the most recent surveys indicate that populations of cutthroat trout near the Blackfoot River headwaters (upstream of Highway 279 (Flesher Pass Road), Figure 1-2) continue a trend of declining numbers noted since the early 1970s (MDFWP, 2000). Based on the timing of this trend, impacts from a 1975 tailings dam breach at the historic Mike Horse Mine are cited in the report as the likely cause (see Section 1.4). The MDFWP report also notes generally low fish population numbers in several tributary drainages, in particular Seven Up-Pete Creek (Figure 1-2). The current fishery survey data were utilized by MDEQ in determining the distribution of impaired water bodies in the Planning Area.

BioAnalysts, Inc. (1996) conducted an assessment of fish populations in a portion the Planning Area in 1996. The purpose of this assessment was to obtain baseline fisheries and habitat data in the vicinity of a large proposed mine development (the McDonald Gold Project). The fishery survey found that salmonids were most abundant in Cadotte and Hardscrabble creeks and lowest in the Landers Fork (Figure 1-2). Copper and Alice creeks had intermediate populations of salmonids.

1.2 Water Quality Standards

Montana surface water quality standards, including water body classifications, beneficial uses, and numeric and narrative standards, are established in Title 17, Chapter 30, subchapter 6 of the Administrative Rules of Montana (ARM 17.30.601 et. seq.). The surface water quality standards are the benchmark used in making beneficial use support decisions and determining if a water body is impaired and in need of TMDL development. The water quality standards also form the basis for developing water quality restoration targets during TMDL development. Following is a brief synopsis of metals-related surface water quality standards and associated issues applicable to the Blackfoot Headwaters Planning Area.

1.2.1 Water Body Classification and Beneficial Uses

The Montana Water Quality Act requires the Montana Board of Environmental Review to classify all state waters in accordance with their current and future most beneficial uses (MCA 75-5-301). Specific numeric and narrative water quality criteria are then established for each water use classification to ensure protection of the intended beneficial uses. All surface waters within the Planning Area are classified as B-1 waters (ARM 17.30.607) with the following intended beneficial uses:

- 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 processing purposes after conventional treatment.

1.2.2 Numeric and Narrative Standards

Numeric water quality standards (water quality standards based on a specific concentration or value) are presented in Circular WQB-7 Montana Numeric Water Quality Standards (MDEQ, 2001b). Narrative water quality standards and standards that are based on a numeric variance from naturally occurring conditions within a water body are presented in the Surface Water Quality Standards (ARM 17.30.623 & 637).

WQB-7 lists numeric water quality criteria for protection of aquatic life and for protection of human health. For most metals, aquatic life criteria are established for both acute and chronic conditions. The chronic standard for some metals is equal to the acute standard. For the more common situation where the two are not equal, the chronic standard is always lower than the acute standard. In some situations, there is only a chronic standard, such as for iron, or only an acute standard, such as for silver. While the water quality standards state that the acute aquatic criteria may not be exceeded in B-1 waters at any time, the chronic aquatic criteria may be exceeded on an instantaneous basis as long as the average concentration of that parameter measured over any 96-hour (or longer) period does not exceed the chronic aquatic criteria (WQB-7, Footnote 4). Following are some notes regarding the application of the WQB-7 numeric water quality standards to this water quality restoration plan:

- Based on the B-1 classification beneficial uses, both the human health standards and aquatic life standards apply to surface waters within the Planning Area. When evaluating impairment conditions and establishing water quality restoration targets in this plan, water quality data were compared to either the aquatic life standard or human health standard, whichever was lower (more stringent).

- Even though there is a lack of information regarding the average metals concentrations for any 96-hour or longer period from the Planning Area, the more stringent chronic aquatic criteria (as opposed to the acute criteria) were used in evaluating impairment conditions and setting water quality restoration targets in this Plan. The application of the chronic criteria is based on the assumption that any one sample event is representative of the previous 48 hours and the following 48 hours.

- The aquatic life standards for several metals (i.e., copper, cadmium, lead, zinc, silver) are a function of water hardness. As hardness decreases (the water becomes more dilute), the applicable numeric standard also decreases (becomes more stringent). In most cases, stream water hardness decreases with increasing flow during spring runoff, resulting in lower applicable aquatic life standards during spring runoff periods. To account for this, impairment conditions and restoration targets are established for both high flow and low flow periods, so that restoration planning will be protective of water quality under various hydrologic conditions. Additional information regarding development of water quality restoration targets and TMDLs is presented in Appendix A.

- For iron and manganese, the water quality standards listed under human health in WQB-7 are not based on specific numeric values since these metals are not categorized as toxins or carcinogens. Instead, WQB-7 states that concentrations of these parameters “must not reach values that interfere with the uses specified in the surface and groundwater standards." WQB-7 further states that the Secondary Maximum Contaminant Levels established by EPA (based on protection of aesthetic issues such as taste, odor, staining) of 300 μ/L (micrograms per liter, or parts per billion) for iron and 50 μg/L for manganese may be considered as guidance in determining if a certain concentration interferes with the specified uses. For the Blackfoot Headwaters Planning Area, the guidance values stated above were used in conjunction with other anecdotal information to determine if concentrations of iron or manganese constitute impairment of a water body. Additional information regarding the application of the iron and manganese guidance values is presented in Appendix A.

- As discussed in Section 1.4, Temporary Water Quality Standards have been adopted for certain stream segments near the Blackfoot River headwaters in conjunction with ongoing mine reclamation activities in the area. The temporary standards supersede the B-1 classification standards for the period that the temporary standards are in effect (2000 to 2008). However, water quality restoration targets and TMDL development in these stream segments are based on the B-1 standards since these are the standards the water bodies will ultimately be required to meet.

In addition to the numeric water quality criteria included in WQB-7, general water quality standards for B-1 classification waters are included in various sections of the Administrative Rules of Montana. General water quality standards utilized in development of this water quality restoration plan, along with certain definitions, are included in Appendix A.

1.2.3 Stream Sediment Metals Criteria

Similar to the water column, elevated metals concentrations in stream sediments can negatively impact aquatic life support (and other beneficial uses) in surface water, and thus contribute to water quality impairment. Elevated metals concentrations in stream sediments can also be an indicator of more severe water quality impacts further upstream. Unlike surface waters, no standards or criteria currently exist specifying allowable metals concentrations in sediments, although there are published guidance values denoting potentially harmful conditions for aquatic biota (Jones et al, 1997; Long and Morgan, 1990).

As part of the water quality restoration planning process, sediment chemistry results in a given stream can be compared to published guidance values, which is the approach taken in this document. Where water column chemistry and/or biological results show an impairment condition, then the sediment chemistry results will be used to help define the level of impairment and metals of concern. If the water column chemistry (both high and low flow conditions) and biological results (both periphyton and macroinvertebrate) do not indicate an impairment condition, then it can be concluded that the water body is not impaired due to metals even if some sediment chemistry metals are greater than published guidance values. The exception is where sediment chemistry metals are greater than published guidance values and potential upstream metals sources indicate the possibility of impairment conditions further upstream in the watershed. Under this scenario, it may be concluded that more data is needed in the upper segments of the watershed if beneficial use determinations have not yet been made regarding potential impacts from metals. These beneficial use determinations can be made by collecting data further upstream closer to the potential sources of metals. The additional upstream data collection will need to include biological (both periphyton and macroinvertebrate) and water column chemistry sampling prior to making a full support conclusion relative to metals impacts on aquatic life. Sediment chemistry sampling may no longer be necessary for making the beneficial use determination depending on how far upstream the sampling occurs and where the sampling is performed relative to the potential sources of metals loading. The amount of additional sampling needed will be based on how much the sediment metals concentrations exceed published guidance values, the estimated severity of potential upstream loading sources, watershed characteristics, and the availability of relevant data throughout the watershed for making beneficial use determinations.

MDEQ has initiated development of a total metals index (TMI) screening level criteria for metals in sediment that accounts for possible cumulative effects of multiple metals within sediments. This sediment metals TMI utilizes some of the above referenced published guidance values denoting potentially harmful conditions for aquatic biota. Until a more formalized TMI or other approach is developed, MDEQ will continue to apply the above referenced approach for assessing beneficial use impacts from metals in sediments within the Blackfoot Headwaters TMDL Planning Area.

1.3 303(d) Listing and Pollutants of Concern

An impaired water body is a water body that does not meet state water quality standards and does not fully support all designated beneficial uses for that water body. Section 303 of the Clean Water Act requires states to submit a list of impaired water bodies (streams, lakes, wetlands) to the U.S. Environmental Protection Agency (EPA) every two years. The 303(d) List identifies which beneficial uses are impaired and indicates the probable causes (i.e., the pollutant such as metals) and the probable sources of the impairment (such as mining or roads). Table 1-1 includes 303(d) listing information for water bodies within the Blackfoot Headwaters TMDL Planning Area that have been listed as impaired due to metals and/or other causes.

Montana’s 2002 303(d) List is the most current EPA-approved list and is based on a higher level of scientific analyses in comparison to past 303(d) Lists. A ruling by the U.S. District Court (CV97-35-M-DWM) on September 21, 2000 stipulates that the state of Montana must complete “all necessary TMDLs for all waters listed as impaired or threatened on the 1996 303(d) List.” In other words, the court ruling requires a TMDL be developed for each pollutant (probable cause) and water body combination identified in Table 1-1 for the 1996 list or any subsequent lists. The exception is where supplemental data and assessment work has determined that the water body is in fact not impaired for the pollutant of concern.

Willow Creek from Sandbar Creek to the mouth was listed for metals in 1996 but not in 2002. This stream segment is not treated as an impaired water body, although a restoration strategy is developed for Willow Creek based on TMDL development and implementation in Sandbar Creek, and efforts to ensure that there are no significant metals sources in the upper part of the Willow Creek drainage. The Blackfoot River from the Landers Fork to Nevada Creek was on the 1996 list for metals, but not on the 2002 list for metals. Based on a review of past and recent high flow water quality data, and documented upstream and tributary metals loading sources, metals TMDLs have been developed for this river segment in conjunction with TMDL development for the upstream segment above Landers Fork. Mike Horse Creek was not on the 1996 or any subsequent lists. Significant impairment conditions in this tributary to Beartrap Creek has led to a decision to develop metals TMDLs for this stream in conjunction with TMDL development for Beartrap Creek. MDEQ files and future 303(d) lists will be updated to reflect the TMDL development and related impairment determinations discussed above.

Based on information provided in Table 1-1 and the above discussion, water bodies in need of TMDL development and water quality restoration planning for metals-related impairment are listed in Table 1-2. These include Beartrap Creek from the confluence with Mike Horse Creek to the mouth (0.5 miles), the lower approximate 0.6 miles of Mike Horse Creek, the Blackfoot River from its headwaters to the confluence with Landers Fork (16.4 miles), the Blackfoot River from Landers Fork to the confluence of Nevada Creek (48.3 miles), Sandbar Creek from the confluence of three tributary forks to the mouth (1.6 miles), and Poorman Creek from headwaters to mouth (14.0 miles). These water bodies are identified on Figure 1-2, with the water bodies included on the 2002 303(d) list highlighted as “metals listed stream segments”.

1.3.1 Evidence of Metals-Related Impairment

Available water quality data from the metals-listed stream segments show that concentrations of certain metals exceed the numeric water quality criteria in the Blackfoot River above Landers Fork, the Blackfoot River below Landers Fork to Nevada Creek, Beartrap Creek, Mike Horse Creek, Sandbar Creek, and a tributary to Poorman Creek. Specific metals exceeding the numeric water quality criteria in one or more of the stream segments include aluminum, cadmium, copper, iron, lead, manganese, and zinc.

Sediment chemistry data also supports the metals impairment determinations for Poorman Creek, Sandbar Creek, Beartrap Creek, Mike Horse Creek, and the Blackfoot River upstream of Landers Fork. Sediment metals concentration from these stream segments significantly exceed published guidance levels denoting metals concentrations believed to be harmful to aquatic life.

In addition to the water and sediment chemistry data, biological data support the impairment determinations for most of the metals-impaired water bodies. Periphyton (attached algae) samples collected in 2001 indicate probable metals contamination at several sites with high proportions of abnormal diatom cells, indicating moderate to severe impairment. These sites include the upper Blackfoot River near Flesher Pass Road, the upper Blackfoot River above the Landers Fork, two upper locations along Poorman Creek, and both sampling locations along Sandbar Creek (Bahls, 2001).

Table 1-1 Blackfoot Headwaters TMDL Planning Area 1996, and 2002 303(d) List of Impaired Waters, Probable Causes and Sources, and Years Listed for Metals.

WATERBODY/ WATERBODY NO.	LIST	PROBABLE CAUSE(S)	PROBABLE SOURCE(S)	YEAR(S) LISTED FOR METALS[1]
Blackfoot River (Headwaters to Landers Fork) MT76F001-010	1996	Metals, Nutrients, Other Inorganics, Siltation	Agriculture, Harvesting, Restoration, Residue Management, Mine Tailings, Resource Extraction, Subsurface Mining	1996, 1998, 2000, 2002
	2002	Metals, Habitat Alterations	Silviculture, Resource Extraction, Acid Mine Drainage, Abandoned Mining, Habitat Modification (other than hydromodification), Bank Modification/Destabilization	
Blackfoot River (Landers Fork to Nevada Cr) MT76F001-020	1996	Metals, Siltation, Suspended Solids	Agriculture, Natural Sources, Resource Extraction, Silviculture	1996, 1998
	2002	Other Habitat Alterations, Siltation	Agriculture, Silviculture	
Willow Cr MT76F002-020	1996	Metals	Resource Extraction, Subsurface Mining	1996, 1998
	2002	Bank Erosion, Habitat alteration, Siltation	Agriculture, Grazing, Habitat Modification, Bank Modification, Highway Maintenance and Runoff	
Poorman Cr (headwaters to mouth) MT76F002-030	1996	Metals, Habitat Alteration, Siltation	Agriculture, Canalization, Dredge Mining, Irrigated Crop Production, Logging Road Construction/ Maintenance, Natural Sources, Resource Extraction, Streambank Modifications/ Destabilization	1996, 1998, 2000, 2002
	2002	Dewatering, Flow Alteration, Metals, Habitat Alterations, Riparian degradation, Siltation	Silviculture, Logging roads, Construction, Resource Extraction, Abandoned Mining	
Beartrap Cr (Mike Horse Cr to mouth) MT76F002-040	1996	Metals	Mill Tailings, Resource Extraction, Subsurface Mining	1996, 1998, 2000, 2002
	2002	Metals	Resource Extraction, Mill Tailings	
Sandbar Cr (from forks to mouth) MT76F002-060	1996	Metals	Resource Extraction Subsurface Mining	1996, 1998, 2000, 2002
	2002	pH, Copper, Metals, Habitat Alterations, Siltation	Resource Extraction, Acid Mine Drainage, Abandoned Mining, Highway Maintenance and Runoff	
Arrastra Cr (headwaters to mouth) MT76F002-070	1996	Flow Alteration, Habitat Alterations, Siltation	Agriculture, Highway/ Road/ Bridge Construction, Natural Sources, Range Land	None
	2002	Habitat Alterations, Siltation	Agriculture, Habitat Modifications, Shoreline Modification, Highway Maintenance and Runoff	

1 – The 1996 and 1998 lists are very similar to each other, and the 2000 and 2002 lists are very similar to each other

Table 1-2 Water Bodies in Need of Restoration Plan for Metals.

Water Body	Stream Segment Number	Stream Miles	Beneficial Uses not Fully Supported	Pollutants of Concern[1]
Blackfoot River from Landers Fork to confluence of Nevada Creek	MT76F001-020	48.3	Aquatic life Cold water fishery	Aluminum, Cadmium, Iron, Zinc
Blackfoot River from headwaters to confluence with Landers Fork	MT76F001_010	16.4	Aquatic life Cold water fishery Drinking water supply	Cadmium, Copper, Iron, Lead, Manganese, Zinc
Beartrap Creek (Mike Horse Cr to mouth)	MT76F002-040	0.5	Aquatic life Cold water fishery Drinking water supply	Cadmium, Copper, Iron, Lead, Manganese, Zinc
Mike Horse Creek	Number not assigned yet	0.6	Aquatic life Cold water fishery Drinking water supply	Aluminum, Cadmium, Copper, Iron, Lead, Manganese, Zinc.
Sandbar Creek (from forks to mouth)	MT76F002-060	1.6	Aquatic life Cold water fishery Drinking water supply	Aluminum, Copper, Iron, Manganese
Poorman Creek (headwaters to mouth)	MT76F002-030	14.0	Aquatic life Cold water fishery	Cadmium, Copper, Lead

1- Based on recent (1996-2002) water and sediment chemistry data

Macroinvertebrate analyses also suggest metals contamination at several sites in the Planning Area. Samples collected during the late 1980s (Ingman et al. 1990, McGuire 1991) indicate a paucity of overall taxa richness and especially mayfly richness at the upstream stations in the vicinity of the Upper Blackfoot Mining Complex. Similarly, the most recent macroinvertebrate samples from 2001 had no mayfly taxa at upper Blackfoot River site and the lower Sandbar Creek below historic mining activities (Bollman, 2002).

Analyses of metals in fish tissues provide further evidence of metals-related impairment. Comparisons of metals accumulating in tissues of macroinvertebrates indicated a trend for greater concentrations of cadmium in insects with increasing proximity to the headwaters (Moore, 1990). Similarly, concentrations of metals in fish livers showed a statistically significant trend for decreasing metals from the headwaters to the mouth (Confluence et al., 2002). This biological data, in conjunction with the water column and stream sediment metals concentration data, confirm that the stream segments listed as impaired for metals in the Planning Area do not fully support all beneficial uses and thus are impaired.

1.4 Upper Blackfoot Mining Complex

The predominant source of metals-related water quality impairment in the Blackfoot Headwaters Planning Area is the Upper Blackfoot Mining Complex (UBMC). The UBMC, also referred to as the Heddleston Mining District, is an area of historic mining activity near the Blackfoot River

Headwaters (Figure 1-2). The UBMC is comprised of several individual historic mines including the Mike Horse, Anaconda, Edith, Paymaster, Carbonate, Capital and Consolation mines, as well as a number of smaller mineral developments. Mining activities began in the late 1800s with the discovery of silver, gold, lead and zinc-bearing ore, with sporadic mine development occurring up until the mid 1950s. The majority of mining activity occurred at the Mike Horse Mine during the 1920s and early 1940s. In this report, the UBMC refers to the area of historic mining activity at the Blackfoot River headwaters (upstream of Pass Creek, Figure 1-2), although no formal legal boundaries have been applied to the UBMC.

In 1939, a 150 ton-per-day flotation mill was built at the Mike Horse Mine, and in 1941 a tailings impoundment was constructed in Beartrap Creek drainage. The tailings impoundment received mill tailings from the Mike Horse Mill from 1941 until 1955 when the Mike Horse Mine was shut down. In June 1975, a combination of heavy rains and blockage of a surface water diversion caused the tailings dam to breach, releasing an estimated 100,000 tons of native soils and mill tailings to Beartrap Creek and the upper Blackfoot River. The tailings dam breach, in conjunction with historic mining activities at the UBMC, have resulted in significant impacts to the environment, including the release of acid mine drainage and metals to area surface waters, and loss of aquatic and riparian habitat. Significant dam repairs were made in 1975 and 1980 following the breach (Dames and Moore, 1975 and 1980).

In 1993, ASARCO Incorporated and ARCO (identified in 1992 by the State of Montana as liable parties for mining-related contamination at the UBMC) initiated mine reclamation activities at the UBMC. From 1993 to 1998, reclamation activities focused primarily on historic mining impacts located on private property (patented mining claims owned by Asarco). Activities included removal of mine waste rock and mill tailings from drainage bottoms and placement in three engineered repositories, regrading and revegetation of disturbed areas, treatment of mine drainage from two historic adits (the Mike Horse and Anaconda mine adits) through a constructed wetlands-based water treatment system, and construction of a second wetlands-based water treatment system for treatment of mine drainage from the historic Paymaster Mine adit.

1.4.1 Temporary Water Quality Standards

In 1999, Asarco petitioned the Montana Board of Environmental Review for adoption of Temporary Water Quality Standards for three stream segments at the UBMC. The temporary standards were sought, in part, so that mine reclamation activities could continue on public lands. The three stream segments include a portion of Mike Horse Creek, a portion of Beartrap Creek, and a portion of the upper Blackfoot River. In accordance with MCA 75-5-312(2), Asarco prepared a support document and Implementation Plan (Hydrometrics, 1999, 2000) for use by the Board and MDEQ in considering the temporary standards petition (see Appendix B). The Implementation Plan identifies documented sources of metals-related water quality impairment to the three stream segments, and lists remedial alternatives for each identified source.

In May of 2000 the Board approved adoption of the temporary water quality standards with the standards taking affect in June of 2000. The standards are scheduled to expire on May 31, 2008 but may be extended up to two years to allow for completion of access agreements to the affected public property (ARM 17.30.630(2)).

1.4.2 Status of UBMC Mine Reclamation Program

Phase I of Asarco's mine reclamation program (1993-1998) focused primarily on mining disturbances located on private property (patented mining claims). With adoption of temporary water quality standards and completion of land access agreements, mine reclamation efforts will be expanded to include mining-related impacts on public lands at the UBMC. Specific reclamation issues to be addressed in the future include, but are not limited to: environmental impacts from, and stability of, the Mike Horse Tailings Impoundment; concentrated mine wastes located along lower Mike Horse Creek; and fluvial tailings located along the Beartrap Creek/Upper Blackfoot River floodplain. The Implementation Plan prepared by Asarco in support of their petition for temporary standards provides a synopsis of remaining sources of metals loading to the affected streams, and an eight-year schedule for remediation of all identified sources. The Temporary Standards Implementation Plan is included as Appendix B of this document.

Asarco and the U.S. Forest Service recently entered into an Administrative Order on Consent (AOC) for development of an Engineering Evaluation/Cost Analysis (EE/CA) by Asarco. The purpose of the EE/CA is to evaluate removal action requirements and alternatives designed to prevent, mitigate, or otherwise respond to or remedy any release or threatened release of hazardous substances on National Forest lands at the UBMC. Reclamation activities performed under the EE/CA will be conducted as a Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) action under supervision of the U.S. Forest Service. Activities performed under the Temporary Standards Implementation Plan will be supervised by MDEQ. Upon completion of the EE/CA, mine reclamation activities will resume at the UBMC in accordance with the EE/CA findings and the Implementation Plan schedule (Appendix B).

1.5 Seasonality and Margin of Safety

All TMDLs must consider seasonality and also incorporate a margin of safety.

1.5.1 Seasonality

Seasonality addresses the need to ensure year round beneficial use support. The TMDL should include a discussion of how seasonality was considered for assessing loading conditions and for developing the target, the TMDL, the allocation scheme, and/or the pollutant controls. As with most metals TMDLs, seasonality plays a critical role due to varying metals loading pathways and varying water hardness during high and low flow conditions. The initial rising limb of the hydrograph during spring runoff is also considered for some water bodies. Loading pathways associated with overland flow and erosion of metals contaminated soils and wastes tend to be the major cause of elevated metals concentrations during high flows, with the highest concentrations and metals loading typically occurring during the rising limb of the hydrograph. Loading pathways associated with ground water transport and/or adit discharges tend to be the major cause of elevated metals concentrations during low or baseflow conditions. Hardness tends to be lower during higher flow conditions, thus leading to lower water quality standards for some metals during the runoff season. Seasonality is addressed in this document as follows:

- Metals impairment and loading conditions are evaluated at high and low flow conditions, and, in some situations, for early spring runoff conditions corresponding to the onset of the rising limb of the hydrograph.
- Metals TMDLs incorporate streamflow as part of the TMDL equation.
- Metals targets apply year round, with monitoring criteria for target compliance developed to address seasonal water quality extremes associated with loading and hardness variations.
- Example targets, TMDLs and load reduction needs are developed for high and low flow conditions.

1.5.2 Margin of Safety

The margin of safety may be applied implicitly by using conservative assumptions in the TMDL development process or explicitly by setting aside a portion of the allowable loading (EPA, 1999). The margin of safety is addressed in several ways as part of this document:

- Seasonality effects are taken into account as discussed above.
- Compliance with targets, refinement of load allocations, and, in some cases, impairment determinations are all based on an adaptive management approach that commits to future monitoring and assessment for updating planning and implementation efforts.
- There are built in margins of safety within existing numeric water quality standards.
- The most protective numeric standard (typically the chronic aquatic life support criteria) is used to set target conditions where multiple numeric standards are applicable.
- In addition to numeric water column criteria, additional beneficial use support targets include biota criteria associated with periphyton and macroinvertebrates.
- Sediment chemistry targets are developed to help ensure full support of aquatic life and cold water fishery.
- A relatively conservative approach is used for identifying impaired water bodies, thus leading to TMDL development for Poorman Creek and the lower segment of the Blackfoot River from Landers Fork to Nevada Creek. A conservative approach is also taken for Willow Creek whereby additional data is needed prior to assuming that no metals TMDLs are required.
- Load allocations are applied to tributary drainages to the Blackfoot River to ensure that the tributaries meet B-1 standards. These reductions, in some situations, may provide loading reductions above and beyond the minimum loading reductions needed to satisfy water quality standards and target conditions`` in the Blackfoot River.
- The above tributary load allocation approach helps ensure timely TMDL development for tributary watersheds in need of TMDL development but not yet identified as impaired water bodies. This furthers efforts to support beneficial uses throughout the watershed.

1.6 Restoration Plan Organization

Sections 2 through 5 of this document describe the individual water bodies and associated TMDL development for metals impairment conditions. Section 2 is the restoration plan for

Sandbar Creek and Willow Creek and includes a discussion of available water quality data, a summary of metals-related impairment conditions, identification and description of metals loading sources, and water quality restoration targets, TMDLs and load allocations. Section 3 provides this same information for Poorman Creek drainage, Section 4 for Beartrap Creek drainage including Mike Horse Creek, and Section 5 addresses the Blackfoot River segments both upstream and downstream of Landers Fork. Section 6 outlines a general restoration strategy for implementation of this TMDL/Water Quality Restoration Plan. The restoration strategy identifies regulatory considerations and potential regulatory programs under which impairment sources may be addressed, and possible funding sources for implementing restoration activities. Section 6 also includes recommendations for additional environmental monitoring intended to provide information necessary for making beneficial use support decisions in certain drainages lacking the required data, for more detailed source area delineation and load allocation, and to support restoration planning and reclamation design to mitigate metals loading sources.

Supporting information is provided in the document appendices. Appendix A provides a general description of the TMDL process, including the definition and purpose of a TMDL, TMDL calculation methods, and special considerations for TMDL development in the Blackfoot Headwaters TMDL Planning Area. Readers likely will benefit by reviewing Appendix A prior to reading Sections 2 through 5. Appendix B contains the Upper Blackfoot Mining Complex Temporary Standards Implementation Plan. This Implementation Plan provides additional detail on the predominant source of metals-related water quality impairment in the Planning Area. Appendix C includes available metals-related water quality data from the drainages of interest. This data is used in the development of the TMDLs and in water quality restoration planning. Appendix D provides supporting information for the restoration strategy and Appendix E includes information on characterization of sources of metals-related impairment. Appendix F is the response to public comment section.

SECTION 2.0
RESTORATION PLAN FOR SANDBAR CREEK AND WILLOW CREEK

The lower 1.6 miles of Sandbar Creek (from the confluence of three tributary forks downstream to the mouth, Figure 2-1) is listed as impaired on the 1996 and 2002 303(d) lists with metals being the probable cause of impairment on the 1996 list, and copper, metals, pH, habitat alterations and siltation listed as probable causes of impairment on the 2002 list (Table 1-1). Sections 2.1 through 2.4 summarize the available water quality and other data for metals, and identify the level of metals-related impairment and potential metals-loading sources in the Sandbar Creek drainage. Water quality restoration targets are developed for those metals found to contribute to water quality impairment in Sandbar Creek. Based on the restoration targets, example TMDLs are presented for high flow and low flow conditions as documented during previous sampling events. Load allocations are then presented based on the restoration targets and example TMDL requirements.

Sandbar Creek flows into Willow Creek and contributes to potential impairment conditions in Willow Creek. Section 2.5 provides a discussion on potential impairment conditions and water quality restoration plan components for Willow Creek, similar to the Sandbar Creek approach in Sections 2.1 through 2.4.

2.1 Available Water Quality Data for Sandbar Creek

Current water quality data from Sandbar Creek drainage includes analytical results from seven surface water samples collected between June 1996 and October 2002. Four samples were collected from lower Sandbar Creek near the National Forest boundary (site designations SCSW-1, C03SNDBC02, and 4229SA01 on Figure 2-1). Two water samples were collected from the main Sandbar Creek channel immediately downstream of the confluence of three main tributary forks (site designations SCSW-2 and C03SNDBC01). One sample has been colleted on the main Sandbar Creek channel upstream of the tributary forks (site SCSW-3). Four of the seven samples were collected in June during spring runoff conditions, although two samples from June 2001 were taken at relatively lower flows at the latter part of the falling limb of the hydrograph. Three samples were collected in October during low flow conditions. All sampling sites are shown on Figure 2-1 and the sampling schedule and analytical parameters listed in Table 2-1. The complete water quality database is included in Appendix C.

Table 2-1 Summary of Current Available Water Quality Data from Sandbar Creek Drainage.

Stream Segment	Site Designations	Date Sampled	Sampled By	Analyses
Upper Sandbar Creek	SCSW-3	10/02	Hydrometrics	Metals, SO4, hard., flow, pH/SC
Sandbar Ck below Forks	C03SNDBC01	6/01	MDEQ	Metals, SO4, hard., flow, pH/SC
	SCSW-2	10/02	Hydrometrics	Metals, SO4, hard., flow, pH/SC
Lower Sandbar Ck	4229SA01	6/96	MDEQ	Metals, SO4, hard., flow, pH/SC
	C03SNDBC02	6/01	MDEQ	Metals, SO4, hard., flow, pH/SC
	SCSW-1	6/02; 10/02	Hydrometrics	Metals, SO4, hard., flow, pH/SC

Site locations shown on Figure 2-1.
SO4- Sulfate; hard - hardness as CaCO3; SC- Specific Conductance

2.2 Sandbar Creek Drainage Impairment Conditions

2.2.1 Water Quality Data

Table 2-2 provides a summary of water quality exceedences in Sandbar Creek, relative to applicable numeric water quality standards for high flow and low flow conditions. Water quality data collected in June 1996, 2001 and 2002 are used to represent higher flow conditions, while data collected in October 2002 represent low flow (baseflow) conditions. The 1996, 2001 and 2002 data were compared to the State of Montana human heath, chronic aquatic life, and acute aquatic life numeric criteria included in WQB-7 (MDEQ, 2001b).

The June water quality data show that metals concentrations in Sandbar Creek routinely exceed applicable B-1 classification standards for copper, aluminum and iron under high flow conditions (Table 2-2). Copper concentrations have exceeded the chronic aquatic criteria in all four high flow samples collected to date and the acute aquatic criteria in three of the four samples. Iron concentrations exceed the domestic use narrative standard guidance value of 300 μg/L in two of the four high flow samples while aluminum exceeded the chronic aquatic criteria in the only sample analyzed for aluminum.

October 2002 water quality data from three sites (SCSW-1, SCSW-2, SCSW-3, Figure 2-1) represent the only low flow water quality data available from Sandbar Creek. The October data show that copper, iron and manganese exceeded applicable water quality criteria at downstream site SCSW-1, while there were no exceedences at the two upstream sites. The copper concentration at SCSW-1 exceeded both the chronic and acute aquatic life criteria, and iron and manganese concentrations exceeded the narrative standard guidance value.

In addition, fine-grained orange precipitates cover the Sandbar Creek streambed in the lower two-thirds of the listed stream segment. Based on appearance, the deposits are believed to consist primarily of iron-hydroxide precipitates and may impede aquatic life support in Sandbar Creek.

Although pH is included on the 2002 303(d) list as a cause of impairment in Sandbar Creek, current data does not support this listing. Of the seven water samples collected from the drainage between 1996 and 2002, pH values have ranged from 6.0 to 8.66 and averaged 7.59. Also, downstream trends in pH as measured in June 2001 and October 2002 show that stream pH values increase in a downstream direction. This suggests that identified sources of water quality impairment in the drainage (historic mining-related disturbances) do not cause excessive variations in pH values and thus do not support an impairment determination for pH. For this reason, TMDL development is not pursued for pH in Sandbar Creek

2.2.2 Streambed Sediment Metals Concentrations

One stream sediment sample was collected from Sandbar Creek sampling site C03SNDBC01 in June 2001 (Figure 2-1). The sediment sample consisted of fine-grained material (<63 μm) and was analyzed for total metals concentrations. Sediment analytical results are shown in Table 2-3.

Table 2-2 Sandbar Creek Drainage Seasonal Metals Impairment Summary.

Metal	Season*	N	Concentration Range µg/L	Exceedence Summary	Water Quality Standards References
Aluminum (dissolved)	High Flow	1	110	• Single dissolved measurement exceeds 87 µg/L chronic aquatic life criteria	17.30.623(2)(h)(i)-WQB-7 17.30.637(1)(d)
	Low Flow	3	<50 to <50	• Consistently less than 87 µg/L chronic aquatic life criteria at all three sites sampled in 10/02.	
Cadmium	High Flow	4	<0.2 to <0.1	• Consistently less than hardness-based chronic and acute aquatic life criteria and 5 µg/L human health standard	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d)
	Low Flow	3	<0.1 to <0.1	• Consistently less than hardness-based chronic and acute aquatic life criteria and 5 µg/L human health standard	
Copper	High Flow	4	5 to 13	• Exceeds hardness-based chronic aquatic life criteria in 4 of 4 measurements and acute aquatic life criteria in 3 of 4 measurements. Consistently less than 1,300 µg/L human health standard.	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d)
	Low Flow	3	1 to 22	• Exceeds hardness-based chronic aquatic and acute aquatic life criteria at downstream site SCSW-1. Consistently less than 1,300 µg/L human health standard.	
Iron	High Flow	4	70 to 580	• Greater than 300 µg/L guidance level in 2 of 4 measurements. Consistently less than 1,000 µg/L aquatic life criteria.	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d) 17.30.637(1)(a) 17.30.601
	Low Flow	3	<30 to 1,020	• Greater than 300 µg/L guidance level and 1,000 µg/L aquatic life criteria at downstream site SCSW-1. No exceedences at two upstream sites.	
Lead	High Flow	4	<1 to <2	• Consistently less than 15 µg/L human health standard and hardness-based chronic and acute aquatic life criteria	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d)
	Low Flow	3	<2 to <2	• Consistently less than 15 µg/L human health standard and hardness-based chronic and acute aquatic life criteria	
Manganese	High Flow	3	<5 to 30	• Consistently less than 50 µg/L guidance level	17.30.623(2)(h)(i) - WQB-7 17.30.601
	Low Flow	3	<10 to 120	• Exceeds 50 µg/L guidance level at downstream site SCSW-1.	
Zinc	High Flow	4	7 to <10	• Consistently less than 2,100 µg/L human health standard and hardness-based chronic and acute aquatic life criteria	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d)
	Low Flow	3	10 to 20	• Consistently less than 2,100 µg/L human health standard and hardness-based chronic and acute aquatic life criteria	

High flow data includes samples from 1 site in June 1996, 2 sites in June 2001 and 1 site in June 2002. Low flow data includes October 2002 samples from SCSW-1, SCSW-2 and SCSW-3.
Evaluation of exceedences based on total recoverable fraction (except for aluminum which is based on dissolved fraction).
n- number of measurements

Table 2-3 Stream Sediment Metals Concentrations from Sandbar Creek Sampling Site C02SNDBC01.

Site C03SNDBC01	Concentration mg/Kg
Aluminum	17300
Arsenic	54
Cadmium	8
Copper	685
Iron	33200
Lead	166
Manganese	2310
Nickel	31
Zinc	685

Sample collected by MDEQ in June 2001
Metals concentrations are total (EPA Method 3050)
Site locations shown on Figure 2-1.

Analytical results indicate the sediment sample contained elevated concentrations of a number of metals. Concentrations of some metals, including cadmium, copper, iron, manganese, lead, arsenic, and zinc, are significantly greater than published guidance levels denoting potentially harmful conditions for aquatic biota associated with sediment metals concentrations (Jones et al., 1997; Long and Morgan, 1990). This indicates that metals concentrations in stream sediments are likely impacting aquatic life support (and possibly other beneficial uses) in Sandbar Creek and need to be considered within this water quality restoration plan.

2.2.3 Impairment Determination for Sandbar Creek

The above discussions on water quality, sediment chemistry, along with the biological data discussed in Section 1.3.1, sufficiently justify the metals impairment determination for the listed portion of Sandbar Creek and the need for TMDL development for multiple metals. TMDL development for pH is not necessary since the data does not indicate an impairment condition.

2.3 Sandbar Creek Source Characterization

2.3.1 Metals Source Inventory

Historic mining disturbances comprise the main sources of metals loading to Sandbar Creek. Two abandoned mines have been identified in the Sandbar Creek drainage bottom through review of USBM and MDEQ abandoned mine databases, and a site reconnaissance. One of the mines is located on the listed stream segment between sampling sites SCSW-1 and SCSW-2 (Figure 2-1). The second (smaller) mine is located upstream of the listed stream segment between sampling sites SCSW-2 and SCSW-3. The mines are relatively small in size with each consisting of a collapsed adit and associated mine waste dump. Due to their proximity to the active stream channel, both mine dumps are potential sources of metals loading to Sandbar Creek. A metals loading analysis performed on Sandbar Creek and included in Appendix E supports this finding. The upstream extent of the iron hydroxide precipitates coating the Sandbar

Creek channel closely coincides in location with the downstream mine. Neither of the collapsed adits shows evidence of current or past water seepage or flow.

In addition to the two mines, there is a section of road that appears to be constructed in part from mine waste material. The road is located a short distance downstream of the uppermost abandoned mine as shown on Figure 2-1. Based on the close proximity of the road to the active stream channel, the road fill material may be a source of metals loading to the creek.

2.4 Sandbar Creek Restoration Targets, TMDLs and Load Allocations

Water quality restoration targets are established below for high flow and low flow conditions in Sandbar Creek. The restoration targets are an integral component of the metals TMDLs and are sometimes referred to as the TMDL endpoints. The restoration targets for specific metals represent the maximum metals concentrations that may occur within Sandbar Creek without exceeding water quality standards. As such, these restoration targets are identical to the B-1 classification numeric water quality standards and represent primary water quality goals of the TMDL process. Additional restoration targets based on sediment toxicity, biota measures, and stream deposits are also presented as an additional margin of safety to ensure full support of aquatic life beneficial uses.

Based on the restoration targets, TMDLs are presented below for the metals that currently exceed restoration targets. Following TMDL development, load allocations are discussed for various source areas in the drainage (see Appendix A for discussion of overall process).

2.4.1 Metals Restoration Targets

Table 2-4 provides water quality restoration targets for those metals that exceed B-1 classification water quality standards in Sandbar Creek, including copper, iron, manganese and aluminum (Section 2.2). The water quality-based restoration targets for aluminum and copper are based on the chronic aquatic life criteria with the copper target adjusted for water hardness (Appendix A). Hardness values used in calculating the targets are based on actual measured values as specified in Table 2-4. Because it is unknown what the actual hardness value will be under restoration conditions, the target values listed in Table 2-4 for these metals represent estimated values at the various flow conditions. The actual targets will be based on in-stream hardness values as measured at the time of sampling. Appendix A provides an example of the hardness adjustment equation for chronic aquatic life support standards.

Basing restoration targets on the chronic aquatic criteria for copper and aluminum will ensure that other numeric criteria (human health, acute aquatic life) are met since the chronic criteria are the most stringent (lowest concentration). The restoration targets for iron and manganese are based on the 300 μg/L and 50 μg/L guidance values for drinking water use support in WQB-7 (MDEQ, 2001b). Iron also has an upper limit target of 1000 ug/l based on the chronic criteria for aquatic life support.

Compliance for the water quality targets will be based on high and low flow water quality data, with no more than one measurement of the concentration for a particular metal exceeding the chronic criteria by more than 10%. This approach is consistent with MDEQ guidance for making beneficial use support determinations (MDEQ, 2002). In evaluating compliance with the iron and manganese drinking water use targets, consideration should be given to the level and frequency of exceedences, and whether or not the exceedences interfere with the uses specified in the surface water quality standards (ARM 16.30.623). Appendix A provides additional discussion for evaluating compliance with the iron and manganese targets.

Based on the metals loading sources specific to Sandbar Creek drainage (historic mine waste), the high flow water quality data will need to be collected during the rising limb of the hydrograph, and the low flow water quality data is to be collected at or near base flow conditions. At a minimum, monitoring locations SCSW-1 and SCSW-2, or comparable sites (Figure 2-1) will be used for determining compliance with targets (see Section 6.3, Monitoring Strategy).

Table 2-4 Water Quality Restoration Targets for Metals in Sandbar Creek.

POLLUTANT	TARGET(S)	LIMITING BENEFICIAL USE
Copper[1]	13.2 (low flow) 9.3 ug/l (high flow)	Aquatic Life (chronic) Aquatic Life (chronic)
Iron	300 ug/l 1000 ug/l (all flows) No visible stream bed deposits associated with controllable human sources	Drinking water (domestic use) Aquatic life (chronic) Aquatic life/Aesthetics
Manganese	50 ug/l	Drinking water (domestic use)
Aluminum	87 ug/l (all flows)	Aquatic Life (chronic)
Metals	No metals concentrations in sediments that may impede beneficial uses. Macroinvertebrate and periphyton communities must show no impairment from metals.	Aquatic Life Aquatic Life

Notes: 1. Copper targets are based on hardness values of 40 mg/L during high flow and 55 mg/L at low flow as determined from past sampling results; copper targets will vary with water hardness at any given time (Appendix A).

In addition to the water chemistry-based targets, iron has an additional target of no visible streambed deposits resulting from human causes. Another target is that metals concentrations in sediments cannot impede beneficial uses, with focus on aquatic life support. This target applies to all metals, either individually or in combination, which may occur at potentially toxic concentrations in stream sediments. Lead and zinc are of special concern given the relatively high levels in sediment chemistry as identified in Table 2-3. Assessment of stream sediment concentrations and beneficial use support conditions will be consistent with the stream sediment screening approach discussed in Section 1.2.3.

As an additional measure of water quality restoration, a target for macroinvertebrate and periphyton communities also applies. These communities must show no impairment from metals as compared to a known reference condition using standard MDEQ protocols (reference Appendix A). The monitoring locations for compliance with the sediment chemistry and biota targets will be based on the same sampling locations used for water column chemistry target compliance, with the option of using just one location if the one location can provide assurance of beneficial use support.

It is important to note that the above targets represent minimum requirements for metals for protecting beneficial uses identified within Montana's Surface Water Quality Standards, and are based on interpretations of available data presented within this plan. Other regulatory programs with water quality protection responsibilities may impose additional requirements to ensure full compliance with all appropriate local, State and Federal laws.

2.4.2 Metals TMDLs for Sandbar Creek

TMDLs are required for the metals aluminum, copper, iron and manganese since these are the metals contributing to impairment of Sandbar Creek (Section 2.2). As discussed in Appendix A, the TMDLs represent the maximum amount of each metal that a stream can assimilate without exceeding water quality standards. This assimilative capacity is a function of the streamflow rate (dilution capacity), and for some metals, the water hardness (which determines the numeric water quality criteria). Therefore, the TMDL must be designed to be protective of beneficial uses and meet water quality standards under the full range of streamflow and water chemistry conditions anticipated. To achieve this, the metals TMDL is presented as an equation to be used to calculate the maximum allowable load of a specific metal at any time or under any conditions. The TMDL equation is as follows:

<u>Equation 2-1:</u> *Total Maximum Daily Load (lb/day) = (X ug/l)(Y cfs)(0.0054)*
where:
X = the applicable water quality numeric standard (target) in ug/l with hardness adjustments where applicable;
Y = streamflow in cubic feet per second;
(0.0054) = conversion factor

Table 2-5 provides high flow and low flow TMDLs for these metals. These TMDLs were calculated from Equation 2-1, using the average of the three June streamflow measurements from monitoring site SCSW-1 (3.4 cfs) for calculating the high flow TMDLs, and the single low flow measurement from SCSW-1 (0.22 cfs) for the low flow TMDLs. The restoration targets were taken from Table 2-4. The calculated TMDLs represent the maximum load (lbs/day) of each particular metal that the creek can accommodate without exceeding applicable water quality standards for the specified streamflow conditions and restoration targets.

Table 2-5 also lists the load reductions needed to meet the specific high flow and low flow TMDLs based on available water quality and streamflow data. Under low flow conditions, required load reductions include 38% for copper, 71% for iron, and 58% for manganese. Required load reductions for high flow conditions include 21% for aluminum, 34% for copper, and 29% for iron. These required load reductions apply to the specific conditions and restoration targets used in calculation of the example TMDLs.

Table 2-5 Sandbar Creek TMDL and Load Reduction Requirement for Metals at Specified High and Low Flow Conditions – Monitoring Location SCSW-1.

Pollutant	Target (ug/l)	Calculated Low Flow and High Flow TMDLs[1] (lb/day)	% Load Reduction Required to Meet TMDLs and Targets
Copper	13.2 (low flow) 9.3 (high flow)	0.016 (low flow) 0.38 (high flow)	38% (low flow); 34% (high flow)
Iron	300 (low flow) 300 (high flow)	0.36 (low flow) 12.1 (high flow)	71% (low flow); 29% (high flow)
Manganese	50 (low flow) 50 (high flow)	0.06 (low flow) 2.02 (high flow)	58% (low flow) 0% (high flow)
Aluminum	87 (low flow) 87 (high flow)	0.10 (low flow) 3.52 (high flow)	0% (low flow); 21% (high flow)

1. Example low flow TMDL based on single low flow measurement of 0.22 cfs at SCSW-1 on 10/7/02.
2. Example high flow TMDL based on average of three flow measurements (3.44 cfs) measure in 6/96, 6/01 and 6/02. Restoration Targets from Table 2-4.

Some additional notes concerning the Table 2-5 TMDLs and the target conditions they are intended to satisfy include:

- For iron, the TMDL based on the 300 ug/l drinking water/domestic use support condition is expected to satisfy the additional target of no visible stream bed deposits associated with iron hydroxide precipitates from human causes.

- Based on seasonal and other considerations associated with the iron and manganese drinking water/domestic use support criteria, a higher TMDL may be acceptable for both iron and manganese as long as other target criteria associated with visible stream deposits, sediment toxicity, biota support, and chronic aquatic life criteria are satisfied.

- Meeting the metals TMDLs is expected to satisfy the target associated with potential sediment toxicity for two reasons. First, restoration activities designed to address existing sources of metals (believed to primarily be historic mining-related) should also eliminate the source(s) of elevated metals concentrations in sediments. Secondly, as metals loads in Sandbar Creek are reduced to TMDL levels, fine-grained metals-bearing sediments likely will flush through the system during high flow periods via typical sediment transport processes. As source areas are reclaimed, the displaced sediments will be replaced with fewer and cleaner sediments. The response of sediment chemistry to implementation of the metals TMDLs will be documented through post-implementation sediment testing (Section 6.3).

- Meeting all of the metals TMDLs is expected to eliminate any metals-related impediments to satisfying the target associated with macroinvertebrate and periphyton communities being at full support conditions in comparison to reference conditions.

The metals TMDLs and required load reductions presented in Table 2-5 apply to specific streamflow conditions (and water hardness in the case of copper) used in their calculation. Due to the limited streamflow data available, the degree to which these examples represent typical high flow and low flow conditions in the drainage is unknown. It is possible that TMDLs calculated from future high flow and low flow data may vary significantly from the examples presented here. Ultimately, the TMDL is the load of a particular pollutant that Sandbar Creek can support without exceeding B-1 water quality standards at any time as determined from Equation 2-1. General information on calculations of TMDLs is included in Appendix A. All available water quality data used in calculations of TMDLs and load reduction requirements are in Appendix C.

2.4.3 Sandbar Creek Load Allocations

A TMDL is the sum of all of the load allocations (for nonpoint sources) plus all of the waste load allocations (for point sources) in a drainage, plus a margin of safety. Because there is no point source discharges subject to the Montana Pollutant Discharge Elimination System permit program in Sandbar Creek drainage, waste load allocations are not required. The margin of safety is addressed implicitly through the use of chronic aquatic standards for calculation of TMDLs under all conditions, incorporation of biologic and sediment restoration targets, development of TMDLs for various flow conditions, and, most importantly, adoption of a monitoring program designed to further quantify metals loading sources, assist in restoration planning, and assess TMDL compliance (Section 6.3). In addition, the numeric water quality criteria used in establishing restoration targets contain built-in margins of safety for protection of beneficial uses. Since no waste load allocations or explicit margins of safety are required, the metals TMDLs for Sandbar Creek drainage consist solely of the nonpoint source load allocations in the drainage.

Based on current information, nonpoint sources of metals impairment potentially requiring load allocations are divided into two categories:

- Category 1: Currently identified sources including the two historic mines and the area of apparent mine waste road fill (Figure 2-1) in addition to any natural background metals loading.

- Category 2: Other potential nonpoint sources not yet identified including additional mining-related disturbances, and other human-caused impacts such as roads.

Table 2-6 includes preliminary load allocations for the nonpoint source categories based on the example TMDL values. At this time, the entire load allocations for aluminum, copper, iron and manganese are allocated to the Category 1 sources. This assumes that no additional significant metals loading sources are present in the drainage and that the restoration targets can be met by addressing Category 1 sources only.

Section 6 describes a water monitoring strategy designed to further evaluate potential sources of metals loading in the drainage, including possible natural background sources. The monitoring plan also addresses post-implementation monitoring requirements intended to assess the effectiveness of restoration activities and compliance with the TMDL goals as required in MCA 75-5-703(7). If future monitoring identifies additional sources, the preliminary load allocations in Table 2-6 will need to be adjusted accordingly as part of a phased allocation approach. Ultimately, the load allocation will be driven by attainment of the B-1 classification-based water quality targets listed in Table 2-4.

Table 2-6 Preliminary Metals Load Allocations for Sandbar Creek Drainage.

METAL	TMDL lb/Day	ALLOCATIONS		Margin of Safety
		Identified Non-Point Sources[1] (Category 1)	Possible Other Non-Point Sources[2] (Category 2)	
Copper	High Flow-.38 Low Flow-.016	0.38 0.016	No allocation at this time	Implicit MOS applied through conservatism in TMDL calculation process and required post-implementation monitoring to assess performance of restoration actions.
Aluminum	High Flow-3.52 Low Flow- 0.10	3.52 0.10	No allocation at this time	
Iron	High Flow-12.1 Low Flow- 0.36	12.1 0.36	No allocation at this time	
Manganese	High Flow-0.06 Low Flow-2.02	0.06 2.02	No allocation at this time	

1- Includes two mine dumps and apparent mine waste in road fill as described in Section 2.3 and shown on Figure 2-1, and natural background loading

2- Includes additional human-caused nonpoint sources, which may be identified through future monitoring. If a load allocation is required for additional sources in the future, then the Category 1 load allocation for Identified Non-Point Sources must be reduced accordingly.

2.5 Willow Creek Restoration Plan

2.5.1 Metals Data and Sources

Sandbar Creek flows into Willow Creek, which is a tributary to the Blackfoot River (Figure 2-1). The portion of Willow Creek from Sandbar Creek to the mouth was listed as impaired for metals on the 1996 303(d) list, and was listed as impaired for bank erosion, habitat alterations, and siltation on the 2002 303(d) list (Table 1-1). The more recent listing did not include metals because water quality sample results from June 2001 (near the end of spring runoff) and other historic data (Appendix C) did not show any exceedences of water quality standards and the periphyton data did not indicate an impairment condition. In addition, sample results from runoff conditions on June 6, 2002 do not show any exceedences of water quality standards. This sampling included locations near the mouth (below Sandbar Creek) and just above Sandbar Creek in the upstream portion of Willow Creek which apparently was not included as part of the impaired stream segment for the 1996 303(d) list.

Two stream sediment samples were collected during June of 2001. Sediment analytical results are shown in Table 2-7. Analytical results show that concentrations of certain metals, including copper, iron, manganese, and arsenic, are greater than published guidance levels denoting potentially harmful conditions for aquatic biota (Jones et al., 1997; Long and Morgan, 1990). This information indicates that metals concentrations in stream sediments could impact aquatic life support. Periphyton data does not imply an impairment condition (Bahls, 2001), although macroinvertebrate data from Willow Creek above Sandbar Creek implies that the water body is impaired based on a borderline partial support conclusion (Bollman, 2002). This partial support condition could be influenced more by sediment, habitat, and channel conditions than by metals contamination based on the individual macroinvertebrate metrics and other visual indicators of negative impacts associated with habitat and stream channel conditions as observed by MDEQ water quality specialists.

Table 2-7 Stream Sediment Metals Concentrations from Willow Creek Sampling Site.

	Site WCSW-1 (upstream of Sandbar Creek) **Concentration mg/Kg**	**Site WCSW-2 (near the mouth of Willow Creek) Concentration mg/Kg**
Aluminum	17300	32400
Arsenic	116	30
Cadmium	2	1
Copper	101	80
Iron	59400	30600
Lead	53	33
Manganese	2050	2530
Nickel	18	16
Zinc	158	163

Metals concentrations are total (EPA Method 3050)

The sediment chemistry data from both Willow Creek locations do indicate the potential for upstream sources of metal contamination, which is not surprising for the segment of Willow Creek below Sandbar Creek. At least one historic mine prospect is located near the headwaters of Willow Creek which could account for the elevated sediment metals concentrations upstream (and possibly downstream to some extent) of the confluence of Sandbar Creek. Other potential upstream sources include erosion and/or leaching of metals from apparently mineralized bedrock and soils in highway roadcuts, or recharge from naturally mineralized groundwater. Also, the upstream Willow Creek sediment sample was taken immediately downstream of a wooden bridge. Wood treatment residue could be a source of arsenic, which is one of the metals occurring at elevated sediment concentrations at the upstream sampling site.

The above data is not sufficient to conclude that Willow Creek is impaired due to metals, but it does indicate a need for more data to evaluate whether or not Willow Creek is impaired. From a practical restoration perspective, this additional data is more important for the section of Willow Creek above Sandbar Creek since restoration efforts in Sandbar Creek, as developed above in Sections 2.1 through 2.4, should address any impairment conditions in the lower portion of Willow Creek if it can be established that there are not any significant metals loading problems in the upper portions of Willow Creek.

2.5.2 Sampling and Restoration Planning for Willow Creek

To ensure that there are not any significant upstream impairment conditions in Willow Creek, at least one location above WCSW-1 should be sampled. The sample location(s) will need to be selected based on an inventory of potential metals sources, with a likely location being about halfway between the Flesher Pass road crossing and the current WCSW-1 sample location site. This location would likely capture upstream metals loading impacts, should they occur. If the sample meets the target criteria in Table 2.8, then it can be assumed that the portion of Willow Creek above Sandbar Creek is not impaired from metals. It can also then be concluded that any potential impairment conditions in the section of Willow Creek below Sandbar Creek are being addressed via TMDL development for Sandbar Creek.

If the target criteria in Table 2.8 cannot be met, then this upper segment of Willow Creek will be considered impaired due to metals and the Table 2.8 targets will apply as TMDL development targets in the same manner that they are applied to Sandbar Creek (Section 2.4). TMDLs for the metals of concern will apply using the equation(s) in Appendix A, and the allowable load will be allocated to the sum of impacts from historical mining, road disturbances, and natural background loading, with further refinement to be pursued as the next step toward restoration planning. Under this scenario, it can be concluded that any potential impairment conditions in the section of Willow Creek below Sandbar Creek are being addressed via TMDL development for both Sandbar Creek and upper Willow Creek.

Table 2-8 Willow Creek Impairment Determinations and Target Criteria for Metals.

POLLUTANT/SAMPLE MEDIA	TARGET(S)
Metals/Water Quality	Continued compliance with water quality standards (reference Appendix A and WQB-7) during low and high flow conditions. Also reference Table 2-4 for applicable targets should impairment conditions exist.
Metals/Biota	Macroinvertebrate and periphyton communities must show no impairment from metals.

SECTION 3.0
POORMAN CREEK DRAINAGE

Poorman Creek originated near the continental divide and empties into the Blackfoot River just south of the Town of Lincoln (Figure 1-2). Significant historic mining has occurred in the drainage resulting in the creek being listed as impaired for metals for its entire length of 14 miles (Table 1-2).

3.1 Available Water Quality Data

Available water quality data from Poorman Creek drainage are summarized in Table 3-1. Current data includes surface water quality data from three sites sampled by the former Montana Department of State Lands in 1993 (MDSL, 1995), water quality data from six sites sampled in June 1996 by MDEQ, surface water and sediment chemistry data from three sites sampled in June 2001 by MDEQ, surface water quality data from five sites sampled in June 2002 by Hydrometrics, and surface water quality from six sites and sediment chemistry data from three sites sampled in October 2002 by Hydrometrics. Of the 23 water samples identified, 15 were collected from the mainstem of Poorman Creek, three were collected from the South Fork of Poorman Creek near the confluence with the mainstem, and five were collected from Swansea Gulch, a tributary to Poorman Creek where significant historic mining activities have occurred. The majority of available data was collected under high flow conditions (June), although samples taken during June 2001 were at relatively lower flows at the latter part of the falling limb of the hydrograph. The October 2002 sampling results represent the only low flow data at baseflow conditions from most portions of the drainage (Table 3-1). Results from three water samples collected by MDFWP in the early 1970s were not used in this evaluation due to the dated nature of this information. Water quality and sediment chemistry data from Poorman Creek is included in Appendix C and in relevant sections of this report. Sampling locations are shown on Figure 3-1.

3.2 Poorman Creek Drainage Impairment Conditions

3.2.1 Water Column Chemistry

Table 3-2 provides a summary of water quality exceedences in Poorman Creek drainage, relative to applicable water quality standards for higher flow and low flow (baseflow) conditions. Water quality data collected in June 1996, 2001 and 2002 were used to represent high flow conditions, while data collected in September 1993 and October 2002 represent low flow conditions.

Based on the current water quality data, exceedences of numeric water quality criteria for metals in Poorman Creek drainage are restricted to an unnamed tributary in the upper drainage previously referred to as Swansea Gulch (Figure 3-1). Results from a June 1996 water sample collected near the mouth of Swansea Gulch (the only high flow water quality data available from the drainage), exceeded the chronic aquatic life criteria for cadmium, copper and lead (Table 3-2). The acute aquatic life criteria for copper was also exceeded in this sample, while no human health or domestic use standards were exceeded. Two water samples collected from Swansea

Gulch near the Swansea tailings in September 1993 as part of Montana's abandoned mine prioritization process (MDSL, 1995), exceeded the acute aquatic criteria for copper and lead. Metals concentrations in an October 2002 water sample collected near the mouth of Swansea Gulch were all below applicable water quality criteria (Appendix C).

Table 3-1 Summary of Current Available Water Quality Data from Poorman Creek Drainage.

Stream Segment	Site Designations	Date Sampled	Sampled By	Analyses
Poorman Ck Upstream of South Fork	011	6/96	MDEQ	Metals, SO4, hard., flow, pH/SC
	C03POORC01	6/01	MDEQ	Metals, SO4, hard., flow, pH/SC
	PCSW-4	6/02	Hydrometrics	Metals, SO4, hard., flow, pH/SC
	PCSW-7	10/02	Hydrometrics	Metals, SO4, hard., flow, pH/SC
Poorman Ck between S. Fork and FS Boundary	4127PO01	6/96	MDEQ	Metals, SO4, hard., flow, pH/SC
	4127PO02	6/96	MDEQ	Metals, SO4, hard., flow, pH/SC
	C0POORC02	6/01	MDEQ	Metals, SO4, hard., flow, pH/SC
	PCSW-3	6/02; 10/02	Hydrometrics	Metals, SO4, hard., flow, pH/SC
Poorman Ck Downstream of FS Boundary	4126PO01	6/96	MDEQ	Metals, SO4, hard., flow, pH/SC
	C03POORC03	6/01	MDEQ	Metals, SO4, hard., flow, pH/SC
	PCSW-1	6/02; 10/02	Hydrometrics	Metals, SO4, hard., flow, pH/SC
	PCSW-2	6/02; 10/02	Hydrometrics	Metals, SO4, hard., flow, pH/SC
South Fork of Poorman Ck	4128PO02	6/96	MDEQ	Metals, SO4, hard., flow, pH/SC
	PCSW-5	6/02; 10/02	Hydrometrics	Metals, SO4, hard., flow, pH/SC
Swansea Gulch (tributary to Poorman Ck)	4128PO01	6/96	MDEQ	Metals, SO4, hard., flow, pH/SC
	PCSW-6	10/02	Hydrometrics	Metals, SO4, hard., flow, pH/SC
	25-208-SW-1	9/93	MDSL	Metals, pH
	25-208-SW-2	9/93	MDSL	Metals, pH
	25-208-SW-3	9/93	MDSL	Metals, pH

SO4- Sulfate
hard.- hardness as CaCO3
SC- Specific Conductance

For the 19 remaining water samples collected from Poorman Creek drainage outside of Swansea Gulch, no exceedences of numeric water quality criteria were recorded, although low levels of copper have been detected. In addition, no metal precipitate sludges or metal colloid concentrations creating problem turbidity levels or visible stream deposits are known to exist in Poorman Creek drainage.

3.2.2 Metals in Streambed Sediments

Results from six stream sediment samples analyzed for total metals concentrations were reviewed to determine if stream sediments might contribute to metals-related impairment in Poorman Creek. Three of the sediment samples were collected by MDEQ in June 2001 with sampling sites corresponding to water sampling locations C03POORC01, C03POORC02 and C03POORC03 (Figure 3-1). The 2002 samples (sample sites PCSed02-1, -2, -3 on Figure 3-1) were collected to verify elevated metals concentrations at one 2001 sample site (C03POORC02), and to evaluate possible sources for metals in sediments.

Table 3-2 Poorman Creek Drainage Metals Impairment Summary.

Metal	Season	n	Concentration Range µg/L	Exceedence Summary
Aluminum	High Flow	5	<10 to 40	• Consistently less than 87 µg/L chronic aquatic life criteria
	Low Flow	8	<50	• Consistently less than 87 µg/L chronic aquatic life criteria
Cadmium*	High Flow	13	<0 to 0.5	• Exceeds hardness-based chronic and acute aquatic life criteria in only high flow sample from Swansea Gulch.
	Low Flow	8	<0.1 to 0.1	• Consistently less than hardness-based chronic and acute aquatic life criteria and 5 µg/L human health standard
Copper*	High Flow	13	1 to <10	• One exceedence of hardness-based chronic and acute aquatic life criteria (in Swansea Gulch).
	Low Flow	8	<1 to 21.3	• Exceeds hardness-based chronic aquatic and acute aquatic life criteria in 2 of 3 samples from Swansea Gulch. Consistently less than 1,300 µg/L human health standard.
Iron	High Flow	13	10 to 200	• Consistently less than 300 µg/L guidance level and 1,000 µg/L chronic aquatic life criteria.
	Low Flow	8	<30 to 265	• Consistently less than 300 µg/L guidance level and 1,000 µg/L chronic aquatic life criteria
Lead*	High Flow	13	1 to 8	• Exceeds hardness dependent chronic aquatic life criteria in single high flow sample from Swansea Gulch.
	Low Flow	8	<2 to 4.3	• Exceeds hardness dependent chronic and acute aquatic life criteria in two of three samples from Swansea Gulch.
Manganese	High Flow	8	<5 to 19	• Consistently less than 50 µg/L guidance level
	Low Flow	8	4.1 to 17.5	• Consistently less than 50 µg/L guidance level
Zinc*	High Flow	13	0.2 to 20	• Consistently less than 2,100 µg/L human health standard and hardness-based chronic and acute aquatic life criteria
	Low Flow	8	7.6 to <10	• Consistently less than 2,100 µg/L human health standard and hardness-based chronic and acute aquatic life criteria

High flow measurements include results from all June samples listed in Table 3-1.
Evaluation of exceedences based on total recoverable fraction except for aluminum, which is based on dissolved fraction.
*-aquatic criteria based on actual hardness of water sample.

Sediment sample analytical results are shown in Table 3-3. Of the six samples, the two samples collected from the mainstem of Poorman Creek between the South Fork and Little Davis Gulch (site C03POORC02/PCSed02-1, Figure 3-1) contained the highest concentrations of most metals. Concentrations of copper and lead are significantly greater than published guidance values denoting potentially harmful conditions for aquatic biota (Jones et al., 1997; Long and Morgan, 1990). The concentration of copper in the 1996 sample from downstream site CO3POORC03 (Figure 3-1) was similar to those at C03POORC02/PCSed02-1. Stream sediment metals concentrations generally decreased in an upstream direction with sample PCSed02-3, from Poorman Creek channel upstream of Swansea Gulch, having the lowest concentrations of most metals (Table 3-3). All concentrations at this site tend to be below or only slightly above the generalized stream sediment toxicity guidance values discussed above.

Table 3-3 Stream Sediment Metals Concentrations from Poorman Creek Main Channel.

Site	**C03POORC 01**	**C03POORC 02**	**C03POORC 03**	**PCSed02-1**	**PCSed02-2**	**PCSed02-3**
Location (and corresponding site designations)	Upper Poorman Ck (PCSW-4)	Mainstem downstream of S. Fork (PCSW-3)	Mainstem downstream of FS Boundary (PCSW-2)	Mainstem Downstream of S. Fork (PCSW-3)	Mainstem downstream of Swansea Gulch (PCSW-7)	Mainstem Upstream of Swansea Gulch
Sample Date	6/01	6/01	6/01	10/02	10/02	10/02
Aluminum	21100	15800	21500	na	na	na
Arsenic	12	28	24	26	7	7
Cadmium	<1	3	<1	3	<2	<2
Copper	27	224	140	172	84	43
Iron	17300	11900	17500	na	na	na
Lead	54	353	68	313	185	46
Manganese	595	365	451	na	na	na
Nickel	37	13	22	17	13	25
Zinc	89	137	91	155	84	95

na-not analyzed
Sediment samples comprised <63 µm size fraction
Metals concentrations are total (EPA Method 3050) and are in mg/Kg
Site locations shown on Figure 3-1

3.2.3 Impairment determinations for Poorman Creek

The above discussions on water quality and sediment chemistry, along with the biological data referenced in Section 1.3.1, sufficiently justify the metals impairment determination for the listed portion of Poorman Creek and the need for TMDL development for multiple metals. Although available water quality data from the mainstem of Poorman Creek do not reveal any exceedences of the numeric water quality criteria, the elevated metals concentrations in sediments (in particular copper and lead), the periphyton data (percent abnormal diatom cells), the significant number of potential mining related sources, and the elevated metals concentrations in Swansea Gulch all indicate that beneficial uses in Poorman Creek likely are impaired due to metals and justify a continued metals impairment determination and TMDL development for the mainstem of Poorman Creek.

3.3 Source Characterization

3.3.1 Metals Source Inventory

There are several historic hardrock mines located within the Poorman Creek drainage, which are potential sources of metals loading to the creek. The MDEQ Abandoned Mine and U.S. Bureau of Mines databases identify more than 30 historic mines in the drainage and numerous small prospects and diggings (Figure 3-1). Most of these mines are limited in size and typically consist of minor prospects with mine workings of limited extent and small associated waste rock piles. Based on available water quality data, the majority of these sites do not appear to significantly impact water quality. However, some of these mines are significant in size and, based on available information, do impact surface water quality in Poorman Creek drainage. Other potential metals loading sources in the drainage may include roads, placer mine tailings in the lower drainage, and natural background sources.

Appendix E includes a metals loading analysis performed on Poorman Creek drainage to better delineate specific sources of metals loading. The loading analysis results (Table 3-4) indicate that multiple metals loading sources exist throughout the drainage during high flow conditions, with the greatest load increases occurring in the downstream half of the drainage. Despite the greater metal loads in the downstream reaches, available water quality data show that metals concentrations are greatest in Swansea Gulch due to the relatively low streamflow rate (resulting in a lower dilution capacity). Water quality data also indicate that Swansea Gulch is the only known stream segment in the drainage that exceeds numeric water quality standards for metals and thus is impaired due to metals concentrations in the water column. As previously discussed however, elevated concentrations of certain metals in Poorman Creek sediments, along with the available biological data, indicate that portions of Poorman Creek main stem are impaired from metals as well.

Table 3-4 Metals and Sulfate Loading Trends in Poorman Creek Drainage for June 13, 1996.

SITE	Description	Flow (cfs)	Copper (lb/day)	Iron (lb/day)	Sulfate (lb/day)
4128PO014	Swansea Gulch above Stemple Rd	0.79	0.043	0.21	26.8
011	Poorman Ck upstream of S. Fork	8.92	0.096	1.92	365
4128PO02	S. Fork Poorman Ck near mouth	17.66	0.095	3.81	571
4127PO01	Poorman Ck below McClellan Ck	56.97	0.614	6.14	2,240
4127PO02	Poorman Ck at NF boundary	59.05	0.318	22.3	2,290

Site listed in downstream order, locations shown on Figure 3-1.

Swansea Gulch contains a number of relatively large historic mines including the Swansea Mine/Tailings Complex and Silver Belle Mine (Figure 3-1). This group of mines and support facilities represents the only currently confirmed sources of metals-related water quality impairment in Poorman Creek drainage (reference Appendix E for additional Swansea Gulch source loading analysis results). It is possible that most or all significant impairment conditions in the main stem are the result of metals loading sources within Swansea Gulch. This scenario is supported by the relatively low concentrations of metals in sediment at PCSW-4 upstream of Swansea Gulch. On the other hand, the somewhat elevated percentage of abnormal diatom cells at this same location tends to contradict this scenario. Nevertheless, the first phase of TMDL development, load allocation, and restoration planning in Poorman Creek drainage focuses on Swansea Gulch, with allocations and restoration plans to be developed in subsequent phases as necessary once additional information on main stem and tributary conditions throughout the drainage becomes available. Section 6.3 includes a monitoring strategy for obtaining information necessary for subsequent phases of TMDL development.

3.4 Restoration Targets, TMDLs and Load Allocations

3.4.1 Metals Restoration Targets for Poorman Creek and Swansea Gulch

The summary of impairment conditions (Table 3-2) identified cadmium, copper and lead as metals that exceed applicable B-1 water quality criteria in Swansea Gulch. Table 3-5 provides high flow and low flow water quality restoration targets, or maximum allowable concentrations, for these metals based on the numeric chronic aquatic life criteria listed in WQB-7 (MDEQ, 2001b). Basing restoration targets on the chronic aquatic criteria will ensure that other numeric criteria (human health, acute aquatic life) are met since the chronic criteria are the most stringent (lowest concentration). Compliance for the water quality targets will be based on high and low flow water quality data, with no more than one measurement for a particular metal exceeding the chronic criteria by more than 10%. This approach is consistent with MDEQ guidance for making beneficial use support determinations (MDEQ, 2002).

The restoration targets have been adjusted for water hardness based on hardness values measured in Swansea Gulch under high flow (50 mg/L) and low flow (75 mg/L) conditions. Due to the hardness dependence of the numeric criteria, the actual targets for these three metals will vary based on the water hardness at any given time. Appendix A provides additional information regarding calculation of numeric water quality criteria-based restoration targets and determination of compliance with the restoration targets.

In addition to the water quality restoration targets, another target for both Poorman Creek and Swansea Gulch is that metals concentrations in sediments cannot impede beneficial uses, with focus on aquatic life support. This target applies to all metals, either individually or in combination, which may occur at potentially toxic concentrations in stream sediments. Lead and copper are of special concern given the relatively high levels in sediment chemistry as identified in Table 3-3. Assessment of stream sediment concentrations and beneficial use support conditions will be consistent with the stream sediment screening approach discussed in Section 1.2.3.

As an additional measure of water quality restoration, a target for macroinvertebrate and periphyton communities also applies to Swansea Gulch and Poorman Creek. Metals concentration must not impede attainment of full support conditions when compared to a known reference condition using standard MDEQ protocols (reference Appendix A).

All Swansea Gulch targets apply at Site PCSW-6 (reference Figure 3-1). Poorman Creek targets apply upstream of Swansea Gulch (at or near PCSW-4), upstream of S. Fk Poorman Creek and downstream of Swansea Gulch (at or near PCSW-7), near the mouth of the S. Fk. Poorman

Creek (at or near PCSW-5), and at least one location downstream of the confluence of the S. Fk. Poorman Creek (such as PSCW-3 and/or 4127PO01). Additional target locations may apply further upstream on the S. Fk. Poorman Creek, near the mouth of McClellan Gulch, or other tributary or mainstem locations where subsequent water quality monitoring indicates impairment conditions. The addition of new target locations and/or subsequent water quality analyses efforts can be used to justify modifications to these target compliance locations.

It is important to note that the above targets represent minimum requirements for protecting beneficial uses identified within Montana's Surface Water Quality Standards, and are based on interpretations of available data presented within this plan. Other regulatory programs with water quality protection responsibilities may impose additional requirements to ensure full compliance with all appropriate local, State and Federal laws.

3.4.2 Poorman Creek Drainage Metals TMDL

Since available water quality data show that numeric water quality criteria are exceeded in Swansea Gulch but not in other portions of Poorman Creek drainage, the initial phase of TMDL development includes TMDL calculations for Swansea Gulch only. TMDLs will be further developed for the main stem of Poorman Creek as necessary following a more detailed source assessment associated with the elevated sediment metals concentrations and metals-impaired biological communities as detailed in the Phase I report (Confluence et al., 2002) and by Bahls (2001). As discussed in Section 3.3.1, it is possible that most or all significant impairment conditions in the main stem are the result of metals loading sources within Swansea Gulch. If so, implementation of the Swansea Gulch TMDL would address metals-related impairment in the main stem as well.

Similar to the TMDL development approach utilized for Sandbar Creek drainage (Section 2.4.2), metals TMDLs for Swansea Gulch are designed to address the full range of streamflow rates and potential restoration targets applicable to Swansea Gulch. Metals TMDLs for Swansea Gulch (as well as any other point in Poorman Creek drainage) are defined by Equation 3-1. Equation 3-1 allows calculation of metals TMDLs for any streamflow conditions and any water quality restoration targets which may occur throughout Poorman Creek drainage.

Equation 3-1: *Total Maximum Daily Load (lb/day) = (X ug/l)(Y cfs)(0.0054)*
where:
X = the applicable water quality numeric standard (target) in ug/l with hardness adjustments where applicable;
Y = streamflow in cubic feet per second;
(0.0054) = conversion factor

Table 3-6 provides high flow and low flow TMDLs for copper, cadmium and lead. The TMDLs were calculated from Equation 3-1, using the single high flow (0.79 cfs) and low flow (0.16 cfs) measurements recorded near the mouth of Swansea Gulch (site PCSW-6). Restoration targets were taken from Table 3-5. The calculated TMDLs represent the maximum load (lbs/day) of each particular metal that the creek can accommodate without exceeding applicable water quality standards based on the specified streamflow conditions and restoration targets.

Table 3-5 Metals Water Quality Restoration Targets for Swansea Gulch and Poorman Creek Drainage.

Stream	Pollutant	Target(s)	Limiting Beneficial Use
Swansea Gulch	Copper[1]	5.2 ug/l (high flow) 7.3 ug/l (low flow)	Aquatic Life (chronic) Aquatic Life (chronic)
Swansea Gulch	Cadmium[1]	0.16 ug/l (high flow) 0.2 ug/l (low flow)	Aquatic Life (chronic) Aquatic Life (chronic)
Swansea Gulch	Lead[1]	1.3 ug/l (high flow) 2.2 ug/l (low flow)	Aquatic Life (chronic) Aquatic Life (chronic)
Swansea Gulch and Poorman Creek	Metals	Continued compliance with WQB-7 numeric water quality standards No metals concentrations in sediments that may impede beneficial uses Macroinvertebrate and periphyton communities must show no impairment from metals.	Aquatic Life Aquatic Life Aquatic Life

Notes: 1. Targets are estimated based on predicted hardness values of 50 mg/L during high flow and 75 mg/L at low flow after completion of restoration activities; actual targets will be determined by hardness at time of sampling as defined in Appendix A

Table 3-6 Poorman Creek TMDL and Load Reduction Requirements for Metals at Specified High Flow and Low Flow Conditions - Site PCSW-6 in Swansea Gulch.

Pollutant	Target (ug/l)	Calculated Low Flow and High Flow TMDL (lb/day)	% Total Load Reduction Needed to Meet TMDLs and Targets
Copper	7.3 (low flow) 5.2 (high flow)	0.006 0.02	0% (low flow); 53% (high flow)
Cadmium	0.2 (low flow) 0.16 (high flow)	0.0002 0.0007	0% (low flow); 65% (high flow)
Lead	2.2 (low flow) 1.3 (high flow)	0.002 0.0055	0% (low flow); 84% (high flow)

Mean low flow of 0.16 cfs based on single low flow measurement obtained near mouth of Swansea Gulch (site PCSW-6) on 10/7/02

Mean high flow of 0.79 cfs based on single high flow measurement obtained near mouth of Swansea Gulch (site 4128PO01) on 6/13/96

Sample locations shown on Figure 3-1.

No load reductions required under the example low flow conditions since no exceedences occurred in the 10/7/02 sample.

Some additional notes concerning the TMDLs in Table 3-6 and the target conditions they are intended to satisfy include:

- Meeting the copper, lead, and cadmium TMDLs is expected to satisfy the target associated with sediment toxicity for two reasons. First, restoration activities designed to address existing sources of these metals (primarily historic mining-related) should also eliminate the source(s) of elevated metals concentrations in sediments. Secondly, as metals loads in Swansea Gulch are reduced to TMDL levels, fine-grained metals-bearing sediments likely will flush through the system during high flow periods via typical sediment transport processes. As source areas are reclaimed, the displaced sediments (in Swansea Gulch and Poorman Creek downstream of Swansea Gulch) will be replaced with fewer and cleaner sediments. Because other metals, which may occur at elevated concentrations in sediments likely are derived from the same mining-related sources as copper, lead, and cadmium, meeting these TMDLs is expected to address possible sediment toxicity issues related to other metals in Swansea Gulch. This is expected to also result in significant reductions in sediment metals concentrations in Poorman Creek. The response of sediment chemistry to implementation of the metals TMDLs will be documented through post-implementation sediment testing (Section 6.3).

- Meeting all of the metals TMDLs is expected to eliminate any metals-related impediments to satisfying the target associated with macroinvertebrate and periphyton communities being at full support conditions in comparison to a reference stream condition.

Table 3-6 also includes the percent metals load reductions required to meet the calculated TMDLs. The required load reductions are based on the example TMDLs and the actual metals loads calculated from the corresponding June 1996 and October 2002 streamflow and water quality data. Based on the June 1996 conditions, required load reductions for copper, cadmium and lead equate to 53%, 65% and 84%, respectively. Based on low flow conditions documented during October 2002, no associated load reductions are required during low flow since metals concentrations were all below applicable water quality standards. Load reductions required to meet the metals TMDLs in the future will be dependent on actual in-stream metals loads and the corresponding TMDLs calculated from Equation 3-1.

The calculated metals TMDLs and required load reductions apply to the specific streamflow conditions and restoration targets used for their calculation only. Due to the limited streamflow data available, the degree to these conditions represent typical high flow and low flow conditions in the drainage is unknown. It is likely that TMDLs calculated in the future for specific streamflow conditions may vary significantly from these examples. Ultimately, the TMDL is equivalent to the load of a particular pollutant that Swansea Gulch (and Poorman Creek) can support without exceeding B-1 water quality standards as determined from Equation 3-1. Appendix A includes information on the calculation of TMDLs. Available water quality data used in calculations of TMDLs and load reduction requirements are in Appendix C.

3.4.3 Load Allocations

As discussed in Appendix A, the metals TMDLs can be expressed as the sum of the load allocations plus the sum of the waste load allocations plus a margin of safety. Because there are no point source discharges subject to the Montana Pollutant Discharge Elimination System permit program in Poorman Creek drainage, waste load allocations are not required. The margin of safety is addressed implicitly through the use of chronic aquatic standards for calculation of TMDLs under all conditions, incorporation of biologic and sediment criteria for water quality restoration targets, calculation of TMDLs for various flow conditions and water hardness conditions, and adoption of an environmental monitoring program designed to further quantify metals loading sources, assist in restoration planning, and assess TMDL compliance (Section 6.3). In addition, the numeric water quality criteria used in establishing restoration targets contain built-in margins of safety for protection of beneficial uses. Since there are no waste load allocations or explicit margins of safety required, the metals TMDLs for Swansea Gulch are the sum of the nonpoint source load allocations in the drainage.

Based on current knowledge of metals loading sources in Swansea Gulch drainage, nonpoint sources of metals impairment potentially in need of load allocations are divided into two categories:

- Category 1: Potential sources currently identified in the Swansea drainage including the Swansea Mine/Mill Complex and the Silver Belle mine (Figure 3-1); plus potential natural background loading within Swansea Gulch.

- Category 2: Other potential nonpoint sources in Swansea Gulch not yet identified, including possible mining-related disturbances, roads, or other human-caused disturbances.

Table 3-7 includes preliminary load allocations for these nonpoint source categories for Swansea Gulch. At this time, the entire Swansea Gulch load allocations for copper, cadmium and lead (which are equivalent to the corresponding TMDLs) are allocated to the Category 1 sources. This assumes that no additional metals loading sources (either human-caused or natural) are present in the drainage, and that the Swansea Gulch restoration targets can be met by addressing Category 1 sources only.

3.4.4 Future TMDL Development and Load Allocations

Section 6.3 describes a water monitoring program designed to further evaluate impairment conditions and potential metals loading sources within Poorman Creek drainage. If future monitoring identifies additional sources within Swansea Gulch, then these sources would likely fall under Category 2 as defined above and load allocations in Table 3-7 will need to be adjusted accordingly. Identification of additional sources may require that load allocations for currently identified sources (Category 1 sources), be decreased to ensure that water quality standards can be achieved. If the monitoring program identifies sources of metals-related impairment in other portions of Poorman Creek drainage, TMDLs and load allocations will be developed for the affected stream segments to ensure all portions of Poorman Creek drainage ultimately comply with water quality standards.

Attainment of TMDL goals through restoration of mining-related disturbances and other human-caused sources assumes that metals loading impacts can be confirmed for these sources and that restoration goals can be achieved via reasonable land, soil and water conservation practices. Ultimately, the load allocation will be driven by attainment of the B-1 classification-based water quality targets listed in Table 3-5.

Table 3-7 Preliminary Metals Load Allocations for Swansea Gulch Drainage.

METAL	TMDL lb/Day	Identified Sources[1] (Category 1)	Possible Other Sources[2] (Category 2)	Margin of Safety
Copper	High Flow-0.02 Low Flow- 0.006	0.02 0.006	No allocation at this time	Implicit MOS applied through conservatism in TMDL calculation process and required post-implementation monitoring to assess performance of restoration actions.
Cadmium	High Flow-0.0007 Low Flow-0.0002	0.0007 0.0002	No allocation at this time	
Lead	High Flow-0.0055 Low Flow-0.002	0.0055 0.002	No allocation at this time	

1- Includes mining disturbances as described in Section 3.3 and shown on Figure 3-1 and natural background loading.
2- Includes additional human-caused nonpoint sources within Swansea Gulch, which may be identified through future monitoring. If a load allocation is required for additional sources in the future, then the load allocation for Identified Non-Point Sources must be reduced accordingly.

SECTION 4.0
RESTORATION PLAN FOR BEARTRAP/MIKE HORSE CREEKS

Beartrap Creek flows westward from the continental divide and joins Anaconda Creek to form the Blackfoot River. The lower portion of the creek (approximately 4,500 feet) is heavily impacted by historic mining activities and is included in the current UBMC mine reclamation program (Appendix B). As discussed in Section 1, temporary water quality standards have been adopted for certain waters within the UBMC including the listed segment of Beartrap Creek (Appendix B). Beartrap Creek is also listed as impaired due to metals from the confluence with Anaconda Creek upstream to Mike Horse Creek.

Mike Horse Creek joins Beartrap Creek immediately downstream of the Mike Horse Tailings Impoundment (Figure 4-1). Mike Horse Creek drainage is the site of the most extensive historic mining at the UBMC, resulting in significant impacts to the lower 3,000 feet of Mike Horse Creek. Although not listed as impaired on the most recent 2002 303(d) list, metals TMDLs have been developed for Mike Horse Creek due to its significance as a source of metals loading to the listed portion of Beartrap Creek, and due to the overwhelming evidence documenting its impaired condition. As with Beartrap Creek, temporary water quality standards have been adopted for the impacted section of Mike Horse Creek.

4.1 Available Water Quality Data

Significant water quantity data has been generated for Beartrap Creek and Mike Horse Creek by Asarco in conjunction with the UBMC mine reclamation program. Current water quality data from the listed portion of Beartrap Creek drainage includes sampling results from three established monitoring sites: BRSW-23 in the upper portion of the listed stream segment, BRSW-39 in the middle portion, and BRSW-38 in the lower portion (Figure 4-1). Established monitoring sites in the metals-impaired section of Mike Horse Creek include: BRSW-4 in the upper portion of Mike Horse Creek; BRSW-22 located downstream of Mike Horse Creek Road; and BRSW-35 located at the mouth of Mike Horse Creek (Figure 4-1). Samples have been collected at all of these sites under a variety of streamflow conditions, including high flow, low flow, and early spring runoff. Although water quality data from these sites dates back to at least the early 1990s, only the 1996 and later data is considered representative of current conditions. Metals concentrations in the metals-impaired portions of Beartrap and Mike Horse Creeks have decreased considerable since the early 1990s due to completion of mine reclamation activities in these drainages. Therefore, only the 1996 and later data have been used for evaluating impairment conditions and developing metals TMDLs. Also, results from sporadic water sampling at a limited number of additional sites in Beartrap and Mike Horse Creeks were not utilized in this restoration plan since water quality data from the sites listed above are adequate for TMDL development. A summary of the current water quality data utilized for TMDL development is shown in Table 4-1. The full water quality dataset is included in Appendix C.

Table 4-1 Summary of Current Water Quality Data from Beartrap and Mike Horse Creek Drainages.

Stream Segment*	Site Designations	Number of Samples**	Sampled By	Analyses
Upper Beartrap	BRSW-23	17	Hydrometrics	Metals, SO4, hard., flow, pH/SC
Middle Beartrap	BRSW-39	7	Hydrometrics	Metals, SO4, hard., flow, pH/SC
Lower Beartrap	BRSW-38	11	Hydrometrics	Metals, SO4, hard., flow, pH/SC
Upper Mike Horse	BRSW-4	14	Hydrometrics	Metals, SO4, hard., flow, pH/SC
Middle Mike Horse	BRSW-22	16	Hydrometrics	Metals, SO4, hard., flow, pH/SC
Lower Mike Horse	BRSW-35	9	Hydrometrics	Metals, SO4, hard., flow, pH/SC

*Descriptions refer to the metals-impacted portions of Beartrap Creek and Mike Horse Creek (Figure 4-1).
**Samples collected from 1996-2001. Earlier data from these sites, as well as sporadic data from a limited number of other sites, is not included.
SO4 – sulfate; hard. – hardness as CaCO3; SC – specific conductance

4.2 Beartrap Creek and Mike Horse Creek Impairment Conditions

Tables 4-2 and 4-3 provide a comparison of current water quality data (1996 through 2001) from the metals-impacted segments of Beartrap and Mike Horse Creeks to applicable water quality standards for various flow conditions. The water quality data are compared to the State of Montana human heath, chronic aquatic life, and acute aquatic like numeric criteria for B-1 classification waters. Although temporary water quality standards were adopted and are currently in effect in both of these stream segments, B-1 classification standards are utilized for evaluating impairment conditions since these standards are scheduled to go back into effect once the temporary standards expire.

Water quality data (metals concentrations) are compared to the applicable water quality standards for three distinct streamflow conditions: high flow, low flow and early spring runoff. Water quality data collected in May and June (spring runoff period) are used to represent high flow conditions, while data collected between September and March represent low flow conditions. The early spring runoff period corresponds to the initial stages of spring runoff and onset of the rising limb of the streamflow hydrograph. This period is characterized by water quality data collected in April. The April data generally exhibits the greatest concentrations and loads for most metals as discussed under Section 4.3.

The summary of impairment conditions for Beartrap Creek is based on water quality data collected at two established monitoring locations; BRSW-23 and BRSW-38 (Figure 4-1). Seasonal water quality data has been collected for a number of years from each of these sites as part of the UBMC mine reclamation program, providing an extensive database for comparison to water quality standards. These sites also provide good spatial coverage of the listed stream segment. The Mike Horse Creek impairment summary is based on water quality data from sites BRSW-4 and BRSW-22 (Figure 4-1). As shown in Tables 4-2 and 4-3, available data for the period 1996-2001 show that water quality conditions within Mike Horse and Beartrap Creeks routinely exceed applicable B-1 classification standards for cadmium, copper, iron, lead, manganese, and zinc.

Table 4-2 Beartrap Creek Drainage Seasonal Metals Impairment Summary for Monitoring Sites BRSW-23 and BRSW-38.

Metal	Season	N	Concentration Range μg/L	EXCEEDENCE SUMMARY	Water Quality Standards References
Aluminum	High Flow	11	<50 to <50	• Consistently less than 87 μg/L chronic aquatic life criteria	17.30.623(2)(h)(i)-WQB-7 17.30.637(1)(d)
	Low Flow	12	<50 to <50	• Consistently less than 87 μg/L chronic aquatic life criteria	
	Early Runoff	4	<50 to 98	• 1 exceedence of 87 μg/L chronic aquatic life criteria	
Cadmium*	High Flow	10	4 to 10	• Consistently exceeds 0.3 μg/L chronic aquatic life criteria	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d)
	Low Flow	11	2 to 37	• Consistently exceeds 0.4 μg/L chronic aquatic life criteria	
	Early Runoff	5	45 to 67	• Consistently exceeds 0.6 μg/L chronic aquatic life criteria	
Copper*	High Flow	10	43 to 79	• Consistently exceeds 9.3 μg/L chronic aquatic life criteria	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d)
	Low Flow	12	4 to 42	• Occasionally exceeds 13.2 μg/L chronic aquatic life criteria	
	Early Runoff	5	180 to 778	• Consistently exceeds 23.9 μg/L chronic aquatic life criteria	
Iron	High Flow	10	<50 to 270	• Consistently less than 300 μg/L domestic use	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d) 17.30.637(1)(a) 17.30.601
	Low Flow	10	45 to 8434	• 2 exceedence of both the 300 μg/L domestic use and 1000 ug/l chronic aquatic life criteria	
	Early Runoff	5	120 to 9500	• 3 exceedences of 300 μg/L domestic use • 2 exceedences of 1000 μg/L chronic aquatic life criteria • Forms objectionable sludge deposits during spring runoff	
Lead*	High Flow	12	16 to 68	• Consistently exceeds 3.2 μg/L chronic aquatic life criteria	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d)
	Low Flow	11	<3 to 21	• Usually exceeds 5.3 μg/L chronic aquatic life criteria	
	Early Runoff	5	76 to 330	• Consistently exceeds 12.9 μg/L chronic aquatic life criteria	
Manganese	High Flow	12	200 to 1700	• Consistently exceeds 50 μg/L domestic use	17.30.623(2)(h)(i) - WQB-7 17.30.601
	Low Flow	14	360 to 9900	• Consistently exceeds 50 μg/L domestic use	
	Early Runoff	5	3120 to 7300	• Consistently exceeds 50 μg/L domestic use	
Zinc*	High Flow	10	660 to 3000	• Consistently exceeds 120 μg/L chronic aquatic life criteria	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d)
	Low Flow	11	560 to 17000	• Consistently exceeds 169 μg/L chronic aquatic life criteria	
	Early Runoff	5	8000 to 14000	• Consistently exceeds 304 μg/L chronic aquatic life criteria	

Includes high flow, low flow and early runoff water quality data from 1996 through 2001 period.
Evaluation of exceedences based on total recoverable fraction (except for aluminum which is based on dissolved fraction).
n- number of measurements
*-aquatic criteria based on actual hardness of water sample.

Table 4-3 Mike Horse Creek Drainage Seasonal Metals Impairment Summary for Monitoring Sites BRSW-4 and BRSW-22.

Metal	Season	N	Concentration Range µg/L	EXCEEDENCE SUMMARY	Water Quality Standards References
Aluminum	High Flow	14	<50 to 130	• 2 exceedences of 87 µg/L chronic aquatic life criteria	17.30.623(2)(h)(i)-WQB-7 17.30.637(1)(d)
	Low Flow	13	<50 to 87	• Consistently less than 87 µg/L chronic aquatic life criteria	
	Early Runoff	6	<50 to 7700	• 3 exceedences of 87 µg/L chronic aquatic life criteria • Forms objectionable sludge deposits during spring runoff	
Cadmium*	High Flow	14	12 to 62.7	• Consistently exceeds 0.27 µg/L chronic aquatic life criteria	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d)
	Low Flow	11	14 to 150	• Consistently exceeds 0.53 µg/L chronic aquatic life criteria	
	Early Runoff	4	110 to 186	• Consistently exceeds 0.61 µg/L chronic aquatic life criteria	
Copper*	High Flow	14	71 to 1780	• Consistently exceeds 9.3 µg/L chronic aquatic life criteria	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d)
	Low Flow	11	24 to 600	• Consistently exceeds 20.4 µg/L chronic aquatic life criteria	
	Early Runoff	4	240 to 4450	• Consistently exceeds 23.9 µg/L chronic aquatic life criteria • Forms objectionable sludge deposits during spring runoff	
Iron	High Flow	14	<20 to 940	• 4 exceedences of 300 µg/L domestic use	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d) 17.30.637(1)(a) 17.30.601
	Low Flow	11	<20 to 840	• 2 exceedences of 300 µg/L domestic use	
	Early Runoff	4	20 to 950	• 1 exceedences of 300 µg/L domestic use • Forms objectionable sludge deposits during spring runoff	
Lead*	High Flow	14	24 to 217	• Consistently exceeds 3.2 µg/L chronic aquatic life criteria	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d)
	Low Flow	11	12 to 140	• Consistently exceeds 10.2 µg/L chronic aquatic life criteria	
	Early Runoff	4	110 to 199	• Consistently exceeds 12.9 µg/L chronic aquatic life criteria	
Manganese	High Flow	14	340 to 6700	• Consistently exceeds 50 µg/L domestic use	17.30.623(2)(h)(i) - WQB-7 17.30.601
	Low Flow	11	97 to 40000	• Consistently exceeds 50 µg/L domestic use	
	Early Runoff	4	3100 to 7400	• Consistently exceeds 50 µg/L domestic use	
Zinc*	High Flow	14	1800 to 14000	• Consistently exceeds 120 µg/L chronic aquatic life criteria	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d)
	Low Flow	11	3100 to 67000	• Consistently exceeds 26.4 µg/L chronic aquatic life criteria	
	Early Runoff	4	14000 to 27600	• Consistently exceeds 304 µg/L chronic aquatic life criteria	

Includes high flow, low flow and early runoff water quality data from 1996 through 2001 period.
Evaluation of exceedences based on total recoverable fraction (except for aluminum which is based on dissolved fraction).
n- number of measurements
*-aquatic criteria based on actual hardness of water sample.

As previously stated and summarized in Tables 4-2 and 4-3, water quality exceedences for certain parameters in Beartrap Creek and Mike Horse Creek are more frequent under early runoff or high flow conditions as compared with low flow conditions. For example, the Beartrap Creek iron data show that, out of 26 measurements, 4 exceedences of the domestic use narrative standard were recorded, with 3 of the exceedences occurring under early spring runoff conditions. Similarly, for copper, 15 samples collected during early runoff and high flow conditions all exceeded chronic aquatic life standards, while only 1 sample out of 12 exceeded the chronic standard under low flow conditions. For other parameters, however (i.e., cadmium, manganese and zinc), concentrations consistently exceed one or more applicable water quality standards during all flow conditions.

In addition to impairments caused by elevated metals concentrations in the water column, metal precipitates form objectionable sludges in Mike Horse and Beartrap Creeks. Based on appearance, these sludges are believed to consist primarily of iron-hydroxide precipitates with copper and aluminum precipitates occurring in upper Mike Horse Creek as well. The precipitates may impact aquatic life in these stream segments by impacting the stream substrate.

Streambed Sediments

Asarco collected one streambed sediment sample from the listed portion of Beartrap Creek in 1993 as part of their Phase I investigation of the UBMC (PTI, 1993). The sample was a composite of four subsamples collected at a 0-2" depth interval across a stream channel transect. According to the Phase I investigation report, the sediment sample location (designated MH-18) was approximately 1000 feet upstream of the confluence of Beartrap and Anaconda Creeks, corresponding to the stream reach between sites BRSW-23 and BRSW-39 (Figure 4-1). The sample was analyzed for total metals concentrations, with the analytical results shown in Table 4-4.

Table 4-4 also includes analytical results from a sediment sample collected in 1989 from Mike Horse Creek (Moore, 1990). This sample was collected in the vicinity of surface water monitoring site BRSW-22. The Mike Horse Creek sample was filtered in the field to exclude sediments greater than 63 microns in size.

Table 4-4 Mike Horse and Beartrap Creek Stream Sediment Metals Concentrations.

	Concentration (mg/Kg)	
Parameter	**Beartrap Creek**	**Mike Horse Creek**
Aluminum	5305	10800
Silver	43	NA
Arsenic	400	180
Cadmium	46	310
Cobalt	36	Na
Chromium	9.4	Na
Copper	1736	11570
Iron	117500	341000

Table 4-4 Mike Horse and Beartrap Creek Stream Sediment Metals Concentrations.

	Concentration (mg/Kg)	
Parameter	**Beartrap Creek**	**Mike Horse Creek**
Manganese	6495	8.296
Nickel	29	83
Lead	8618	3095
Zinc	8668	149448

Beartrap Creek sediment sample collected at site MH-18 as part of Phase I Investigation (PTI, 1993)
Mike Horse Creek sediment sample collected at site T-215.0 (near BRSW-22) by J.N. Moore, 1990.
NA- Not Analyzed

Results from the Beartrap Creek and Mike Horse Creek sediment samples indicate the stream sediments contain elevated concentrations of several metals, including arsenic, cadmium, copper, iron, manganese, lead, and zinc. These values are significantly greater than published guidance values denoting potentially harmful conditions for aquatic biota from streambed sediments (Jones et al., 1997; Long and Morgan, 1990). Based on these results, metals concentrations in stream sediments likely contribute to impairment of beneficial uses in Beartrap and Mike Horse Creeks. It is possible that current sediment metals concentrations are less than those shown in Table 4-4 due to recent mine reclamation activities, although more recent sediment data is not available.

4.3 Source Characterization

4.3.1 Beartrap Creek and Mike Horse Creek Metals Source Inventory

Sources of metals loading to the listed portion of Beartrap Creek drainage have been well documented through the UBMC site characterization program and reclamation activities (Hydrometrics, 2000, 2001a, 2002). Identified sources of metals loading to the listed stream segment include:

- Acidic surface seepage (and possibly subsurface seepage) water originating from the toe of the Mike Horse Tailings Dam;
- Surface water inflow from Mike Horse Creek;
- Dispersed mine waste located along the Beartrap Creek floodplain; and
- Mine waste dumps associated with a small mining prospect (the Flosse and Louise Mine) located along the Beartrap Creek drainage bottom.

The sources identified above (and shown on Figure 4-1) are believed to represent the predominant sources of metals loading to the listed segment of Beartrap Creek. Additional metals loading sources may exist however, including other mining-related sources, recharge of mineralized groundwater to the creek, and/or natural background metals loading.

Sources of metals loading to Mike Horse Creek identified through past site characterizations activities include:

- An area of acidic seepage in the upper Mike Horse area; and
- The lower Mike Horse Mine waste piles (Figure 4-1).

Significant metals loading to Mike Horse Creek has been documented from both of these source areas (Hydrometrics, 2000, 2001a, 2002). As with the Beartrap Creek, it is possible that other metals loading sources exist in Mike Horse Creek drainage beyond the documented sources listed above. For purposes of this water quality restoration plan, it is anticipated that all sources of metals loading in Mike Horse and Beartrap Creek drainages (including potential sources not currently identified) will be addressed through the ongoing UBMC mine reclamation program and temporary standards implementation plan as required by applicable water quality regulations (MCA 75-5-312 (3)(c)).

4.3.2 Metals Source Analysis

Detailed seasonal surface water and groundwater sampling performed in Beartrap Creek drainage in conjunction with the UBMC mine reclamation program provides insight into the impact to surface water quality from the various metals loading sources (Hydrometrics, 2001a, 2002). For instance, this sampling has shown that concentrations (and loads) of most metals are greatest during the early spring runoff (April) period. Total recoverable copper concentrations at site BRSW-23 in 2001 ranged from 350 μg/L in April, to 72 μg/L in May, 53 μg/L in June, and 4 μg/L in October (Table 4-5). Zinc concentrations varied from 12,000 μg/L to 1,200 μg/L to 990 μg/L to 740 μg/L during this same time period. Diurnal variations in copper concentrations have also been documented in Beartrap Creek during the April early runoff period. For example, copper concentrations ranged from 180 to 490 μg/L, respectively, in two samples collected from site BRSW-38 in the morning and afternoon of April 25, 2001 (Appendix B).

Table 4-5 Metals Loading Trends for Early Runoff, High Flow and Low Flow Conditions in Beartrap Creek.

	Flow cfs	Copper Conc. μg/L	Copper Load lb/Day	Zinc Conc. μg/L	Zinc Load lb/Day
4/25/01	0.74	350	1.4	12,000	48
5/22/01	4.2	72	1.6	1,200	27.2
6/26/01	3.6	53	1.03	990	19.2
10/4/01	0.23	4	.005	740	0.92

Metals concentrations and loads based on total recoverable fraction.
Water quality data from site BRSW-23 (see Figure 4-1)

The exceptionally high April metals concentrations in Beartrap Creek may result from flushing of metal salts from the dispersed floodplain tailings. Oxidation of metal-sulfide minerals (primarily pyrite) during the dry summer and fall, coupled with soil moisture evaporation, produces a coating of metal-sulfate salts on the ground surface. It is likely that these highly soluble metal-salts are flushed into the creek (and possibly to the shallow alluvial water table) during melting of the drainage-bottom snowpack. The UBMC Temporary Standards Implementation Plan identifies the dispersed floodplain tailings as a source of metals loading to Beartrap Creek. The implementation plan schedule includes reclamation of the floodplain tailings (Hydrometrics, 2000).

Seepage from the Mike Horse Tailings Impoundment has been monitored numerous times to quantify seepage water quality and associated metals loading rates. Based on May 2001 sampling results, metals loads in the tailings dam seepage totaled 0.04 lb/day for cadmium, 0.16 lb/day for copper, 0.58 lbs/day for iron, 0.25 lb/day for lead, 4.5 lbs/day for manganese, and 7.8 lb/day for zinc (Hydrometrics, 2002). The cumulative seepage loads equate to 25% of the cadmium load, 10% of the copper load, 35% of the iron load, 40% of the lead load, 32% of the manganese load, and 29% of the zinc load in Beartrap Creek as measured at site BRSW-23 at that time (Figure 4-1).

Metals loading from Mike Horse Creek to Beartrap Creek has been quantified through extensive synoptic surface water sampling and metals loading analyses in the Upper Blackfoot River drainage. Seasonal surface water sampling and streamflow monitoring near the mouth of Mike Horse Creek (monitoring site BRSW-35, Figure 4-1), and at downstream sites on Beartrap Creek, allow determination of the relative load contribution from Mike Horse Creek to Beartrap Creek. Figure 4-2 depicts the seasonal loading rates (in pounds per day) for cadmium, copper, lead and zinc at monitoring site BRSW-35 near the mouth of Mike Horse Creek, site BRSW-23 in Beartrap Creek below the confluence with Mike Horse Creek, and at site BRSW-38 near the mouth of Beartrap Creek (Figure 4-1). As shown in Figure 4-2, metals loading from Mike Horse Creek typically accounts for a significant portion of the metals load present in the listed portion of Beartrap Creek. During May and June 2001, metal loads calculated for Mike Horse Creek site BRSW-35 accounted for an average of 73% of the downstream metal loads at Beartrap Creek site BRSW-23, and 61% of the load at Beartrap Creek site BRSW-38. For example, the May 2001 copper load at Mike Horse Creek site BRSW-35 (1.1 lb/day) accounted for 68% of the load measured at site Beartrap Creek site BRSW-23 (1.6 lb/day).

During the April 2001 monitoring event, metal loads in Mike Horse Creek actually exceeded those measured in Beartrap Creek. The copper load for April 2001 was 2.6 lb/day at BRSW-35 (Mike Horse Creek) and 1.4 lb/day at BRSW-23 (Beartrap Creek). This loading decrease suggests removal of metals from the water column to streambed sediments through precipitation and/or adsorption is likely occurring in Beartrap Creek (downstream decreases in streamflow, which could also cause the observed load decrease, were not observed at the time of the sampling). The phase transfer of metals from water to sediments is consistent with the elevated concentrations of metals observed in Beartrap Creek sediments (Table 4-4), and with visual observations of metal precipitate coatings on the streambed.

4.4 Restoration Targets, TMDLs and Load Allocations

Water quality restoration targets and TMDLs are established below based on applicable water quality standards and documented streamflow rates in Beartrap Creek and Mike Horse Creek. Target and TMDL calculation sites include monitoring site BRSW-23 in Beartrap Creek, and site BRSW-22 in Mike Horse Creek. Due to the large seasonal fluctuations in metals concentrations and loads, specific restoration targets and TMDLs are developed for high flow, low flow, and early spring runoff conditions, which typically occur in April.

4.4.1 Metals Restoration Targets

Water quality restoration targets for metals in Beartrap Creek and Mike Horse Creek are listed in Table 4-6. Restoration targets are established for the metals aluminum (Mike Horse Creek only), cadmium, copper, iron, lead, manganese and zinc since extensive testing has indicated that these metals exceed applicable water quality standards on at least a periodic basis. Due to the common primary source for the elevated metals concentrations in these two drainages (historic mining), it is assumed that restoration activities aimed at these metals will also address any other metals that may occur at elevated levels. Restoration targets for cadmium, copper, lead and zinc are based on the applicable numeric water quality standards associated with chronic aquatic life criteria with appropriate hardness modifications. Basing restoration targets on the chronic aquatic criteria will ensure that other numeric criteria (human health, acute aquatic life) are met since the chronic criteria are the most stringent (lowest concentration). The restoration targets for iron and manganese are based on the 300 μg/L and 50 μg/L guidance values for drinking water use support in WQB-7 (MDEQ, 2001b). Iron also has an upper limit target of 1000 ug/l based on the chronic criteria for aquatic life support.

Hardness values used in calculating the targets are based on actual measured values and include 100 mg/L (as $CaCO_3$) for high flow, 150 mg/L for low flow, and 250 mg/L during early runoff conditions in Beartrap Creek, and 100 mg/L during high flow, 250 mg/L during low flow, and 300 mg/L during early runoff conditions in Mike Horse Creek. Because it is unknown what the actual hardness values will be under restoration conditions, the target values listed in Table 4-6 for these metals represent estimated values at the various flow conditions. The actual targets will be based on actual in-stream hardness values as measured at the time of sampling. Appendix A of this document provides an example of the hardness adjustment equation for chronic aquatic life support standards.

Compliance for the water quality targets will be based on high and low flow water quality data, with no more than one measurement of the concentration for a particular metal exceeding the chronic criteria by more than 10%. This approach is consistent with MDEQ guidance for making beneficial use support determinations (MDEQ, 2002). In evaluating compliance with the iron and manganese drinking water use targets, consideration should be given to the level and frequency of exceedences, and whether or not the exceedences interfere with the uses specified in the surface water quality standards (ARM 16.30.623). Appendix A provides additional discussion for evaluating compliance with the iron and manganese targets.

In addition to the water chemistry-based targets, iron has an additional target in Beartrap Creek and Mike Horse Creek of no visible streambed deposits of iron precipitates resulting from human caused conditions. This same target is applied to copper and aluminum in Mike Horse Creek. Furthermore, metals concentrations in sediments cannot impede beneficial uses, with focus on aquatic life support. This target applies to all metals, either individually or in combination, which may occur at potentially toxic concentrations in stream sediments. Assessment of stream sediment concentrations and beneficial use support conditions will be consistent with the stream sediment screening approach discussed in Section 1.2.3.

Table 4-6 Water Quality Restoration Targets for Metals in Beartrap Creek and Mike Horse Creek.

Pollutant	Beartrap Creek Target(s)	Mike Horse Creek Target(s)	Limiting Beneficial Use
Aluminum	NA	87 ug/l (all flows) No visible stream bed deposits associated with controllable human sources (all flows)	Aquatic Life (chronic) Aquatic life/Aesthetics
Cadmium[1]	0.37 ug/l (low flow) 0.27 ug/l (high flow) 0.53 ug/l (early runoff)	0.53 ug/l (low flow) 0.27 ug/l (high flow) 0.61 ug/l (early runoff)	Aquatic Life (chronic) Aquatic Life (chronic) Aquatic Life (chronic)
Copper[1]	13.2 ug/l (low flow) 9.3 ug/l (high flow) 20.4 ug/l (early runoff)	20.4 ug/l (low flow) 9.3 ug/l (high flow) 23.9 ug/l (early runoff) No visible stream bed deposits associated with controllable human sources (all flows)	Aquatic Life (chronic) Aquatic Life (chronic) Aquatic Life (chronic) Aquatic life/Aesthetics
Iron	300 ug/l 1000 ug/l (all flows) No visible stream bed deposits associated with controllable human sources (all flows)	300 ug/l 1000 ug/l (all flows) No visible stream bed deposits associated with controllable human sources (all flows)	Drinking water (domestic use) Aquatic life (chronic) Aquatic life/Aesthetics
Lead[1]	5.3 ug/l (low flow) 3.2 ug/l (high flow) 10.2 ug/l (early runoff)	10.2 ug/l (low flow) 3.2 ug/l (high flow) 12.9 ug/l (early runoff)	Aquatic Life (chronic) Aquatic Life (chronic) Aquatic Life (chronic)
Manganese	50 ug/L	50 ug/L	Drinking water (domestic use)
Zinc[1]	169 ug/l (low flow) 120 ug/l (high flow) 260.4 ug/l (early runoff)	260 ug/l (low flow) 120 ug/l (high flow) 304 ug/l (early runoff)	Aquatic Life (chronic) Aquatic Life (chronic) Aquatic Life (chronic)
Metals	No metal concentrations in sediment that may impede beneficial uses. Macroinvertebrate and periphyton communities must show no impairment from metals.	No metal concentrations in sediment that may impede beneficial uses. Macroinvertebrate and periphyton communities must show no impairment from metals.	Aquatic Life Aquatic Life

Notes: 1. Targets are estimated based on predicted hardness values of 100 mg/L during high flow, 150 mg/L at low flow, and 250 mg/L during early runoff (as $CaCO_3$) in Beartrap Creek and 100 mg/L during high flow, 250 mg/L during low flow, and 300 mg/L during early runoff in Mike Horse Creek after completion of restoration activities; actual targets will be determined by hardness at time of sampling as defined in Appendix A.

As an additional measure of overall beneficial use attainment, a restoration target for macroinvertebrate and periphyton communities also applies. Metals concentrations must not impede attainment of full support conditions when compared to a known reference condition using standard MDEQ protocols (reference Appendix A). The monitoring locations for compliance with the sediment chemistry and biota targets will be the same as discussed above for water chemistry sampling, although it should be noted that such sampling typically occurs once at each location during low flow conditions

It is important to note that the above targets represent minimum requirements for protecting beneficial uses identified within Montana's Surface Water Quality Standards, and are based on interpretations of available data presented within this plan. Other regulatory programs with water quality protection responsibilities may impose additional requirements to ensure full compliance with all appropriate local, State and Federal laws.

4.4.2 Beartrap Creek and Mike Horse Creek Metals TMDL

Similar to the TMDL development approach utilized for Sandbar and Poorman creek drainages, metals TMDLs for Beartrap Creek and Mike Horse Creek are designed to ensure compliance with water quality standards under any streamflow rates and potential restoration targets. Metals TMDLs are defined by Equation 4-1.

Equation 4-1: *Total Maximum Daily Load (lb/day) = (X* ug/l*)(Y cfs)(0.0054)*

where:
X = the applicable water quality numeric standard (target) in ug/l with hardness adjustments where applicable (see above discussion on targets);
Y = streamflow in cubic feet per second;
(0.0054) = conversion factor

Tables 4-7 and 4-8 include TMDLs for documented high flow, low flow, and early spring runoff conditions in Beartrap Creek and Mike Horse Creek, respectively. The calculated TMDLs are based on the restoration targets presented in Table 4-6, and the average measured streamflow rates from monitoring site BRSW-23 in Beartrap Creek, and site BRSW-22 in Mike Horse Creek for the specified flow condition. The TMDLs presented in Tables 4-7 and 4-8 apply to the specified conditions only, with actual TMDLs being dependent on the stream loading capacity (which in turn is determined by the flow rate and water hardness) at any given location and time. In this manner, the TMDLs defined by Equation 4-1 address seasonal variability in streamflow and water chemistry (hardness) in the metals impacted segments of Beartrap and Mike Horse Creeks.

Some additional notes concerning the Beartrap Creek and Mike Horse Creek TMDLs and the target conditions they are intended to satisfy include:

- For iron, the TMDL based on the 300 ug/l drinking water/domestic use support condition is expected to satisfy the additional target of no visible stream bed deposits associated with iron hydroxide precipitates from human causes. This is also true of aluminum and copper in Mike Horse Creek, whereby meeting the aluminum and copper TMDLs is expected to eliminate visible streambed deposits from these metals.

- Based on seasonal and other considerations associated with the iron and manganese drinking water/domestic use support criteria, a higher TMDL may be acceptable for both iron and manganese as long as other target criteria associated with visible stream deposits, sediment toxicity, biota support, and chronic aquatic life criteria are satisfied.

- Meeting the cadmium, copper, iron, lead, manganese and zinc TMDLs is expected to satisfy the restoration targets associated with sediment toxicity (Table 4-6) for two reasons. First, restoration activities designed to address existing sources of water quality impairment (acidic seepage, mine waste piles, floodplain tailings), should also eliminate the source(s) of elevated sediment concentrations. Secondly, as metal loads in Beartrap and Mike Horse Creeks are reduced to TMDL levels, the fine-grained metals-bearing sediments likely will flush through the system during high flow periods via typical sediment transport processes. As source areas are reclaimed through the ongoing UBMC reclamation program, the displaced sediments will be replaced with fewer metals-bearing sediments. Also, since other metals which may occur at elevated concentrations in sediments are likely derived from the same mining-related sources as cadmium, copper, iron, lead, manganese and zinc, meeting the TMDLs for these metals are expected to address sediment toxicity issues which may exist for other metals in Beartrap and Mike Horse Creeks. The response of sediment chemistry to implementation of the metals TMDLs will be documented through post-implementation sediment testing (Section 6.3).

- Meeting all of the metals TMDLs is expected to eliminate any metals-related impediments to satisfying the target associated with macroinvertebrate and periphyton communities being at full support conditions in comparison to reference conditions.

- Meeting the metals TMDLs should address diurnal variations in metals concentrations observed in Beartrap Creek drainage during early spring runoff since the suspected source of the diurnal variations (the floodplain tailings) will need to be addressed to meet the TMDLs.

Tables 4-7 and 4-8 also provide estimates of the percent total load reduction needed to meet the TMDLs and water quality restoration targets under the various flow conditions. These estimates are based on the seasonal streamflow rates and metals concentrations measured at monitoring site BRSW-23 in Beartrap Creek and BRSW-22 in Mike Horse Creek from 1996 through 2001 (Figure 4-1). For example, the required load reduction for cadmium in Beartrap Creek is greater than 95% during both high flow and low flow conditions, and greater than 98% during early runoff conditions in order to meet the TMDL and water quality restoration targets established at site BRSW-23. Note that no load reductions are required for copper under low flow conditions, and for iron under high and low flow conditions (Table 4-7). This is due to the fact that, although these metals have on occasion exceeded applicable water quality standards under these flow conditions (Table 4-2), the average of all measurements obtained for these flow conditions (and used in estimating the percent load reduction required), are less than the applicable water quality standards. Therefore, these metals are currently meeting the flow-specific TMDLs the majority of the time.

Table 4-7 Beartrap Creek TMDLs and Required Load Reductions for Metals at Specified High Flow, Low Flow, and Early Runoff Conditions at Monitoring Location BRSW-23.

Pollutant	Target (ug/l)	Mean Low Flow (0.30 cfs) TMDL[1] (lb/day)	Mean High Flow (7.51 cfs) TMDL[1] (lb/day)	Mean Early Runoff (1.27 cfs) TMDL[1] (lb/day)	% Total Load Reduction Needed to Meet TMDLs and Targets
Cadmium*	0.4 (low flow) 0.3 (high flow) 0.6 (early runoff)	0.0007	0.012	0.0041	95.4% (low flow) 95.5% (high flow) 98.3% (early runoff)
Copper*	13.2 (low flow) 9.3 (high flow) 23.9 (early runoff)	0.021	0.376	0.164	0% (low flow); 84.0% (high flow) 88.9% (early runoff)
Iron	300 (low flow) 300 (high flow) 300 (early runoff)	0.488	12.13	2.05	0% (low flow); 0% (high flow) 76.4% (early runoff)
Lead*	5.3 (low flow) 3.2 (high flow) 12.9 (early runoff)	0.009	0.129	0.089	35.8% (low flow); 87.7% (high flow) 89.2% (early runoff)
Manganese	50 ug/L (low flow) 50 ug/L (high flow) 50 ug/L (early runoff)	0.081	2.022	0.342	97.2% (low flow); 92.3% (high flow) 98.7% (early runoff)
Zinc*	169 ug/l (low flow) 120 ug/l (high flow) 304 (early runoff)	0.275	4.854	2.079	93.9% (low flow 91.9% (high flow) 97.0% (early runoff)

1 Mean high flow, low flow and early runoff values based on average of seasonal flow measurements from site BRSW-23 from 1996 through 2001.
Early runoff data from April.
*- TMDL based on water hardness of 100 mg/L for high flow, 150 mg/L for low flow, and 250 mg/L (as $CaCO_3$) for early runoff conditions, based on 1996-2001 sampling results.

Table 4-8 Mike Horse Creek TMDLs and Required Load Reductions for Metals at Specified High Flow, Low Flow, and Early Runoff Conditions at Monitoring Location BRSW-22.

Pollutant	Target (ug/l)	Mean Low Flow (0.052 cfs) TMDL[1] (lb/day)	Mean High Flow (1.29 cfs) TMDL[1] (lb/day)	Mean Early Runoff (0.35 cfs) TMDL[1] (lb/day)	% Total Load Reduction Needed to Meet TMDLs and Targets
Aluminum	87 (low flow) 87 (high flow) 87 (early runoff)	0.024	0.61	0.16	-43% (low flow) -45% (high flow) -36% (early runoff)
Cadmium*	0.4 (low flow) 0.3 (high flow) 0.6 (early runoff)	0.00015	0.0019	0.0012	99% (low flow) 99% (high flow) 99% (early runoff)
Copper*	13.2 (low flow) 9.3 (high flow) 23.9 (early runoff)	0.0057	0.065	0.045	68% (low flow); 97% (high flow) 98% (early runoff)
Iron	300 (low flow) 300 (high flow) 300 (early runoff)	0.084	2.09	0.57	-36% (low flow); -48% (high flow) 43% (early runoff)
Lead*	5.3 (low flow) 3.2 (high flow) 12.9 (early runoff)	0.003	0.022	0.024	76% (low flow); 94% (high flow) 90% (early runoff)
Manganese	50 ug/L (low flow) 50 ug/L (high flow) 50 ug/L (early runoff)	0.014	0.348	0.095	99% (low flow); 96% (high flow) 99% (early runoff)
Zinc*	169 ug/l (low flow) 120 ug/l (high flow) 304 (early runoff)	0.073	0.840	0.575	98% (low flow 97% (high flow) 98% (early runoff)

1 Mean high flow, low flow and early runoff values based on average of seasonal flow measurements from site BRSW-22 from 1996 through 2001.
Early runoff data from April.
*- TMDL based on water hardness of 100 mg/L for high flow, 250 mg/L for low flow, and 300 mg/L (as $CaCO_3$) for early runoff conditions, based on 1996-2001 sampling results.
Negative value for "% Total Load Reduction Needed" indicates standard is being met on average although periodic exceedences do occur.

The metals TMDLs and required load reductions presented in Tables 4-7 and 4-8 apply only to the specific streamflow rates and restoration targets used in their calculation. The degree to which these particular conditions represent typical high flow, low flow, and early runoff conditions in Beartrap and Mike Horse Creeks is unknown. It is likely that TMDLs calculated from future data may vary significantly from these examples. Ultimately, the TMDL is equivalent to the load of a particular pollutant that the creeks can support without exceeding B-1 water quality standards at a given flow as calculated from equation 4-1. General information on calculations of TMDLs is included in Appendix A. Available water quality data used in calculations of TMDLs and load reduction requirements are in Appendix C.

4.4.3 Beartrap Creek and Mike Horse Creek Load Allocations

In light of the ongoing mine reclamation activities at the Upper Blackfoot Mining Complex, and the fact that the portions of Beartrap and Mike Horse Creeks to which the TMDLs apply are subject to the UBMC reclamation requirements, a performance-based approach for allocation of metal loads has been adopted for Beartrap Creek and Mike Horse Creek. The performance-based approach recognizes the ongoing mine reclamation activities in the drainages, and the regulatory programs and cleanup commitments currently in place as part of the Temporary Water Quality Standards process. As stipulated in the Montana water quality regulations (MCA 75-5-312), before the Board of Environmental Review can grant temporary standards to a water body, the petitioner must submit an implementation plan designed to eliminate the water quality limiting factors to the extent considered achievable, and a schedule for implementing the plan that ensures that the water quality standards are met as soon as reasonably practicable, and in no event later than the time allowed by the board in the temporary standards. It is believed that all significant human-caused sources of metals loading to the metals-impaired segments of Beartrap and Mike Horse Creeks are identified in, and will be addressed by, the Temporary Standards Implementation Plan. The implementation plan requires post-reclamation water quality monitoring be conducted for the purpose of documenting water quality improvements in Beartrap Creek (as well as Mike Horse Creek) in response to mine reclamation activities. In the event that post-reclamation monitoring shows that B-1 classification standards (and thus the water quality restoration targets and TMDLs) are not being met, the causes and sources for continued water quality impairments must be identified and mitigated (except natural sources) to the extent considered achievable. Therefore, the Temporary Standards regulations include built-in contingencies to ensure that all human-caused sources of water quality impairment to the metals-impaired segments of Beartrap and Mike Horse Creeks are addressed.

The Temporary Standards Implementation Plan identifies the following known or suspected sources of metals loading to Beartrap and Mike Horse Creeks:

- Mike Horse Creek Drainage
  - Upper Mike Horse Seepage area
  - Lower Mike Horse mine waste
- Mike Horse Tailings Impoundment
- Beartrap Creek Floodplain Tailings
- Flosse and Louise Mine

Each of these source areas is described in detail in various reports (Hydrometrics, 1999, 2000, 2001a, 2002). Following is a brief discussion of each source, and restoration options and schedules included in the Temporary Standards Implementation Plan. The complete Implementation Plan is included in Appendix B.

Mike Horse Creek Drainage: Known sources of metals loading to Mike Horse Creek (and thus to the listed portion of Beartrap Creek) include; the Upper Mike Horse Creek Seepage Area, and the Lower Mike Horse Mine Waste Area (Figure 4-1). Possible restoration actions included in the Temporary Standards Implementation Plan for the Upper Mike Horse Seepage Area include (but are not limited to): removal of the previously reclaimed Upper Mike mine waste piles if shown to be a source of metals loading to the seepage water; construction of surface water and/or groundwater diversions around the area; or treatment of seepage water. Reclamation options listed in the Implementation Plan for the Lower Mike Horse Mine Waste include complete or partial mine waste removal and placement in an engineered repository, and in-place reclamation of mine waste through mine waste regrading, amendment, and/or covering.

Mike Horse Tailings Impoundment: As summarized above (Section 4.3) and described in detail in previous reports (Hydrometrics, 2002), surficial seepage from the Mike Horse Tailings Impoundment is a documented source of metals loading to Beartrap Creek. The Temporary Standards Implementation Plan addresses metals loading from the tailings impoundment and outlines possible actions for mitigation of this loading source. Possible actions include, but are not limited to: revegetating the dam face; sealing the inner dam face to reduce seepage; capture of seepage water at the dam toe for treatment; removal of seasonally exposed tailings along the tailings pond beach which are subject to oxidation and release of metals and acidity; manipulating pond water levels to either reduce seepage or flood exposed tailings; partial sealing of the pond bottom; and partial or complete removal of the impoundment. The implementation plan also addresses the geotechnical stability of the dam and recognizes the possible need for an emergency overflow spillway. A preliminary evaluation of the dam design and stability and spillway requirements has been completed (Hydrometrics, 2001b).

Beartrap Creek Floodplain Tailings: The dispersed floodplain tailings occur along the Beartrap Creek drainage bottom from the Mike Horse Tailings Dam to the mouth of Beartrap Creek (Figure 4-1). Year 2000 and 2001 implementation plan activities in Beartrap Creek drainage have focused on characterizing the lateral and vertical distribution of tailings, the tailings physical and chemical characteristics, and evaluating specific modes of metals loading from the tailings to the creek (Hydrometrics, 2002). Mitigation alternatives identified in the implementation plan for the dispersed floodplain tailings include, but are not limited to: complete or partial tailings removal and placement in an engineered repository; partial tailings removal with construction of settling basins/wetland structures along the drainage bottom for physical and chemical stabilization and/or water treatment; consolidation of tailings with local closure; in-place reclamation through soil amendment and revegetation.

Flosse and Louise Mine: The Flosse and Louise Mine is located along the impaired segment of the Beartrap Creek drainage bottom (Figure 4-1). Unlike other property holdings within the UBMC, the Flosse and Louise patented mine claims are not under Asarco ownership nor are they National Forest System lands. Mine features include a collapsed adit and an approximately

1,500 cubic yard waste rock dump. Asarco has conducted characterization activities at the Flosse and Louise Mine in the past two years including mine waste sampling, trenching and subsurface exploration, and surface water sampling in the vicinity of the mine. Reclamation alternatives are not specified in the implementation plan pending discussions and agreements with the landowner, but will likely include complete or partial mine waste removal and placement in an engineered repository, or in-place amendment and closure.

All identified sources of metals loading in Beartrap Creek and Mike Horse Creek as listed above are addressed and scheduled for reclamation in the Temporary Standards Implementation Plan (Appendix B). As such, completion of the implementation plan program is expected to result in attainment of the water quality restoration targets listed in Table 4-6 and the metals TMDLs. If future water quality monitoring as required by the implementation plan shows otherwise, additional site investigation and reclamation activities will be required under the implementation plan to address all human-caused sources of metals loading which may individually or collectively cause B-1 water quality standards for metals to be exceeded. The ultimate goal of the temporary water quality standards of attaining B-1 water quality standards, to the extent considered achievable, should ensure that the performance-based load allocation adopted for Beartrap and Mike Horse Creeks results in successful attainment of the metals TMDL goals and water quality restoration targets. This includes appropriate implementation monitoring and maintenance of restoration efforts to ensure success.

If the performance based allocation approach discussed above should undergo significant delays or otherwise run into significant implementation problems, then a source-specific category allocation approach will apply. Under this scenario, the load allocations for mining related sources as well as natural background sources will be set equal to the TMDL as defined by Equation 4-1 to be consistent with numeric B-1 water quality standards.

SECTION 5.0
RESTORATION PLAN FOR THE BLACKFOOT RIVER

The Blackfoot River flows through the Headwaters Planning Area from the confluence of Anaconda Creek and Beartrap Creek (the beginning of the Blackfoot River) to the confluence with Nevada Creek. Of this approximately 60 mile stretch of river, the upper 16.4 miles (from the headwaters to the confluence with Landers Fork) is listed as impaired for metals (Figure 5-1) on the most recent 2002 303(d) list. Relevant features of this listed stream segment include a large natural marsh system, which occupies much of the upper half of the drainage bottom, and the Upper Blackfoot Mining Complex (UBMC). The upper 1.2 miles of river (upstream of the confluence with Pass Creek) are included in the current UBMC mine reclamation program.

Sections 5.1 through 5.4 address TMDL development and restoration plan development for the section of the Blackfoot River above Landers Fork. The upper 1.2 miles of this river segment upstream of the confluence with Pass Creek is addressed separately within Sections 5.1 through 5.4. This is due to the significant differences in the physical and chemical characteristics upstream of Pass Creek as compared to the river segment from Pass Creek to Landers Fork, and the ongoing mine reclamation activities and Temporary Standards Implementation Plan requirements focused on the upper river segment.

Section 5.5 addresses metals TMDL development and restoration plan development for the section of the Blackfoot River from Landers Fork to Nevada Creek.

5.1 Available Water Quality Data for the Blackfoot River upstream of Landers Fork

Significant water quality data has been collected for the portion of the Blackfoot River from the Landers Fork upstream to the headwaters. A comprehensive review identified five general sources of water quality information including the UBMC database (data collected in conjunction with the UBMC mine reclamation program), the EPA-maintained STORET database, an USGS-maintained database, the MDEQ-maintained STOREASE database, and miscellaneous data collection studies/reports by various entities including the USGS, University of Montana, and private companies. Available water quality data from these sources was reviewed to determine the most appropriate data for use in evaluating impairment conditions in the Blackfoot River, and determine restoration targets and TMDLs.

The water quality data were screened for applicability and suitability for the intended uses according to the following criteria:

- Date of data collection;
- Sampling location; and
- Reported parameters.

The water quality data set selected for evaluation of impairment conditions consists of data from twelve established water sampling stations located on the Blackfoot River between the headwaters and the confluence with Landers Fork (Figure 5-1). This data set was selected based on the availability of recent sampling data (ranging from 1991 through 2001), the spatial coverage provided along the Blackfoot River and in relation to major tributaries, and the availability of the required data (total recoverable metals, dissolved aluminum, and water hardness) for comparison with water quality standards. The majority of data was collected either by Hydrometrics for the UBMC mine reclamation program, MDEQ for various project-related needs, or the USGS. In a number of cases, water quality data has been collected from the same (or similar) location by one or more entities resulting in multiple site designations for individual sampling sites (e.g., UBMC site BRSW-18 corresponds with MDEQ site CO3BKFTR02, Figure 5-1).

Water quality data for the selected sites is available for dates ranging from the late 1980s through the present. However, for the upstream segment of the Blackfoot River (above Pass Creek), only data collected after 1995 is considered representative. Due to mine reclamation activities conducted in the headwaters area in the early to mid 1990s, concentrations of many metals in the river upstream of Pass Creek have decreased. Therefore, only post-1995 data have been used to evaluate impairment conditions and develop metals TMDLs in the upstream segment of the Blackfoot River. Further downstream, effects of reclamation on water quality have been less pronounced, and the available dataset consists in some cases of only pre-1996 data. Therefore, the complete dataset has been used for impairment evaluation and TMDL development for the segment of the Blackfoot River between Pass Creek and Landers Fork.

The water quality data set used in quantifying impairment conditions in the Blackfoot River includes results for 130 samples collected from the Blackfoot River between the headwaters and the confluence with the Landers Fork. Samples were collected under a variety of streamflow conditions, including high flow, low flow, and early spring runoff. A summary of this data is shown in Table 5-1 and the full water quality dataset is included in Appendix C.

Table 5-1 Summary of Current Blackfoot River Water Quality Data. (Headwaters to Landers Fork)

Stream Segment*	Site Designations	Number of Samples**	Sampled By	Analyses
Headwaters	BRSW-29	14	Hydrometrics	Metals, SO4, hard., flow, pH/SC
Upstream of 1st Natural Marsh	BRSW-12 470226112224501	15 8	Hydrometrics USGS	Metals, SO4, hard., flow, pH/SC Metals, SO4, hard., flow, pH/SC
Downstream of 1st Natural Marsh	BRSW-31	8	Hydrometrics	Metals, SO4, hard., flow, pH/SC
Upstream of 2nd Natural Marsh	BRSW-16	25	Hydrometrics	Metals, SO4, hard., flow, pH/SC
Near Hwy 279 Crossing	BRSW-17 C03BKFTR01	10 1	Hydrometrics MDEQ	Metals, SO4, hard., flow, pH/SC Metals, SO4, hard., flow, pH/SC
Upstream of Hogum Creek	SP-SW-1.B SW-1.B 12334650	36 7 8	MDEQ Hydrometrics USGS	Metals, SO4, hard., flow, pH/SC Metals, SO4, hard., flow, pH/SC Metals, SO4, hard., flow, pH/SC
At Aspen Grove Campground	BRSW-18 C03BKFTR02	11 1	Hydrometrics MDEQ	Metals, SO4, hard., flow, pH/SC Metals, SO4, hard., flow, pH/SC

*See Figure 5-1 for sample locations.
**Samples collected 1996-2001 for sites BRSW-29, BRSW-12, 470226112224501.
hard. – hardness as CaCO3; SO4 – sulfate; SC – specific conductance

5.2 Impairment Conditions for the Blackfoot River Upstream of Landers Fork

Impairment conditions were evaluated for the two distinct segments of this part of the Blackfoot River: from the confluence of Anaconda and Beartrap Creeks downstream to Pass Creek, and from Pass Creek downstream to the confluence with Landers Fork (Figure 5-1).

5.2.1 Water Quality Data

Similar to Beartrap Creek (Section 4.0), water quality data for the Blackfoot River above Pass Creek show significant variability, with water quality data collected during early spring runoff exhibiting the greatest concentrations. Therefore, impairment conditions upstream of Pass Creek were quantified for three distinct streamflow conditions: high flow, low flow and early spring runoff. For the stream segment from Pass Creek downstream to Landers Fork, where distinct water quality trends during early runoff conditions are not significant, the evaluation of impairment conditions was restricted to high flow and low flow conditions only. Water quality data collected primarily in May and June (spring runoff period) were used to represent high flow water quality conditions, while data collected between August and March represent low flow conditions. For the upstream river segment, April sampling data was used to represent early spring runoff conditions.

Table 5-2 provides a comparison of current water quality data from the segment of the Blackfoot River upstream of Pass Creek to applicable water quality standards for three flow conditions. Sample sites included in this comparison are BRSW-29, BRSW-12, and 470226112224501 (Figure 5-1). Table 5-3 provides a comparison of current water quality data from the Blackfoot River between Pass Creek and Landers Fork to applicable water quality standards for high flow and low flow. Water quality data from all nine sites shown on Figure 5-1 downstream of Pass Creek were used in this comparison. The water quality data are compared to the Montana human health, chronic aquatic life, and acute aquatic life numeric criteria, and domestic use standards (for iron and manganese) for B-1 classification waters. Although temporary water quality standards were adopted and are currently in effect in the Blackfoot River upstream of Pass Creek, B-1 classification standards are utilized for evaluating impairment conditions since these standards are scheduled to take effect once again when the temporary standards expire in 2008.

The evaluation results for the Blackfoot River upstream of Pass Creek show that applicable B-1 standards are consistently exceeded for the metals cadmium, manganese, and zinc under high flow, low flow, and early runoff conditions (Table 5-2). For lead, copper, and iron water quality standards are exceeded under high flow and early runoff conditions only (Table 5-2). For the segment of Blackfoot River between Pass Creek and Landers Fork, B-1 classification standards are either consistently or occasionally exceeded for aluminum, cadmium, copper, iron, lead, manganese, and zinc, depending on the particular location (Table 5-3). Typically, concentrations of these metals are greatest and consistently exceed water quality standards in the upper portion of this stream segment near monitoring sites BRSW-31 and BRSW-16 (Figure 5-1) whereas metals concentrations exceed standards only occasionally in the middle stream reach from monitoring sites BRSW-17 to SP-SW-1.B. At monitoring site BRSW-18 above the confluence

Table 5-2 Seasonal Metals Impairment Summary for Blackfoot River Upstream of Pass Creek.

Metal	Season	n	Concentration Range (µg/L)	EXCEEDENCE SUMMARY	Water Quality Standards References
Cadmium	High Flow	12	1 to 11	• Consistently exceeds 0.2 µg/L chronic aquatic life criteria	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d)
	Low Flow	11	2 to 6	• Consistently exceeds 0.4 µg/L chronic aquatic life criteria	
	Early Runoff	4	6 to 16.6	• Consistently exceeds 0.3 µg/L chronic aquatic life criteria	
Copper	High Flow	12	5 to 170	• Usually exceeds 7.3 µg/L chronic aquatic life criteria	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d)
	Low Flow	11	4 to 10	• Consistently less than 13.2 µg/L chronic aquatic life criteria	
	Early Runoff	4	22 to 222	• Consistently exceeds 11.3 µg/L chronic aquatic life criteria	
Iron	High Flow	12	<30 to 800	• 1 exceedence of 300 µg/L domestic use	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d) 17.30.637(1)(a)
	Low Flow	11	39 to 82	• Consistently less than 300 µg/L domestic use	
	Early Runoff	4	260 to 1100	• 3 exceedences of 300 µg/L domestic use • 1 exceedence of 1000 µg/L chronic aquatic life criteria	
Lead	High Flow	12	4 to 13	• Consistently exceeds 2.2 µg/L chronic aquatic life criteria	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d)
	Low Flow	11	<3 to 3	• Consistently less than 5.3 µg/L chronic aquatic life criteria	
	Early Runoff	4	8 to 46	• Consistently exceeds 4.2 µg/L chronic aquatic life criteria	
Manganese	High Flow	12	62 to 1600	• Consistently exceeds 50 µg/L domestic use	17.30.623(2)(h)(i) - WQB-7
	Low Flow	11	100 to 770	• Consistently exceeds 50 µg/L domestic use	
	Early Runoff	4	420 to 1300	• Consistently exceeds 50 µg/L domestic use	
Zinc	High Flow	12	260 to 3600	• Consistently exceeds 94 µg/L chronic aquatic life criteria	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d)
	Low Flow	11	570 to 2400	• Consistently exceeds 169 µg/L chronic aquatic life criteria	
	Early Runoff	4	1500 to 3460	• Consistently exceeds 145 µg/L chronic aquatic life criteria	

Evaluation applies to Blackfoot River from confluence of Anaconda and Beartrap Creeks to confluence with Pass Creek (Figure 5-1).
Includes high flow, low flow and early runoff water quality data from 1996 through 2001.
Evaluation of exceedences based on total recoverable fraction (except for aluminum which is based on dissolved fraction).
n- number of measurements
*-aquatic criteria based on actual hardness of water sample.

Table 5-3 Blackfoot River Seasonal Metals Impairment Summary for Downstream River Segment Between Pass Creek and Landers Fork.

Metal	Season	N	Concentration Range (µg/L)	Segment Reach*	EXCEEDENCE SUMMARY	Water Quality Standards References
Aluminum	High Flow	31	<50 to 260	UPSTREAM MIDDLE DOWNSTREAM	• 2 exceedences of 87 µg/L chronic aquatic life criteria • 2 exceedences of 87 µg/L chronic aquatic life criteria • Consistently lower than 87 µg/L chronic aquatic life criteria	17.30.623(2)(h)(i)-WQB-7 17.30.637(1)(d)
	Low Flow	37	<50 to 300	UPSTREAM MIDDLE DOWNSTREAM	• Consistently lower than 87 µg/L chronic aquatic life criteria • Consistently lower than 87 µg/L chronic aquatic life criteria • Consistently lower than 87 µg/L chronic aquatic life criteria	
Cadmium	High Flow	29	<0.1 to 2.4	UPSTREAM MIDDLE DOWNSTREAM	• Consistently exceeds 0.2 µg/L chronic aquatic life criteria • 2 exceedences of 0.3 µg/L chronic aquatic life criteria • Consistently lower than 0.3 µg/L chronic aquatic life criteria	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d)
	Low Flow	46	<0.1 to 2	UPSTREAM MIDDLE DOWNSTREAM	• Consistently exceeds 0.3 µg/L chronic aquatic life criteria • 1 exceedence of 0.3 µg/L chronic aquatic life criteria • Consistently lower than 0.3 µg/L chronic aquatic life criteria	
Copper	High Flow	29	<1 to 18	UPSTREAM MIDDLE DOWNSTREAM	• Consistently exceeds 7.3 µg/L chronic aquatic life criteria • 1 exceedence of 8.5 µg/L chronic aquatic life criteria • Consistently lower than 8.5 µg/L chronic aquatic life criteria	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d)
	Low Flow	46	<1 to 19	UPSTREAM MIDDLE DOWNSTREAM	• Occasionally exceeds 11.3 µg/L chronic aquatic life criteria • Consistently lower than 10.1 µg/L chronic aquatic life criteria • Consistently lower than 10.1 µg/L chronic aquatic life criteria	
Iron	High Flow	29	80 to 1680	UPSTREAM MIDDLE DOWNSTREAM	• Occasionally exceeds 300 µg/L domestic use • 1 exceedences of 300 µg/L domestic use; 1 exceedence of 1000 µg/L chronic aquatic life criteria • 1 exceedence of 300 µg/L domestic use	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d) 17.30.637(1)(a)

Table 5-3 Blackfoot River Seasonal Metals Impairment Summary for Downstream River Segment Between Pass Creek and Landers Fork.

Metal	Season	N	Concentration Range (µg/L)	Segment Reach*	EXCEEDENCE SUMMARY	Water Quality Standards References
	Low Flow	46	<30 to 880	UPSTREAM MIDDLE DOWNSTREAM	• Consistently exceeds 300 µg/L domestic use at BRSW-31; and occasionally exceeds this value at BRSW-16 • 1 exceedence of 300 µg/L domestic use • Consistently lower than 300 µg/L domestic use	
Lead	High Flow	29	<2 to <10	UPSTREAM MIDDLE DOWNSTREAM	• Occasionally exceeds 2.2 µg/L chronic aquatic life criteria • 1 exceedence of 2.8 µg/L chronic aquatic life criteria • Consistently lower than 2.8 µg/L chronic aquatic life criteria	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d)
	Low Flow	46	<2 to <10	UPSTREAM MIDDLE DOWNSTREAM	• 1 exceedence of 4.2 µg/L chronic aquatic life criteria • Consistently lower than 3.6 µg/L chronic aquatic life criteria • Consistently lower than 3.6 µg/L chronic aquatic life criteria	
Manganese	High Flow	26	8 to 220	UPSTREAM MIDDLE DOWNSTREAM	• Consistently exceeds 50 µg/L domestic use • 2 exceedences of 50 µg/L domestic use • Consistently lower than 50 µg/L domestic use	17.30.623(2)(h)(i) - WQB-7
	Low Flow	36	<5 to 340	UPSTREAM MIDDLE DOWNSTREAM	• Consistently exceeds 50 µg/L domestic use • 2 exceedences of 50 µg/L domestic use • Consistently lower than 50 µg/L domestic use	
Zinc	High Flow	29	<10 to 760	UPSTREAM MIDDLE DOWNSTREAM	• Consistently exceeds 94 µg/L chronic aquatic life criteria • 4 exceedences of 110 µg/L chronic aquatic life criteria • Consistently less than 110 µg/L chronic aquatic life criteria	17.30.623(2)(h)(i) - WQB-7 17.30.637(1)(d)
	Low Flow	46	<10 to 880	UPSTREAM MIDDLE DOWNSTREAM	• Consistently exceeds 145 µg/L chronic aquatic life criteria • 2 exceedences of 130 µg/L chronic aquatic life criteria • Consistently less than 110 µg/L chronic aquatic life criteria	

Evaluation applies to Blackfoot River from confluence with Pass Creek to confluence with Landers Fork (Figure 5-1).
Includes high flow and low water quality data from 1991 through 2001; n- number of measurements.
Evaluation of exceedences based on total recoverable fraction (except for aluminum which is based on dissolved fraction); aquatic criteria based on actual hardness of water sample.
*UPSTREAM = sites BRSW-31, BERSW-16; MIDDLE = sites BRSW-17, C03BKFTR01, SP-SW-1.B; DOWNSTREAM = sites BRSW-18, C03BKFTR02

with the Landers Fork, only one potential exceedence of water quality standards (an iron concentration of 400 µg/L on 4/26/99) was recorded in 12 samples collected between 1991 and 2001 (Appendix C). Table 5-4 shows the percentage of total measurements exceeding applicable water quality standards under various flow conditions in the upstream and downstream segments of the Blackfoot River headwaters.

Table 5-4 Percentage of Water Quality Measurements Exceeding Applicable Standards on a Seasonal Basis.

	Blackfoot River Upstream of Pass Creek			Blackfoot River Between Pass Creek and Landers Fork	
Parameter	High Flow	Low Flow	Early Runoff	High Flow	Low Flow
Cd	100%	100%	100%	52%	28%
Cu	92%	0%	100%	31%	11%
Fe	0%	0%	75%	24%	15%
Pb	100%	0%	100%	17%	4%
Mn	100%	100%	100%	35%	39%
Zn	100%	100%	100%	52%	33%

Applicable water quality standards include human health/domestic use, aquatic acute and aquatic chronic criteria. Domestic use standard refers to guidance level included in WQB-7 for iron and manganese in surface water per ARM 17.30.601.

5.2.2 Streambed Sediment Metals Concentrations

Two stream sediment samples were collected from the Blackfoot River upstream of Pass Creek as part of the UBMC mine reclamation program (PTI, 1993). The samples were collected from the 0 to 2-inch depth interval but the sediment size fraction sampled is not specified in the report. The sampling locations (designated MH-19 and MH-20) are immediately downstream of the confluence of Beartrap and Anaconda Creeks (corresponding approximately to surface water sampling site BRSW-29), and about 1000 feet further downstream, respectively. The samples were analyzed for total metals concentrations, with the analytical results shown in Table 5-5.

Several investigations have documented stream sediment metals concentrations in the Blackfoot River between Pass Creek and Landers Fork (Moore, 1990; Menges, 1997, Nagorski et al., 2000). Results from two of the more recent samples (1998) are included in Table 5-5. The location above Hogum Creek represents the lower portion of this stream segment, and the location above Meadow Creek represents the upper portion of this stream segment in the vicinity of the Upper Marsh (Figure 5-1).

Results from these sediment samples indicate the channel sediments contain elevated concentrations of a number of metals, including arsenic, cadmium, copper, iron, manganese, lead, and zinc. These values significantly exceed typical guidance values presented in the literature for assessing toxicity concerns for aquatic biota from streambed sediments (Jones et al., 1997; Long and Morgan, 1990), particularly at the three upstream locations. The lowest sampling location (above Hogum Creek) shows a significant decrease in overall metals concentrations of concern, with zinc being the metal that appears to be elevated above probable background conditions more than any other metal. Based on this data, it is concluded that streambed sediment metals concentrations are likely contributing to impairment of the Blackfoot

River from the headwaters downstream to the confluence with Landers Fork, particularly in the upstream portions.

Table 5-5 Blackfoot River Stream Sediment Metals Concentrations.

Parameter	Upstream of Pass Creek[1]		Downstream of Pass Creek[2]	
	Site MH-19 Mg/Kg	**Site MH-20 Mg/Kg**	**BFR above Meadow Ck Mg/Kg**	**BFR above Hogum Ck Mg/Kg**
Aluminum	9050	10638	18856	6307
Silver	13	4.8	Na	Na
Arsenic	181	67	84	17
Cadmium	22	11	32	3
Cobalt	26	15	Na	Na
Chromium	12	12	9	10
Copper	552	344	1414	81
Iron	67750	33525	66863	21557
Manganese	3030	2122	4610	1270
Nickel	24	17	Na	Na
Lead	1879	1238	1263	43
Zinc	4113	2540	5723	959

1 Sampling results from PTI, 1993.
2 Sampling results from Nagorski et al., 2000.

5.2.3 Impairment Determination for the Blackfoot River

The water quality and sediment chemistry data summarized above, along with the biological data presented in the Phase I report (Confluence et al., 2002), and summarized in Section 1.3.1, justify the metals impairment determination and TMDL development for the Blackfoot River upstream of Landers Fork.

5.3 Source Characterization for the Blackfoot River Upstream of Landers Fork

5.3.1 Metals Source Inventory

Sources of metals loading to the Blackfoot River upstream of Landers Fork are primarily related to historic mining activities. The majority of mining activity within the drainage occurred at the UBMC, although numerous other mines, most of them small in size and production history, are located in the portion of the drainage downstream of the UBMC (Figure 5-1). Other possible sources of metals loading to the river include roads and natural background sources. Documented sources of metals loading are described below. As in previous discussions, the source assessment includes separate discussions on the Blackfoot River upstream of Pass Creek and downstream of Pass Creek to Landers Fork.

5.3.1.1 Sources Upstream of Pass Creek

Known sources of metals loading to the segment of river upstream of Pass Creek in upstream to downstream order include: surface water inflow from Beartrap Creek; discharge of treated mine drainage from the constructed wetlands-based water treatment system operated by Asarco and regulated under the Montana Pollutant Discharge Elimination System (MPDES) program; surface water inflow from Stevens Gulch; an area of concentrated mine tailings on the Blackfoot River floodplain near the confluence with Shave Gulch; dispersed tailings located along the floodplain, and surface water inflow from Paymaster Creek (Figure 5-1 and 5-2).

5.3.1.2 Sources Downstream of Pass Creek

Metals loading sources to the Blackfoot River are not as well documented downstream of Pass Creek as are upstream sources. However, the available water quality data does identify a number of potential metals loading sources, and certain metals loading source areas where metals loads increase but specific sources cannot be identified. In addition to the loading from sources upstream of Pass Creek, identified metals loading sources or source areas to the Blackfoot River in this downstream segment include, but may not be limited to: the upper and lower marsh complex (Figure 5-1) where loads of certain metals in the river increase; and loads associated with surface water inflow from tributary drainages (e.g. Hogum Creek, Hardscrabble Creek, Alice Creek) (Figure 5-1).

5.3.2 Metals Source Analysis

5.3.2.1 Source Upstream of Pass Creek

Metals loading sources within the UBMC have been well characterized through synoptic surface water sampling and streamflow monitoring completed under Asarco’s mine reclamation program (Hydrometrics, 2000a, 2001, 2002). Figure 5-3 depicts downstream seasonal loading trends (April, May, June, and October 2001) for the metals cadmium, copper, iron, lead, manganese and zinc from monitoring site BRSW-29, located at the confluence of Anaconda and Beartrap Creeks, to monitoring site BRSW-12, located near the UBMC Implementation Plan boundaries (Figure 5-2). Data for monitoring site BRSW-32, located between BRSW-29 and BRSW-12 downstream of a concentrated tailings deposit near the confluence with Shave Gulch, is also included on Figure 5-3 to provide additional detail on loading trends in the river relative to potential sources.

Historical data has shown that metal loads at site BRSW-29, the furthest upstream site on the Blackfoot River, are derived almost exclusively from Beartrap Creek, with no significant contribution from Anaconda Creek (Hydrometrics, 2002; see also Figure 4-2 and Figure 5-3). In 2001, for example, calculated cadmium loads at the furthest downstream Beartrap Creek site (BRSW-38) were 0.27 lb/day in April, 0.19 lb/day in May, 0.20 lb/day in June, and 0.006 lb/day in October. At site BRSW-29, cadmium loads were 0.20 lb/day in April, 0.24 lb/day in May, 0.20 lb/day in June, and 0.01 lb/day in October.

The combined contributions of metals loading sources on the Blackfoot River downstream of site BRSW-29 to site BRSW-12 for the year 2001 are evident in Figure 5-3. As noted previously, these sources include discharge of treated mine drainage from the constructed wetlands-based water treatment system; surface water inflow from Stevens Gulch; concentrated mine tailings along the Blackfoot River floodplain near the confluence with Shave Gulch; and dispersed tailings located along the floodplain. Paymaster Creek enters the Blackfoot River through the marsh system downstream of BRSW-12. Therefore, metals loading from this source is not depicted on Figure 5-3.

Figure 5-3 shows that seasonal metal loads in the river increase from BRSW-29 to BRSW-12 during high flow periods (May and June) with nearly all of the increase occurring between BRSW-29 and BRSW-32. During low flow (October), loads increase from BRSW-29 to BRSW-32, then decrease further downstream due primarily to a decrease in flow between BRSW-32 and BRSW-12. During the early runoff period (April), the metals load at site BRSW-29 is typically greater than or equal to the load at downstream site BRSW-12 (Figure 5-3), suggesting that during the early runoff period, the metals load contribution from Beartrap Creek drainage dominates the total load in the portion of the Blackfoot River upstream of Pass Creek. The downstream decrease in the load of certain metals observed during April (copper, iron, manganese, lead) presumably is due to precipitation of metals from the water column to the streambed.

Metal loading from the known specific sources in this portion of the Blackfoot River is summarized below.

- Constructed Wetlands Discharge – Loading from the wetlands discharge was calculated for May and October 2001, and compared with the instream loads for May and October 2001 at monitoring site BRSW-34, located on the Blackfoot River immediately downstream of the discharge (Figure 5-2). Wetland discharge metal loads were 3.5 lb/day iron, 22 lb/day manganese, and 53 lb/day zinc in May, and 0.013 lb/day cadmium, 0.03 lb/day copper, 1.3 lb/day manganese, and 9.0 lb/day zinc in October (loads were not calculated for metals reported as below detection limits in the wetland discharge). These loads correlate to the following percentages of instream metal loads: 0.7% iron, 0.3% manganese, and 0.5% zinc in May, and 15.2% cadmium, 15.2% copper, 36.5% manganese, and 100% zinc in October (Hydrometrics, 2002). Based on this information, the treatment system discharge represents a significant source of metals loading to the Blackfoot River and will require further reductions, particularly for low flow periods.

- Stevens Gulch – Surface water from Stevens Gulch contains elevated concentrations of some metals, and thus represents a potential loading source to the Blackfoot River. Metal loads at lower Stevens Gulch site BRSW-8 were calculated for May and October 2001, and compared with the instream loads for May and October 2001 at monitoring site BRSW-9, located on the Blackfoot River immediately downstream of the confluence of Stevens Gulch with the river. Stevens Gulch loads at BRSW-8 were 0.002 lb/day cadmium, 0.16 lb/day copper, 0.19 lb/day iron, 0.45 lb/day manganese, 0.01 lb/day lead, and 0.33 lb/day zinc in May, and 0.00004 lb/day cadmium, 0.0006 lb/day copper, 0.00007 lb/day iron, 0.002 lb/day manganese, 0.00001 lb/day lead, and 0.001 lb/day zinc in October. These loads accounted for the following percentage of instream metals loads during May and October, respectively: cadmium, 0.6% and 0.03%; copper, 10% and 3 %; iron, 6% and 0.06 %, manganese, 2.4% and 0.2%; lead, 1.5% and 0.2%; and zinc, 0.6% and 0.02%.

- Concentrated Tailings/Dispersed Tailings/Remaining Sources – Additional known sources of metal loading to the Blackfoot River upstream of Pass Creek include an area of concentrated tailings near the confluence with Shave Gulch (Figure 5-2); dispersed tailings located along the Blackfoot River floodplain; and possible additional sources currently unidentified such as additional mining sources or recharge from mineralized groundwater. Water quality data collected along the Blackfoot River has shown consistent loading increases through this area. For example, metal load increases measured in May 2001 from site BRSW-9 to site BRSW-12, where the river traverses the area of concentrated and dispersed tailings, were 0.2 lb/day for cadmium, 0.8 lb/day for copper, 3.6 lb/day for iron, 0.2 lb/day for lead, 10 lb/day for manganese, and 46 lb/day for zinc. Consistent metal load increases were also observed in this reach during June 2001, and during October 2001 for all metals except manganese and zinc. These load increases can be attributed to the concentrated or dispersed tailings as well as any remaining sources not yet identified.

- Paymaster Creek – Paymaster Creek enters the Blackfoot River opposite Pass Creek and downstream of monitoring site BRSW-12 (Figure 5-2). Water quality data confirms that the surface waters in the drainage contain elevated concentrations of some metals, including aluminum, copper, iron and manganese (Hydrometrics, 2000). Asarco and ARCO reclaimed the historic Paymaster Mine, part of the UBMC, in 1996, although only portions of the Paymaster Voluntary Cleanup Plan were approved by MDEQ since other issues associated with this source such as groundwater and its impacts on Paymaster Creek remain unresolved.

  Since Paymaster Creek enters the Blackfoot River as dispersed flow through the marsh complex, direct measurement of metals loading to the Blackfoot River is not possible. However, water quality data collected from lower Paymaster Creek (monitoring site BRSW-13) show that during May 1999 the creek carried 0.7 lb/day copper, 71 lb/day iron, 0.1 lb/day lead, 1.1 lb/day manganese, and 0.5 lb/day zinc to the Blackfoot River marsh system; during October 1999, load contributions were 0.03 lb/day copper, 1.3 lb/day iron, 0.0007 lb/day lead, 0.08 lb/day manganese, and 0.02 lb/day zinc (cadmium concentrations were below detection limits). Historical data for Paymaster Creek has also shown that water quality exceedences in the creek are present both upstream and downstream of historic mining activity. For example, in October 1998, the iron concentration at BRSW-13 (downstream of the Paymaster Mine) was 4900 µg/L, while at BRSW-21 (upstream of the mine) the concentration was 4800 µg/L. Similarly, the manganese concentration was 340 µg/L downstream and 290 µg/L upstream. Investigations of the Paymaster Mine area have suggested that, in addition to possible remaining impacts from past mining activities, metals concentrations may be naturally elevated in portions of the drainage (Furniss, 1998).

5.3.2.2 Source Analysis Downstream of the Pass Creek

Figure 5-4 depicts downstream seasonal loading trends for cadmium, copper, iron, lead, manganese, and zinc from the downstream end of the UBMC Implementation Plan boundary (monitoring site BRSW-12) to immediately upstream of the confluence with the Landers Fork (monitoring site BRSW-18, Figure 5-1). Loading trends are shown for recent representative low flow (October 1998) and high flow (April 1999) events.

The dominant sources of metals loading to the Blackfoot River downstream of Pass Creek are the UBMC sources upstream of Pass Creek. Therefore, UBMC reclamation responsibilities may extend downstream of Pass Creek under the Montana Comprehensive Environmental Cleanup and Responsibility Act (CECRA), which is further discussed in Section 6.2.1. As shown in Figure 5-4, the April 1999 metal loads exiting the UBMC (site BRSW-12) are greater than downstream loads for all metals except iron. Based on data from site BRSW-12 collected from 1996 through 2001, the average Blackfoot River metal load exiting the UBMC area under high flow conditions was 0.6 lb/day cadmium, 4.1 lb/day copper, 22 lb/day iron, 41 lb/day manganese, 2 lb/day lead, and 132 lb/day zinc. Over the same period, the average load under low flow conditions was 0.04 lb/day cadmium, 0.06 lb/day copper, 0.4 lb/day iron, 2.7 lb/day manganese, 0.02 lb/day lead, and 11 lb/day zinc. Metals loading from the UBMC is being addressed under the temporary standards Implementation Plan currently in effect for the section of the Blackfoot River upstream of Pass Creek (see Section 4.4 and 5.4). Completion of activities outlined in the Implementation Plan is intended to result in compliance with B-1 water quality standards at the downstream margin of the UBMC as defined by the Implementation Plan (Hydrometrics, 2000).

Immediately downstream of the UBMC Implementation Plan boundary, metal loading trends vary on a seasonal basis. With the exception of iron, metal loads consistently decreased through the upper marsh system (between sites BRSW-12 and BRSW-31) in April 1999 indicating metals were being removed from the water column through chemical precipitation and/or adsorption processes. Conversely, loads of several metals, including copper, iron and manganese, increased through the marsh in October 1998 (Figure 5-4). Comparison of data collected at sites BRSW-12 and BRSW-31 from 1998 through 2001 shows the following metals loading trends through the marsh system:

- Iron loads increase through the marsh during both high and low flow conditions. At high flow, the average increase is 216% or 18.2 lb/day, and during low flow, the average increase is 2743%, or 9.2 lb/day.
- Copper and manganese loads increase through the marsh under low flow conditions, but decrease under high flow conditions. Average increases during low flow for these parameters are 0.2 lb/day or 371% for copper, and 3.3 lb/day or 433% for manganese.
- Zinc, lead and cadmium loads typically decrease or remain unchanged through the marsh under both high and low flow conditions.

Loading trends through the marsh may be related to a number of mechanisms, including the presence of historically deposited mine tailings within the marsh, tributary inflows, recharge from mineralized groundwater, and removal of metals from the water column through chemical precipitation and/or adsorption. It is also possible that seasonally precipitated/ adsorbed metals may be released back to the water column during other times of the year, thus acting as a seasonal loading source. Such mechanisms could explain the seasonal loading trends noted for copper through the marsh. If so, future improvements in Blackfoot River water quality, anticipated in response to the UBMC mine reclamation program, should reduce and may eliminate certain seasonal metals load increases currently attributed to the upper marsh.

Metal loads vary significantly downstream of the upper marsh complex to the confluence with Landers Fork (Figure 5-4). Of particular interest are the significant load increases for copper, iron and manganese recorded between sites BRSW-17 and BRSW-18. During April 1999, loads across this reach increased by 4.2 lb/day for copper, 480 lb/day for iron, and 16 lb/day for manganese. Low flow sampling in October 1998 showed load increases of 0.3 lb/day for copper and 3.6 lb/day for iron. Possible sources for these load increases include tributary inflows, possible metals-bearing sediments within the lower marsh complex located between these two sites, and/or recharge from mineralized groundwater. Major tributaries within this stream reach include Willow Creek, Alice Creek, Hardscrabble Creek, and Hogum Creek (Figure 5-1). Available water quality data indicate that some of these tributaries contain detectable concentrations of metals, with concentrations of some metals periodically exceeding the numeric water quality criteria. Section 6.3 outlines a monitoring program designed to better delineate the source(s) of metal load increases to this portion of the Blackfoot River. It is important to note, however, that despite the significant increases in loads of certain metals noted in Figure 5-4 at BRSW-18, metals concentrations at this site meet applicable water quality standards. This means that efforts to address these metal load increases may not be critical to restoration plan development for the Blackfoot River, although such efforts could be critical to ensure full support of beneficial uses in one or more of the tributaries along this river segment.

5.4 Restoration Targets, TMDLs and Load Allocations for the Blackfoot River Upstream of Landers Fork

Water quality restoration targets and TMDLs are established below based on applicable water quality standards and documented streamflow rates in the Blackfoot River. Due to the significant differences in physical and chemical characteristics of the Blackfoot River upstream and downstream of Pass Creek, water quality restoration targets and metals TMDLs are developed separately for these two river segments. The two river segments are also addressed separately in defining load allocations due to the applicability of UBMC Temporary Standards Implementation Plan to the segment of river upstream of Pass Creek only, and the differing levels of relevant information available from the two stream segments.

5.4.1 Metals Restoration Targets

Water quality restoration targets for metals in the Blackfoot River upstream of Pass Creek and downstream of Pass Creek are listed in Table 5-6. For the stream segment above Pass Creek, restoration targets are presented based on water hardness data from monitoring site BRSW-12. For the stream segment between Pass Creek and Landers Fork, restoration targets are presented for two sites, BRSW-31 in the upper portion of this stream segment, and SP-SW-1.B in the lower portion (Figure 5-1), due to varying water chemistry and hardness conditions through this segment. For both stream segments, restoration targets are established for the metals cadmium, copper, iron, lead, manganese and zinc since extensive testing has indicated that these metals exceed applicable water quality standards on a regular basis. Due to the anticipated common sources of elevated metals concentrations in the drainage (historic mining), it is assumed that restoration activities focusing on these metals will also address any other metals that may exceed applicable water quality standards.

Restoration targets are established for three distinct streamflow conditions for the stream segment above Pass Creek (monitoring location BRSW-12). These include high flow (near peak), low flow (at or near baseflow conditions), and early runoff conditions (rising limb of the hydrograph). Similar to conditions within Beartrap Creek drainage (Section 4), metals concentrations in this portion of the river generally are greatest during early runoff (generally in April) conditions (see water quality data, Appendix C). For the stream segment between Pass Creek and Landers Fork (monitoring locations BRSW-31 and SP-SW-1.B), restoration targets are developed for high (near peak) and low flow (at or near baseflow) conditions only since early spring runoff water quality does not differ significantly from that of other flow periods.

The restoration targets for cadmium, copper, lead and zinc are based on the applicable numeric water quality standards associated with chronic aquatic life criteria, with appropriate hardness modifications Basing restoration targets on the chronic aquatic criteria will ensure that other numeric criteria (human health, acute aquatic life) are met since the chronic criteria are the most stringent (lowest concentration). The restoration targets for iron and manganese are based on the 300 μg/L and 50 μg/L guidance values for drinking water use support in WQB-7 (MDEQ, 2001b). Iron also has an upper limit target of 1000 ug/l based on the chronic criteria for aquatic life support.

Hardness values used in calculating the targets are based on actual measured values as specified in Table 5-6. Because it is unknown what the actual hardness value will be under restoration conditions, the target values listed in Table 5-6 for these metals represent estimated values at the various flow conditions. The actual targets will be based on in-stream hardness values as measured at the time of sampling. Appendix A provides an example of the hardness adjustment equation for chronic aquatic life support standards.

Compliance with the water quality targets will require that the concentration of each individual metal not exceed the applicable water quality standards in more than 10% of the water samples. This approach is consistent with MDEQ guidance for making beneficial use support determinations (MDEQ, 2002). In evaluating compliance with the iron and manganese drinking water use targets, consideration should be given to the level and frequency of exceedences, and whether or not the exceedences interfere with the uses specified in the surface water quality standards (ARM 16.30.623). Appendix A provides additional discussion for evaluating compliance with the iron and manganese targets.

In addition to the water chemistry-based targets, iron has an additional target of no visible streambed deposits of iron precipitates resulting from human caused conditions. Another target is that metals concentrations in sediments cannot impede beneficial uses, with focus on aquatic life support. This target applies to all metals, either individually or in combination, which may occur at potentially toxic concentrations in stream sediments. A number of metals are of concern, especially further upstream, given the relatively high levels in sediment chemistry as identified in Table 5-5. Assessment of stream sediment concentrations and beneficial use support conditions will be consistent with the stream sediment screening approach discussed in Section 1.2.3.

Consistent with the Sandbar Creek, Poorman Creek, and Beartrap Creek restoration targets, an additional restoration target for macroinvertebrate and periphyton communities also applies. Metals concentrations must not impede attainment of full support conditions for these communities when compared to a known reference condition using standard MDEQ protocols (reference Appendix A). The monitoring locations for compliance with the sediment chemistry and biota targets will be the same as discussed above for water chemistry sampling, although it should be noted that such sampling typically occurs once at each location during low flow conditions.

It is important to note that the above targets represent minimum requirements for protecting beneficial uses identified within Montana's Surface Water Quality Standards, and are based on interpretations of available data presented within this plan. Other regulatory programs with water quality protection responsibilities may impose additional requirements to ensure full compliance with all appropriate local, State and Federal laws.

5.4.2 Blackfoot River Metals TMDL

Similar to the metals TMDLs developed for other Planning Area water bodies, the Blackfoot River metals TMDLs are based on a loading equation designed to ensure compliance with water quality standards under any streamflow rates and potential restoration targets. Equation 5-1 defines the metals TMDLs for the Blackfoot River.

Equation 5-1: *Total Maximum Daily Load (lb/day) = (X ug/l)(Y cfs)(0.0054)*
where:
X = the applicable water quality numeric standard (target) in ug/l with hardness adjustments where applicable (see above discussion on targets);
Y = streamflow in cubic feet per second;
(0.0054) = conversion factor

Tables 5-7 and 5-8 provide metals TMDLs calculated for specific high flow, low flow, and early runoff conditions in the Blackfoot River above Pass Creek, and high flow and low flow conditions below Pass Creek, respectively. Upstream of Pass Creek, the TMDLs were developed for site BRSW-12. Downstream of Pass Creek, TMDLs were developed for two locations; BRSW-31 at the downstream end of the upper marsh, and site SP-SW-1.B near the confluence with Landers Fork (Figure 5-1). The TMDLs were calculated using Equation 5-1, and the seasonal water quality restoration targets presented in Table 5-6 and corresponding streamflow rates measured at each site. For streamflow rates, the average of all available flow measurements from a particular site for the specified season were used. For example, the low flow TMDL for site BRSW-12 is based on the average of seven streamflow measurements (1.4 cfs) taken in October at BRSW-12. The streamflow rates used in calculating the seasonal TMDLs are specified in Tables 5-7 and 5-8.

Table 5-6 Water Quality Restoration Targets for Metals in the Blackfoot River Upstream and Downstream of Pass Creek.

Pollutant	Restoration Targets Upstream of Pass Creek	Restoration Targets From Pass Creek to Landers Fork		Limiting Beneficial Use
	Site BRSW-12	**Site BRSW-31**	**Site SP-SW-1.B**	
Cadmium	0.4 ug/l (low flow) 0.2 ug/l (high flow) 0.3 ug/l (early runoff)	0.3 ug/l (low flow) 0.2 ug/l (high flow)	0.3 ug/l (low flow) 0.3 ug/l (high flow)	Aquatic Life (chronic) Aquatic Life (chronic) Aquatic Life (chronic)
Copper[1]	13.2 ug/l (low flow) 7.3 ug/l (high flow) 11.3 ug/l (early runoff)	11.3 ug/l (low flow) 7.3 ug/l (high flow)	10.1 ug/l (low flow) 8.5 ug/l (high flow)	Aquatic Life (chronic) Aquatic Life (chronic) Aquatic Life (chronic)
Iron	300 ug/l 1000 ug/l (all flows) No visible stream bed deposits associated with controllable human sources	300 ug/l 1000 ug/l (all flows) No visible stream bed deposits associated w/ controllable human sources	300 ug/l 1000 ug/l (all flows)	Drinking water (domestic use) Aquatic life (chronic) Aquatic life
Lead	5.3 ug/l (low flow) 2.2 ug/l (high flow) 4.2 ug/l (early runoff)	4.2 ug/l (low flow) 2.2 ug/l (high flow)	3.6 ug/l (low flow) 2.8 ug/l (high flow)	Aquatic Life (chronic) Aquatic Life (chronic) Aquatic Life (chronic)
Manganese	50 ug/L	50 ug/L	50 ug/L	Drinking water (domestic use)
Zinc	169 ug/l (low flow) 94 ug/l (high flow) 145 ug/l (early runoff)	145 ug/l (low flow) 94 ug/l (high flow)	130 ug/l (low flow) 110 ug/l (high flow)	Aquatic Life (chronic) Aquatic Life (chronic) Aquatic Life (chronic)
Metals	No metals concentrations in sediments that may impede beneficial uses. Macroinvertebrate and periphyton communities must show no impairment from metals.			Aquatic Life Aquatic Life

Notes: 1. Targets are estimated based on predicted hardness values of 75 mg/L during high flow, 150 mg/L at low flow, and 125 mg/L (as $CaCO_3$) at BRSW-12, 75 mg/L at low flow and 125 mg/L ay high flow at BRSW-31, and 90 mg/L at high flow and 110 mg/L at low flow at SP-SW-1.B after completion of restoration activities; actual targets will be determined by hardness at time of sampling.

The TMDLs presented in the tables apply to the specified streamflow and water hardness conditions only. Equation 5-1 allows calculation of TMDLs for any specific streamflow rate and water quality restoration target. Because the TMDLs in Tables 5-7 and 5-8 are based on the average of multiple flow measurements obtained at the specified sites under the specified flow conditions, the TMDLs are believed to be representative of overall seasonal TMDL requirements.

Some additional notes concerning the Blackfoot River TMDLs and the target conditions they are intended to satisfy include:

- For iron, the TMDL based on the 300 ug/l drinking water/domestic use support condition is expected to satisfy the additional target of no visible stream bed deposits associated with iron hydroxide precipitates from human causes.

- Based on seasonal and other considerations associated with the iron and manganese drinking water/domestic use support criteria, a higher TMDL may be acceptable for both iron and manganese as long as other target criteria associated with visible stream deposits, sediment toxicity, biota support, and chronic aquatic life criteria are satisfied.

  Meeting the cadmium, copper, iron, lead, manganese and zinc TMDLs is expected to satisfy the restoration targets associated with sediment toxicity (Table 5-6) for two reasons. First, restoration activities designed to address existing sources of water quality impairment should also eliminate the source(s) of elevated sediment concentrations. Secondly, as metal loads in the Blackfoot River are reduced to TMDL levels, the fine-grained metals-bearing sediments likely will flush through the system during high flow periods via typical sediment transport processes. As source areas are reclaimed through the ongoing UBMC reclamation program and downstream reclamation efforts, the displaced sediments will be replaced with fewer metals-bearing sediments. Since other metals which may occur at elevated concentrations in sediments are likely derived from the same mining-related sources as cadmium, copper, iron, lead, manganese and zinc, meeting the TMDLs for these metals are expected to address sediment toxicity issues which may exist for other metals in the Blackfoot River. The assumption that TMDL implementation will result in attainment of the sediment chemistry target will be confirmed through post-implementation sediment sampling.

- Meeting all of the metals TMDLs is expected to eliminate any metals-related impediments to satisfying the target associated with macroinvertebrate and periphyton communities being at full support conditions in comparison to reference conditions.

Tables 5-7 and 5-8 also provide estimates of the percent total load reduction required to meet the TMDLs and water quality restoration targets under the various flow conditions. These estimates are based on current metal loads calculated from seasonal streamflow and metals concentration data from monitoring site BRSW-12, BRSW-31 and SP-SW-1.B. For example, the required load reduction for meeting the TMDL for cadmium at BRSW-12 is greater than 90% during high flow, low flow and early runoff conditions (Table 5-7). Note that the required load reductions in Tables 5-7 and 5-8 are negative for certain metals under some flow conditions. This indicates that the restoration target for that particular metal is currently being met at least part of the time

Table 5-7 TMDL and Load Reduction Examples for Metals at Documented High Flow, Low Flow and Early Runoff Conditions for Blackfoot River Above Pass Creek (Site BRSW-12).

Pollutant	Target (ug/l)	Mean Low Flow (1.38 cfs) TMDL[1] (lb/day)	Mean High Flow (37.3 cfs) TMDL[1] (lb/day)	Mean Early Runoff (15.8 cfs) TMDL[1] (lb/day)	% Total Load Reduction Needed to Meet TMDLs and Targets
Cadmium	0.4 (low flow) 0.2 (high flow) 0.3 (early runoff)	0.003	0.040	0.026	92.0% (low flow) 93.4% (high flow) 95.6% (early runoff)
Copper	13.2 (low flow) 7.3 (high flow) 11.3 (early runoff)	0.10	1.46	0.96	-52% (low flow); 60.9% (high flow) 74.3% (early runoff)
Iron	300 (low flow) 300 (high flow) 300 (early runoff)	2.24	60.2	25.5	-470% (low flow); -270% (high flow) 7.7% (early runoff)
Lead	5.3 (low flow) 2.2 (high flow) 4.2 (early runoff)	0.04	0.44	0.36	-76.7% (low flow); 76.8% (high flow) 68.9% (early runoff)
Manganese	50 (low flow) 50 (high flow) 50 (early runoff)	037	10.03	4.25	84.3% (low flow); 77.1% (high flow) 89.6% (early runoff)
Zinc	169 (low flow) 94 (high flow) 145 (early runoff)	1.26	18.87	12.33	89.2% (low flow 87.2% (high flow) 90.9% (early runoff)

1. Mean high flow, low flow and early runoff values based on average of seasonal flow measurements from site BRSW-12 from 1996 through 2001.
Early runoff data from April.
Negative value for % Total Load Reduction Required indicates that the restoration target is being met most or all of the time at site BRSW-12 during the specified flow conditions. However, these metals consistently exceed restoration targets in the Blackfoot River upstream of BRSW-12.

Table 5-8 TMDL and Load Reduction Examples for Metals at Documented High Flow and Low Flow Conditions for Blackfoot River Between Pass Creek and Landers Fork (Monitoring Sites BRSW-31 and SP-SW-1.B).

	BRSW-31			**SP-SW-1.B**		
Pollutant	**Water Quality Restoration Target (ug/l)**	**Mean Low Flow (2.6 cfs) and High Flow (28 cfs) TMDL[1] (lb/day)**	**% Total Load Reduction Required**	**Water Quality Restoration Target (ug/l)**	**Mean Low Flow (40 cfs) and High Flow (154 cfs) TMDL[1] (lb/day)**	**% Total Load Reduction Required**
Cadmium	0.3 (low flow) 0.2 (high flow)	0.0042 (low flow) 0.03 (high flow)	77.4% (low flow) 90.2% (high flow)	0.3 (low flow) 0.3 (high flow)	0.06 (low flow) 0.25 (high flow)	-200% (low flow) -50% (high flow)
Copper	11.3 (low flow) 7.3 (high flow)	0.157 (low flow) 1.10 (high flow)	37.2% (low flow); 43.9% (high flow)	10.1 (low flow) 8.5 (high flow)	2.15 (low flow) 7.04 (high flow)	-710% (low flow); -113% (high flow)
Iron	300 (low flow) 300 (high flow)	4.16 (low flow) 45.0 (high flow)	57.0% (low flow); -34.3% (high flow)	300 (low flow) 300 (high flow)	64.0 (low flow) 248.0 (high flow)	-471% (low flow); 30.9% (high flow)
Lead	4.2 (low flow) 2.2 (high flow)	0.06 (low flow) 0.33 (high flow)	-40.0% (low flow); 26.7% (high flow)	3.6 (low flow) 2.8 (high flow)	0.77 (low flow) 2.32 (high flow)	-20.0% (low flow); 30.0% (high flow)
Manganese	50 (low flow) 50 (high flow)	0.69 (low flow) 7.50 (high flow)	83.1% (low flow); 34.5% (high flow)	50 (low flow) 50 (high flow)	10.7 (low flow) 41. 4 (high flow)	-510% (low flow); 24.9% (high flow)
Zinc	145 (low flow) 94 (high flow)	2.01 (low flow) 14.2 (high flow)	77.3% (low flow 85.0% (high flow)	130 (low flow) 110 (high flow)	27.7 (low flow) 91.1 (high flow)	-194% (low flow -40.0% (high flow)

1-Mean high flow and low flow values based on average of seasonal flow measurements at specified sites.
Negative value for % Total Load Reduction Required indicates that the restoration target is being met most or all of the time at specified site during the specified flow conditions. However, these metals consistently exceed restoration targets in the Blackfoot River upstream of specified sampling site.

at the designated monitoring site under the specified flow conditions. Water quality and streamflow data used in evaluating impairment conditions, loading sources and TMDL calculation for the Blackfoot River are included in Appendix C.

5.4.3 Blackfoot River Source Load Allocations

Different approaches are used for allocating metals loads in the Blackfoot River upstream and downstream of Pass Creek. For the stream segment above Pass Creek (and entirely within the UBMC Implementation Plan boundaries), a performance-based approach to load allocation and waste load allocation as applied to Beartrap Creek is used. The performance based approach is based on the assumption that water quality restoration requirements mandated in the UBMC Temporary Standards Implementation Plan (Appendix B) will address all human-caused sources of metals-related water quality impairment in this portion of the Blackfoot River. For the segment of river between Pass Creek and Landers Fork, a source-specific approach to load allocation is used. Load allocations for the two stream segments are discussed below.

5.4.3.1 Waste Load and Load Allocations Upstream of Pass Creek

Due to the presence of one point source discharge (discharge from the wetlands-based water treatment system, MPDES #MTR0030031), source load allocations in the Blackfoot River upstream of the confluence with Pass Creek include both a waste load allocation (point source) and load allocations (nonpoint sources). A performance based allocation approach is taken for the waste load and load allocations. This performance-based approach recognizes the ongoing mine reclamation activities in the drainage, and the regulatory programs and cleanup commitments currently in place as part of the Temporary Water Quality Standards process. As stipulated in the Montana water quality regulations (MCA 75-5-312), before the Board of Environmental Review can grant temporary standards to a water body, the petitioner must submit an implementation plan designed to eliminate the water quality limiting factors to the extent considered achievable, and a schedule for implementing the plan that ensures that the water quality standards are met as soon as reasonably practicable, and in no event later than the time allowed by the Board in the temporary standards. At this time it is assumed that all significant human-caused sources of metals loading to the Blackfoot River upstream of Pass Creek are or will be identified and addressed by the Temporary Standards Implementation Plan reclamation program. In the event that post-reclamation water quality monitoring as required by the Implementation Plan shows that B-1 classification standards (and thus the water quality restoration targets) are not being met, the causes and sources for continued water quality impairments must be identified and mitigated (except natural background sources) to the extent considered achievable. Therefore, the Temporary Standards regulations include built-in contingencies to ensure that all human-caused sources of water quality impairment to the Blackfoot River upstream of Pass Creek are ultimately identified and addressed.

The Temporary Standards Implementation Plan (Appendix B), includes a description of all known or suspected sources of metals loading to affected surface waters within the UBMC Implementation Plan boundary, including the Blackfoot River. Sources associated with performance based load and waste load allocations and identified in the plan include:

- Surface water inflow from Beartrap Creek drainage (load allocation);
- Discharge from the constructed wetlands-based mine water treatment system (waste load allocation);
- Surface water inflow from Stevens Gulch (load allocation);
- An area of Concentrated tailings on the Blackfoot River floodplain near the confluence with Shave Creek (load allocation);
- Dispersed Tailings located along the Blackfoot River floodplain (load allocation); and
- Surface water inflow from Paymaster Creek (load allocation).

The Implementation Plan includes a reclamation schedule and options for addressing each of these sources. Annual sampling and analyses plans and work plans are to be prepared annually for review by MDEQ to guide site characterization and reclamation planning. Annual reports summarizing the previous years activities are also required under the Implementation Plan for MDEQ review (Appendix B).

Each of the sources listed above is shown in Figure 5-2 and described in detail in various reports (Hydrometrics, 1999, 2000, 2001a, 2002). Following is a brief discussion of each source, and restoration options and schedules included in the Temporary Standards Implementation Plan.

Surface Water Inflow from Beartrap Creek Drainage: Metals loading sources and trends in Beartrap Creek drainage are described in Section 4. Known sources include surface water inflow from Mike Horse Creek, seepage from the Mike Horse tailings impoundment, dispersed floodplain tailings, and possible seepage and runoff from the Flosse and Louise Mine (Figure 4-1). All known sources of metals loading in Beartrap Creek drainage are addressed in the Temporary Standards Implementation Plan with reclamation activities scheduled by 2006 (Hydrometrics, 2000). This schedule may be extended by up to two years based on completion of negotiations between the Forest Service and Asarco.

Discharge from Wetlands-Based Water Treatment System: In 1996**,** Asarco constructed, and currently operates, a wetlands-based water treatment system for treatment of mine drainage from the Mike Horse 300 level adit and Anaconda Mine adit. Discharge from the treatment system is regulated under the Montana Pollutant Discharge Elimination System (MPDES) permitting program (MPDES Permit No. MTR0030031). The discharge permit stipulates effluent limits for the metals cadmium, copper, iron, lead, mercury and zinc. The implementation plan requires Asarco continue to optimize the water treatment system to decrease metals concentrations in the effluent by enhancing the treatment system efficiency, and/or decreasing metals concentrations in the influent through pretreatment steps or source control. Under the performance based approach, this discharge will ultimately be set at levels that satisfy the targets and water quality standards in a manner consistent with MPDES permitting requirements. Therefore, for each metal the waste load allocation is set equal to the load that results in discharges that either satisfy numeric water quality standards within the discharge water or within the receiving stream where a mixing zone approach is used. MPDES permitting currently requires no exceedence of any acute aquatic life standards within the mixing zone and no exceedence of any chronic aquatic life standards at the end of the mixing zone. The use of a mixing zone for human health standards is a case-specific permit determination. The TMDL equation presented in Appendix A, along with applicable mixing zone equations, would apply under all stream flow and discharge conditions. This will require additional significant reductions in discharge loads from this source area given the high percentage of metals loading from this source, particularly during low flow conditions (reference Section 5.3.2.1).

Surface Water Inflow from Stevens Gulch Drainage: Stevens Gulch enters the Blackfoot River from the south approximately 2,500 feet upstream of monitoring site BRSW-12 (Figure 5-2). As described in Section 5.3, metals loading from the drainage to the Blackfoot River has been documented through extensive water monitoring (Hydrometrics, 2002). Stevens Gulch drainage has been the site of historic mining activities, with one mine (the Capital Mine) reclaimed by Asarco in 1997. The implementation plan schedule includes mitigation of additional human-caused sources of metals loading in Stevens Gulch drainage between 2003 and 2006.

Concentrated Floodplain Tailings Deposits: An area of concentrated tailings has been identified on the Blackfoot River floodplain near the confluence with Shave Creek (Figure 5-2). 2001 implementation plan activities include delineation of the lateral and vertical extent of tailings, and determination of the tailings physical and chemical characteristics (Hydrometrics, 2002). Reclamation options specified in the plan include: complete or partial removal of tailings and placement in an engineered repository; consolidation of tailings with local closure; and in-place closure through soil amendment and revegetation. Reclamation of the dispersed tailings is scheduled to occur between 2003 and 2005 with possible extension of the schedule by up to two years based on completion of ongoing negotiations between the U.S. Forest Service and Asarco.

Dispersed Floodplain Tailings: Dispersed tailings occur along the Blackfoot River floodplain from the confluence of Beartrap and Anaconda Creeks, downstream to the head of the marsh system near the confluence with Pass Creek (Figure 5-2). 2001 implementation plan activities include mapping and characterization of the dispersed tails (Hydrometrics, 2002). Reclamation options listed in the implementation plan include: complete or partial removal of tailings and placement in an engineered repository; consolidation of tailings with local closure; and in-place closure through soil amendment and revegetation. Reclamation of the dispersed tailings is scheduled to occur between 2003 and 2005 with possible extension of the schedule by up to two years based on property access issues and ongoing negotiations between the U.S. Forest Service and Asarco.

Surface Water Inflow from Paymaster Creek Drainage: Paymaster Creek enters the upper marsh system on the Blackfoot River between monitoring site BRSW-12 and the confluence with Pass Creek (Figure 5-2). The lower 2000 feet of Paymaster Creek has been impacted by the historic Paymaster Mine, which was reclaimed by Asarco in 1996-97. Asarco constructed a second wetlands-based water treatment system at the Paymaster Mine for treatment of a seasonal discharge from the Paymaster Adit. The Paymaster treatment system discharges to groundwater and is regulated under the Montana Groundwater Pollution Control System (MGWPCS) program (Permit No. MGWPCS-001001).

Despite the mine reclamation and water treatment efforts, Paymaster Creek remains a source of metals loading to the Blackfoot River (Section 5.3). Previous investigations in the drainage indicate that natural background sources may account for at least a portion of the remaining metals load (Furniss, 1998). Although additional water quality restoration activities for Paymaster Creek drainage are not specifically addressed in the Temporary Standards Implementation Plan, the overall plan requirements of attaining B-1 classification water quality standards in the Blackfoot River, to the extent considered achievable, will require any additional human-caused sources of metals-related water quality impairment in the drainage to be addressed.

All sources of metals loading to the Blackfoot River upstream of Pass Creek as listed above (with the exception of Paymaster Creek drainage) are specifically addressed and scheduled for reclamation in the Temporary Standards Implementation Plan. The overall goal of the temporary standards, meeting B-1 classification water quality standards to the affected portion of the Blackfoot River, will ensure that any remaining human-caused sources of impairment in Paymaster Creek drainage are also addressed. Completion of implementation plan activities is expected to result in attainment of the water quality restoration targets listed in Table 5-6 and the required metals TMDLs unless precluded by naturally occurring sources. It is assumed that all UBMC restoration activities will be implemented in a manner consistent with all reasonable land, soil and water conservation practices thereby satisfying the intent of Montana's Water Quality Standards for metals, including appropriate monitoring and maintenance to ensure reclamation success (ARM 17.30.602(21)).

It should be noted that additional historic mining disturbances do exist within the Blackfoot River drainage upstream of Pass Creek. Examples include the Viking Mine at the head of Stevens Gulch, the Mary P mine waste pile located in the Blackfoot River drainage bottom upstream of Stevens Gulch, and a number of small mines located in Shave Gulch drainage. These mines are located primarily on National Forest System Lands and are not addressed in the implementation plan. Existing information indicates that these mine disturbances do not represent significant sources of water quality impairment to the Blackfoot River. As with Paymaster Creek, if detailed water quality monitoring required by the implementation plan shows that B-1 standards are not being met following completion of reclamation activities, additional site investigation and reclamation activities will be required to address remaining human-caused sources of metals loading which may individually, or collectively, cause metals-related water quality standards to be exceeded. In the event that additional sources of water quality impairment are identified and required restoration activities do not fall under the Implementation Plan requirements, load allocation(s) will be identified for these additional sources as needed. Any necessary load allocation will be consistent with the load or load reduction needed to satisfy the water quality targets and B-1 standards in the Blackfoot River and any potentially impacted tributary.

If the performance based allocation approach discussed above should undergo significant delays or otherwise run into significant implementation problems, then a specific source category allocation approach will apply. Under this scenario, the load allocations for mining related sources as well as natural background sources will be set equal to the TMDL as defined by the TMDL equation. The waste load allocation associated with the mine discharge will be developed in such a way that the discharge does not exceed any metals numeric standards associated with a B-1 classified water body.

5.4.3.2 Load Allocation for Blackfoot River Downstream of Pass Creek

The load allocation approach presented above addresses metals loading sources that originate upstream of Pass Creek and are a major source of metals loading to the Blackfoot River downstream of Pass Creek. There currently are not any ongoing reclamation activities or mandated reclamation efforts in place to address other metals-related sources of loading downstream of Pass Creek. Therefore, a source-area approach to load allocation is used for this segment of river instead of the performance-based approach used upstream. The source area load allocation approach is well suited for this river segment where areas of increasing metal loads have been identified (Section 5.3), but sufficient information is not currently available to identify and quantify individual loading sources. The source area load allocations developed below can be used to guide future source area characterization efforts and restoration planning.

Metals loading source areas to the Blackfoot River between Pass Creek and Landers Fork were discussed in Section 5.3 and include:

- The Upper Blackfoot Mining Complex area above BRSW-12;
- The Upper Marsh system located immediately downstream of the UBMC Implementation Plan boundary (between monitoring sites BRSW-12 and BRSW-31); and
- All Remaining Potential Sources, which may include: metals loading from surface water inflow from tributary drainages; historic mining impacts along the Blackfoot River downstream of the UBMC Implementation Plan boundary such as mine waste deposited along the drainage bottom; or recharge of mining-impacted and/or naturally mineralized groundwater to the river.

In order to ensure protection of beneficial uses in the entire segment of river between Pass Creek and Landers Fork, the source area load allocations are based on the TMDLs, or metals loading capacity, as calculated at two separate locations: monitoring sites BRSW-31 and SP-SW-1.B (Figure 5-1). The sum of the load allocations for upstream source areas must be equal to or less than the TMDL for each metal of concern at each location. Following is a discussion of load allocations by source area.

Upper Blackfoot Mining Complex
Metal loads in the Blackfoot River exiting the UBMC area above monitoring site BRSW-12 represent a source of metals loading (and impairment) to the downstream river segment. Load and waste load allocations for this source area are already addressed through the metals TMDLs and allocations applied to the Blackfoot River within the UBMC upstream of BRSW-12 (Section 5.4.3.1).

Upper Marsh Area
Existing water quality data show concentrations (and loads) of several metals increase through the marsh complex immediately downstream of the Blackfoot River/Pass Creek confluence (Figure 5-2). The metals loading analysis (Section 5.3.2) shows that iron loads increase through the Upper Marsh during both high and low flow conditions, copper and manganese loads increase under low flow and decrease under high flow, and zinc, lead and cadmium loads

typically decrease or remain unchanged through the marsh. Water quality data also show that these metals typically exceed numeric water quality criteria immediately downstream of the marsh at site BRSW-31. Although the precise cause for load increases through the marsh is not currently known, possible sources include: metals-bearing sediments deposited within the marsh; tributary inflows; and/or recharge of mine-impacted and/or naturally mineralized groundwater to the river.

In order to address water quality impairments associated with metals loading from the Upper Marsh area, a source area load allocation is applied to the Upper Marsh. The source area load allocation is based on maintaining metals concentrations in the Blackfoot River within and downstream of the marsh at levels below the applicable B-1 based numeric water quality restoration targets, as well satisfying the sediment toxicity and macroinvertebrate and periphyton restoration targets applied to the Blackfoot River (Section 5.4.1). Since the metals TMDLs developed for monitoring site BRSW-31 (located at the downstream end of the Upper Marsh) are based on meeting these targets under all streamflow and water hardness conditions, each metal load allocation for the Upper Marsh source area is set at levels that would satisfy the corresponding TMDL at BRSW-31 once restoration targets are satisfied at BRSW-12. Therefore, the metals loading from the Upper Marsh plus any remaining metals load that can be attributed to the UBMC area above BRSW-12 must be equal to or less than the TMDL for each applicable metal.

The load allocations for the Upper Marsh source area apply to all potential contributing sources including: tributary inflows, potential metals-bearing sediments within the marsh, and recharge from mineralized groundwater. Tributaries entering the upper marsh include Pass Creek, Swamp Gulch, Meadow Creek and Paymaster Creek (Paymaster Creek is part of the UBMC reclamation program however and is addressed within the UBMC performance-based load allocations in Section 5.4.3.1). A more detailed accounting of potential contributing sources is necessary before the Upper Marsh source area load allocation can be further refined, and restoration requirements and options determined. For some metals, satisfying the allocation for the UBMC above BRSW-12 during high and/or low flow may result in a situation where the TMDL for that metal is also satisfied at BRSW-31.

Remaining Sources

The metals loading analysis included in Section 5.3.2 shows that the primary sources of metals loading with the Blackfoot River are located within or upstream of the Upper Marsh. The loading analysis also shows however, that loads of certain metals, particularly iron and copper, increase in the stream segment between the upper marsh and Landers Fork (Figure 5-4). Appendix C data also indicates aluminum loading increases in this segment during high flow, although aluminum has not been identified as one of the metals causing impairment to this segment of the Blackfoot River at this time since elevated levels may be associated with naturally occurring conditions. Because sufficient information is not currently available to quantify individual loading sources in this downstream reach, potential loading sources are grouped under the Remaining Sources category. Potential remaining metals loading sources include, but may not be limited to: metals loading from surface water contributions from tributary drainages; possible historic mining-related impacts along the Blackfoot River drainage bottom (i.e., metals-bearing sediments); or recharge of mining-impacted and/or naturally mineralized groundwater to the river.

At this time, load allocations may not be necessary for the Remaining Sources category since existing water quality data indicate that mitigation of all metals loading sources within and upstream of the Upper Marsh will result in attainment of all metals-related water quality restoration targets downstream of the Upper Marsh as well. In other words, documented load increases downstream of the Upper Marsh do not by themselves appear to cause impairment conditions. Nevertheless, load allocations are applied to the mouth of each major tributary drainages downstream of the Upper Marsh. These allocations are set at levels that would satisfy all B-1 water quality standards, within each tributary, and need only apply to those tributaries where impairment conditions are subsequently documented via formal MDEQ procedures (MDEQ, 2002). Although these allocations, if needed, may not result in noticeable improvements to the Blackfoot River for most metals, they can contribute to a margin of safety in addition to improving beneficial use support conditions within the tributary of concern. Including these load allocations within this document can help focus future assessment and restoration planning in tributaries where important fisheries may exist.

Another Remaining Source category where load allocations are developed is the lower marsh areas shown on Figure 5-1. The apparent metals sink and source characteristics of these marshes will need to be further investigated to see if localized impairment conditions associated with water column, sediment, or floodplain chemistry could persist within the lower marshes even after all restoration targets are met at upstream sources. Given the copper and iron load increases documented through the lower marshes (Figure 5-4), and the potential for metals-bearing sediments to accumulate in the marshes from historic mining activities, these locations may represent localized source areas in need of load allocations. Therefore, an additional performance based allocation is applied at this time to both of these lower marsh areas to address the potential need for water quality restoration activities. Restoration activities would be pursued as necessary to ensure that all TMDL restoration targets for the Blackfoot River are met and the B-1 based beneficial uses can be achieved. This could lead to additional target compliance locations as needed to support beneficial uses within this section of the Blackfoot River. Section 6.3 outlines a water and sediment monitoring program designed to further characterize possible Remaining Source Category sources, including the lower marsh area sediments and tributary drainages.

5.5 Blackfoot River from Landers Fork to Nevada Creek

The segment of the Blackfoot River from Landers Fork to Nevada Creek (MT76F001-020) was listed as partially supporting of aquatic life and cold water fishery on the 1996 303(d) list with metals being one of the identified causes (Table 1-1). Recent 303(d) lists (2000, 2002) have not shown this segment as being impaired for metals, due in part to MDEQ reviews of 1995 through 1997 water quality data from monitoring sites along the Blackfoot River (Lawlor, 2000), and also due to results of sampling by MDEQ in 2001. The 1995-97 sites include one site in the lower part of this segment above Nevada Creek near Helmville (USGS Station Number 12335100), one in the middle part of this segment near the Dalton Mountain Road bridge (USGS Station Number 12334800), and one in the upper part of this segment below Seven-up-Pete Creek (USGS Station Number 12334700). Appendix C presents data for all three sites, including data for 1993 through 1995 at the upstream site, data for 1995 through 1997 at all three sites as discussed above, and data for 2002 at all three sites.

The data from all three sites occasionally exceed the 300 ug/l drinking water use guidance value for iron during high flow, and the data from the upper and lower sites occasionally exceed the 50 ug/l drinking water use guidance values for manganese during high flow. Based on the level and frequency of exceedences, and the likelihood that elevated levels of iron would be removed during conventional treatment, the data suggests that the drinking water beneficial use is not impaired (reference Appendix A).

Water quality data from the upper site (Blackfoot River below Seven Up-Pete Creek) include two exceedences of the chronic aquatic criteria for cadmium and iron, and one exceedence for aluminum and zinc. All of these exceedences occurred between 1993 and 1995, with no exceedences of the chronic criteria recorded since 1995. Water quality data from the lower site (above confluence with Nevada Creek), show one exceedence of the chronic aquatic standard for cadmium (10% above the standard) and iron (20% above the standard) each, during June 2002. In addition to the above water quality data, MDEQ collected river sediment samples for total metals analyses, and macroinvertebrate and periphyton data from the lower part of this segment in 2001. The sediment sample results indicate no metals at levels of concern, the macroinvertebrate data indicates no metals related problems, and the periphyton result for percent abnormal diatom cells indicates some potential metals related impact, but generally not enough to conclude that there is an impairment condition based on this data alone.

The water quality exceedences summarized above for the Blackfoot River between Landers Fork and Nevada Creek, although somewhat infrequent and limited to high flow conditions, indicate a borderline aquatic life and cold water fish impairment situation per MDEQ Water Quality Assessment Process and Methods (MDEQ, 2002).

Much of the metals loading, particularly in the upper-most portion of this segment is apparently due to metals loads from the Blackfoot River drainage above Landers Fork, with some potential loading from Landers Fork and Seven Up Pete Creek. Further downstream, loading trends indicate there are additional sources of iron and possibly cadmium loading. Potential downstream sources include inflows from tributaries such as Poorman Creek, and possibly leaching or re-suspension of metals from river or floodplain sediments. The data throughout the watershed also indicate the possibility of relatively high natural background loads, although increased erosion from human activities could also be contributing to loading from mineralized areas.

It is anticipated that meeting the targets and satisfying all load allocations in the Blackfoot River drainage upstream of Landers Fork, as discussed within Sections 5.1 through 5.4, may result in fully supporting conditions in the Blackfoot River immediately downstream of Landers Fork, and possibly the entire stream segment downstream to Nevada Creek. As an added level of assurance, the high flow water column metals targets for cadmium, iron and zinc that apply to Blackfoot River Site SP-SW-1.B above the Landers Fork (Table 5-6), along with the appropriate TMDLs as defined by the TMDL equation in Appendix A, are applied to the Blackfoot River below Seven Up-Pete Creek (USGS Station Number 12334700) and the Blackfoot River above

Nevada Creek (USGS Station Number 12335100). Aluminum is also added as a high flow target, with the target value based on the B-1 chronic aquatic life support criteria of 87 ug/l. In addition, the load allocations applied to the tributary drainages between Pass Creek and Landers Fork (reference "Remaining Sources" under Section 5.4.3.2), also apply to the Landers Fork and Seven Up Pete Creek, and any other tributaries where it is subsequently concluded that impairment conditions exist for iron, cadmium, zinc, aluminum, and/or any other metals of concern. This means that the allocations for these tributary water bodies are set at levels that would satisfy all B-1 water quality standards within each tributary, and would only apply where impairment conditions are subsequently documented via formal MDEQ procedures (MDEQ, 2002).

An adaptive management TMDL development and implementation approach is applied for the segment of the Blackfoot River between the Landers Fork and Nevada Creek. The goal of this approach is to pursue the activities listed below as necessary to meet the applicable metals targets:

1. Continue with UBMC restoration efforts upstream where load reductions are anticipated.
2. Continue with restoration planning and TMDL implementation in Sandbar Creek and the Poorman Creek drainage.
3. Continue with development and implementation of the water quality and habitat restoration plan (currently in draft), which includes sediment TMDLs that could result in reduced metals transport via erosion.
4. Obtain more data where necessary and make beneficial use determinations in other tributary drainages downstream of Pass Creek where existing data indicates potential metals-related impairment conditions may exist. Develop TMDLs and associated targets and allocations for the tributaries where impairment conditions are identified.
5. Determine the potential for additional loading from the two lower marshes of the Blackfoot River upstream of Landers Fork.
6. Continue monitoring within the Blackfoot River as needed to update beneficial use support determinations, better delineate the extent and sources of metals-related impairment, and evaluate progress toward meeting targets. This information will help evaluate and document anticipated improvements from UBMC and other restoration efforts defined within the Water Quality Restoration Plan for Metals in the Blackfoot Headwaters TMDL Planning Area.
7. If the above activities do not eventually result in metals concentrations consistent with full use support conditions, then pursue additional studies to identify remaining metals loading sources and apply additional load allocations where appropriate.

Following the above adaptive management approach will lead to a better understanding of and resolution to water quality impacts and beneficial use limitations within this segment of the Blackfoot River from Landers Fork to Nevada Creek.

SECTION 6.0
RESTORATION STRATEGY

This section outlines strategies for addressing metals loading sources in need of restoration activities within the Blackfoot Headwaters TMDL Planning Area (planning area). The restoration strategies focus on regulatory mechanisms and/or programs applicable to the particular source types present within the planning area, which for the most part are associated with historic mining. The strategies identified below address currently known or suspected sources, as well as additional sources of metals-related impairment which may be identified through future investigations. The planning area is divided into two geographical areas for discussion of restoration strategies; the portion of the planning area located within the Upper Blackfoot Mining Complex Implementation Plan boundaries (Beartrap Creek/Mike Horse Creek and the Blackfoot River Upstream of Pass Creek); and that located outside of these boundaries (Sandbar Creek, Willow Creek, Poorman Creek, and the downstream Blackfoot River segments).

Also presented in this section is a monitoring program designed to more fully quantify impairment conditions and individual metals loading sources in portions of the listed stream segments. The monitoring program is also intended to assess the effectiveness of current (UBMC) and future restoration activities designed to meet the restoration targets and TMDLs presented in this plan. The monitoring plan also includes provisions for assessing stream segments not listed as impaired for metals, but available data show have exceeded B-1 classification numeric criteria for certain metals on an occasional basis.

6.1 Restoration Strategy for Sources Covered Under the UBMC Implementation Plan

Restoration strategies for the listed portion of Beartrap Creek and the Blackfoot River upstream of Pass Creek, as well as the metals-impaired segment of Mike Horse Creek, are primarily addressed by the Upper Blackfoot Mining Complex Temporary Standards Implementation Plan (Appendix B). As stated in the Temporary Standards regulations, when the board adopts temporary standards, the goal is to improve water quality to the point where all beneficial uses designated for the water body or segment are supported (75-5-312(1)). Since the restoration targets established for Beartrap Creek, Mike Horse Creek, and the Blackfoot River upstream of Pass Creek are based on attainment of all B-1-based beneficial uses, the goals and requirements of the temporary standards mine reclamation program are consistent with the goals and requirements of this water quality restoration plan.

In accordance with Section 75-5-312(4), the Temporary Standards Implementation Plan submitted to the Board of Environmental Review by Asarco includes a description of known sources of metals-related water quality impairments, general remedial options for eliminating these sources to the extent considered achievable, and an implementation schedule. The Implementation Plan source inventory is based on detailed site characterization activities conducted by Asarco from 1991 through 1999 and is believed to represent the vast majority of metals-related water quality impairment sources at the UBMC.

The Implementation Plan schedule requires all identified sources of water quality impairment to be addressed by 2006, with a possible extension of up to two years pending completion of negotiations between Asarco and the U.S. Forest Service. The Implementation Plan schedule also requires Asarco conduct seasonal water quality monitoring in association with reclamation activities to assess compliance with the temporary standards, and post reclamation monitoring for two years following completion of scheduled reclamation activities (Section 6.3). Monitoring results will be used by MDEQ and the Board of Environmental Review to determine if the scheduled reclamation activities are successful in restoring surface waters at the UBMC to B-1 classification water quality standards to the extent considered achievable. If B-1 standards are not being met, remaining sources must be identified and addressed as appropriate (except for natural background sources if shown to exist). Therefore, the goals and requirements of the Temporary Standards program as applied to the UBMC are expected to result in attainment of the metals restoration targets and TMDLs in Mike Horse Creek, Beartrap Creek and the Blackfoot River upstream of Pass Creek. Although the Temporary Standards water quality restoration requirements do not extend to sources downstream of Pass Creek, these activities are expected to result in significant water quality improvements in the Blackfoot River downstream of the UBMC Implementation Plan boundaries as well.

In addition to the Temporary Standards requirements, Asarco and the U.S. Forest Service entered into an administrative order on consent (AOC) in February 2003 for an Engineering Evaluation/Cost Analysis (EE/CA). The purpose of the EE/CA is to address certain historic mining impacts at the UBMC. The EE/CA will be prepared in accordance with EPA's Guidance on Conducting Non-Time Critical Removal Actions Under Comprehensive Environmental Response, Cleanup and Liability Act (CERCLA) (EPA, 1993). Non-Time Critical Removal Actions are defined by the CERCLA and the National Oil and Hazardous Substance Pollution Contingency Plan (NCP) as actions that are implemented by the lead agency for "the cleanup or removal of released hazardous substances from the environment…as may be necessary to prevent, minimize, or mitigate damage to the public health or welfare, or to the environment…" As such, the EE/CA will in part compliment the Implementation Plan requirements and will further ensure that sources of metals-related water quality impairment at the UBMC are adequately characterized and addressed through these established reclamation programs.

6.2 Restoration Strategy for Sources Outside of the UBMC Implementation Plan Boundary

Stream segments listed as impaired for metals and/or in need of additional data and located outside of the UBMC Implementation Plan boundaries include: Sandbar Creek, Willow Creek, Poorman Creek, the Blackfoot River between Pass Creek and Landers Fork, and the Blackfoot River between Landers Fork and Nevada Creek. Currently, there are no ongoing restoration programs or scheduled restoration activities aimed at mitigating mining related metals loading sources in these drainages, other than the UBMC efforts that will ultimately mitigate impairment conditions in the downstream sections of the Blackfoot River. In some cases, specific metals loading sources or source areas have been identified in these drainages, such as two mine waste dumps in Sandbar Creek drainage (Section 2), Swansea Gulch in Poorman Creek drainage (Section 3), and the upper marsh on the Blackfoot River (Section 5). In other cases, available water quality data indicate that additional metals loading sources exist in these drainages, although specific loading sources cannot be identified and adequately delineated based on available information. Available water quality data also suggests that certain tributary drainages not listed as being impaired for metals may exceed B-1 classification water quality standards for some metals on an occasional basis. Examples include Alice Creek, Hogum Creek, Hardscrabble Creek, and Seven-Up Pete Creek (Appendix C).

Following is a discussion of general restoration programs and funding mechanisms applicable to both listed and unlisted water bodies within the planning area and outside of the UBMC Implementation Plan boundary. The need for further characterization of impairment conditions and loading sources in some stream segments is addressed in Section 6.3 under the water quality monitoring program.

6.2.1 General Restoration Options

A number of state and federal regulatory programs have been developed over the years to address water quality problems stemming from nonpoint sources of pollution. Nonpoint sources of pollution, particularly historic mines and associated disturbances, constitute the majority of the metals loading sources to the Blackfoot Headwaters TMDL Planning Area. Some regulatory programs and approaches considered most applicable in the planning area include:

- The State of Montana Mine Waste Cleanup Bureau's Abandoned Mine Lands (AML) Reclamation Program;
- The Montana Comprehensive Environmental Cleanup and Responsibility Act (CECRA) which incorporates additional cleanup options under the Controlled Allocation of Liability Act (CALA) and the Voluntary Cleanup and Redevelopment Act (VCRA); and
- The federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Montana Mine Waste Cleanup Bureau Abandoned Mine Reclamation Program
The Montana Department of Environmental Quality's Mine Waste Cleanup Bureau (MWCB), part of the MDEQ Remediation Division, is responsible for reclamation of historical mining disturbances associated with abandoned mines in Montana. Historical mining-related disturbances are believed to comprise the majority of metals-loading sources in the planning area. Therefore, the MWCB abandoned mine reclamation program may be a viable alternative for addressing certain metals loading sources in the planning area.

The MWCB abandoned mine reclamation program is funded through the Surface Mining Control and Reclamation Act of 1977 (SMCRA) with SMCRA funds distributed to states by the federal government. In order to be eligible for SMCRA funding, a site must have been mined or affected by mining processes, and abandoned or inadequately reclaimed, prior to August 3, 1977 for private lands, August 28, 1974 for Forest Service administered lands, and prior to 1980 for lands administered by the U.S. Bureau of Reclamation. Furthermore, there must be no party (owner, operator, other) who may be responsible for reclamation requirements, and the site must not be located within an area designated for remedial action under the federal Superfund program or certain other programs. Abandoned Mine Lands Cleanup is discussed further in Appendix D.

Two sites within the planning area are currently on the MWCB's priority list of sites to be reclaimed with SMCRA funds (MDSL, 1995). These include the Swansea Mine and Tailings in Poorman Creek drainage, and the Seven-Up Pete/Rover Mine in Seven-Up Pete Creek drainage. The Swansea Mine and Tailings have been identified as a source of metals loading and water quality impairment to Swansea Gulch, a tributary to Poorman Creek. Although not listed for metals, available water quality data indicates that Seven-Up Pete Creek has exceeded numeric water quality criteria for certain metals on an occasional basis (Section 6.3). The Seven-Up Pete/Rover mine complex has been the subject of significant reclamation activities in the past but may still act as a source of metals loading to Seven-Up Pete (and possible Hogum) Creek.

Both the Swansea and Seven-Up Pete mines are ranked relatively low on the MWCB's list of priority sites (145 and 185 out of 273, respectively) meaning the reclamation schedules for these mines are uncertain at this time. However, inclusion on the priority list should result in eventual reclamation of these sites, assuming adequate funding through SMCRA, or some other source, is available.

In addition to the two sites included on the AML priority list, other known historic mining sources, such as the historic mining-related disturbances in Sandbar Creek drainage, may eventually be eligible for SMCRA funding for reclamation assuming they meet the eligibility criteria.

Montana Comprehensive Environmental Cleanup and Responsibility Act (CECRA)
Reclamation of historic mining-related disturbances administered by the State of Montana and not addressed under SMCRA typically are addressed through the MDEQ State Superfund or CECRA program. The CECRA program maintains a list of facilities potentially requiring response actions based on the confirmed release or substantial threat of a release of a hazardous or deleterious substance that may pose an imminent and substantial threat to public health, safety or welfare or the environment (ARM 17.55.108). Listed facilities are prioritized as maximum, high, medium or low priority or in operation and maintenance status based on the potential threat posed. The UBMC is a high priority CECRA listed facility, but cleanup is currently pursued via a voluntary cleanup approach based on an agreement between the responsible party and the State of Montana. The application of temporary water quality standards, as discussed throughout this document, provides an additional level of regulatory oversight from a water quality standards perspective. The only other CECRA-listed facility in the planning area is the medium priority Alice Creek Post and Pole Site. The Alice Creek site is not considered a potential source of metals loading to surface waters.

CECRA also encourages the implementation of voluntary cleanup activities under the Voluntary Cleanup and Redevelopment Act (VCRA), and the Controlled Allocation and Redevelopment Act (CALA). The CECRA program is discussed further in Appendix D.

It is possible that one or more historic mining-related metals loading sources in the planning area could be added to the CECRA list and addressed through CECRA, with or without the VCRA and/or CALA process. A site can be added to the CECRA list at MDEQ's initiative, or in response to a written request, containing the required information, made by any person to the department.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

CERCLA is a Federal program that addresses cleanup of sites, including historic mining areas, where there has been a release, or there is the threat of release, of a hazardous substance. Sites are prioritized on the National Priority List (NPL) using a hazard ranking system with the primary focus on protection of human health. Under CERCLA, the potentially responsible party or parties must pay for all remediation efforts based upon the application of a strict, joint and several liability approach whereby any existing or historical land owner can be held liable for restoration costs. Where viable landowners are not available to fund cleanup, funding can be provided under Superfund authority. The CERCLA program is discussed further in Appendix D.

Asarco and the U.S. Forest Service entered into an administrative order on consent in February 2003 for performance of an Engineering Evaluation/Cost Analysis under CERCLA for reclamation of certain mining disturbances on National Forest System lands at the UBMC. It may be possible for other water quality restoration activities, which may be required on public lands to be addressed under the EE/CA process, with or without a PRP.

6.2.2 Funding Options

In addition to the funding mechanisms associated with the regulatory programs discussed above, other funding mechanisms may be available for water quality restoration activities. Possible funding sources may include the yearly RIT/RDG grant program or the EPA Section 319 Nonpoint Source yearly grant program. The RIT/RDG program can provide up to $300,000 to address environmental related issues. This money can be applied to sites included on the MWCB's AML priority list but of low enough priority where cleanup under AML is uncertain (such as the Swansea Mine). RIT/RDG program funds can also be used for conducting site assessment/characterization activities such as identifying specific sources of water quality impairment.

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

There may be other grant programs and funding sources that could be utilized to help protect water quality and address environmental concerns, especially where such concerns are associated with an important resource such as the Blackfoot River. State and Federal agencies are often able to provide some assessment-related support. Where sufficient funding can be obtained, then detailed assessment and cleanup such as might occur under VCRA, could be pursued.

6.3 Monitoring Strategy

As noted throughout this water quality restoration plan, the availability of seasonal water quality data is limited for most stream segments outside of the UBMC Implementation Plan boundaries. For much of the Blackfoot Headwaters Planning Area, additional information is required to better define seasonal impairment conditions, to delineate specific metals loading sources, to support allocation of loads, and for restoration planning. In addition, environmental monitoring will be required to assess the effectiveness of future restoration actions and attainment of restoration targets.

Following is a conceptual environmental monitoring program for the Blackfoot Headwaters Planning Area. Ongoing monitoring activities as required by the Temporary Standards Implementation Plan are discussed first. Specific data needs for drainages or stream segments outside of the UBMC and/or downstream of Pass Creek are discussed last. The focus of the below monitoring is to address water quality and beneficial use support per Montana's State Surface Water Quality Standards within the context of TMDL development and implementation. Specific monitoring requirements beyond those discussed below will typically be imposed as part of any regulatory cleanup effort such as efforts associated with the UBMC and/or efforts associated with any of the regulatory options discussed in Section 6.2.1. These monitoring requirements may be associated with the protection and cleanup of surface waters in addition to other media such as soils or ground water, and may impose significant additional sampling requirements to further determine the extent of and risk posed by contamination in addition to requiring evaluation of specific remediation actions.

6.3.1 Existing UBMC Water Monitoring Requirements

Section 3.4 of the UBMC Temporary Standards Implementation Plan (Hydrometrics, 2000) includes a water quality monitoring program for the UBMC upstream from and including BRSW-12. The monitoring program requirements include collection of surface water samples from pre-established monitoring sites BRSW- 12, BRSW-9 and BRSW-29 on the Blackfoot River upstream of Pass Creek, BRSW-23 and BRSW-38 on Beartrap Creek, and BRSW-22 and BRSW-35 on Mike Horse Creek. The Blackfoot River and Beartrap Creek monitoring sites correspond to the sites utilized for TMDL development in these two stream segments (Sections 4 and 5).

Water sample analytical parameters include pH, specific conductance, water temperature and flow (field measurements); total recoverable and dissolved aluminum, cadmium, copper, iron, lead, manganese and zinc; and calcium, magnesium, sodium, potassium and sulfate.

Water samples are to be collected from each site four times annually including: during early runoff conditions (typically in April); near peak spring runoff (typically in May); during the falling limb of the spring runoff hydrograph (typically in June); and under baseflow conditions (fall). This sampling schedule covers the three flow regimes (early spring runoff, high flow, low flow) evaluated for TMDL development in Mike Horse, Beartrap Creek and the Blackfoot River upstream of Pass Creek. Monitoring is to continue until the Temporary Standards expire in 2008 (or 2010 if extended for two additional years per 17.30.630(2)(c)). This includes two years of post-implementation monitoring to assess the effectiveness of currently planned reclamation activities on water quality restoration.

The UBMC monitoring program also includes biological monitoring for the purpose of documenting current baseline biological conditions. The monitoring program requires annual macroinvertebrate sampling at Blackfoot River site BRSW-12 through 2003, with future monitoring needs to be evaluated at that time.

The specific sampling schedule, locations, and analytical parameters outlined above represent the minimum UBMC project sampling requirements for the first three-year period that temporary standards are in effect (through 2003). During the first two years of the temporary standards program, field sampling activities have significantly surpassed these minimum requirements. Additional sampling has focused on further source area delineation and restoration planning activities including: sampling of 10 to 20 supplemental surface water sites per sampling event in addition to the seven required monitoring sites; extensive soil and mine waste sampling; additional macroinvertebrate sampling; and groundwater sampling (Hydrometrics, 2001a, 2002). After 2003, monitoring requirements will be reviewed by MDEQ and revised as appropriate pending project developments and informational needs. Additional future monitoring requirements will need to include monitoring of the performance of specific restoration activities and structures such as the Upper Mike Horse Repository and possible future repository sites in order to satisfy the performance based allocation approach discussed in Sections 4.4.3 and 5.4.3.1. Also, additional monitoring will be necessary to verify beneficial use support in tributary drainages.

In addition to the Temporary Standards Implementation Plan monitoring requirements, Asarco is required to collect monthly water samples of the discharge from the wetlands-based water treatment system they operate at the UBMC. This sampling is required under the facility MPDES permit (permit #MT-0030031), and includes testing for aluminum, arsenic, cadmium, copper, iron, lead, manganese, zinc, mercury, sulfate, pH, total suspended solids, and flow. The monitoring results allow calculation of monthly metals loading rates from the treatment system to the Blackfoot River (see Section 5.3.2.1 for discussion on overall loading impacts from this source). The sampling results are submitted to MDEQ on a monthly basis.

The existing UBMC monitoring program should provide the vast majority of environmental information required for any continued TMDL development, restoration planning, and target compliance determinations in Beartrap and Mike Horse Creeks, and the Blackfoot River upstream of Pass Creek. Preparation of annual sampling and analysis plans and monitoring activities reports as required by the Implementation Plan will provide TMDL planners (and other stakeholders) the opportunity to review and track environmental monitoring activities and results. Because current monitoring requirements include only two years of post-implementation monitoring (through 2008 or possibly 2010), additional monitoring program(s) may be required to ensure monitoring continues beyond this time if necessary.

6.3.2 Monitoring Strategy for the Remainder of the Blackfoot Headwaters Planning Area

There are no metals related monitoring programs similar in scope to the UBMC program currently being implemented elsewhere in the planning area. Although numerous water quality studies have been completed in the planning area (e.g. Nagorski et al., 2000, Lawlor, 2000), and other studies are likely to take place in the future, additional TMDL-specific monitoring likely will be required to address outstanding restoration planning issues. MDEQ will be responsible in many situations for ensuring that these monitoring efforts are undertaken and that the data is made available to appropriate stakeholders. At a minimum, any monitoring plans and activities that address this part of the monitoring strategy should be reviewed by MDEQ to ensure consistency with the goals of this plan, MDEQ monitoring and assessment protocols, data requirements for beneficial use determinations, and data requirements associated with specific remediation programs.

The TMDL-specific monitoring needs include additional assessment monitoring and implementation monitoring. Assessment monitoring addresses additional data needs for more complete delineation of metals-impaired stream segments throughout the headwaters planning area, better delineation of specific sources of metals impairment, refinement of load allocations in some drainages, and restoration planning. The implementation monitoring is required to assess the effectiveness of future restoration activities, to assess whether compliance with water quality standards has been obtained by evaluating progress toward meeting restoration targets, and to assist with any adaptive management decisions as needed. Implementation monitoring to assess progress toward meeting restoration targets is required by the TMDL rules (75-5-703(7) & (9)), and is also an integral component of the implicit margin of safety incorporated in the metals TMDLs developed in this restoration plan. Some general assessment and implementation monitoring requirements and recommendations are identified below.

It is important to note that the below monitoring requirements and recommendations are based on TMDL related efforts to protect beneficial uses in a manner consistent with Montana's Surface Water Quality Standards. Other regulatory programs with water quality protection responsibilities may impose additional requirements to ensure full compliance with all appropriate local, State and Federal laws. For example, reclamation of a mining related source of metals under CECRA will likely require source-specific sampling requirements, which cannot be defined at this time, to determine the extent of and risk posed by contamination and to evaluate the success of specific remedial actions.

6.3.2.1 Monitoring Needed for Further Source Assessment and Restoration Planning

Poorman Creek Drainage:

- Water quality data and possibly sediment chemistry data is needed from tributary drainages such as the upper South Fork drainage, McClellan Gulch, and other tributary drainages where mining has occurred and no current water quality data is available. This information will be used to better quantify water quality impairment conditions and potential metals loading sources in Poorman Creek drainage, and will likely lead to detailed source specific characterization monitoring as discussed below for Swansea Gulch. Seasonal flows and likely pollutant transport mechanisms will need to be considered for developing a more effective characterization of source areas.

- Detailed water quality data and possibly sediment chemistry is needed from Swansea Gulch drainage to better delineate specific sources (and mechanisms) of metals loading from mining-related disturbances to Swansea Gulch (and thus Poorman Creek). Water quality sampling should quantify metal load contributions from various portions of the mine, and metals transport mechanisms (i.e., leaching of dissolved metals from mine waste via shallow groundwater or precipitation infiltration, or transport of particulate metals to surface waters through mine waste erosion). The detailed sampling should also assess possible sources upgradient of the Swansea Mine as indicated by the 1993 data (Section 3.3).

Sandbar Creek Drainage:

- Detailed water sampling is needed to further quantify the metals loading contribution from the three apparent identified sources. Sandbar Creek should be sampled immediately upstream and downstream of the two identified mine waste piles and the area of apparent mine waste road fill (Section 2.3). The resulting data will help quantify the metal loads attributable to each of these sources, which will help in restoration planning and prioritization. Sediment chemistry data will likely be needed from these sites as well.

Willow Creek Drainage:

- Additional water quality and biota sampling is needed upstream of Sandbar Creek (at a minimum) to make impairment determinations and to help identify metals loading sources if an impairment condition is identified.

Blackfoot River From Pass Creek to Landers Fork:

- Detailed water and sediment sampling is needed in the vicinity of the Upper Marsh where seasonal increases in Blackfoot River metals loads have been documented. Sampling should occur at points within the marsh (as well as at upstream and downstream sites) and flows measured (where possible) to better delineate areas of load increases. Potential tributary sources should also be sampled, as well as additional sediment and floodplain sampling.
- Detailed water sampling is needed in the vicinity of the two lower marshes, where localized metals-related impairment conditions may exist. Sampling should occur at points within the marshes (as well as at upstream and downstream sites) and flows measured (where possible) to better delineate areas of load increases. Sediment and floodplain sampling should be conducted, as should potential tributary sources (see below).

Blackfoot River From Landers Fork to Nevada Creek:

- Additional sampling is recommended to better quantify and determine the extent of impairment conditions at the upper and lower portions of this segment of the Blackfoot River. Sampling of tributaries with potentially significant metals loading is also needed, as discussed below.

Tributary Drainages

- Major Blackfoot River tributaries with potential metals impairment conditions not yet defined include Alice Creek, Hardscrabble Creek, Hogum Creek, Seven Up-Pete Creek, and Arrastra Creek, as well as several smaller drainages (Figure 5-1). Water quality data show detectable concentrations of aluminum, cadmium, copper, iron and manganese in one or more of these tributaries on an occasional basis. Existing water quality data also show periodic exceedences of the B-1 classification water quality standards have occurred in all the tributaries identified above except Willow Creek (Appendix C). Additional water quality data in coordination with analyses of existing data will be needed for most of these and possibly other tributary drainages to:

    1) Determine if these tributaries currently meet B-1 water quality standards; and
    2) Quantify possible metals loading from these tributaries to the Blackfoot River if B-1 standards are not met.

    Sampling will need to be consistent with standard MDEQ protocols used for making beneficial use determinations where metal impairment conditions may exist. If warranted, the assessment of impairment conditions will be modified based on the resulting water quality data. The sampling results will also be used to further evaluate metals loading to the Blackfoot River from tributaries, to set specific load allocations where needed, and for restoration planning and prioritization.

6.3.2.2 Implementation Monitoring

Implementation monitoring is required in all impaired drainages to assess the effectiveness of specific restoration activities and progress toward ultimate attainment of the restoration targets defined within this plan. In accordance with TMDL regulations (75-5-703(7) & (9)), MDEQ will develop and undertake an implementation monitoring program in the Blackfoot Headwaters Planning Area, with focus on evaluating progress toward meeting restoration targets. Efforts to assess the effectiveness of specific restoration activities focused on individual sources or source areas will tend to be an inherent part of the specific regulatory program/approach utilized (Section 6.2.1). At this time it would not be appropriate to identify all of these monitoring details, although it is expected that there would be some overlap with efforts to evaluate attainment of the restoration targets discussed below.

Implementation monitoring to assess overall progress toward meeting the restoration targets identified in Sections 2 through 5 of this plan will include a combination of water quality monitoring, sediment sampling for metals concentrations, and biological monitoring. Implementation monitoring will be done at least once every five years as defined by the TMDL regulations, with additional monitoring performed as needed to ensure timely evaluation of completed restoration activities in a particular drainage.

This monitoring program may need to incorporate portions of the UBMC if the UBMC water monitoring requirements per the temporary standards program or some other agreement expire before target compliance is verified or if the program does not address all monitoring needed to verify target compliance. Table 6-1 is a summary of minimal target compliance monitoring parameters and locations identified within this document. All monitoring efforts are to be done using standard MDEQ sampling and analyses protocols. The UBMC monitoring program locations used as target compliance locations are also included for completeness.

Table 6-1 Monitoring Locations and Parameters to Evaluate Target Compliance.

Stream	Location(s)	Parameters[1]	Flow Sample Period
Sandbar Creek	SCSW-1 & SCSW-2 SCSW-1 and/or SCSW-2	Copper, Iron, Manganese, Aluminum. Sediment Chemistry, Macroinvertebrate, Periphyton, no visible metals deposits	High & Low Flow Low Flow
Willow Creek (contingent upon impairment finding)	Upstream of Sandbar Creek Upstream of Sandbar Creek	Metals (as needed). Sediment Chemistry, Macroinvertebrate, Periphyton (as needed)	High and/or Low Flow (as needed) Low Flow (if needed)
Poorman Creek Drainage	PCSW-4, PCSW-5, PCSW-6, PCSW-7, PCSW-3 (or 4127PO01), and other locations as identified	Metals (specifically Copper, Cadmium and Lead), Sediment Chemistry, Macroinvertebrate, Periphyton	High & Low Flow for Metals, Low Flow for Biota Sampling and Sediment Chemistry
Mike Horse Creek	BRSW-22 BRSW-22	Copper, Iron, Manganese, Aluminum, Cadmium, Lead, Zinc. Sediment Chemistry, Macroinvertebrate, Periphyton, no visible metals deposits	High, Low Flow & Early Spring Runoff Low Flow
Beartrap Creek	BRSW-23 BRSW-23	Copper, Iron, Manganese, Cadmium, Lead, Zinc. Sediment Chemistry, Macroinvertebrate, Periphyton, no visible metals deposits	High, Low Flow & Early Spring Runoff Low Flow
Blackfoot River (from above Pass Creek to Landers Fork)	BRSW-12, BRSW-31 & SP-SW-1.B BRSW-12, BRSW-31 & SP-SW-1.B	Copper, Iron, Manganese, Cadmium, Lead, Zinc. Sediment Chemistry, Macroinvertebrate, Periphyton, no visible metals deposits	High & Low Flow; plus Early Spring Runoff for BRSW-12 Low Flow
Blackfoot River between Landers Fork and Nevada Creek	USGS Gaging Sites 12334700 & 12335100	Aluminum, Cadmium, Iron and Zinc	High Flow

1 – All metals samples are to be total recoverable except aluminum, which will be dissolved.

6.4 Action Items

Based on the findings of this TMDL and water quality restoration plan, the following action items are identified. These action items represent a logical next step in the Blackfoot headwaters water quality restoration process and are intended to facilitate transition into the implementation phase of the TMDL. One or more of the Blackfoot River watershed stakeholders, such as the Blackfoot Challenge, in conjunction with appropriate State and/or Federal government agencies, may pursue implementation of these action items. The action items are listed and briefly discussed below.

1. Pursue Restoration Activities at the UBMC:
   The most critical element for metals-related water quality restoration in the Blackfoot Headwaters Planning Area is continuation of the mine reclamation program at the UBMC. Reclamation activities completed by Asarco and ARCO from 1993 through 1998 have resulted in significant water quality improvements, with further improvement anticipated through Asarco's currently scheduled reclamation activities. Efforts should focus on ensuring that currently scheduled reclamation activities are completed in accordance with all reasonable land, soil and water conservation practices, and in accordance with the Administrative Order on Consent recently signed by Asarco and the U.S. Forest Service.

2. Sandbar Creek Restoration Activities:
   The Sandbar Creek water quality restoration plan identifies two mine waste piles and a segment of road likely contributing to metals-related water quality impairment in Sandbar Creek and possibly in Willow Creek also. It is possible that these apparent sources constitute the majority, if not all, of the metals loading sources in the drainage. Efforts should focus on reclamation of these apparent sources following more detailed site characterization as outlined in the Monitoring Strategy (Section 6.3). Detailed surface water sampling should be initiated in early 2003 (starting in March or April) to better quantify metals loading rates and mechanisms from the three source areas, and to identify other potential loading sources through Sandbar Creek drainage. Additional information in the form of stream sediment chemistry and mine waste physical and chemical characteristics should be obtained so that reclamation planning can be pursued in 2003. Implementation planning will need to be coordinated with the U.S. Forest Service since the apparent source areas are believed to be located on National Forest System lands.

3. Poorman Creek Restoration Activities:
   Similar to Sandbar Creek, restoration planning should be initiated in Poorman Creek drainage in 2003. The detailed water and stream sediment sampling outlined in Section 6.3 for Swansea Gulch, as well as other portions of Poorman Creek drainage, should be initiated in March or April 2003. This will allow for reclamation planning in Swansea Gulch, and delineation of impairment conditions and potential loading sources throughout the drainage. The Swansea Gulch activities would occur primarily on private property and will require coordination with the property owners.

4. Water Quality Sampling and Other Related Monitoring:
   Monitoring activities outlined in Section 6.3 for Poorman Creek drainage, Sandbar Creek drainage, Willow Creek drainage, the Blackfoot River between Pass Creek and Landers Fork, the Blackfoot River between Landers Fork and Nevada Creek, and key tributary drainages, should be initiated in 2003. The Poorman Creek and Sandbar Creek monitoring requirements are covered in items 2 and 3 above. For the Blackfoot River, additional surface water and sediment sampling will be required to identify metals loading sources and mechanisms within the Upper Marsh, and to characterize possible

metals loading sources in the lower marsh complex. Surface water sampling is needed from select tributaries flowing into the Upper Marsh in addition to key tributaries flowing into the Blackfoot River downstream of the Upper Marsh.

5. Seek Funding Mechanisms:
   Immediate efforts should focus on possible funding mechanisms for implementation of these action items. Possible funding mechanisms are discussed in Section 6.2 and in Appendix D. Funding may be pursued by private stakeholders, such as the Blackfoot Challenge, and/or State and Federal government agencies.

6.5 Adaptive Management Approach to Restoration

The water quality restoration targets and associated metals TMDLs presented in this water quality restoration plan are based on the goal of ultimate compliance with the B-1 classification water quality standards. Therefore, it is imperative that all significant sources of metal loading be addressed via all reasonable land, soil, and water conservation practices so that the restoration targets (and thus the B-1 standards) are met to the extent considered achievable. It is recognized however, that in spite of all reasonable efforts, attainment of the restoration targets may not be possible due to the potential presence of non-controllable human-caused sources and natural background sources of metals loading. For this reason, an adaptive management approach, consistent with the performance-based allocation approach for several water bodies within the UBMC Implementation Plan boundaries, is adopted for all metals targets including those for waters outside the UBMC Implementation Plan boundaries. Under this adaptive management approach, all metals identified in this plan as requiring restoration targets and TMDLs will ultimately fall into one of the three categories identified below:

1) The restoration targets are achieved or likely will be achieved due to the successful performance of restoration activities.
2) The target is not achieved and will likely not be achieved even though all applicable investigation and restoration activities have been undertaken in a manner consistent with all reasonable land, soil and water conservation practices. Under this scenario, site-specific water quality standards and/or a reclassification of the water body may be necessary. This would then lead to a new target (and TMDL) for the pollutant of concern, and this new target would either reflect the existing conditions at the time or the anticipated future conditions associated with the restoration work that was performed.
3) The target is not achieved and will not likely be achieved due, at least in part, to a failure to implement restoration actions in a manner consistent with all reasonable land, soil and water conservation practices. Under this scenario the water body remains impaired in recognition of the need for further restoration efforts associated with the pollutant of concern. The target may or may not be modified based on additional characterization efforts, but conditions still exist whereby additional pollutant load reductions are needed to support beneficial uses and meet applicable water quality standards via some form of additional restoration work.

For metals ultimately falling under Categories 1 or 2, restoration efforts will have been completed in a manner consistent with the restoration targets, which should allow applicable beneficial uses to be supported to the extent considered achievable. Continuous feedback associated with the performance of restoration work and follow-up monitoring will provide the information necessary to make decisions about the appropriateness of any given target. For the UBMC, this feedback will include the MDEQ reports to the Board of Environmental Review as required under the temporary water quality standards process, as well as review of post-implementation monitoring data from throughout the Blackfoot Headwaters TMDL Planning Area.

The MDEQ Remediation Division and/or MDEQ Standards Program personnel will provide the lead within MDEQ in making determinations concerning the appropriateness of specific mine cleanup activities relative to temporary standards requirements and/or Montana's expectations for mining cleanup efforts for any impairment condition associated with mining impacts. This includes consideration of appropriate evaluation of cleanup options, actual cleanup planning and design, as well as the appropriate performance and maintenance of the cleanup activities such as proper performance of any repository sites. Where NPDES permitted point sources are involved, the MDEQ Permitting Program personnel will also be involved. MDEQ TMDL program personnel will need to be involved in the above matters to ensure consistency in water quality restoration goals as they apply to beneficial use support. Determinations on the appropriate performance of all aspects of cleanup efforts, or lack thereof, will then be used along with available in-stream data to update impairment determinations. The information will also help determine any further cleanup/load reduction needs for any applicable water body and will ultimately help determine the appropriate target category as discussed above.

The U.S. Forest Service will be involved with some of the above decisions, especially where they involve work performed on or potentially impacting National Forest Lands. Other stakeholders, including opportunities for public comment, will also be involved as required under applicable regulations.

SECTION 7.0
PUBLIC AND STAKEHOLDER INVOLVEMENT

There have been several opportunities for public and stakeholder involvement in the development of this water quality restoration plan. The 303(d) lists that MDEQ develops every two years undergo public review, including public meetings. The draft version of this Water Quality Restoration Plan for Metals in the Blackfoot Headwaters underwent a one-month public comment period that started December 23, 2002. This included a public review notice with directions regarding how to access the Plan on the MDEQ website to encourage public input. MDEQ has reviewed and addressed the comments (Appendix F), with assistance from key stakeholders.

The Blackfoot Challenge has facilitated public and stakeholder involvement in cooperation with the Big Blackfoot Chapter of Trout Unlimited. Prior to and during the public comment period, a draft and a summary of this report was circulated via email to the Blackfoot Challenge Board, the Blackfoot Habitat and Water Quality Restoration Committee, ASARCO Incorporated, and other interested parties.

Because a large part of this overall plan revolves around restoration planning efforts for the Upper Blackfoot Mining Complex (UBMC), the public has had the opportunity to review and comment on the temporary standards and associated implementation work plan. Public involvement in the UBMC is any ongoing process through MDEQ and the Montana Board of Environmental Review public participation process.

Restoration work pursued outside the context of the UBMC will typically involve numerous stakeholders, including the affected public. There is a high level of stakeholder interest in metals related issues because of impacts to such a key fishery as the Blackfoot River and due to impacts on important species such as bull trout and westslope cutthroat trout. Additional areas for public and stakeholder involvement and comment may include comment on eventual target categories as described in Section 6.5 of the Plan. Public comment on target categories will be facilitated via comments on UBMC restoration plans, agency decisions associated with temporary standards or water body classifications, and/or comment on restoration plans outside the context of UBMC project.

Any future significant revisions to this plan or identification of water quality impairment conditions on future 303(d) lists will also undergo public review.

SECTION 8.0 REFERENCES

Bahls, L. L. 2001. Support of Aquatic Life Uses in the Upper Blackfoot River and Tributaries Based on the Composition and Structure of the Benthic Algae Community. Prepared for the Montana Department of Environmental Quality. August 29, 2001.

BioAnalysts, Inc. 1996. Assessment of Fish Populations in the Upper Blackfoot River Basin. Prepared for Seven-Up Pete Joint Venture.

Bollman, W. 2002. An Analysis of the Aquatic Invertebrate and Habitat of Streams in the Blackfoot River Watershed. Prepared for the Montana Department of Environmental Quality. April, 2002.

Confluence Consulting, DTM Consulting. 2002. Blackfoot Headwaters Planning Area Phase I Assessment. Prepared for Blackfoot Challenge. March 15, 2002.

Dames and Moore. 1975. Design Report on Repair of the Tailings Embankment, Mike Horse Mine Near Lincoln, MT. Prepared for the Anaconda Company.

Dames and Moore. 1980. Report on 1980 Construction Activities and Supervision, Mike Horse Dam-Heddleston Property Near Lincoln, Montana. Prepared for the Anaconda Company.

Furniss, G. 1998. Holocene Ferricrete of Paymaster Creek Reveals Natural Acid Drainage History, Heddleston Mining District, Lewis and Clark County, MT. In Northwest Geology, v.28, p21-25.

Hydrometrics, Inc. 1999. Support Document and Implementation Plan for Temporary Modification of Water Quality Standards for a Portion of Mike Horse Creek, a Portion of Beartrap Creek, and a Portion of the Upper Blackfoot River. Prepared for ASARCO Incorporated. October 1999.

Hydrometrics, Inc. 2000. Implementation Plan in Support of Petition for Adoption of Temporary Water Quality Standards, Upper Blackfoot Mining Complex. Prepared for ASARCO Incorporated. August 2000.

Hydrometrics, Inc. 2001a. 2000 Monitoring Activities Report for the Upper Blackfoot Mining Complex. Prepared for ASARCO Incorporated. March 2001.

Hydrometrics, Inc. 2001b. Letter Report on Mike Horse Mine Tailings Impoundment Investigation from Hydrometrics, Inc. to the U.S. Forest Service and the Montana Department of Environmental Quality. August 20, 2001.

Hydrometrics, Inc. 2002. Draft 2001 Monitoring Activities Report for the Upper Blackfoot Mining Complex. Prepared for ASARCO Incorporated. May 2002.

Jones, D.S., G.W. Suter II, and R.N. Hull. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1997 Revision. U.S. Department of Energy Document ES/ER/TM-95/R4. November 1997.

Lawlor, S.M. 2000. Streamflow and Water-Quality Data for the Blackfoot River Basin, Western Montana, September 1995-May 1997. U.S.G.S. Open File Report 00-80. April 2000.

Long, E.R., and L.G. Morgan. 1990. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. National Oceanic and Atmospheric Administration. Seattle, WA.

Menges, J. 1997. Investigation of Temporal Changes of Heavy Metal Concentrations in Sediments and Water of the Blackfoot River, Montana. University of Montana Masters Thesis. March 1997.

Montana Department of Environmental Quality. 2001a. Preliminary Assessment Report-Blackfoot Headwaters Planning Area, Version 2. July 2001.

Montana Department of Environmental Quality. 2001b. Water Quality Bulletin WQB-7.

Montana Department of Environmental Quality 2001c. Nonpoint Source Management Plan.

Montana Department of Environmental Quality. 2002. Water Quality Assessment Process and Methods. 303(d) list, Appendix A. Montana Department of Environmental Quality - Monitoring and Data Management Bureau, Helena, MT.

Montana Department of State Lands. 1995. Abandoned Hardrock Mine Priority Sites, 1995 Summary Report. Prepared by the Abandoned Mine Reclamation Bureau. April 1995.

Moore, J. N. 1990. Mine Effluent Effects on Non-Point Source Contaminants in the Blackfoot River, Montana. Prepared for Lewis and Clark City-County Health Department and Montana Department of Health and Environmental Sciences.

Nagorski, S., T., McKinnon, J. Moore, and D. Smith. 2000. Geochemical Characterization of Surface Water and Streambed Sediment of the Blackfoot River, Montana During Low Flow Conditions, August 16-20, 1998. USGS Open File Report 00-003.

PTI Environmental Services. 1993. Upper Blackfoot Mining Complex Phase 1 Data Report. Prepared for Asarco, Inc. and ARCO. August 1993.

Roberts, S.M. 1986. A guide to Proterozoic Rocks of Western Montana and Adjacent Areas.

U.S. Environmental Protection Agency. 2001. Metals and pH TMDLs for the Tygart Valley River Watershed, West Virginia. USEPA Region 3. March 2001

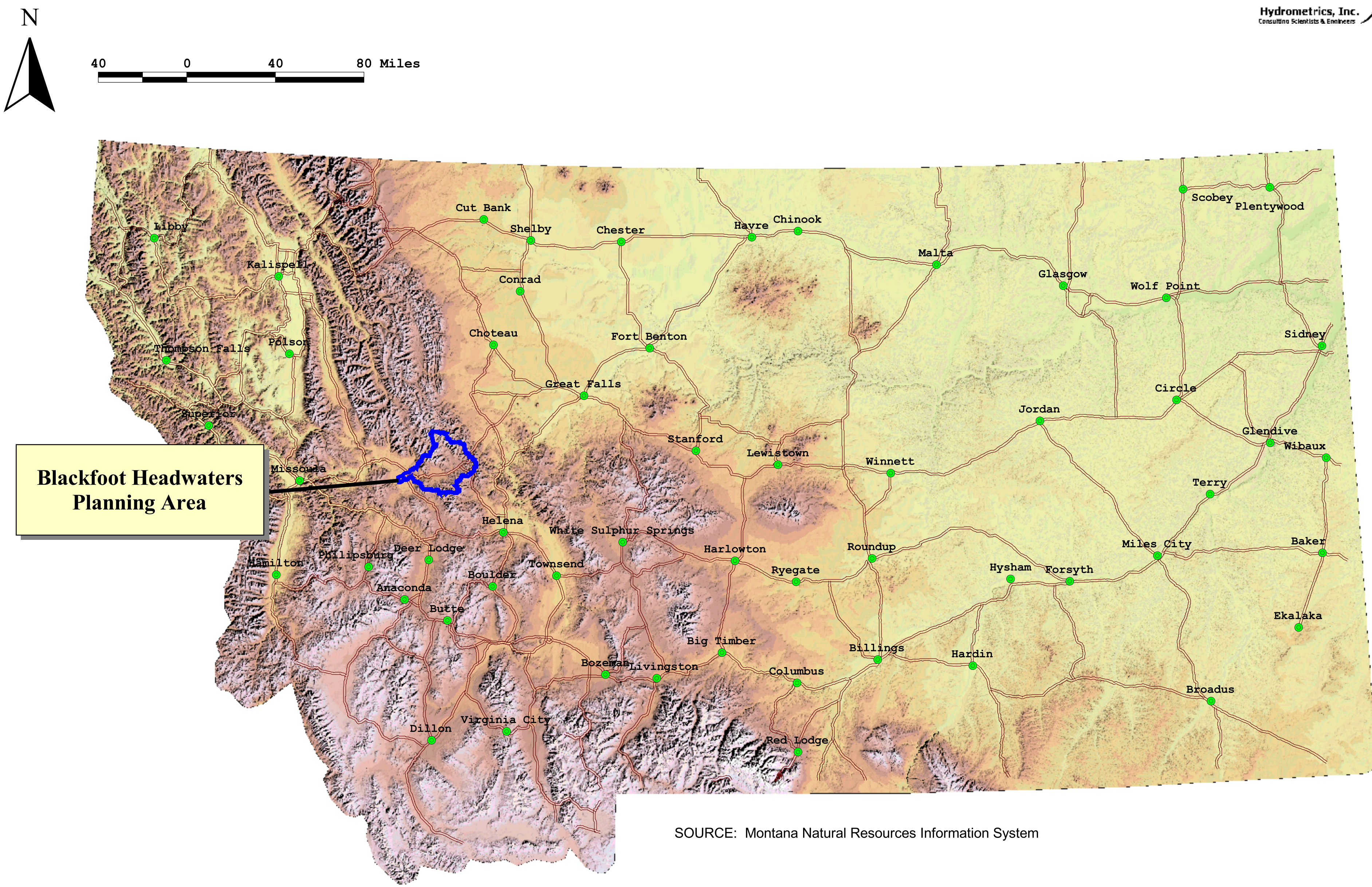
U.S. Environmental Protection Agency. 1999. Protocol for Developing Sediment TMDLs, Office of Water, 4503 F, Washington DC 20460. EPA 841-B-99-004

U.S. Environmental Protection Agency. 1991. Guidance for Water Quality Based Decisions: The TMDL Process.

FIGURES

Figure 1-1. Blackfoot Headwaters Planning Area General Location Map
Figure 1-2. Blackfoot Headwaters TMDL Planning Area
Figure 2-1. Sandbar Creek Drainage Showing Listed Stream Segment, Water Sampling Locations, and Other Relevant Features
Figure 3-1. Poorman Creek Drainage Showing Listed Stream Segment, Water Sampling Locations, and Other Relevant Features
Figure 4-1. Surface Water Monitoring Sites and Metals Loading Sources to the Impaired Segment of Beartrap Creek
Figure 4-2. 2001 Seasonal Metals Loading Trends in Mike Horse and Beartrap Creeks
Figure 5-1. Blackfoot River Drainage from Headwaters to the Confluence with Landers Fork
Figure 5-2. Historic Mining and Water Resource Features Within the Upper Blackfoot Mining Complex
Figure 5-3. Blackfoot River 2001 Loading Trends Upstream of Pass Creek
Figure 5-4. Blackfoot River Loading Trends Downstream of Pass Creek

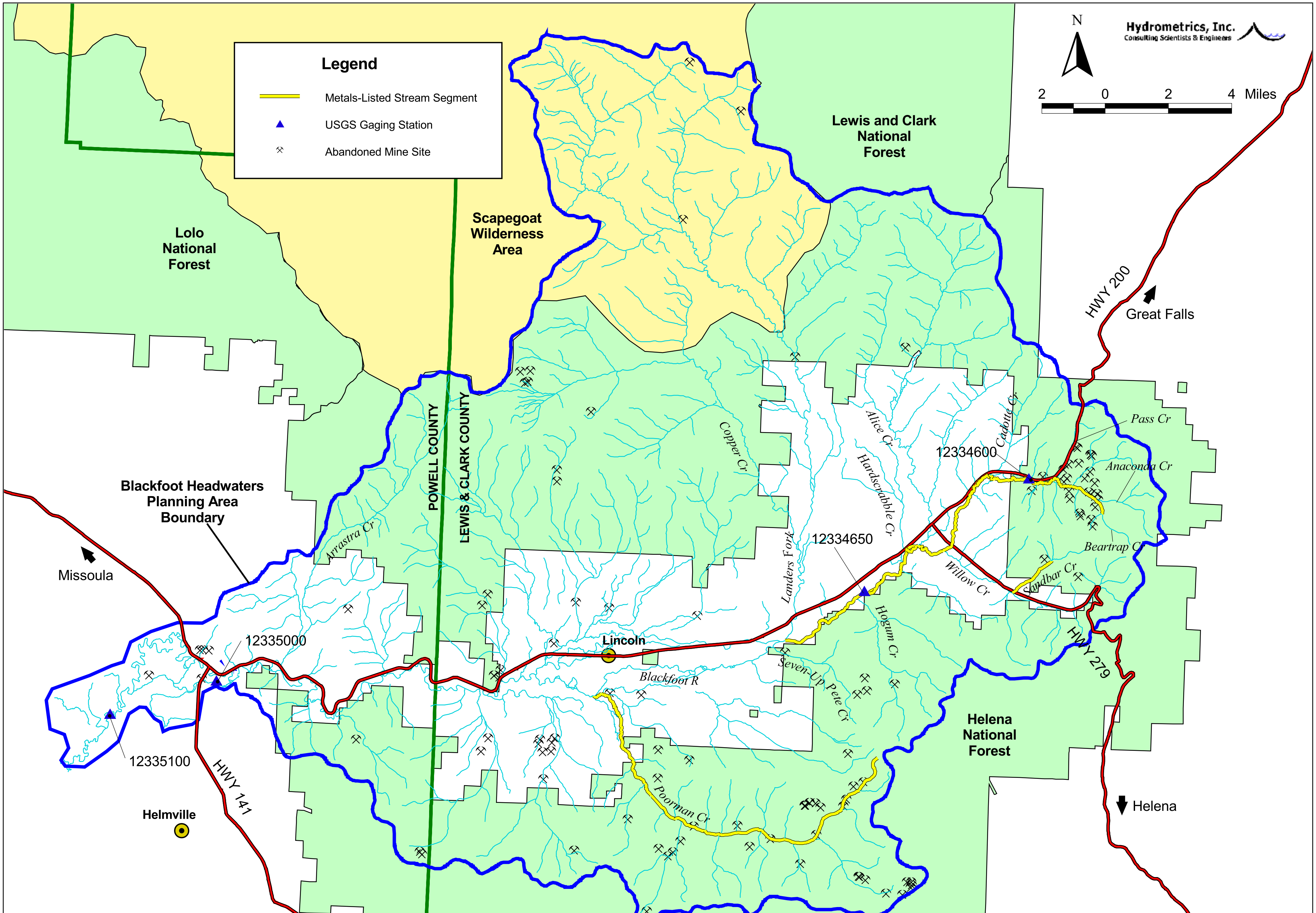
Hydrometrics, Inc.
Consulting Scientists & Engineers



SOURCE: Montana Natural Resources Information System

K:\PROJECT\2020\MAPPING\LOCATION MAPS\BLACKFOOT HW.APR\LAYOUT 2

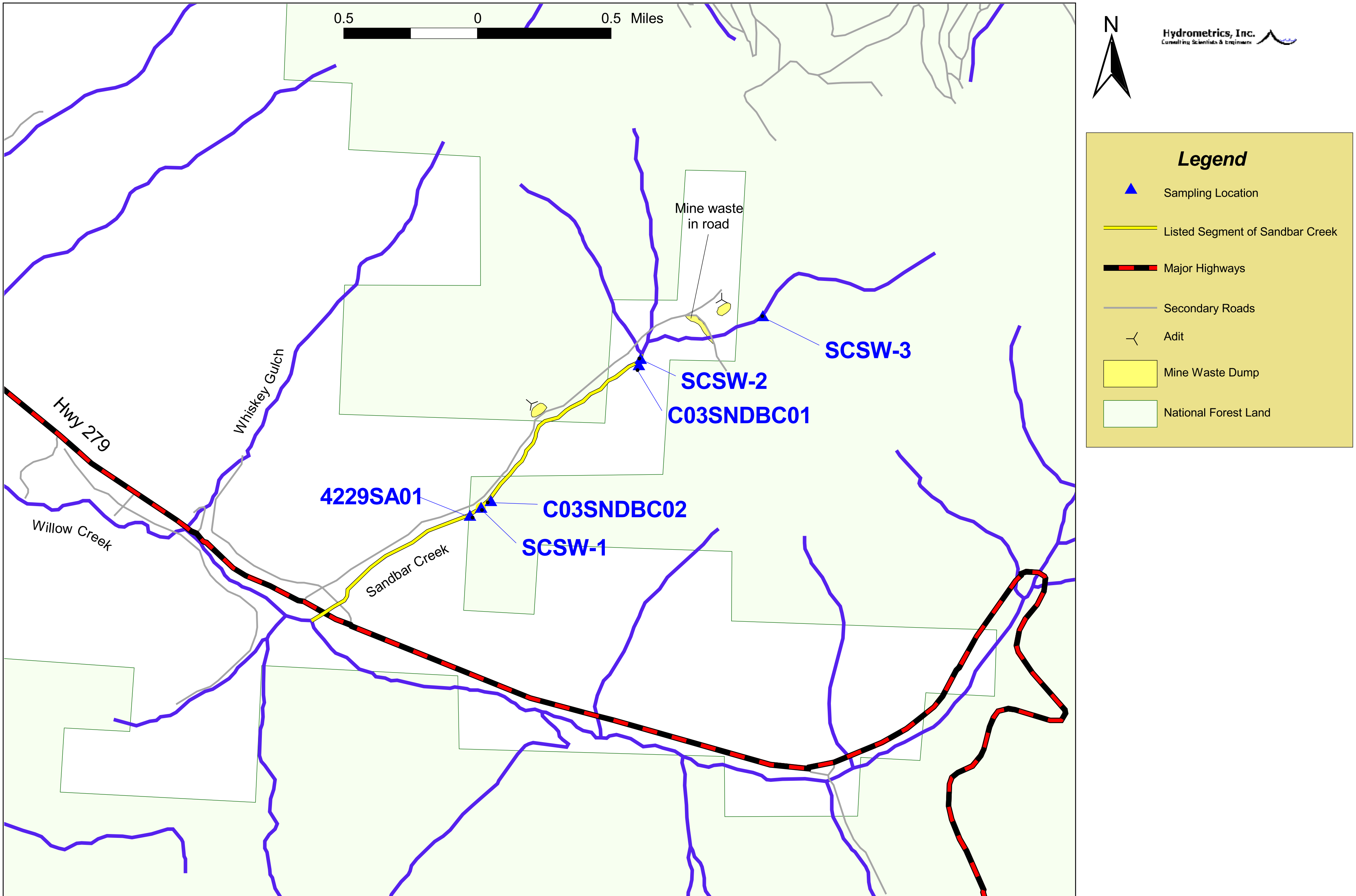
Water Quality Restoration Plan for the Blackfoot Headwaters TMDL Planning	Blackfoot Headwaters Planning Area General Location Map	FIGURE 1-1



Water Quality Restoration Plan for the Blackfoot Headwaters TMDL Planning Area	Blackfoot Headwaters TMDL Planning Area	FIGURE 1-2

SOURCE: Montana Natural Resources Information System

K:\PROJECT\2020\MAPPING\LOCATION MAPS\BLACKFOOT HW.APR\LAYOUT 1

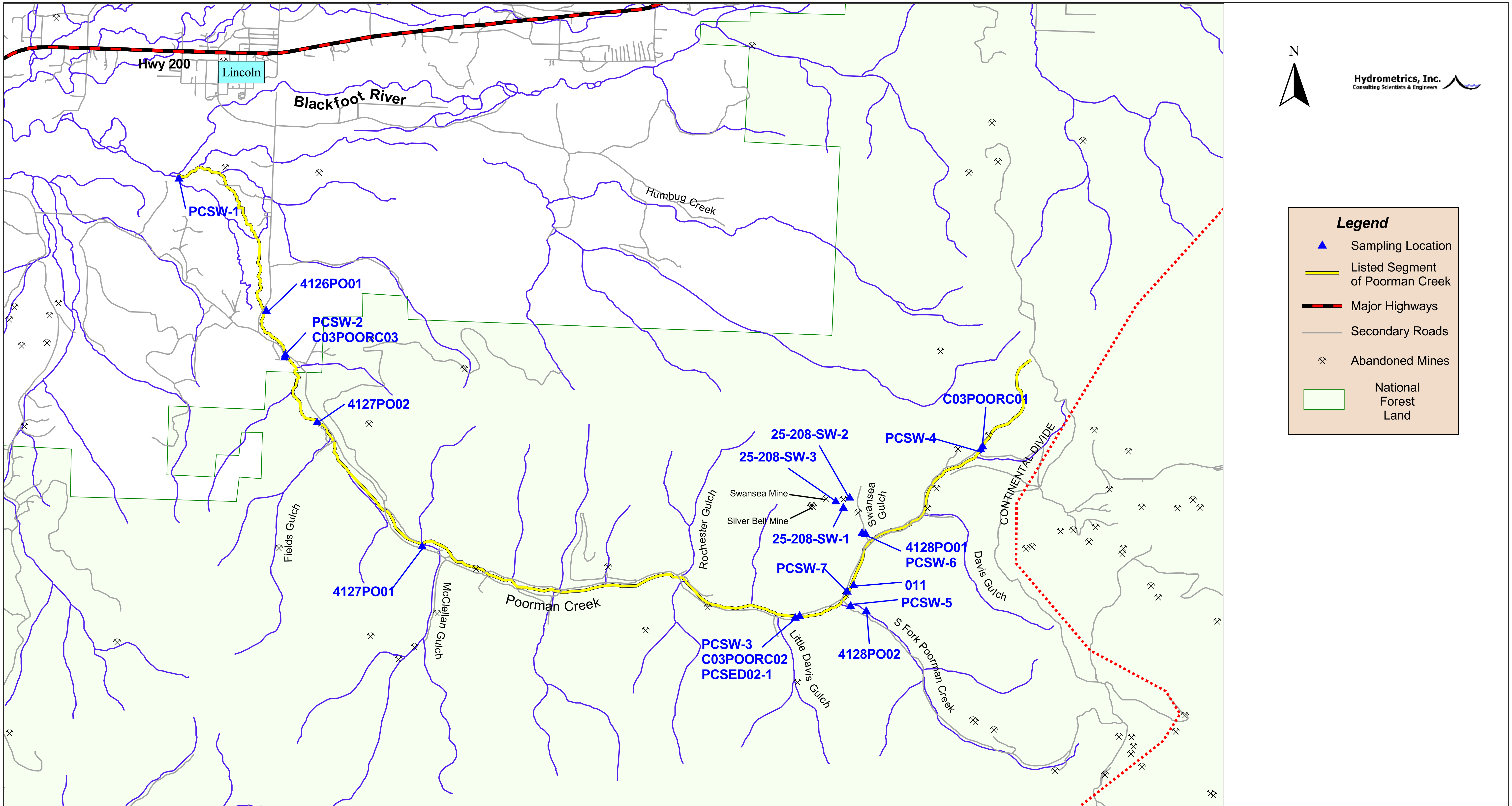


Water Quality Restoration Plan for the Blackfoot Headwaters TMDL Planning Area

Sandbar Creek Drainage Showing Listed Stream Segment, Water Sampling Locations, and Other Relevant Features

FIGURE 2-1

K:\PROJECT\2020\MAPPING\SANDBAR CR\SANDBAR.APR\Layout 1

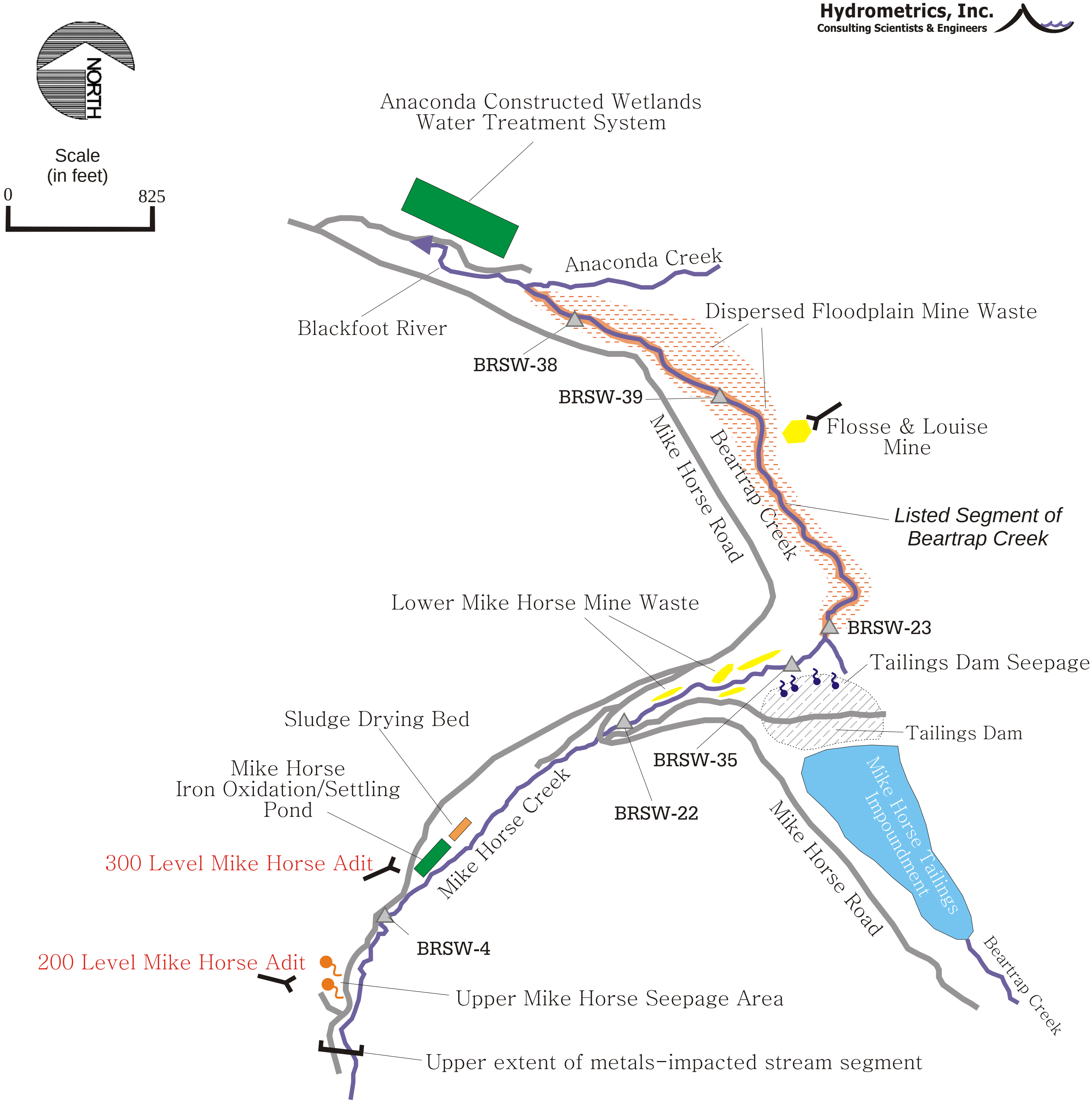


Source of Base: Montana Natural Resources Information System (NRIS)

Water Quality Restoration Plan for the Blackfoot Headwaters TMDL Planning Area	Poorman Creek Drainage Showing Listed Stream Segment, Water Sampling Locations, and Other Relevant Features	FIGURE 3-1

K:\PROJECT\2020\MAPPING\POORMAN CR\POORMAN.APR\Layout 1

Hydrometrics, Inc.
Consulting Scientists & Engineers



NOTE: Stream, road, and sample location features captured with Global Positioning System. Other feature locations are approximate.

Water Quality Restoration Plan for the Blackfoot Headwaters TMDL Planning Area	**SURFACE WATER MONITORING SITES AND METALS LOADING SOURCES TO THE IMPAIRED SEGMENT OF BEARTRAP CREEK**	**FIGURE 4-1**

K:\PROJECT\2020\BEARTRAP.CDR

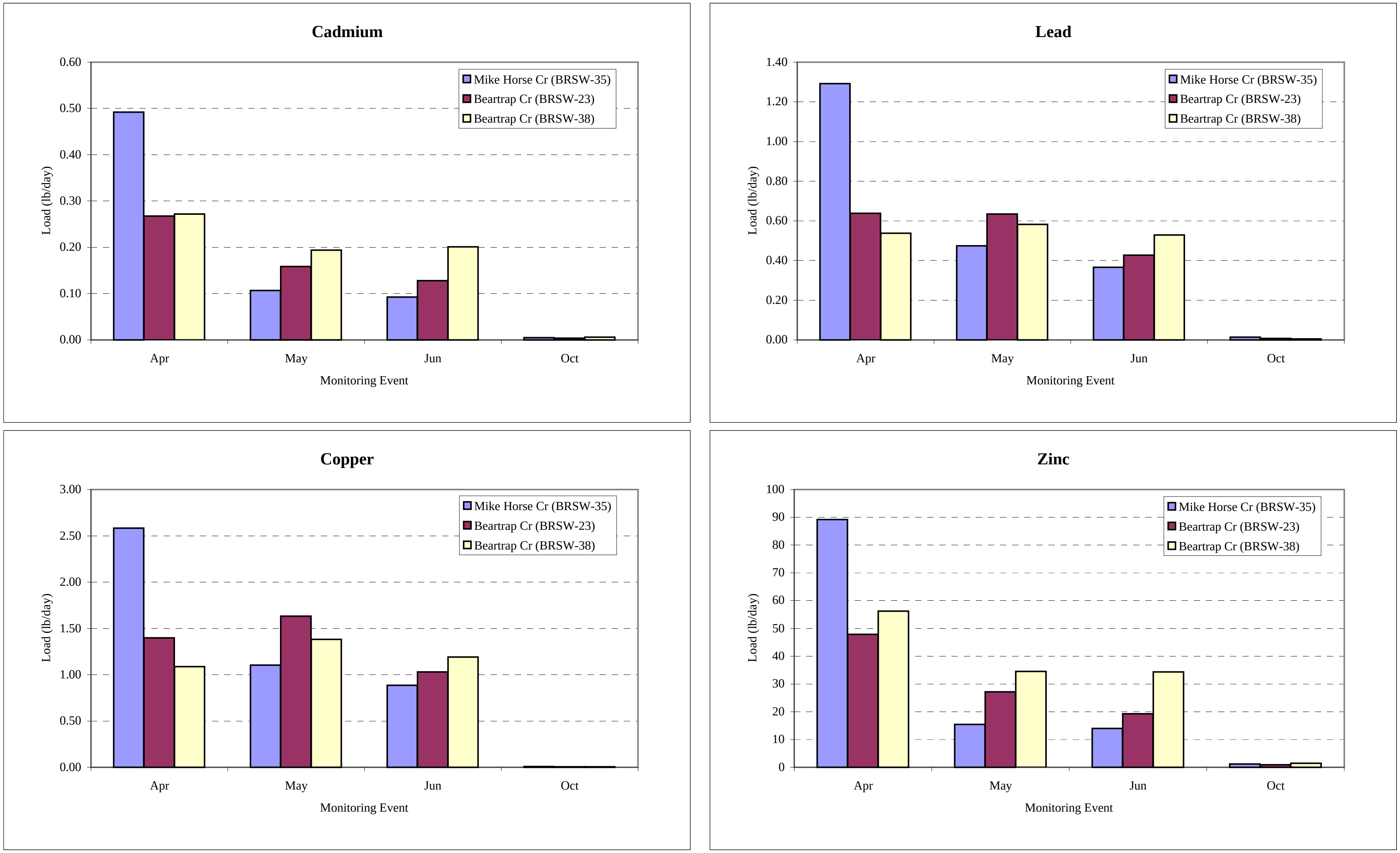
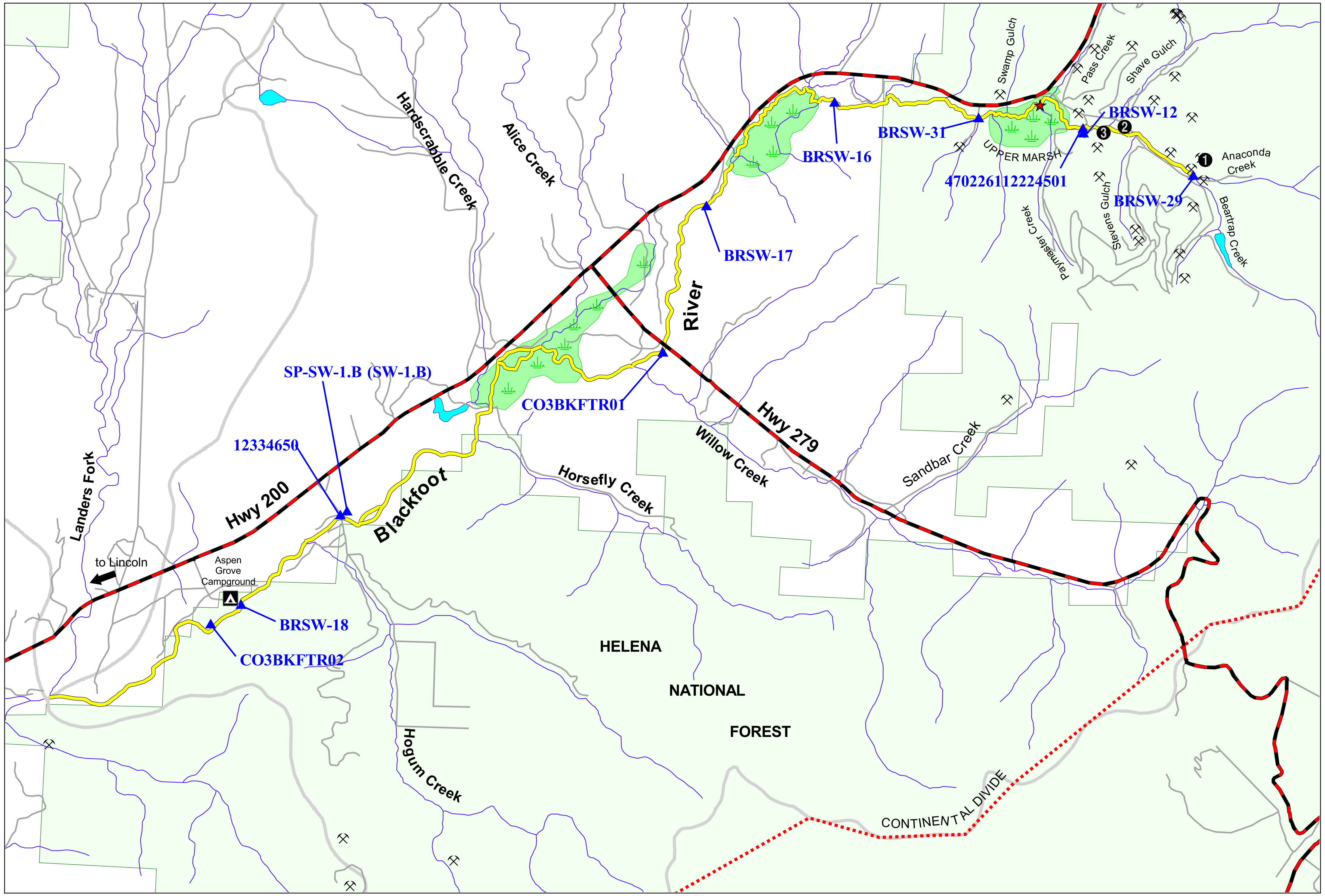


FIGURE 4-2.
2001 SEASONAL METALS LOADING TRENDS IN MIKE HORSE AND BEARTRAP CREEKS

Hydrometrics, Inc.
Consulting Scientists & Engineers



N

Legend

- ▲ Sampling Location
- Listed Segment of Blackfoot River
- Major Highways
- Secondary Roads
- Marsh Area
- National Forest Land
- ⚒ Abandoned Mines

Upper Blackfoot Mining Complex Loading Sources

1. Constructed Wetlands Water Treatment System Discharge
2. Concentrated Tailings Area
3. Dispersed Floodplain Tailings Area

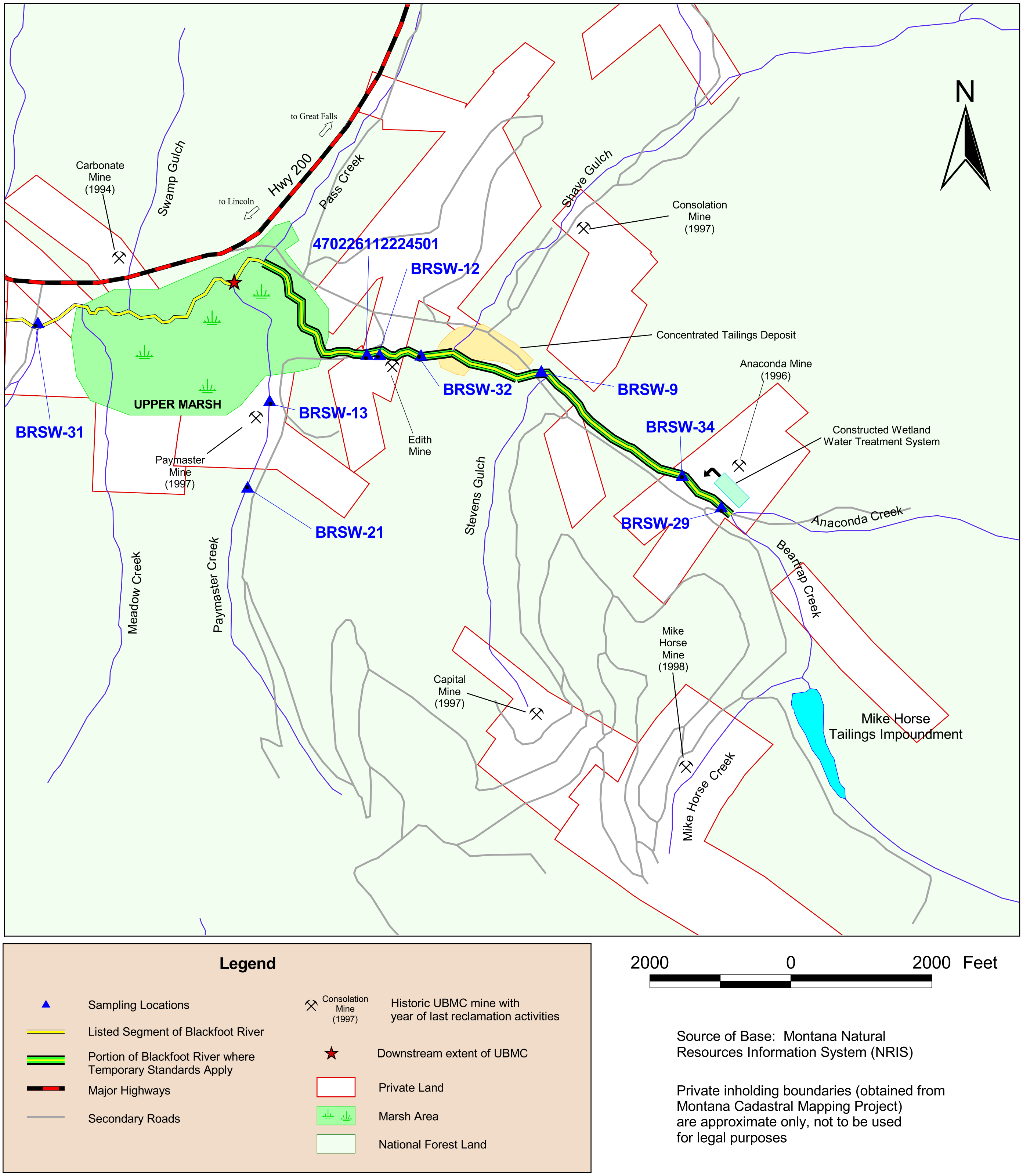
★ Downstream Extent of UBMC

1 0 1 Miles

Source of Base: Montana Natural Resources Information System (NRIS)

K:\PROJECT\2020\MAPPING\BLACKFOOT ABOVE LF\BLACKFOOTHW.APR\Headwaters Layout
10/4/02 0845

Water Quality Restoration Plan for the Blackfoot Headwaters TMDL Planning Area	Blackfoot River Drainage from Headwaters to the Confluence with Landers Fork	FIGURE 5-1



Source of Base: Montana Natural Resources Information System (NRIS)

Private inholding boundaries (obtained from Montana Cadastral Mapping Project) are approximate only, not to be used for legal purposes

Water Quality Restoration Plan for the Blackfoot Headwaters TMDL Planning Area	Historic Mining and Water Resource Features within the Upper Blackfoot Mining Complex	FIGURE 5-2

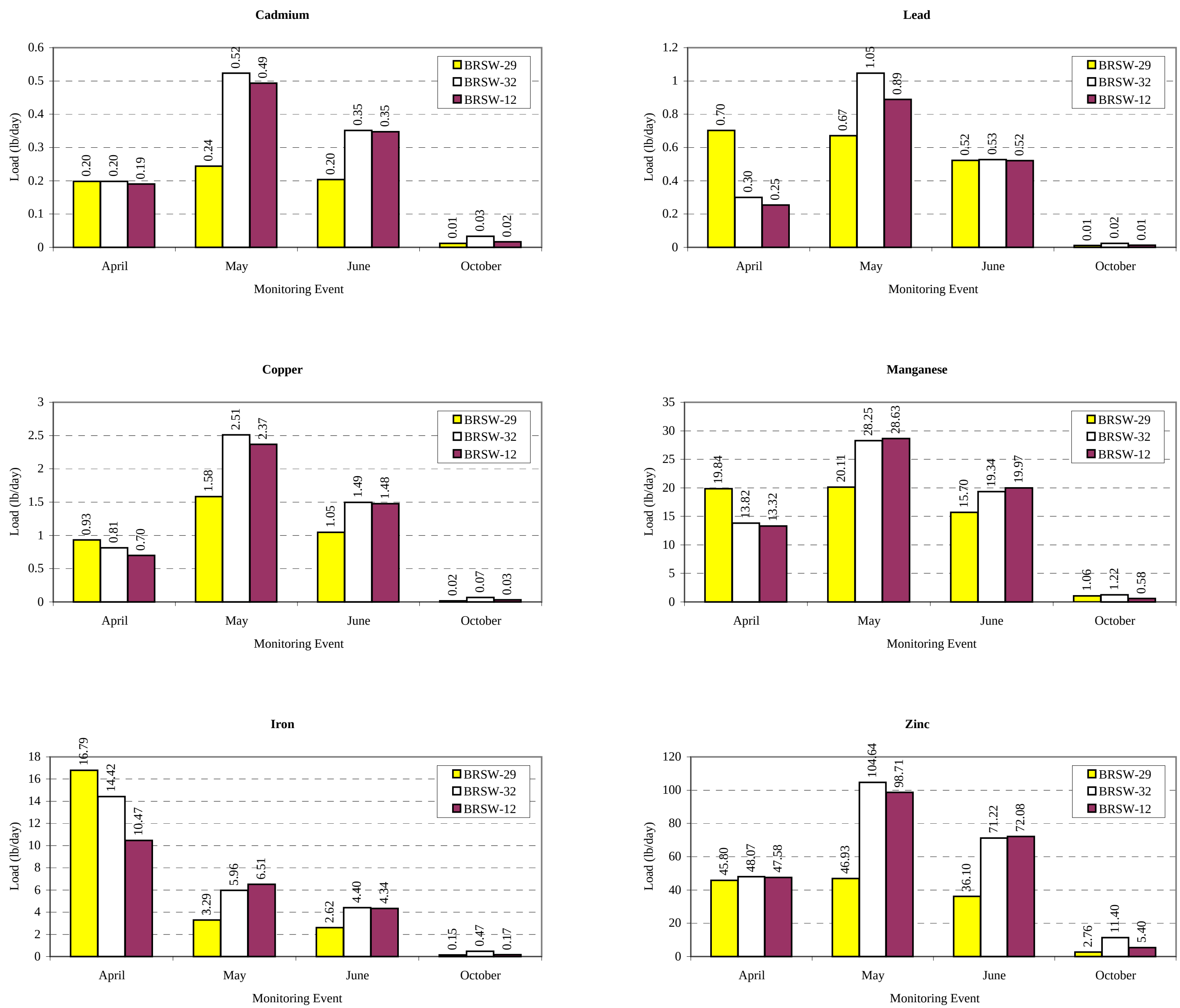
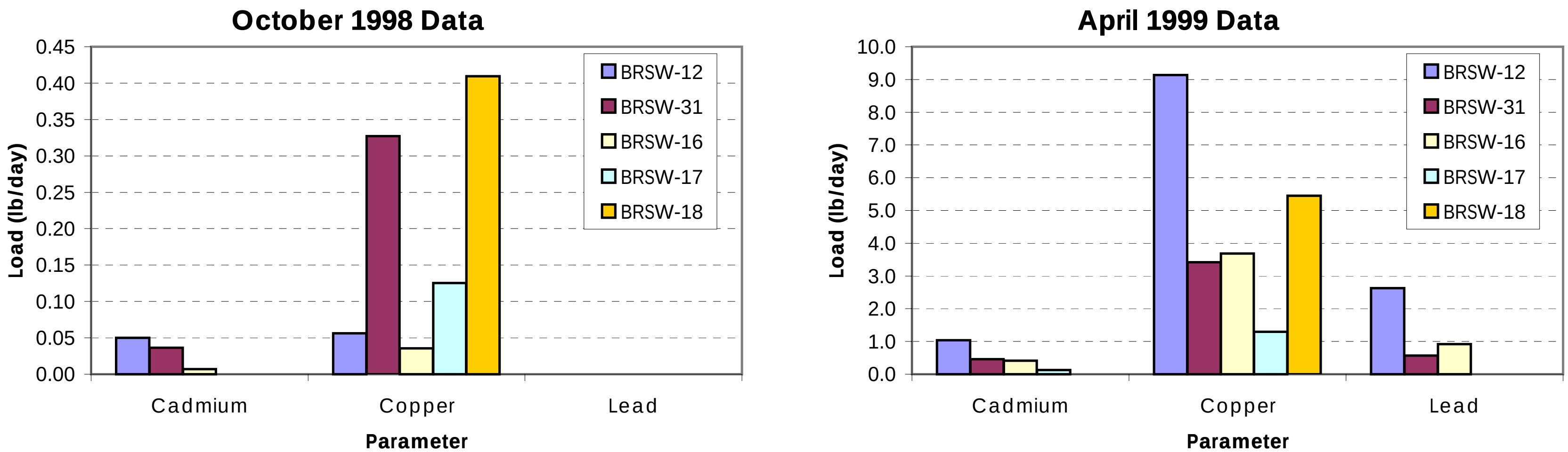


FIGURE 5-3
BLACKFOOT RIVER 2001 LOADING TRENDS UPSTREAM OF PASS CREEK



NOTE: For concentrations reported as below detection limits, no load was calculated.

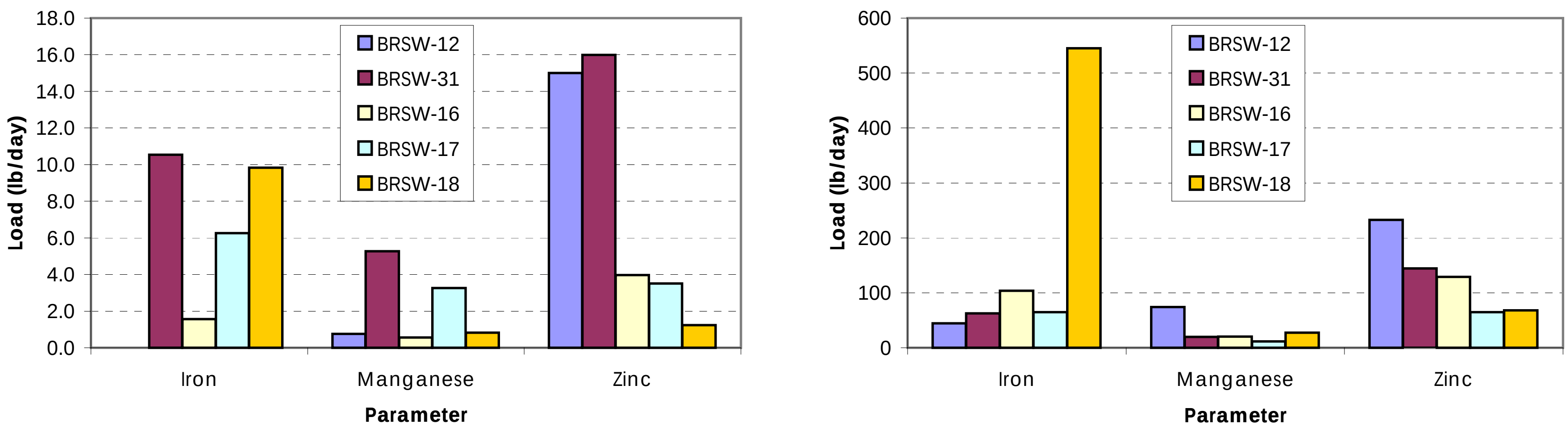


FIGURE 5-4.
BLACKFOOT RIVER LOADING TRENDS DOWNSTREAM OF PASS CREEK

APPENDIX A
TOTAL MAXIMUM DAILY LOAD (TMDL)
DEFINITION, PURPOSE, AND CALCULATION

Definitions

A TMDL is defined under Section 75-5-103 of the Montana Water Quality Act as follows:

"**Total Maximum Daily Load** or TMDL means the sum of the individual waste load allocations for point sources, and load allocations for nonpoint sources and natural background sources, established at a level necessary to achieve compliance with applicable surface water quality standards" (MCA 75-5-103 (32)).

A TMDL can also be viewed as a plan, or pollutant budget, establishing the maximum amount of a pollutant that a water body can assimilate (the water body loading capacity) without exceeding applicable water quality standards. TMDLs are often expressed in terms of an amount, or load, of a particular pollutant (expressed in units of mass per time such as pounds per day). TMDLs can also be expressed as the maximum allowable concentration of a parameter, as a required load reduction, or as specific mandates ensuring that water quality standards are met (e.g., no toxic concentrations of sediment metals concentrations).

"**Loading capacity** means the mass of a pollutant that a water body can assimilate without a violation of water quality standards. For pollutants that cannot be measured in terms of mass, it means the maximum change that can occur from the best practicable condition in a surface water without causing a violation of the surface water quality standards" (75-5-103-15).

"**Waste load allocation** means the portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources" (75-5-103-34).

"**Load allocation** means the portion of a receiving water's loading capacity that is allocated to one of its existing or future nonpoint sources or to natural background sources" (75-5-103-14).

Together, the above defined terms along with a margin of safety comprise the TMDL as follows:

TMDL = Loading Capacity = SUM of Waste Load Allocations + SUM of Load Allocations + Margin of Safety

The **margin of safety (MOS)** is included in the TMDL equation to account for uncertainty regarding the relationship between pollutant loads and receiving water quality (CWA 303(d)(1)(C)). The margin of safety is typically incorporated into a TMDL through use of conservative assumptions during TMDL development, referred to as an implicit MOS. An MOS can also be included as a specific amount, or percentage of the total TMDL, referred to as an explicit MOS (EPA, 1999). TMDLs for nonpoint sources typically rely on post-TMDL Implementation Monitoring as an MOS to ensure that the TMDL targets are met. An implicit

MOS, including post-implementation monitoring, has been utilized for the Blackfoot Headwaters Planning Area metals TMDL.

Purpose of A TMDL

A TMDL provides a framework for identification and prioritization of sources and causes of water quality impairment in a watershed, and to direct restoration efforts required to attain compliance with water quality standards and restore beneficial uses. By providing this information, the TMDL serves as a blueprint for water quality restoration planning within all, or a portion of, a watershed. The term *water quality restoration plan* is often used to more effectively describe a TMDL document, such as this one, which presents a TMDL and associated information required for water quality restoration planning.

TMDL Development for Blackfoot Headwaters Planning Area

Section 303(d) of the Federal Clean Water Act requires that TMDLs be establish at a level, which accounts for seasonal variability in water body conditions. For metals, the stream loading capacity, and thus the TMDL, is a function of the streamflow rate (dilution capacity). For certain metals (i.e., cadmium, copper, lead, zinc) the numeric water quality criteria (target metals concentrations for the TMDL) are a function of water hardness. Therefore, the TMDL must be developed in such a manner to ensure that water quality standards are met under any streamflow or water hardness conditions.

In order to accomplish this, the Blackfoot Headwaters metals TMDLs are presented as an equation yielding the stream loading capacity for any given streamflow and water hardness.

TMDL (lb/day) = X (μg/L)(Y cfs)(0.0054)

Where:

X= the numeric water quality criteria in micrograms per liter (parts per billion) for a specific metal adjusted for water hardness as necessary;

Y= streamflow rate in cubic feet per second;

0.0054 = conversion factor.

Throughout this document, flow data is given in cubic feet per second (cfs or ft^3/sec) and concentration data for most pollutants is in micrograms per liter (ug/l), which is the equivalent of parts per billion. The equation identifies the overall loading capacity to the stream under any conditions and at any time.

Water Quality Restoration Targets

Water quality restoration targets are identified in the water quality restoration plan to serve as TMDL goals, or endpoints. For metals in the Blackfoot Headwaters Planning Area, restoration targets consist of numeric water quality targets, aquatic life support targets, and stream sediment targets

Numeric Water Quality Targets

For most metals, water quality restoration targets are based on the numeric water quality standards, or criteria, included in State water quality standards (MDEQ WQB-7). The numeric water quality criteria represent the maximum concentration of a specific metal allowable in State surface waters by Montana law, and are based on protection of intended beneficial uses (i.e., aquatic life support, drinking water supply).

With the exception of aluminum, the water quality restoration targets for all metals in this plan are based on the total recoverable fraction. The aluminum restoration targets are based on the dissolved fraction in accordance with the state of Montana water quality standards (WQB-7).

Water Hardness/Water Quality Restoration Target Interdependence

For copper, cadmium, lead, and zinc (and some other metals), the aquatic water quality criteria are dependent on the water hardness (Reference WQB-7; Note 12). The chronic aquatic life standard equation for these metals is identified below (WQB-7 also provides the applicable equation for acute aquatic life standards):

$$(X\ ug/l) = \exp\{mc[\ln(hardness)] + bc\}$$

where:

X = the chronic aquatic life standard calculated as a function of hardness
mc = constant that varies by metal; values provided in WQB-7;
bc = constant that varies by metal; values provided in WQB-7;
hardness = hardness value in mg/l $CaCO^3$; (use 400 if >400 and 25 if <25)

For aluminum, iron, and manganese, the standard and associated targets are not a function of hardness.

Application of Iron and Manganese Standards

Iron and manganese, unlike cadmium, copper and most other metals addressed in this restoration plan, are not classified as toxins or carcinogens. Consequently, narrative standards have been adopted for these metals to ensure protection of most designated uses as opposed to specific numeric standards. WQB-7 states that concentrations of these parameters "must not reach values that interfere with the uses specified in the surface and groundwater standards". WQB-7 further states that the Secondary Maximum Contaminant Levels established by EPA (based on protection of aesthetic issues such as taste, odor, staining) of 300 μg/L (micrograms per liter, or parts per billion) for iron and 50 μg/L for manganese may be considered as guidance in determining if a certain concentration interferes with the specified uses. In addition to the general narrative standard, iron has a numeric chronic aquatic life standard of 1,000 μg/L.

For the Blackfoot Headwaters Planning Area, the guidance values stated above were used in conjunction with other anecdotal information to determine if concentrations of iron or manganese constitute impairment of a water body. For instance, in cases where iron and/or manganese exceed the guidance values in a water body, consideration was given to the number of measurements exceeding the guidance values and the level of the exceedence(s). Exceedences of iron can also be less of a concern since iron will tend to be in a particulate (total recoverable) versus dissolved form during higher flows, allowing for some removal via conventional treatment (reference ARM 17.30.623(2)(h)(i)). If the data showed that either guidance value would be exceeded on a consistent basis and exceeded by a significant margin after conventional treatment, the water body was considered impaired for iron and/or manganese. Ultimately, the measure of compliance with the drinking water standards for iron and manganese is based on the need for B-1 waters being suitable for drinking, culinary and food processing purposes after conventional treatment.

For iron, water quality data were also compared to the chronic aquatic life criteria of 1,000 μ/L. Water bodies exceeding the aquatic criteria for iron were considered impaired for the beneficial uses of aquatic life and cold water fish. There is no aquatic life standard for manganese in WQB-7, although potential toxic impacts associated with elevated levels of manganese, as well as iron, in sediment chemistry is considered.

The above approaches for making iron and manganese impairment determinations are also applied toward setting and evaluating compliance with iron and manganese targets.

Aquatic Life Support Restoration Targets

In addition to the numeric water quality criteria, restoration targets in this plan are also based on biotic indicators of macroinvertebrate and periphyton communities. These biota indicators must show no metals-related impediments to full support conditions when compared to a known reference condition as defined in MDEQ's water quality assessment process and methods document (MDEQ, 2002). Reference conditions may be determined by collecting regional reference data from a different water body possessing similar geology, hydrology, morphology and habitat conditions, and exhibiting minimal anthropogenic impacts and/or all reasonable land, soil and water conservation practices having been applied. Reference conditions can also be determined locally through comparison to a different segment of the same water body, such as an unimpaired segment from the same stream, or through comparison to an unimpaired stream segment in the same watershed. Local reference condition development must also consider most or all of the same criteria considered in the development of regional reference conditions.

MDEQ has developed criteria for macroinvertebrates and periphyton that shall be used as targets when a local reference site is not available. The sampling protocols and criteria are documented within Montana's SOP manual in Sections 12.1.2.4 and 12.1.3.3. Targets must use the criteria for the appropriate ecoregion that reflect aquatic beneficial use support conditions. Generally, if a stream is within 75% of the reference condition it is considered to be fully supporting. Although the goal is to be equal to the reference condition, this overall reference condition approach and the use of 75% value accounts for variations in natural systems and analytical methods used to compare conditions in one stream with conditions in another. Where this variability can be reduced, for example under conditions of more localized reference condition information, then a higher number than 75% can and should be used, which is why the 75% value has not been specifically incorporated into any of the targets.

Stream Sediment Metals Concentration Targets

Since there are no numeric limits for metals in sediments as there are for water, a narrative restoration target/criteria is established mandating that stream sediment metals concentrations may not impede beneficial uses (focus is protection of aquatic life). Compliance with this target will be determined through comparison of sediment metals concentrations to published values denoting potentially harmful conditions for aquatic life, in conjunction with biological assemblage sampling to verify if the aquatic life support beneficial use is being achieved. MDEQ will be developing screening level sediment criteria for evaluating potential impacts from stream sediment metals concentrations in the future. Once developed, the criteria will be used to help determine compliance with the restoration target and as an indicator of potential upstream impairment conditions.

Applicable Narrative Water Quality Standards

ARM 17.30.623(2)(h)(i):

> "*Concentrations of carcinogenic, bioconcentrating, toxic or harmful parameters which would remain in the water after conventional water treatment may not exceed the applicable standards set forth in department Circular WQB-7*"

ARM 17.30.623(2)(c):

> "*Induced variations of hydrogen ion concentration (pH) within the range of 6.5 to 8.5 must be less than 0.5 pH unit. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0.*"

ARM 17.30.637(1):

> "*State surface waters must be free from substances attributable to municipal, industrial, agricultural practices or other discharges that will:*

ARM 17.30.637(1)(a):

> "*settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines;*"

ARM 17.30.637(1)(d):

> "*create concentrations or combinations of materials which are toxic or harmful to human, animal, plant or aquatic life;*"

ARM 17.30.602 Definitions:

17.30.602 (17):

> *"Naturally occurring " means conditions or material present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil and water conservation practices have been applied. Conditions resulting from the reasonable operation of dams in existence as of July 1, 1971 are natural.*

ARM 17.30.602(21):

"Reasonable land, soil, and water conservation practices" means methods, measures, or practices that protect present and reasonably anticipated beneficial uses. These practices include but are not limited to structural and nonstructural controls and operation and maintenance procedures. Appropriate practices may be applied before, during, or after pollution-producing activities.

MCA 75-5-103(30):

"Sufficient Credible Data" means chemical, physical monitoring data, alone or in combination with narrative information, that supports a finding as to whether a water body is achieving compliance with applicable water quality standards.

IMPLEMENTATION PLAN IN SUPPORT OF
PETITION FOR ADOPTION OF TEMPORARY WATER QUALITY STANDARDS
UPPER BLACKFOOT MINING COMPLEX
-Lewis and Clark County, Montana-

Prepared for:

ASARCO Incorporated
59148 Silver Valley Road
Osburn, ID 83849

Prepared by:

Hydrometrics, Inc.
2727 Airport Road
Helena, MT 59601

August 2000

TABLE OF CONTENTS

LIST OF TABLES iii

LIST OF FIGURES..iii

1.0 INTRODUCTION...1-1

2.0 WATER QUALITY TRENDS IN PETITIONED STREAM SEGMENTS.............2-1

2.1 MIKE HORSE CREEK 2-1

2.1.1 Potential Loading Sources to Mike Horse Creek...........................2-1

2.2 BEARTRAP CREEK...2-3

2.2.1 Potential Loading Sources to Beartrap Creek 2-4

2.3 BLACKFOOT RIVER..2-5

2.3.1 Potential Loading Sources to Blackfoot River..............................2-6

3.0 IMPLEMENTATION PLAN ACTIVITIES 3-1

3.1 MIKE HORSE CREEK DRAINAGE 3-1

3.2 BEARTRAP CREEK DRAINAGE...3-4

3.3 BLACKFOOT RIVER DRAINAGE 3-7

3.4 ENVIRONMENTAL MONITORING..3-10

3.4.1 Surface Water Quality Monitoring...3-11

3.4.1.1 Surface Water Monitoring Sites.....................................3-11

3.4.1.2 Surface Water Monitoring Schedule.............................3-11

3.4.1.3 Analytical Parameter List...3-11

3.4.2 Biological Monitoring..3-12

3.4.2 Evaluation of Monitoring Data 3-12

4.0 IMPLEMENTATION PLAN SCHEDULE 4-1

LIST OF TABLES

TABLE 4-1. IMPLEMENTATION PLAN SCHEDULE, UPPER BLACKFOOT MINING COMPLEX 4-2

LIST OF FIGURES

FIGURE 2-1. UPPER BLACKFOOT MINING COMPLEX PETITIONED STREAM SEGMENTS (I:\LAND PROJECTS\0018B201\DWG\0018B201H003.DWG) 2-2

IMPLEMENTATION PLAN IN SUPPORT OF
PETITION FOR ADOPTION OF TEMPORARY WATER QUALITY STANDARDS
UPPER BLACKFOOT MINING COMPLEX
-Lewis and Clark County, Montana-

1.0 INTRODUCTION

The Upper Blackfoot Mining Complex (UBMC) is an area of historic mining activity located at the headwaters of the Blackfoot River in Lewis and Clark County, Montana. A number of historic mines and related features are located at the UBMC on properties of mixed ownership. From 1993-1998, ASARCO Incorporated (Asarco), in partnership with ARCO, implemented a voluntary reclamation program at the UBMC focusing on mitigation of environmental impacts from historic mining disturbance on Asarco's patented mining claims. In October 1999, Asarco submitted a petition and support document to the Montana Department of Environmental Quality (MDEQ) and the Montana Board of Environmental Review (Board) seeking adoption of temporary water quality standards in portions of Mike Horse Creek, Beartrap Creek, and the Upper Blackfoot River. Water quality in these stream reaches has been impacted by historic mining activities and may have been impacted by other potential sources, (e.g., natural sources). Adoption of temporary water quality standards was sought by Asarco to allow additional in-stream reclamation activities to occur, and to provide time for optimization of a passive water treatment system constructed in 1996 by Asarco and regulated under the Montana Pollutant Discharge Elimination System (MPDES) program. The Board approved adoption of the temporary standards as of June 1, 2000 for a period of eight years, with up to two additional years allotted if land access and other negotiations between the U.S.D.A. Forest Service and Asarco require more than one year to complete.

In accordance with MCA §75-5-312 (3)(c) and (3)(d), Asarco has prepared this implementation plan and schedule outlining a remedial action plan for identification and mitigation of remaining causes of water quality impairment in the three petitioned stream segments. As required under the temporary standards regulations, the plan addresses all potential sources of water quality impairment in the three petitioned stream segments, including potential sources not associated with Asarco properties, or mining activities not associated with Asarco or their predecessors. As such, implementation of the plan will likely require the involvement of other landowners along the stream segments if sources are found to originate from these properties.

The implementation plan briefly summarizes current water quality conditions in the three petitioned stream segments and identifies potential sources impacting water quality. The implementation plan also outlines a conceptual scope of work to first characterize each potential source area, and then address each area appropriately. The ultimate goal of the implementation plan and schedule is to mitigate water quality limiting factors in the three petitioned stream segments to the extent considered achievable. Detailed work plans, including sampling plans and remedial design plans, will be prepared annually to address specific yearly activities and will be provided to MDEQ for review and approval prior to initiation of field activities.

In conjunction with source characterization, the first step of the plan will involve negotiation with other landowners, primarily the U.S. Forest Service. Negotiations will address access issues as well as responsibility for overall plan implementation. Asarco will conduct the characterization and identification of each source.

Section 2 of this plan summarizes current water quality conditions in each petitioned stream segment and potential sources of water quality impairment. Section 3 describes site characterization and potential reclamation activities for each drainage, and Section 4 includes an implementation plan schedule.

2.0 WATER QUALITY TRENDS IN PETITIONED STREAM SEGMENTS

Asarco has conducted extensive water quality monitoring at the UBMC since 1991. The resulting water quality data have been used in the planning and design of mine reclamation activities performed from 1993-1998 as part of Asarco's voluntary mine reclamation program. Following is a drainage by drainage discussion of current water quality conditions in the three petitioned stream segments, and a summary of potential sources of water quality impairment based on the observed water quality trends and field observations. This information forms the basis for the implementation plan and associated schedule presented in Sections 3 and 4. Figure 2-1 includes a map of the UBMC delineating the three petitioned stream segments, water quality monitoring sites, and potential sources of metals loading to the streams.

2.1 MIKE HORSE CREEK

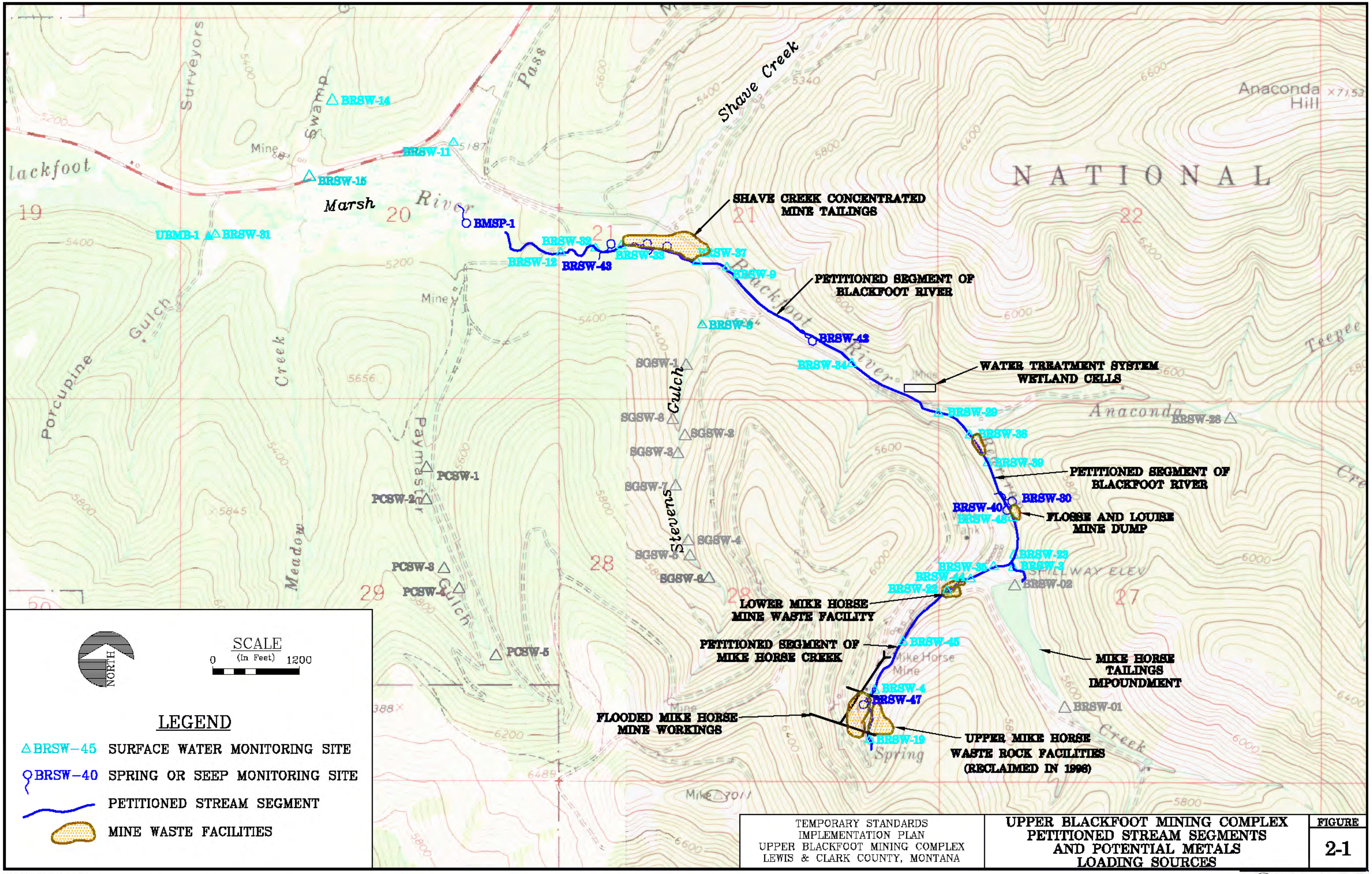
Loads of most metals (aluminum, cadmium, copper, iron, lead, manganese and zinc) increase consistently in a downstream direction through the petitioned segment of Mike Horse Creek. This trend persists during both high streamflow and low streamflow conditions, although the magnitude of load increases through the stream reach is much greater in the spring than in the fall. The metals loads vary seasonally over several orders of magnitude through Mike Horse Creek; for example, the 1999 zinc load varied from 64 lbs/day in April, to 81 lbs/day in May, to 0.5 lbs/day in October at monitoring site BRSW-35 near the mouth of Mike Horse Creek. During April and May 1999 synoptic water sampling events, significant load increases occurred in Mike Horse Creek both upstream and downstream of site BRSW-22; in October, however, load increases in Mike Horse Creek were of greater magnitude, upstream of BRSW-22.

Metals concentrations were particularly high in Mike Horse Creek during April 1999. The highest concentrations were recorded in the middle section of the creek near monitoring site BRSW-4 (Figure 2-1). Metals concentrations at that time include 5.2 mg/L aluminum, 4.5 mg/L copper, and 27.6 mg/L zinc. These high metals concentrations were traced, at least in part, to a seep emanating from the hillside southwest of BRSW-4. Identification of the source of this water is addressed in the implementation plan.

2.1.1 Potential Loading Sources to Mike Horse Creek

Based on current site knowledge, possible sources of metals loading in Mike Horse Creek include:

- <u>Historic Mine Waste:</u>
  Historic mine waste specific to Mike Horse Creek drainage includes the upper Mike Horse mine waste rock facilities which were reclaimed in-place in 1998, and historic mine waste rock facilities located on National Forest lands in lower Mike Horse drainage (Figure 2-1).



UPDATE TIME: 2:14PM
0072\HEL\020700\I:\Land Projects\0018B201\dwg\0018B201H003.dwg

Hydrometrics, Inc.

The Upper Mike Horse mine waste rock facilities include mine waste rock and overburden material placed on the hillsides and drainage bottoms during historic mine development. These mine facilities were reclaimed in-place in 1998 as part of Asarco's voluntary reclamation program. Reclamation included regrading of the waste rock facilities and construction of storm water diversion ditches to divert water around the mine waste, incorporation of soil amendments into the mine waste rock and partial covering of the regraded waste with growth medium soil, and seeding of the reclaimed facilities. The reclamation activities were intended to reduce infiltration into and potential metals leaching from the mine waste, and to reduce erosion. Water quality monitoring in 1999 showed continued metal load increases in Mike Horse Creek in the vicinity of the reclaimed waste rock facilities. It is likely that more than one year will be required for the full benefits of the 1998 reclamation activities to be realized in Mike Horse Creek.

The lower Mike Horse mine waste rock facilities are located adjacent to, and in some cases are bisected by, Mike Horse Creek. Based on their location and documented water quality trends in the vicinity of these facilities, the lower Mike Horse mine waste rock facilities are believed to contribute metals and possibly sediment to Mike Horse Creek. The facilities are located on U.S. Forest Service property and therefore were not addressed in Asarco's voluntary reclamation program. Reclamation of the lower Mike Horse mine waste rock facilities will require coordination with the Forest Service and with other federal and state permitting agencies (Section 3).

- <u>Seepage of Water from the Mike Horse Mine Workings:</u>
  In 1995/96, the Mike Horse Mine 300-Level Adit was fitted with a flow-through bulkhead plug intended to regulate flows from the adit and to flood a portion of the underground mine workings. By flooding the mine workings and excluding oxygen from the mineralized wall rock, the annual load of metals discharged from the Mike Horse Adit has been significantly reduced. The water level in the mine workings is generally maintained at an elevation of 5,650 feet to 5,750 above mean sea level. As such, a positive hydraulic gradient exists between the mine pool and the creek channel near and downstream of monitoring site BRSW-4 (Figure 2-1). Therefore, the potential for seepage of water from the Mike Horse Mine workings to negatively impact Mike Horse Creek will be assessed under this implementation plan.

2.2 BEARTRAP CREEK

Metals loading trends vary seasonally through the petitioned segment of Beartrap Creek (from the Mike Horse Tailings Impoundment to the confluence with Anaconda Creek, Figure 2-1). In April 1999, streamflow and metals loads increased in the upper portion of Beartrap Creek (between sites BRSW-23 and BRSW-39). Increases in metals loads were also apparent in April between sites BRSW-35 (Mike Horse Creek) and BRSW-23 (Beartrap Creek just downstream of the confluence with Mike Horse Creek). Further downstream, between monitoring sites BRSW-39 and BRSW-38, streamflow, metals concentrations, and metals loads were all relatively constant.

Sampling conducted in May 1999, during high streamflow conditions, showed relatively little increase in flow, metals concentrations, or metals loads through Beartrap Creek. Iron, zinc, and manganese showed very modest concentration and load increases through this reach. For example, iron increased from 0.14 mg/L to 0.19 mg/L and from 10.7 lb/day to 14.9 lb/day between site BRSW-23 and site BRSW-38.

Low streamflow metals loading trends in Beartrap Creek, as documented through fall season sampling, show streamflow rates, metals concentrations and metals loads remain relatively constant in the upper stream reach (between monitoring sites BRSW-23 and BRSW-48, Figure 2-1). The fall season load of some metals in Beartrap Creek, particularly lead, iron and zinc, do increase by about three to four times further downstream between BRSW-48 and the mouth of Beartrap Creek.

2.2.1 Potential Loading Sources to Beartrap Creek

Based on the water quality data and other site information, potential sources of water quality impairment in Beartrap Creek include:

- Dispersed Mine Waste in Drainage Bottom:
  Dispersed tailings are evident along the petitioned segment of Beartrap Creek. These tailings generally occur in isolated pods along the floodplain, and are particularly evident in early spring when a white crust (presumably metal-salts forming from the oxidation of metal-sulfides) has been observed on the surface of the tailings. These dispersed tailings may be a source of metals loading to Beartrap Creek during the early stages of spring runoff due to flushing of metal-salts by snowmelt or rising stream levels. This could account for the relatively high metal concentrations and consistent load increases observed through Beartrap Creek in April 1999.

- Mine Waste and/or Discharges Associated with the Flosse and Louise Mining Claim:
  A mine waste rock facility is located in the Beartrap Creek floodplain on the Flosse and Louise mining claim (Figure 2-1). The Flosse and Louise claim is a patented mining claim not in Asarco's ownership. The mine waste rock facilities have the potential to contribute to metals and sediment loading to Beartrap Creek through erosion and leaching of metals during snowmelt and precipitation periods.

  A small, orange-stained seep emanates from the waste rock facility area near what appears to be a collapsed adit. The seep (monitoring site BRSW-30 on Figure 2-1) contains elevated concentrations of some metals including iron, lead, and zinc. The low flow rate of the seep results in a relatively small metals load contribution. It is possible, however, that metals load increases detected in Beartrap Creek through this area are attributable to subsurface loads contributed from these potential sources.

- <u>The Mike Horse Tailings Impoundment</u>
  Two potential mechanisms exist for metals loading from the Mike Horse Tailings Impoundment to Beartrap Creek (and possibly to lower Mike Horse Creek). The first is lateral seepage through the tailings impoundment dam and discharge to the head of the petitioned segment of Beartrap Creek. Such seepage does in fact occur and is monitored at the base of the dam (monitoring site BRSW-3, Figure 2-1). The second potential mechanism is via vertical seepage of tailings pond water through the pond bottom, commingling with the underlying groundwater, and subsequent lateral flow and recharge to Beartrap Creek downstream of the impoundment. These two mechanisms are discussed below.

  Based on seasonal water sampling during the period 1991 through 1999, the tailings dam seepage water as monitored at site BRSW-3 meets most water quality standards with only occasional exceedances for cadmium, manganese and zinc. The small flow at BRSW-3, as compared to that in Beartrap Creek, makes the dam seepage load relatively insignificant. However, other seeps do occur seasonally near the dam toe which flow directly to lower Mike Horse Creek or Beartrap Creek, and are not accounted for in the BRSW-3 samples. Additional seepage also could occur through the shallow subsurface, thus increasing the potential metals load from the tailings dam seepage. The implementation plan includes measures to quantify, and mitigate if necessary, seepage at the toe of the tailings dam (Section 3).

  No information is presently available to assess whether or not vertical seepage of pond water and subsequent metals loading to the underlying groundwater system is occurring. Historic water sampling of the pond surface water has consistently shown the pond water to be of excellent quality. The potential for seepage through the pond bottom sediments to contribute metals to the petitioned stream segments will be addressed through a detailed site evaluation (Section 3).

2.3 BLACKFOOT RIVER

Metal loads generally increase through the petitioned segment of the Blackfoot River, from the confluence of Beartrap and Anaconda Creeks downstream to the first natural marsh (Figure 2-1), although the magnitude of increases varies seasonally. In April 1999, there was little change in metals concentrations over the entire stream reach from BRSW-29 to BRSW-12, and most metals showed slight decreases in concentration. However, loads of zinc, iron, and lead all increased from BRSW-29 to BRSW-12. For iron and lead, loads increased about two to three times, and the majority of the load increase occurred between sites BRSW-9 and BRSW-12 in the vicinity of a concentrated deposit of floodplain tailings (Figure 2-1).

In contrast to April 1999, the May 1999 synoptic sampling (high flow conditions) showed consistent load increases (about two to three times) for all metals from BRSW-29 to BRSW-12. Iron (9 to 27 lb/day) and zinc (66 to 146 lb/day) showed the largest load increases. The May metals concentrations remained similar or increased slightly over this reach. Also in contrast to the April trends, load increases of similar magnitude were observed in the upper portion of the reach (BRSW-29 to BRSW-9) and the lower portion of the reach (BRSW-9 to BRSW-12) for all metals except iron, which increased primarily in the lower reach (between BRSW-9 and BRSW-12).

Low streamflow synoptic sampling (typically performed in October) also has shown load and concentration increases for most metals through the petitioned reach of the Blackfoot River. Compared to April and May 1999 data, the October 1999 data showed the largest percent increases in load (generally from three to four times). Exceptions to the general increase in loads and concentrations included manganese, which increased only slightly in load and decreased in concentration from BRSW-29 to BRSW-9, and lead, which was below laboratory detection limits in the entire stream segment between BRSW-29 and BRSW-12. Similar to April 1999, load increases for all metals except zinc occurred in the lower portion of the reach, while the zinc load increase occurred upstream between BRSW-29 to BRSW-9.

2.3.1 Potential Loading Sources to Blackfoot River

Possible sources of metals loading to the petitioned segment of the Blackfoot River include:

- Concentrated Mine Waste Near the Confluence with Shave Creek
  An area of concentrated mine tailings is located along the Blackfoot River floodplain near the confluence of the Blackfoot River and Shave Creek (Figure 2-1). Concentrations and loads of most metals in the Blackfoot River increase through this tailings area, presumably due to leaching of metals from the tailings. Based on current knowledge, the tailings are located predominantly on Forest Service property, with a small fraction potentially located on Asarco patented mining claims. The precise origin and mode of deposition of these concentrated tailings is presently unknown, however, based on the condition of the tailings and vegetation patterns, the tailings may have been deposited several decades ago (i.e., before the 1975 Mike Horse Tailings Dam breach). The implementation plan scope of work includes characterization and delineation of the concentrated tailings deposit, including determination of the tailings source (Section 3). Subsequent details and the timing of reclamation of the concentrated tailings will be dependent on the source of the tailings, and access and other agreements as to the nature and scope of, as well as responsibility to carry out, the reclamation activity to be agreed upon with the U.S. Forest Service and other potentially responsible parties. Permitting requirements through various federal and state agencies may also be required, including a U.S. Army Corps of Engineers CWA Section 404 permit.

- Dispersed Tailings in Drainage Bottom
  Similar to Beartrap Creek, dispersed tailings are evident along the petitioned segment of the Blackfoot River. These tailings generally occur in isolated pods along the floodplain and may act as a source of metals loading to the Blackfoot River, especially during the early stages of spring runoff. These dispersed tailings are located both on National Forest lands, and Asarco patented mining claims.

The implementation plan scope of work includes characterization and delineation of the dispersed tailings. Subsequent details and the timing of reclamation of the Blackfoot River dispersed tailings will be dependent on the source of the tailings, and access and other agreements as to the nature and scope of, as well as responsibility to carry out, the reclamation activity to be agreed upon with the U.S. Forest Service and other potentially responsible parties. Permitting requirements through various federal and state agencies may also be required.

- Surface Water from Stevens Gulch Creek
  Surface water flow from Stevens Gulch Creek, a tributary to the Blackfoot River, contains elevated concentrations of some metals. As such, Stevens Gulch Creek serves as a loading source to the Blackfoot River for some petitioned parameters. Asarco has conducted reclamation activities on its property and considerable water quality monitoring in Stevens Gulch drainage as part of its voluntary reclamation program. Existing information will be reviewed, and new information obtained if needed, to delineate the remaining sources of metals loading in this drainage (Section 3).

- Water Treatment System Discharge
  Asarco constructed a wetlands-based passive water treatment system to treat discharge waters from the Mike Horse Mine and Anaconda Mine adits as part of the voluntary mine reclamation program. The treatment system discharge enters the petitioned segment of the Blackfoot River (Figure 2-1). Presently, the treatment system removes most of the cadmium, copper, iron and lead from the adit discharges, and the majority of manganese and zinc. However, each of these metals are periodically present in detectable concentrations in the treatment system discharge. Discharge of manganese and zinc are currently above B-1 standards. Additionally, although the passive wetland system has been in operation for several years, it has undergone continuous treatability testing and system refinements and thus, the reliability of consistent treatment of other metals, e.g., cadmium, copper, iron and lead, is still under review. This implementation plan requires Asarco to continue efforts to enhance the treatment system performance and thus reduce metals loading to the petitioned segment of the Upper Blackfoot River. Options for enhancing the water treatment system performance will focus on improving metals removal through the constructed wetlands and on reducing metals concentrations in the Mike Horse Adit discharge.

3.0 IMPLEMENTATION PLAN ACTIVITIES

Based on the water quality trends and potential loading sources summarized in Section 2, the following implementation plan components and activities have been developed. As required by MCA §75-5-312 (3)(c), this implementation plan has been prepared by Asarco to identify and address all potential sources of water quality impairment to the three petitioned stream segments, regardless of property ownership patterns, the origin of specific sources, or individual liability issues. Asarco will conduct the field investigations necessary to delineate individual sources and will mitigate those sources for which they are responsible. Reclamation of source areas which are Asarco's responsibility, but are located on Forest Service property, will require the granting of access by the Forest Service. Asarco will discuss with the Forest Service and other potentially responsible parties the need to develop and implement appropriate reclamation plans for those sources not found to be Asarco's responsibility. Based on current site knowledge, known potential sources and reclamation alternatives are described below with individual responsibilities specified where known.

The following discussion lists general implementation plan activities to be performed by Asarco. Based on site characterization results and negotiations with the Forest Service and other landowners and potentially responsible parties, annual work plans will be prepared detailing activities proposed each year. The plans will be submitted to MDEQ for review and comment prior to initiation of field activities. Following is a summary of proposed implementation plan activities. A preliminary implementation plan schedule is included in Section 4.

3.1 MIKE HORSE CREEK DRAINAGE

Based on current site knowledge, potential sources of water quality impairment in Mike Horse Creek drainage include historic mine waste, the hillside seepage near monitoring site BRSW-4, and seepage from the flooded underground mine workings. These potential sources, along with any other potential sources identified through field investigations and/or remedial activities, will be evaluated and addressed as appropriate. Proposed actions addressing each potential source area are discussed below.

Historic Mine Waste:

Lower Mike Horse Mine Waste Rock Facilities

Existing stream water quality data and field observations indicate that the lower Mike Horse mine waste rock facilities are a source of sediment and metals loading to Mike Horse Creek. The lower Mike Horse waste rock facilities are located on U.S. Forest Service property and most likely resulted from historic operations at the Mike Horse mine. Asarco will characterize these facilities to determine the volume of mine waste present, and physical and chemical parameters necessary to assess reclamation options. Physical and chemical parameters to be determined through sample collection and testing include total metals concentrations, acid-base accounting parameters, and total sulfur forms. Geotechnical parameters also will be determined for use in reclamation and closure design plans. Asarco will conduct site characterization activities in 2000-2001, pending access from the Forest Service, so that this discrete source of metals loading can be addressed as soon as possible.

Following collection of required information, Asarco will develop and implement an appropriate reclamation plan for the lower Mike Horse mine waste facilities. Potential reclamation options include:

1. Complete or partial mine waste removal and placement in an off-site repository (such as the existing Paymaster Repository);
2. Consolidation of mine waste with local closure;
3. In-place reclamation through mine waste amendment and revegetation, and associated improvements to Mike Horse Creek channel; and
4. No action. Based on existing information however, a no action response likely will not be deemed appropriate for the lower Mike Horse mine waste facilities.

Asarco will conduct the necessary waste characterization and reclamation actions at the lower Mike Horse mine waste facilities. Preliminary scheduling calls for the lower Mike Horse mine waste to be reclaimed in 2002 and 2003 (see Section 4). The exact schedule is dependent on results of the waste facility characterization, coordination with the U.S. Forest Service for access to the area, and attainment of necessary permits including, but not limited to, a 310 permit from the Lewis and Clark County Conservation District, a 3A permit and storm water permit from MDEQ, and a Section 404 permit from the U.S. Army Corp of Engineers. Detailed sampling and analysis plans and engineering design plans will be prepared and submitted to MDEQ prior to initiation of any activities in lower Mike Horse Creek.

Upper Mike Horse Mine Waste Rock Facilities

The Upper Mike Horse waste rock facilities include historic mine waste situated on the hillsides in Mike Horse Creek drainage (Figure 2-1). These facilities were reclaimed in-place by Asarco in 1998 and are located in the middle reach of Mike Horse Creek where an increase in metals loads was observed in 1999.

Asarco will further evaluate the potential relationship between Mike Horse Creek water quality and the reclaimed upper Mike Horse mine waste facilities. Year 2000 activities will include stream water quality monitoring in the vicinity of the reclaimed mine waste to further evaluate water quality trends and possible sources, and possible sampling of runoff water and shallow groundwater immediately downstream of the mine waste facilities. If the reclaimed waste rock is in fact a source of metals loading to Mike Horse Creek, future monitoring may show a decreasing trend in metal loads as the reclaimed waste rock stabilizes and a complete vegetation cover is established. Full impacts to water quality from the 1998 reclamation activities may take a number of years to be realized.

Characterization of the upper Mike Horse mine waste facilities will closely complement characterization of the hillside seepage as described below. If field investigations indicate that the upper Mike Horse mine waste facilities continue to be a source of metals loading to

Mike Horse Creek, Asarco will develop and implement an appropriate reclamation plan. Potential reclamation actions may include:

1. Complete or partial removal of portions of the mine waste facilities found to be contributing to metal loading in Mike Horse Creek;
2. Additional mine waste amendment to enhance vegetation establishment and reduce metals mobility; and
3. Selective capping of mine waste with soil or synthetic materials to inhibit water infiltration and subsequent metals leaching.

Field investigations of the upper Mike Horse waste rock facilities will commence in 2000 with detailed water quality monitoring in Mike Horse Creek and other potential activities as described above. Additional reclamation activities, if needed, are currently scheduled to occur between 2002 and 2004 (Section 4). Because the upper Mike Horse waste rock facilities are located on Asarco property, scheduling of these activities is not contingent upon access agreements or negotiations with other parties.

Hillside Seepage:
Based on 1999 water quality monitoring activities, seepage from the hillside in middle Mike Horse Creek (site BRSW-47 on Figure 2-1) is a significant contributor of metal loading to Mike Horse Creek. On May 21, 1999, the small surface flow at seep BRSW-47 (approximately 4.5 gpm) accounted for approximately 25% of the sulfate load, 50% of the aluminum load, 45% of the copper load and 20% of the zinc load present at monitoring site BRSW-4, located in Mike Horse Creek downstream of the seep (Figure 2-1). It is possible that additional loading to Mike Horse Creek may be attributable to shallow subsurface flow associated with the seep. Based on the location, the source of metals loading to the seep may be the reclaimed mine waste rock located immediately uphill of the seep. Alternatively the seep chemistry may result from groundwater impacted by historic mining disturbances or natural geochemical processes. The seepage area is located in the vicinity of a mineralized vein system associated with the Mike Horse ore body.

Asarco will initiate field investigations in 2000 to quantify the total metal load attributable to the seep area, and to identify the source of water and of the metal load in the seep. The field investigation may include trenching in the seep area to identify the source of seepage and quantify the potential subsurface component of flow, installation of piezometers and/or monitoring wells to delineate groundwater flow paths and groundwater chemistry near the seep, and possible tracer testing to identify seep recharge zones.

Following source identification, Asarco will develop and implement an appropriate reclamation plan for the seep area. Reclamation actions may include:

1. Reclamation of portions of the upper Mike Horse waste rock facilities as described above;
2. Construction of surface water and/or groundwater diversions around source area(s);

3. In-situ treatment of seepage water with reactive barrier wall or other appropriate technology; and
4. No action (if the seepage chemistry is found to be caused by natural conditions).

Field investigations of the seepage area are scheduled for 2000-2002, with reclamation scheduled for 2002 to 2004. Because the upper Mike Horse seepage area is located on Asarco property, scheduling of these activities is not contingent upon access agreements or negotiations with other parties. Scheduling of reclamation activities, if required, may be dependent on attainment of necessary permits including a 310 permit from the Lewis and Clark County Conservation District, a 3A permit and storm water permit from MDEQ, and a Section 404 permit from the U.S. Army Corps of Engineers.

Seepage from Mine Workings:

Seepage from Mike Horse Mine Workings

Although there are no indications that seepage of water from the flooded Mike Horse Mine workings is impacting water quality in Mike Horse Creek, the location of the workings and the mine water level resulting from plugging of the adit indicate that seepage of water from the workings to Mike Horse Creek is possible. Despite the fact that the locations suggest that seepage of mine water could be the cause of the metal load increases observed through the middle reach of Mike Horse Creek, and the high metals concentrations in seep BRSW-47 (Figure 2-1), water quality trends in both the seep and in Mike Horse Creek contradict this scenario. For instance, both seep BRSW-47 and site BRSW-4 in middle Mike Horse Creek contained very little iron (less than 1 mg/L in spring and fall 1999). This compares to an iron concentration in the adit water of approximately 100 mg/L. Conversely, the May 1999 copper and aluminum concentrations in seep BRSW-47 (66 and 128 mg/L, respectively) compare to concentrations of approximately 1 mg/L or less in the Mike Horse Adit for both these metals. Nonetheless, Asarco will investigate the potential for seepage of water to occur from the mine workings, and take corrective actions if this seepage is found to significantly contribute to water quality impairment in Mike Horse Creek.

The mine seepage evaluation will be conducted in conjunction with the upper Mike Horse waste rock facility and hillside seepage investigations described above. The water sampling, trenching, and piezometer and/or monitoring well installations proposed for those sites also will be used to evaluate seepage from the workings. In addition, tracer testing may be performed to further address the potential mine seepage issue. If seepage from the mine workings is found to be a significant cause of water quality impairment in Mike Horse Creek, mitigative measures would most likely involve lowering of the mine pool level to minimize outward seepage. These actions will be conducted concurrently with the other activities proposed above for Mike Horse drainage.

3.2 BEARTRAP CREEK DRAINAGE

Potential sources of metals loading in Beartrap Creek drainage include the Mike Horse Tailings Impoundment, dispersed floodplain tailings, and the mine waste rock and possible adit discharge located on private property (the Flosse and Louise claim). These potential sources, along with any other potential sources identified through field investigations and/or remedial activities, will be evaluated and addressed as appropriate. Proposed actions addressing each potential source area are discussed below.

Mike Horse Tailings Impoundment:
Asarco will undertake a field investigation program to evaluate the geotechnical stability of the Mike Horse Tailings Impoundment, and to determine if seepage from the tailings impoundment is a significant source of metal loading to Beartrap Creek (or lower Mike Horse Creek). Following the tailings impoundment field investigation, Asarco will develop and implement appropriate reclamation plans if warranted. Because the tailings impoundment is located on properties administered by the Helena National Forest (and is covered by a special use permit), all activities associated with the tailings impoundment are contingent on obtaining access and other agreements from the Forest Service to conduct field investigations and reclamation actions.

Following negotiations between Asarco and the Forest Service, Asarco will evaluate the suitability of the tailings impoundment design from a geotechnical stability standpoint, and implement a field investigation to assess potential seepage and metals loading from the impoundment. The design review also will be used to design and construct an emergency overflow spillway in the dam that meets current U.S. Forest Service design standards. Pending agreements with the Forest Service, Asarco intends to construct the overflow spillway in 2000 or 2001.

Asarco also will implement a field investigation program to determine if seepage and associated metals loading is occurring either through the impoundment dam or through the pond bottom. Field investigations associated with potential dam seepage will include; a comprehensive inventory of all dam face seeps including measurement of seep flow rates and metals concentrations, and installation of shallow piezometers at the dam toe to evaluate potential seepage through the shallow subsurface. Field activities designed to determine if seepage through the pond bottom and metals loading to the underlying groundwater body and/or Beartrap Creek is occurring may include; installation of nested bedrock groundwater monitoring wells at the dam toe and elsewhere in Beartrap Creek drainage to delineate groundwater flow paths and chemistry in the vicinity of the tailings impoundment; characterization of tailings along the pond beach where periodic wetting and drying of the tails may occur; and sampling of pond bottom tailings and/or pond water at depth to assess water quality at the water/tailings interface. The tailings impoundment field investigations are scheduled for 2000 to 2002.

Based on field investigation results, Asarco will develop and implement an appropriate reclamation plan if the impoundment is found to contribute significantly to metals loading in Beartrap Creek. Possible reclamation alternatives include:

1. Establish vegetation on dam face to stabilize slope (this action was proposed by Asarco in 1998 but site access was denied by the Forest Service);
2. Seal inner dam face to reduce dam seepage;

3. Treat dam seepage with passive treatment cell at dam toe;
4. Complete or partial removal of seasonally exposed tailings along the pond beach;
5. Controlling pond water levels to manipulate seepage rates and/or geochemical conditions within the pond;
6. Partial sealing of pond bottom to reduce potential seepage;
7. Partial or complete removal of the impoundment and tailings; and
8. No action.

Tailings impoundment reclamation activities are tentatively scheduled for 2002-2006 (Section 4), pending results of the field investigations, access and other agreements with the Forest Service, and obtaining required permits including a U.S. Army Corps of Engineers Section 404 permit.

Dispersed Floodplain Tailings:
Dispersed tailings are present along the Beartrap Creek channel and floodplain from the Mike Horse Tailings Impoundment to the confluence with Anaconda Creek (Figure 2-1). The tailings occur in isolated pods through this reach of stream. Potential sources of these tailings include historic disposal of the Mike Horse Mill tailings prior to construction of the tailings impoundment in 1941, or material washed downstream from the 1975 Mike Horse tailings dam breach. Existing water quality data indicate that these dispersed tailings may act as a source of metals to Beartrap Creek at least seasonally. The majority of dispersed tailings are located on U.S. Forest Service lands.

Asarco will implement a field investigation program to determine if the dispersed tailings act as a metal loading source, and to quantify the location, the volume, and the chemical and physical properties of the dispersed tailings. Metals loading from the dispersed tailings will be assessed through detailed water sampling in the tailings area, including sampling of Beartrap Creek and runoff water from the tailings. The locations and volume of tailings will be determined through detailed mapping and sampling to delineate the lateral extent and depth of tailings. Field investigations along Beartrap Creek may also include stream sediment sampling. Determination of physical and chemical tailings characteristics will be determined through sampling of tailings and testing for total metals content, acid-base accounting, and other properties determining reclamation and closure options. Investigation of the dispersed tailings is scheduled for 2000 to 2001.

Following the field investigation program, Asarco will develop appropriate reclamation plans for the dispersed tailings. Asarco will then discuss with other interested parties, possibly including the Forest Service and ARCO, the responsibility to implement an appropriate reclamation plan. Potential reclamation options include:

1. Complete or partial tailings removal and placement in an off-site repository;
2. Consolidation of tailings with local closure in Beartrap Creek drainage;
3. In-place reclamation through mine waste amendment and revegetation;
4. Partial tailings removal with construction of settling basins and/or wetlands structures to enhance water quality in the drainage; and
5. No action.

Reclamation of the Beartrap Creek dispersed tailings is scheduled for 2002-2004. The exact schedule is dependent on results of the field investigation, timing of upstream reclamation activities, obtaining access to the property from the U.S. Forest Service and agreement with other interested parties (the Forest Service and ARCO), and obtaining the required construction and environmental permits including a U.S. Army Corps of Engineers Section 404 permit.

Mining Disturbance on Private Property (Flosse and Louise Claim):
Beartrap Creek flows through the west corner of a patented claim (the Flosse and Louise mining claim) not owned by Asarco. A mine dump and apparent collapsed adit are located on the this property and may impact water quality in Beartrap Creek. Pending access and agreement with the property owner, Asarco will conduct a field investigation to quantify potential metals loading from this site. Site investigations may include sampling of runoff water from the site, continued sampling of Beartrap Creek immediately upstream and downstream of the property, characterization of mine waste material, and possible investigation of the apparent collapsed adit. Pending access agreements, Asarco will conduct these investigative activities between 2000 and 2001.

Following site characterization, Asarco will develop an appropriate reclamation plan for the Flosse and Louise mine facilities and will discuss with the landowner and any other interested parties the responsibility to implement the plan. The preliminary schedule calls for reclamation of the site between 2002 and 2004. The exact schedule is dependent on obtaining access and other agreements with the landowner, obtaining required construction permits, and the timing of upstream reclamation activities.

3.3 BLACKFOOT RIVER DRAINAGE

Potential sources of water quality impairment in the petitioned segment of the Blackfoot River include an area of concentrated tailings near the confluence with Shave Creek, dispersed tailings located along the Blackfoot River floodplain, loading from surface water in Stevens Gulch, and discharge from the water treatment system. These potential sources, along with any other potential sources identified through field investigations and/or remedial activities, will be evaluated and addressed under this implementation plan as appropriate. Similar to Beartrap Creek, most of the petitioned segment of the Blackfoot River is located on National Forest lands. Therefore, proposed activities on the Blackfoot River will require access agreements from the Forest Service and agreements with the Forest Service and possibly other parties as to responsibility for individual sources of water quality impairment and related reclamation activities. Proposed actions for the Blackfoot River drainage are discussed below.

Concentrated Tailings Near Confluence with Shave Creek:
An area of concentrated mine tailings is present along the Blackfoot River near the confluence with Shave Creek (Figure 2-1). These concentrated tailings differ from the dispersed tailings along the Blackfoot River and Beartrap Creek in their lateral extent (the

tailings are continuous over an area of more than an acre), and their appearance (the concentrated tailings support mature vegetation indicating they have been in place for a considerable length of time). The concentrated tailings are located predominantly on National Forest lands.

Pending access and other agreements with the Forest Service, Asarco will initiate a field investigation to characterize and determine the source of the concentrated tailings. The investigation will include mapping of the tailings to determine the lateral extent and volume of tailings, and sampling of the tailings to determine metals content, acid-base accounting, total sulfur species, and geotechnical properties required for reclamation and closure design. Asarco will conduct the site investigation between 2001 and 2002.

Following the site investigation, Asarco will develop an appropriate reclamation plan for the concentrated tailings. Possible reclamation actions include:

1. Complete or partial tailings removal and placement in an off-site repository (such as the Paymaster Repository);
2. Consolidation and local closure of tailings;
3. In-place closure through incorporation of amendments and revegetation; and
4. No action (based on existing water quality information, a no action alternative most likely would not be deemed appropriate).

The schedule outlined in Section 4 includes reclamation of the concentrated mine tailings between 2003 and 2005. The reclamation action selected and the timing of reclamation activities will be dependent on access and other agreements with the Forest Service and other potentially responsible parties related to responsibility for carrying out the reclamation action, the timing of upstream reclamation activities, and obtaining permits which may be required including a U.S. Army Corp of Engineers Section 404 Permit.

Dispersed Floodplain Tailings:
Similar to Beartrap Creek, dispersed tailings are present along portions of the petitioned segment of the Blackfoot River. These dispersed tailings occur in isolated pods and may have originated from historic mining operations predating construction of the Mike Horse Tailings Impoundment, or may have been deposited during the 1975 tailings dam breach. Unlike Beartrap Creek, the Blackfoot River dispersed tailings are located among dense vegetation, including grasses, brush and trees, thus limiting vehicular access to the site. The tailings are located on both Asarco patented mining claims and U.S. Forest Service lands.

Asarco will implement a field investigation program to characterize the dispersed tailings and determine if they act as a significant source of metals loading to the Blackfoot River. The characterization will include mapping the location and volume of tailings on both Asarco and Forest Service lands, and sampling of the tailings to determine chemical and physical properties. Tailings samples will be tested for metals content, acid-base accounting, total sulfur forms, and geotechnical properties required for reclamation and closure design. Investigation of the Blackfoot River dispersed tailings is scheduled for 2001 to 2002.

Following the field investigation program, Asarco will develop appropriate reclamation plans for the dispersed tailings. Potential reclamation options include:

1. Complete or partial tailings removal and placement in an off-site repository;
2. Consolidation of tailings with local closure;
3. In-place reclamation through mine waste amendment and revegetation; and
4. No action.

Asarco will discuss with the Forest Service and other interested parties the responsibility to implement the reclamation plan. Reclamation of the Blackfoot River dispersed tailings is presently scheduled for 2003 to 2005. The exact schedule is dependent on results of the field investigation, timing of upstream reclamation activities, and agreement with the Forest Service and other interested parties. Scheduling of reclamation activities also will be dependent on obtaining the required construction and environmental permits, possibly including a U.S. Army Corp of Engineers Section 404 permit.

Loading from Stevens Creek:
Concentrations of some metals in Stevens Creek, a tributary to the petitioned segment of the Blackfoot River, are elevated and thus contribute to the load of some petitioned parameters in the Blackfoot River. Typical metals concentrations in Stevens Creek include; 1 to 2 mg/L aluminum, 0.2 mg/L copper, and 0.25 mg/L zinc. Coupled with the low flow rates typical of Stevens Creek, these concentrations result in a relatively small load contribution to the Blackfoot River (i.e. 0.2 lbs/day for zinc in April 1999 compared to 230 lbs/day in the Blackfoot River immediately downstream of the confluence). Although the associated metals load contribution is small, this implementation plan includes provisions to identify sources of metals loading in Stevens Gulch, and to mitigate those sources if warranted. Asarco has previously conducted water quality monitoring in Stevens Gulch, and in 1997 completed mine reclamation activities on their properties in Stevens Gulch. Actions conducted under this implementation plan will focus on remaining potential loading sources located predominantly on U.S. Forest Service property. It also is possible that remaining metals loads in Stevens Creek are caused at least in part by recharge to the creek of naturally mineralized groundwater.

Asarco will implement a field program to quantify remaining metals loading sources and rates in Stevens Gulch. Field activities may include detailed mapping of mine waste facilities, additional surface water sampling to augment existing data, installation of shallow piezometers or monitoring wells to assess groundwater quality and flow directions, and an assessment of natural water quality within the drainage. Based on results of the field program, Asarco will evaluate reclamation alternatives if warranted and discuss with land owners and other potentially responsible parties the responsibility to implement appropriate reclamation activities. Potential activities may include complete or partial removal of waste rock facilities, in-place reclamation of waste rock facilities, or no action. The field investigation program presently is scheduled for 2001 to 2002, with reclamation activities scheduled for 2003-2006, if necessary. The exact timing of Stevens Gulch activities is dependent on access agreements with the Forest Service, and coordination with other potentially interested parties.

Water Treatment System Discharge:
The passive wetlands-based water treatment system removes metals from the historic Mike Horse Mine and Anaconda Mine adits. Asarco identified the Mike Horse Adit as a significant contributor of metals to the upper Blackfoot River early in their investigations at the UBMC. Collection and treatment of the adit discharge became a central focus of the mining company's voluntary reclamation program. The treatment system has been operating since October 1996 and has reduced the loads of most metals entering the River system from the two adits by 90% or more.

Asarco will continue efforts to enhance the water treatment system performance and thus reduce the load of metals entering the Blackfoot River. Efforts will be focused on two fronts; reducing the load of metals in the Mike Horse Adit discharge, and improving metals removal rates through the water treatment system. Efforts to reduce metal loads in the Mike Horse Adit discharge will include continued flooding of the mine workings to limit the oxidation of sulfide minerals, optimization of water management strategies within the mine workings to reduce seasonal variations in adit discharge quality, and evaluation of alternative mine discharge scenarios. Efforts to enhance metals removal through the treatment system will include evaluation of active carbon addition to enhance wetlands biological activity, increasing the hydraulic residence time within the wetlands by increasing the substrate thickness, or other measures identified through the ongoing treatability testing program. Improvements to the water treatment system will be conducted under the direction of the facility MPDES discharge permit.

3.4 ENVIRONMENTAL MONITORING

An environmental monitoring program consisting of surface water quality monitoring and biological monitoring will be implemented in the three petitioned stream segments. The following monitoring program represents a minimum scope of monitoring to be implemented for the first three-year period that temporary standards are in effect (2000 through 2003). Additional monitoring may be implemented during this three-year period pending conditions encountered in the field during sampling, sampling results, and discussions between Asarco, MDEQ, and other interested parties. At the end of the first three-year period, the environmental monitoring program will be reviewed and revised as appropriate. Monitoring protocol will be consistent throughout the period that temporary standards are in effect to ensure comparability of data collected throughout the entire period. Monitoring details will be provided in annual work plans to be submitted by Asarco to MDEQ for review and comment. Year 2000 monitoring will begin upon finalization of this implementation plan and the 2000 work plan.

3.4.1 Surface Water Quality Monitoring

Surface water monitoring will be conducted in the petitioned segments of Mike Horse Creek, Beartrap Creek, and the upper Blackfoot River. The purpose of surface water monitoring is to provide current water quality data for assessment of long-term water quality trends through comparison to historic water quality data, and to provide data for comparison to the temporary water quality standards.

3.4.1.1 Surface Water Monitoring Sites

Surface water monitoring will be conducted at several pre-established monitoring sites (Figure 2-1) including:

- BRSW-12 in the downstream portion of the petitioned segment of the Blackfoot River;
- BRSW-9 and BRSW-29 in the upstream portion of the petitioned segment of the Blackfoot River;
- BRSW-23 and BRSW-38 in the petitioned segment of Beartrap Creek;
- BRSW-22 and BRSW-35 in the petitioned segment of Mike Horse Creek.

All of these sites have been monitored in the past, thus providing historic water quality data for assessment of water quality trends. Water quality data from sites BRSW-12, BRSW-9, BRSW-23 and BRSW-22 will also be used for comparison to the temporary standards, since data from these sites were used to calculated the standards.

3.4.1.2 Surface Water Monitoring Schedule

Surface water monitoring will be conducted in April, May, June and October to provide information during various hydrologic conditions and seasons. The April, May and June sampling will coincide with spring runoff when water quality is generally most variable. The April and May sampling will coincide with the early and late stages of the rising limb of the spring runoff hydrograph, respectively, and the June sampling will coincide with the falling limb of the hydrograph. The October sampling event will quantify water quality during baseflow, or low flow conditions, when surface water quality generally exhibits less variability. The May and October sampling data will be particularly useful for assessment of temporal water quality trends since the majority of existing water quality data was collected during these periods.

3.4.1.3 Analytical Parameter List

Water quality samples will be analyzed for the same suite of parameters employed in recent (1997-1999) surface water monitoring programs at the UBMC. Field-measured parameters will include pH, specific conductance, water temperature and dissolved oxygen. Laboratory parameters will include the metals aluminum, cadmium, copper, iron, lead, manganese and zinc, and total dissolved solids, total alkalinity (as $CaCO_3$), calcium, magnesium, sodium, potassium and sulfate. Metals analyses will include both total recoverable and dissolved metals concentrations. Stream flow will also be measured at each monitoring site.

3.4.2 Biological Monitoring

Biological monitoring will be conducted in the Blackfoot River to assess the current state of benthic macroinvertebrate community composition at the downstream end of the petitioned stream segments. The monitoring will initially be restricted to site BRSW-12 (Figure 2-1), near the downstream portion of the petitioned stream reaches, since this is the portion of the petitioned stream segments most likely to show improved biological conditions over the next few years. One monitoring event will be conducted per year for the first three-year period (2000 to 2003), starting in 2000. The resulting biological data will be used to establish a baseline of aquatic community conditions for comparison to historic and future biological monitoring data. This comparison will determine how past reclamation activities, and future reclamation activities as described in this implementation plan, affect the aquatic community structure.

3.4.2 Evaluation of Monitoring Data

The surface water and biological monitoring data will be used to assess temporal trends in water quality and biological conditions in the petitioned stream segments. The 2000-2003 data will provide a baseline for comparison to future monitoring results to assess improvements resulting from reclamation activities to be conducted under the implementation plan. The data will also be compared to pre-reclamation (pre 1995) data to assess overall improvements in aquatic conditions in response to reclamation activities already completed by Asarco during the period the temporary standards are in effect.

The surface water quality data collected under the implementation plan will also be used to assess in-stream concentrations of the temporary standards parameters. Concentrations of the temporary standards parameters measured at monitoring sites BRSW-12 (downstream segment of Blackfoot River), BRSW-9 (upstream segment of Blackfoot River), BRSW-23 (Beartrap Creek) and BRSW-22 (Mike Horse Creek) will be compared to the numeric temporary standards applicable to those sites on an annual basis. In addition, mean parameter concentrations will be calculated following the first three-year monitoring period (6/00-6/03) for a site by site comparison to mean concentrations from the baseline period (1997-1999). The comparison of mean concentrations will be used to assure that overall water quality is not allowed to worsen during the period that temporary water quality standards are in effect, accounting for natural variability in the dataset. The comparison of mean concentrations will begin in 2003 once a sufficient dataset is established to allow a statistical comparison to the baseline data. As additional data is collected in subsequent years (after 2003), a rolling average will be calculated using data from the three previous years for annual comparisons to the baseline period concentrations. For example, mean concentrations for the period 6/01-6/04 will be used for comparison to the baseline period at the end of 2004.

The comparison of parameter concentrations to the numeric temporary standards, and the three-year rolling mean concentrations to the baseline period mean concentrations, will be included in the annual project monitoring reports to be submitted to the Montana Department of Environmental Quality. This information will also be presented to the Montana Board of Environmental Review during the Board's triennial reviews of temporary standards, or more frequently if requested by the Department or the Board.

4.0 IMPLEMENTATION PLAN SCHEDULE

Table 4-1 includes a preliminary schedule for the implementation plan activities outlined in Section 3. The schedule calls for source characterization activities to begin in 2000, pending necessary access agreements for those potential source areas not on Asarco property. Reclamation activities will commence as soon as the required information, access and other agreements related to specific responsibility for carrying out planned action, and necessary construction and environmental permits are obtained. Pending the necessary agreements, Asarco intends to construct an emergency overflow spillway in the Mike Horse Tailings Impoundment in 2000 or 2001. Reclamation activities will then proceed in a general upstream to downstream direction to minimize potential negative impacts to reclaimed areas from upstream sources. Reclamation activities in Mike Horse Creek are scheduled to commence in 2002, and will proceed downstream to Beartrap Creek and the Blackfoot River. Preference also will be given to more significant sources of water quality impairment when determining precise reclamation schedules. The following schedule allots one year for negotiations with the U.S. Forest Service, and possibly other landowners and/or responsible parties, to finalize access and other agreements for sources not on Asarco property. As provided for in the temporary standards rule, the reclamation schedule may be extended for up to two years if negotiations with the Forest Service extend beyond one year. It is assumed that site characterization and certain reclamation activities can be implemented concurrently with negotiations.

Following adoption of temporary water quality standards, Asarco will prepare annual sampling and analysis plans and engineering design plans for each year’s activities. The annual plans will be submitted to MDEQ and other interested parties for review and comment prior to initiation of field activities. Annual reports will also be prepared and submitted to all interested parties detailing results of activities during the previous year. Following is a schedule for work plan and reporting requirements starting in 2001:

Submittal	Submittal Date
Draft Annual Data Summary Reports	January 15
Final Annual Data Summary Reports	20 business days from receipt of all agency comments
Draft Annual Work Plans (including SAP)	January 31
Final Annual Work Plans	20 business days from receipt of all agency comments
Draft Engineering Design Plans	February 28
Final Engineering Design Plans	20 business days from receipt of all agency comments

TABLE 4-1. IMPLEMENTATION PLAN SCHEDULE, UPPER BLACKFOOT MINING COMPLEX

MIKE HORSE CREEK DRAINAGE

Potential Source	TASK	SCHEDULE
Lower Mike Horse Creek Mine Waste (waste rock facilities located on Forest Service property)	Negotiate access and other agreements with Forest Service and other party(ies).	2000 to 2001
	Quantify load contribution from mine waste. Actions may include, but may not be limited to: • Detailed water quality sampling. • Characterization of mine waste chemistry and volume.	2000 to 2001
	Develop and Implement Reclamation Plan. Actions may include, but may not be limited to: • Mine waste removal and placement in repository • In-place reclamation • No Action	2002-2003 Pending access from and other agreements with Forest Service
Middle Mike Horse Creek (Area of significant load increases near monitoring site BRSW-4 and upper Mike Horse reclaimed waste piles).	Investigate source of high metals concentration water to BRSW-47 seep and ultimately to Mike Horse Creek. Actions may include, but may not be limited to: • Excavate trenches in seep area. • Install wells/piezometers to delineate deep and shallow groundwater flow directions and quality and interactions with Mike Horse Creek. • Possible tracer testing to delineate source areas	2000-2002
	Conduct Reclamation Actions as appropriate. Reclamation actions may include: • Removal of reclaimed Mine Waste if it acts as source. • Construct surface water and/or groundwater diversions around source area(s). • In-situ treatment of groundwater with reactive wall or other technology. • No Action	2002-2004
Seepage from Flooded Mike Horse Mine Workings to Mike Horse Creek	Investigate whether seepage occurs. Actions may include, but may not be limited to: • Continuous monitoring of mine pool level, Mike Horse Creek flow, and Mike Horse Creek quality. • Conduct tracer testing if warranted.	2000-2002
	Implement Corrective Measures. May include: • Modify mine water management strategies.	Continuous

BEARTRAP CREEK DRAINAGE

Potential Source	TASK	SCHEDULE
Mike Horse Tailings Impoundment: Evaluate Impoundment for Potential Source of Metals Loading and for Dam Stability	Negotiate access and other agreements with Forest Service and other party(ies).	2000-2001
	Evaluate Tailings Impoundment Stability and Integrity. Perform Corrective Measures if needed: • Evaluate dam stability. • Design and construct emergency overflow spillway.	2000-2001 pending access from and other agreements with Forest Service
	Quantify Metals Loading to Beartrap Creek from Tailings Dam Seepage. Actions may include, but may not be limited to: • Quantify total seepage rate, seepage water quality, and seepage loading rate to Beartrap Creek accounting for seasonal variability. • Install shallow piezometers to quantify subsurface seepage rates and quality.	2000-2001 pending access from and other agreements with Forest Service

TABLE 4-1. IMPLEMENTATION PLAN SCHEDULE, UPPER BLACKFOOT MINING COMPLEX (continued)

BEARTRAP CREEK DRAINAGE - continued

Potential Source	TASK	SCHEDULE
Tailings Impoundment (continued)	Investigate Potential Seepage Through Tailings Pond Bottom and Possible Metals Loading to Groundwater and Downgradient Surface Waters. Actions may include, but may not be limited to: • Install nested bedrock monitoring wells at base of tailings dam, along Beartrap Creek, and possible other locations to document groundwater flow paths and groundwater quality in vicinity of impoundment. • Map and sample tailings pond beach tailings. • Sampling of pond water at depth to quantify water quality at water/tailings interface.	2000-2002 Pending access from and other agreements with Forest Service
	Develop and Implement Tailings Impoundment Reclamation Plan if required. Actions may include, but may not be limited to: • Establish vegetation cover on dam face. • Seal inner dam face to reduce seepage. • Treat dam seepage with passive wetland at base of dam. • Removal of seasonally exposed tailings along beach if present. • Controlling pond water levels to manipulate seepage and/or geochemical conditions within the pond. • Partial sealing of pond bottom. • Partial or complete removal of impoundment. • No action	2002-2006 Pending access from and other agreements with Forest Service
Dispersed Floodplain Tailings	Negotiate access and other agreements with Forest Service and other party(ies).	2000 to 2001
	Map and Sample Dispersed Tailings Deposited Along Beartrap Creek Floodplain from Mike Horse Creek to Anaconda Creek. Quantify locations, depths and volumes of tailings. Characterize for metals content, acid-base accounting, and sulfur forms.	2000-2001
	Develop and Implement Appropriate Reclamation Plans. Actions may include, but may not be limited to: • Complete or partial tailings removal and placement in off-site repository. • Consolidation and local closure of tailings. • In-place reclamation through amendment and revegetation. • Partial removal with construction of settling basins, wetland structures along drainage bottom. • No action	2002-2004 Pending access from and other agreements with Forest Service, and ARCO, and timing of upstream reclamation activities at the tailings impoundment and Mike Horse Creek drainage.
Mine Waste and Possible Adit Discharge on private property (Flosse and Louise Patented Claim)	Quantify Metals Load Contribution to Beartrap Creek: • Conduct detailed water sampling of seepage and Beartrap Creek to document seasonal load increases. • Characterize mine waste rock facilities through mapping and sampling, pending land owners permission.	2000-2001 Pending access from and other agreements with landowner(s).
	• Develop and implement appropriate reclamation plan.	2002-2004 Pending access from and other agreements with landowner(s).

TABLE 4-1. IMPLEMENTATION PLAN SCHEDULE, UPPER BLACKFOOT MINING COMPLEX (continued)

UPPER BLACKFOOT RIVER

Potential Source	TASK	SCHEDULE
Concentrated Tailings near Confluence with Shave Creek	Negotiate access and other agreements with Forest Service and other party(ies).	2000 to 2001
	Characterize Concentrated Tailings: • Delineate lateral extent, depth and volume of tailings. • Sample and analyze tailings chemistry. • Determine source of tailings.	2001-2002 Pending access from and other agreements with Forest Service
	Develop Reclamation Alternatives. Alternatives may include, but may not be limited to: • Complete or partial tailings removal and placement in off-site repository. • Consolidation of tailings with local closure. • In-place closure through soil amendment and revegetation. • No action Reclamation activities to be implemented pursuant to agreement with responsible party(ies).	2003-2005 Pending access from and other agreements with Forest Service and timing of upstream reclamation activities
Dispersed Floodplain Tailings	Negotiate access and other agreements with Forest Service and other party(ies).	2000 to 2001
	Characterize Dispersed Tailings Along Blackfoot River Floodplain from Anaconda Creek to the First Marsh: • Delineate lateral extent, depth and volume of tailings. • Sample and analyze tailings chemistry. • Determine source of tailings.	2001-2002
	Develop Reclamation Alternatives. Alternatives may include, but may not be limited to: • Complete or partial tailings removal and placement in off-site repository. • Consolidation of tailings with local closure. • In-place closure through soil amendment and revegetation. • No action Reclamation activities to be implemented pursuant to agreement with responsible party(ies).	2003-2005 Pending access from and other agreements with Forest Service, and ARCO, and timing of upstream reclamation activities at the tailings impoundment and Mike Horse Creek drainage.
Stevens Gulch	Negotiate access and other agreements with Forest Service and other party(ies).	2000 to 2001
	Quantify remaining loading sources from drainage: • Conduct additional water sampling as needed to augment existing data. • Delineate remaining metals loading sources. • Evaluate natural water quality in creek.	2001-2002
	Develop Reclamation Alternatives: • Complete or partial source removal. • In-place reclamation. • No action Reclamation activities to be implemented pursuant to agreement with responsible party(ies).	2003-2006 Pending access from and other agreements with Forest Service
Water Treatment System Discharge	Continue treatment system optimization through: • Enhancing metals removal through treatment system components. • Reducing metals concentrations in Mike Horse Adit discharge.	Ongoing

TABLE 4-1. IMPLEMENTATION PLAN SCHEDULE, UPPER BLACKFOOT MINING COMPLEX (continued)

WATER QUALITY MONITORING		
Program	**TASK**	**SCHEDULE**
Compliance Monitoring	Surface water monitoring for the period that temporary standards are in place to evaluate compliance. • Seasonal monitoring at frequency to be determined in consultation with MDEQ.	During period that temporary standards are in affect.
Post Reclamation Water Quality Monitoring	Surface water monitoring after completion of reclamation activities to asses ultimate achievable water quality. • Seasonal monitoring at frequency to be determined in consultation with MDEQ.	2007-2008 1-2 years after completion of reclamation activities, or until temporary standards expire.

Waterbody	Site	Description
Alice Creek	SP-SW-47.A	Alice Creek near mouth (confluence with Blackfoot River)
	470114112280701	Alice Creek near mouth (confluence with Blackfoot River)
Arrastra Creek	4225AR01	Arrastra Creek above Highway 200 crossing
	C03ARRAC01	Arrasta Creek 1-1.5 mi downstream of National Forest boundary
	C03ARRAC02	Arrastra Creek above Highway 200 crossing
	ACSW-1	Arrastra Creek above Highway 200 crossing
Beartrap Creek	4329BE01	Beartrap Creek upstream of tailings impoundment
	4329BE03	Beartrap Creek downstream of confluence with Mike Horse Creek
	4329BE04	Beartrap Creek downstream of confluence with Mike Horse Creek
	4329BE05	Beartrap Creek downstream of confluence with Mike Horse Creek
	BRSW-38	Beartrap Creek near mouth (confluence with Anaconda Creek)
	BRSW-39	Beartrap Creek downstream of confluence with Mike Horse Creek
	BRSW-23	Beartrap Creek below tailings dam and confluence with Mike Horse Creek
Blackfoot River	BRSW-29	Blackfoot River at confluence of Anaconda and Beartrap Creeks
	BRSW-12	Blackfoot River above first marsh (below UBMC)
	470226112224501	Blackfoot River above first marsh (below UBMC)
	BRSW-31	Blackfoot River at Meadow Creek Road bridge
	BRSW-16	Blackfoot River at head of second marsh
	BRSW-17	Blackfoot River near Highway 279 crossing
	C03BKFTR01	Blackfoot River near Highway 279 crossing
	SW-1.B	Blackfoot River upstream of Hogum Creek
	SP-SW-1.B	Blackfoot River upstream of Hogum Creek
	12334650	Blackfoot River upstream of Hogum Creek
	BRSW-18	Blackfoot River at Aspen Grove Campground
	C03BKFTR02	Blackfoot River at Aspen Grove Campground
	SW-16.B	Blackfoot River downstream of Seven-Up Pete Creek
	SP-SW-16.B	Blackfoot River downstream of Seven-Up Pete Creek
	12334700	Blackfoot River downstream of Seven-Up Pete Creek
	BFRSW-2	Blackfoot River downstream of Seven-Up Pete Creek
	12334800	Blackfoot River at Dalton Mountain Road bridge, near Lincoln, Montana
	12335100	Blackfoot River above Nevada Creek, near Helmville, Montana
Copper Creek	SP-SW-41.C	Copper Creek upstream of Sucker Creek Road bridge
	CCSW-1	Copper Creek at Sucker Creek Road bridge
	CCSW-2	Copper Creek below confluence with Cotter Creek at Red Creek road bridge
	CCSW-3	Copper Creek upstream of confluence with Cotter Creek
Hardscrabble Creek	SP-SW-45.HS	Hardscrabble Creek upstream near confluence of east and west forks
	SP-SW-37.HS	Hardscrabble Creek near mouth (confluence with Blackfoot River)
Hogum Creek	SP-SW-49.HG	Hogum Creek near mouth (confluence with Blackfoot River)
Landers Fork	SP-SW-34.L	Landers Fork above confluence with Copper Creek
	SW-34.L	Landers Fork above confluence with Copper Creek
	SP-SW-15.L	Landers Fork near mouth (Highway 200 crossing)
	SW-15.L	Landers Fork near mouth (Highway 200 crossing)
	SP-SW-43.L	Landers Fork near mouth (confluence with Blackfoot River)
	12334680	Landers Fork near mouth (Highway 200 crossing)
Mike Horse Creek	BRSW-4	Mike Horse Creek near upper mine workings and disturbance
	BRSW-22	Mike Horse Creek among lower Mike Horse mine waste piles
	BRSW-35	Mike Horse Creek near mouth
Poorman Creek	4226PO01	Poorman Creek below confluence with McCarthy Gulch
	4128PO02	South Fork Poorman Creek
	4128PO01	Poorman Creek above confluence with South Fork Poorman Creek
	PCSW-6	Swansea Gulch near confluence with Poorman Creek
	4127PO02	Poorman Creek below confluence with Fields Gulch
	4127PO01	Poorman Creek below confluence with McClellan Gulch
	C03POORC01	Poorman Creek near headwaters
	C03POORC02	Poorman Creek above confluence with Little Davis Gulch
	C03POORC03	Poorman Creek below confluence with McCarthy Gulch
	25-208-SW-1	Swansea Gulch upstream of Swansea mine/tailings
	25-208-SW-2	Swansea Gulch downstream of Swansea mine/tailings
	PCSW-1	Poorman Creek at mouth (confluence with Blackfoot River)
	PCSW-2	Poorman Creek below confluence with McCarthy Gulch
	PCSW-3	Poorman Creek above confluence with Little Davis Gulch
	PCSW-4	Poorman Creek near headwaters
	PCSW-5	South Fork Poorman Creek
	011	Poorman Creek above confluence with South Fork Poorman Creek
	PCSW-7	Poorman Creek above confluence with South Fork Poorman Creek
Sandbar Creek	4229SA01	Sandbar Creek at National Forest boundary
	C03SNDBC01	Sandbar Creek upstream below confluence of three forks
	SCSW-2	Sandbar Creek upstream below confluence of three forks
	C03SNDBC02	Sandbar Creek at National Forest boundary
	SCSW-1	Sandbar Creek at National Forest boundary
	SCSW-3	Sandbar Creek east fork upstream of mine waste area
Seven-Up Pete Creek	SW-10.S	Seven-Up Pete Creek near headwaters
	SW-12.S	Seven-Up Pete Creek tributary near headwaters
	SW-14.S	Seven-Up Pete Creek near mouth (confluence with Blackfoot River)
	SW-9.S	Seven-Up Pete Creek near headwaters
	25-020-SW-1	Seven-Up Pete Creek tributary above Seven-Up Pete mine
	25-020-SW-2	Seven-Up Pete Creek tributary below Seven-Up Pete mine
	SPSW-1	Seven-Up Pete Creek near mouth (confluence with Blackfoot River)
Willow Creek	4328WI01	Willow Creek near mouth (confluence with Blackfoot River)
	C03WILLC01	Willow Creek at West Flesher Road bridge
	C03WILLC02	Willow Creek near mouth (confluence with Blackfoot River)
	WCSW-1	Willow Creek at West Flesher Road bridge
	WCSW-2	Willow Creek near mouth (confluence with Blackfoot River)

Segment Name: Alice Creek

Site	Sample Date	Ag, TR (µg/L)	Al, D (µg/L)	Al, TR (µg/L)	As, TR (µg/L)	Ba, TR (µg/L)	Be, TR (µg/L)	Ca (mg/L)	Cd, TR (µg/L)	Co, TR (µg/L)	Cr, TR (µg/L)	Cu, TR (µg/L)	Flow (cfs)	Hardness (mg/L)	Fe, TR (µg/L)	Hg, TR (µg/L)
SP-SW-47.A	22-Oct-92	<3			<3	300	<1	30	<0.1	<10	<1	<1	4.4	128	50	<0.6
SP-SW-47.A	16-Dec-92	<3			<3	300	<1	30	<0.1	<10	<1	<1	3.0	124	30	<0.6
SP-SW-47.A	16-Mar-93	<3		<100	<3	300	<1	28	<0.1	<10	<1	<1		118	<30	<0.6
SP-SW-47.A	03-Apr-93	<3		<100	<3	200	<1	27	<0.1	<10	1	<1	4.9	111	150	<0.6
SP-SW-47.A	19-Apr-93	<3		<100	<3	300	<1	25	<0.1	<10	<1	1	11.9	102	150	<0.6
SP-SW-47.A	05-May-93	<3		300	<3	200	<1	18	<0.1	<10	<1	9	94.8	73	1680	<0.6
SP-SW-47.A	19-May-93	<3		<100	<3	200	<1	20	<0.1	<10	<1	2	92.0	81	<80	<0.6
SP-SW-47.A	09-Jun-93	<3		<100	<3	200	<1	23	<0.1	<10	<1	1	59.8	93	160	<0.6
SP-SW-47.A	23-Jun-93	<3		<100	<3	200	<1	22	<0.1	<10	<1	3	76.9	89	70	<0.6
SP-SW-47.A	08-Jul-93	<3		<100	<3	300	<1	26	<0.1	<10	<1	<1	32.8	104	90	<0.6
SP-SW-47.A	11-Aug-93	<3		<100	<3	300	<1	27	<0.1	<10	<1	<1	26.4	109	90	<0.6
SP-SW-47.A	22-Sep-93	<3		<100	<3	300	<1	28	<0.1	<10	<1	<1	27.3	112	100	<0.6
SP-SW-47.A	14-Oct-93	<3		<100	<3	300	<1	28	<0.1	<10	<1	<1	18.6	114	80	<0.6
SP-SW-47.A	02-Feb-94	<3		<100	<3	300	<1	31	<0.1	<10	<1	<1	0.0	127	60	<0.6
SP-SW-47.A	15-Mar-94	<3		<100	<3	300	<1	30	0.7	<10	1	2	11.8	124	170	<0.6
SP-SW-47.A	06-Apr-94	<3		<100	<3	200	<1	25	<0.1	<10	<1	2	11.8	100	160	<0.6
SP-SW-47.A	18-Apr-94	<3	600		<3	200	<1	22	<0.1	<10	<1	7	127.3	88	1060	<0.6
SP-SW-47.A	03-May-94	<3	<100		<3	200	<1	22	<0.1	<10	<1	4	83.6	90	120	<0.6
SP-SW-47.A	16-May-94	<3	<100		<3	300	<1	23	<0.1	<10	<1	1	68.1	94	110	<0.6
SP-SW-47.A	07-Jun-94	<3	<100		<3	300	<1	27	<0.1	<10	<1	1	29.8	108	140	<0.6
SP-SW-47.A	21-Jun-94	<3	<100		<3	300	<1	29	<0.1	<10	<1	<1	20.3	119	120	<0.6
SP-SW-47.A	20-Jul-94	<3	<100		<3	300	<1	28	<0.1	<10	<1	<1	15.0	115	130	<0.6
SP-SW-47.A	17-Aug-94	<3	<100		<3	300	<1	30	<0.1	<10	<1	<1	9.1	125	80	<0.6
SP-SW-47.A	18-Oct-94	<3	<100		<3	300	<1	31	<0.1	<10	<1	1	8.3	129	160	<0.6
SP-SW-47.A	08-Dec-94	<3	<100		<3	300	<1	30	<0.1	<10	<1	<1	6.8	123	100	<0.6
SP-SW-47.A	15-Mar-95	<3	<100		<3	200		27	0.2	<10	<1	1	6.1	114	180	<0.6
SP-SW-47.A	13-May-95	<3	<100		<3	200		19	<0.1		<1	4		76	300	<0.6
SP-SW-47.A	26-Jun-95	<3	<100		<3	300		24	<0.1		<1	<1	52.5	97	140	<0.6
SP-SW-47.A	13-Nov-95	<3	<100	<100	<3	300		29	<0.1		<1	<1	10.9	123	110	<0.6
470114112280701	07-Sep-95				< 1	< 10		28	< 1			< 1.0	11		70	
470114112280701	02-Nov-95				< 1	< 10		30	< 1			< 1.0	6.1		70	
470114112280701	19-Apr-96				< 1			21	< 1			3	102		140	
470114112280701	20-Jun-96				< 1			25	< 1			1	48		120	
470114112280701	21-Aug-96				< 1			30	< 1			< 1.0	12		50	
470114112280701	24-Oct-96				< 1			29	< 1			< 1.0	9		60	
470114112280701	14-Apr-97				< 1			26	< 1			< 1.0	8.6		90	
470114112280701	30-May-97				< 1			20.2	< 1			1.8	131		100	

NOTES: [shaded cell] = water quality standard exceedance

Segment Name: Alice Creek

Site	Sample Date	Mg (mg/L)	Mn, TR (µg/L)	Mo, TR (µg/L)	Ni, TR (µg/L)	pH	Pb, TR (µg/L)	Sb, TR (µg/L)	Se, TR (µg/L)	Sn, TR (µg/L)	SO4 (mg/L)	Tl, TR (µg/L)	V, TR (µg/L)	Zn, TR (µg/L)
SP-SW-47.A	22-Oct-92	13	8	<5	<20	7.86	<3	<10	<1	<100	4	<3	<100	10
SP-SW-47.A	16-Dec-92	12	5	<5	<20	8.33	<3	<10	<1	<100	<1	<3	<100	13.7
SP-SW-47.A	16-Mar-93	12	<5	<5	<20	6.1	<3	<10	<1	<100	4	<3	<20	<10
SP-SW-47.A	03-Apr-93	11	6	<5	<20	7.23	<3	<10	<1	<100	4	<3	<20	20
SP-SW-47.A	19-Apr-93	10	<5	<5	<20	6.9	<3	<10	<1	<100	4	<3	<20	<10
SP-SW-47.A	05-May-93	7	170	<5	<20	7.72	<3	<10	<1	<100	4	<3	<20	<10
SP-SW-47.A	19-May-93	8	6	<5	<20	7.85	<3	<10	<1	<100	4	<3	<20	<10
SP-SW-47.A	09-Jun-93	9	8	<5	<20	6.74	<3	<10	<1	<100	4	<3	<20	20
SP-SW-47.A	23-Jun-93	8	5	<5	<20	7.05	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-47.A	08-Jul-93	10	5	<5	<20	7.03	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-47.A	11-Aug-93	10	6	<5	<20	6.94	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-47.A	22-Sep-93	10	5	<5	<20	7.55	<3	<10	<1	<100	4	<3	<20	14
SP-SW-47.A	14-Oct-93	11	<5	<5	<20	6.78	<3	<10	<1	<100	3	<3	<20	14
SP-SW-47.A	02-Feb-94	12	<5	<5	<20	8.57	<3	<10	<1	<100	4	<3	<20	10
SP-SW-47.A	15-Mar-94	12	<5	<5	<20	8	<3	<10	<1	<100	5	<3	<20	14
SP-SW-47.A	06-Apr-94	9	6	<5	<20	7.47	<3	<10	<1	<100	5	<3	<20	<10
SP-SW-47.A	18-Apr-94	8	70	<5	<20	7.56	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-47.A	03-May-94	8	8	<5	<20	7.63	<3	<10	<1	<100	4	<3	<20	<10
SP-SW-47.A	16-May-94	9	8	<5	<20	7.29	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-47.A	07-Jun-94	10	8	<5	<20	7.23	<3	<5	<1	<100	3	<3	<20	<10
SP-SW-47.A	21-Jun-94	11	7	<5	<20	7.91	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-47.A	20-Jul-94	11	<5	<5	<20	8.63	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-47.A	17-Aug-94	12	6	<5	<20	7.81	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-47.A	18-Oct-94	13	7	<5	<20	8.65	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-47.A	08-Dec-94	12	6	<5	<20	6.88	<3	<10	<1	<100	4	<3	<20	<10
SP-SW-47.A	15-Mar-95	11	5	<5	<20	7.27	<3	<10	<1	<100	3	<3	<20	14
SP-SW-47.A	13-May-95	7	13		<20	9.4	<3	<10	<1		3			20
SP-SW-47.A	26-Jun-95	9	8		<20	7.94	3	<10	<1		3			<10
SP-SW-47.A	13-Nov-95	12	6		<20	7.7	<3	<5	<1		4			<10
470114112280701	07-Sep-95	12	20			8.2	< 1				2.7			< 10
470114112280701	02-Nov-95	12	< 10			7.9	< 1				3.2			< 10
470114112280701	19-Apr-96	8.1	< 10			7.9	< 1				3.1			< 10
470114112280701	20-Jun-96	10	10			8.2	< 1				2.9			< 10
470114112280701	21-Aug-96	11	< 10			8.2	< 1				2.5			< 10
470114112280701	24-Oct-96	12	< 10			8	< 1				3.2			< 10
470114112280701	14-Apr-97	10.9	< 10			8.2	< 1				3.8			< 10
470114112280701	30-May-97	7.8	11			8.2	< 1				2.2			< 10

NOTES: (shaded cell) = water quality standard exceedance

Segment Name: <u>Arrastra Creek</u>

Site	Sample Date	Ag, TR (µg/L)	Al, D (µg/L)	Al, TR (µg/L)	As, TR (µg/L)	Ba, TR (µg/L)	Be, TR (µg/L)	Ca (mg/L)	Cd, TR (µg/L)	Cu, TR (µg/L)	Cr, TR (µg/L)	Flow (cfs)	Hardness (mg/L)	Fe, TR (µg/L)
4225AR01	4/1/1974											6		
4225AR01	5/8/1974											7.1		
4225AR01	7/24/1974											31.09		
4225AR01	5/11/1989											50		
C03ARRAC01	6/19/2001	3		<100	<3	67	<1	13	<0.1	3	<1	11.5	50	10
C03ARRAC02	6/19/2001	<3		<100	<3	113	<1	23	<0.1	<1	<1	36	91	60
ACSW-1	6/7/2002		<10		<50	60	<10	13.2	<1	<1	<1	126	50.8	70
ACSW-1	10/8/2002		<50		<5			25	<0.1	<1		8.1	99	<30

NOTES: [shaded cell] = water quality standard exceedance

Segment Name: Arrastra Creek											
Site	**Sample Date**	**Mg (mg/L)**	**Mn, TR (µg/L)**	**Ni, TR (µg/L)**	**pH**	**Pb, TR (µg/L)**	**Sb, TR (µg/L)**	**Se, TR (µg/L)**	**SO4 (mg/L)**	**Tl, TR (µg/L)**	**Zn, TR (µg/L)**
4225AR01	4/1/1974										
4225AR01	5/8/1974				8.2						
4225AR01	7/24/1974										
4225AR01	5/11/1989										
C03ARRAC01	6/19/2001	4	5	10	8.0	<2	<3	1	1	2	<10
C03ARRAC02	6/19/2001	8	<5	<10	8.1	2	<3	<1	2	<2	30
ACSW-1	6/7/2002	4.3	<10	<20	8.67	<1		<50	1.38		<10
ACSW-1	10/8/2002	9	<10		8.42	<2			2		<10
NOTES:	(shaded)	= water quality standard exceedance									

Segment Name: Beartrap Creek

Site	Sample Date	Ag, D (µg/L)	Ag, T (µg/L)	Al, D (µg/L)	Al, T (µg/L)	Al, TR (µg/L)	As, D (µg/L)	As, T (µg/L)	As, TR (µg/L)	Ba, D (µg/L)	Ba, TR (µg/L)	Be, TR (µg/L)	Ca (mg/L)	Cd, D (µg/L)	Cd, T (µg/L)	Cd, TR (µg/L)	Co, D (µg/L)	Co, T (µg/L)	Cu, D (µg/L)	Cu, T (µg/L)	Cu, TR (µg/L)	Cr, D (µg/L)	Cr, TR (µg/L)	Flow (cfs)	Hardness (mg/L)	Fe, D (µg/L)	Fe, T (µg/L)
4329BE01	9/7/1984												21.7		***					***				0.11	108		***
4329BE01	5/30/1986		***					***					24.89		***					***				12	97		***
4329BE03	6/23/1975							86.99							>49.99					>1099							120000
4329BE03	6/6/1977						***	***						***	***				***	***						***	***
4329BE03	7/29/1977						1	***						***	***				***	***						29.99	***
4329BE03	9/7/1984												31.59		***					***				0.17	147		***
4329BE04	6/6/1977						***	***						***	***				10	***						29.99	***
4329BE04	7/29/1977						1	***						***	***				***	***						***	***
4329BE05	9/7/1984													54.59	***					***				0.89	290		***
BRSW-38	4/28/1999			<50		1820	<2		<2				57	50.4		50.8			253		738			3.1	295	<10	
BRSW-38	5/28/1999			<50		240	<2		<2				20	4.7		5.5			33		79			14.5	95	<10	
BRSW-38	10/19/1999			<50		<50	<2		<2				31	3		3			<5		7			0.34	152	<50	
BRSW-38	10/11/2000			<50		<50	<5		<5				41	5		5			4		5			0.33	193	<50	
BRSW-38	4/25/2001			98		1000	<5		<5				72	45		45			33		180			1.12	349	120	
BRSW-38	4/25/2001					2700			7							65					490			1.61			
BRSW-38	5/22/2001			<50		150	<5		<5				25	8		9			34		64			4	124	<50	
BRSW-38	6/26/2001			<50		110	<5		<5				25	7.1		7.6			30		45			4.9	124	<50	
BRSW-38	6/26/2001					130			<5							7.1					43			3.9			
BRSW-38	10/16/2001			<50		58	<5		<5				35	4.6		4.2			4		5			0.31	170	<20	
BRSW-38	10/17/2001			<50		<50	<5		<5				35	4.2		5.3			3		4			0.21	170	21	
BRSW-39	4/29/1999			<50		1630	<2		<2				58	45.2		45			257		648			3.3	301	<10	
BRSW-39	10/19/1999			<50		<50	<2		<2				32	3		3			<5		<5			0.32	158	<50	
BRSW-39	10/11/2000			<50		<50	<5		<5				41	4		5			4		6			0.35	197	<50	
BRSW-39	4/25/2001			96		1200	<5		<5				73	47		49			36		220			0.88	351	100	
BRSW-39	5/22/2001			56		160	<5		<5				25	8		9			37		66			4.3	128	<50	
BRSW-39	6/26/2001			<50		120	<5		<5				24	7.1		7.1			32		45			4.3	122	<50	
BRSW-39	10/17/2001			<50		<50	<5		<5				37	4.5		4.5			3		4			0.23	179	22	
BRSW-23	10/26/1993	<0.2	0.2	<100	<100		<3	<3		<200	<200		39	4.9	6		<50	<50	<10	17		<10	<10	1.76	209	<100	1095
BRSW-23	5/18/1994			100		230							35	6		7			17		88			5.98	178	63	
BRSW-23	10/26/1994			<50		957	<2		8				91	36		42			7		209			0.36	482	110	
BRSW-23	5/1/1995			<50		420	<2		<2				47	35		33			67		210			1.49	241	30	
BRSW-23	10/23/1995			<50		50	<2		<2				39	5		5			<5		13			0.21	200	<30	
BRSW-23	5/22/1996			<50		180	<2		<2				25	8		7			31		54			9.35	132	<50	
BRSW-23	10/21/1996			<50		<50	<2		<2				94	41		37			22		42			0.359	486	<30	
BRSW-23	2/26/1997			<100		<100	<5		<5				41	4		4			<10		<10			0.17	201	<30	
BRSW-23	5/27/1997			<50		95	<2		<2				19	4		4			29		44			12.12	93	<30	
BRSW-23	10/20/1997			<50		<50	<2		<2				39	13		13			8		11			0.388	192	<50	
BRSW-23	5/5/1998			<50		120	<2		<2				36	12		10			25		47			1.59	176	<30	
BRSW-23	10/22/1998			<50		<50	<2		<2				33	3		3			5		6			0.305	165	<50	
BRSW-23	4/29/1999			<50		1880	<2		<2				54	49.7		50.4			392		778			1.8	287	<10	
BRSW-23	5/28/1999			<50		200	<2		<2				20	4.5		5.2			37		79			14.2	95	<10	
BRSW-23	10/19/1999			<50		<50	<2		<2				31	2		2			<5		<5			0.25	156	<50	
BRSW-23	10/11/2000			<50		<50	<5		<5				41	4		4			4		5			0.29	189	<50	
BRSW-23	10/12/2000			<50		<50	<5		<5				42	4		4			4		7			0.26	195	<50	
BRSW-23	4/25/2001			75		2100	<5		<5				69	67		67			67		350			0.74	329	200	
BRSW-23	5/22/2001			53		170	<5		<5				23	7		7			43		72			4.2	115	<50	
BRSW-23	6/26/2001			<50		120	<5		<5				23	6		6.6			33		53			3.6	115	<50	
BRSW-23	10/4/2001																							0.29			
BRSW-23	10/17/2001			<50		<50	<5		<5				36	3.2		3.1			3		4			0.23	176	<20	

NOTES: *** = value reported in STORET database as 0 concentration
[shaded cell] = water quality standard exceedance

Segment Name: Beartrap Creek

Site	Sample Date	Fe, TR (µg/L)	Hg, T (µg/L)	Mg (mg/L)	Mn, D (µg/L)	Mn, T (µg/L)	Mn, TR (µg/L)	Mo, D (µg/L)	Mo, T (µg/L)	Ni, D (µg/L)	Ni, TR (µg/L)	pH	Pb, D (µg/L)	Pb, T (µg/L)	Pb, TR (µg/L)	Sb, D (µg/L)	Sb, T (µg/L)	Se, D (µg/L)	Se, TR (µg/L)	SO4 (mg/L)	Zn, D (µg/L)	Zn, T (µg/L)	Zn, TR (µg/L)
4329BE01	9/7/1984			13		***						7.8								22		***	
4329BE01	5/30/1986			11.5		***						7.2	***							35		***	
4329BE03	6/23/1975					>83000								18000								>9000	
4329BE03	6/6/1977												***	***							130	***	
4329BE03	7/29/1977												***	***							210	***	
4329BE03	9/7/1984			16.39		***						7.4								51		***	
4329BE04	6/6/1977												***	***								3500	***
4329BE04	7/29/1977												***	***								3000	***
4329BE05	9/7/1984			37.29		***						7.3								188		***	
BRSW-38	4/28/1999	190		37	3000		3120					7.07	3		76					276	9180		9280
BRSW-38	5/28/1999	150		11	313		374					7.76	6		35					32	860		980
BRSW-38	10/19/1999	<50		18	420		420					8.36	<3		12					70	950		1000
BRSW-38	10/11/2000	2700		22	640		620					6.31	<3		<3					109	1300		1500
BRSW-38	4/25/2001	9500		41	3900		3900					6.56	5		89					375	8700		9300
BRSW-38	4/25/2001	120					7300					6.16			330								14000
BRSW-38	5/22/2001	60		15	870		900					6.72	8		27					78	1600		1600
BRSW-38	6/26/2001	64		15	650		670					8.01	9		20					65	1200		1300
BRSW-38	6/26/2001	66					640					8.03			20								1200
BRSW-38	10/16/2001	46		20	550		540					8.07	<3		4					80	980		990
BRSW-38	10/17/2001			20	630		670					7.15	<3		5					90	1300		1300
BRSW-39	4/29/1999	650		38	3810		3780					7.07	4		70					252	8920		8160
BRSW-39	10/19/1999	<50		19	530		490					8.26	<3		5					75	690		710
BRSW-39	10/11/2000	88		23	840		840					6.53	<3		3					123	1200		1200
BRSW-39	4/25/2001	2600		41	4400		4600					6.72	5		110					401	8900		10000
BRSW-39	5/22/2001	230		16	880		910					7.05	8		26					78	1600		1600
BRSW-39	6/26/2001	68		15	670		700					8.17	9		19					60	1100		1200
BRSW-39	10/17/2001	60		21	810		830					8.19	<3		<3					100	1100		1200
BRSW-23	10/26/1993		<0.2	27	1803	1930		<50	<50	<40	<40	6.57	<3	12		<60	<60	<5	<5	127	1898	2632	
BRSW-23	5/18/1994	490		22	740		840					7.12	<2		16					61	1600		2100
BRSW-23	10/26/1994	8434		62	6818		6745					7.49	<2		369					462	13600		16500
BRSW-23	5/1/1995	530		30	1900		2000					7.31	9		68					169	7700		7700
BRSW-23	10/23/1995	310		25	900		870					7.62	6		24					91	1400		1300
BRSW-23	5/22/1996	270		17	1500		1700					7.85	6		27					103	2700		3000
BRSW-23	10/21/1996	180		61	10000		9900					6.8	6		21					435	17000		17000
BRSW-23	2/26/1997	50		24	400		400					5.44	10		10					97	1290		1330
BRSW-23	5/27/1997	50		11	190		200					7.2	8		17					22	690		660
BRSW-23	10/20/1997	<50		23	1300		1400					7.94	4		8					118	2000		2000
BRSW-23	5/5/1998	150		21	560		600					8.63	10		32					123	2100		2200
BRSW-23	10/22/1998	90		20	640		610					7.24	<3		7					71	570		590
BRSW-23	4/29/1999	540		37	3930		3910					6.9	7		79					249	9070		8000
BRSW-23	5/28/1999	140		11	289		323					7.83	6		30					29	770		850
BRSW-23	10/19/1999	<50		19	590		570					8.24	<3		5					57	580		560
BRSW-23	10/11/2000	<50		21	400		360					7.46	<3		4					110	1000		1100
BRSW-23	10/12/2000	50		22	430		400					7.46	<3		6					105	1100		920
BRSW-23	4/25/2001	2000		38	3900		3900					6.79	6		160					357	11000		12000
BRSW-23	5/22/2001	74		14	600		620					7.63	14		28					64	1200		1200
BRSW-23	6/26/2001	<50		14	450		460					8.03	11		22					53	940		990
BRSW-23	10/4/2001											6.81											
BRSW-23	10/17/2001	45		21	520		520					7.9	<3		6					87	740		740

NOTES:
*** = value reported in STORET database as 0 concentration
[shaded cell] = water quality standard exceedance

Segment Name: Blackfoot River at Confluence of Anaconda and Beartrap Creeks

Site	Sample Date	Al, D (µg/L)	Al, TR (µg/L)	As, TR (µg/L)	Ca (mg/L)	Cd, TR (µg/L)	Cu, TR (µg/L)	Flow (cfs)	Hardness (mg/L)	Fe, TR (µg/L)	Mg (mg/L)	Mn, TR (µg/L)	pH	Pb, TR (µg/L)	SO4 (mg/L)	Zn, TR (µg/L)
BRSW-29	5/27/1997	<50	61	<2	15	**1**	**13**	39.4	68	47	7.4	**62**	6.68	**8**	11	**260**
BRSW-29	10/20/1997	<50	<50	<2	27	**4**	<5	1.14	125	<50	14	**400**	7.75	<3	46	**610**
BRSW-29	5/5/1998	<50	<50	<2	17	**2**	5	9.77	78	<30	8.6	**79**	8.02	**4**	25	**350**
BRSW-29	10/22/1998	<50	<50	<2	27	**2**	5	0.882	129	60	15	**100**	7.02	<3	49	**570**
BRSW-29	4/28/1999	<50	440	<2	32	**16.6**	**222**	11.1	158	260	19	**1270**	7.08	**24**	99	**3460**
BRSW-29	5/28/1999	<50	<50	<2	16	**2.2**	**26**	33	73	50	8	**141**	7.66	**13**	15	**370**
BRSW-29	10/19/1999	<50	<50	<2	26	**2**	<5	0.76	123	<50	14	**180**	8.48	<3	35	**660**
BRSW-29	10/10/2000	<50	<50	<5	32	**3**	4	0.77	146	<50	16	**220**	7.42	<3	72	**720**
BRSW-29	4/24/2001	<50	480	<5	39	**13**	**61**	2.83	184	**1100**	21	**1300**	7.05	**46**	145	**3000**
BRSW-29	5/21/2001	<50	72	<5	19	**4**	**26**	11.3	89	54	10	**330**	7.0	**11**	35	**770**
BRSW-29	6/18/2001		80	<5		**4**	**27**	20.1		60		**310**	7.97	**10**		**830**
BRSW-29	6/25/2001	<50	71	<5	20	**3.9**	**20**	9.7	95	<50	11	**300**	8.23	**10**	35	**690**
BRSW-29	10/4/2001							0.84					6.71			
BRSW-29	10/16/2001	<50	52	<5	29	**3**	4	0.73	138	39	16	**270**	8.09	3	50	**700**

NOTES: [shaded cell] = water quality standard exceedance

Segment Name:		Blackfoot River Above First Marsh (Below UBMC)																			
Site	Sample Date	Ag, T (µg/L)	Al, D (µg/L)	Al, T (µg/L)	Al, TR (µg/L)	As, T (µg/L)	As, TR (µg/L)	B, T (µg/L)	Ba, T (µg/L)	Be, TR (µg/L)	Ca (mg/L)	Cd, T (µg/L)	Cd, TR (µg/L)	Cr, T (µg/L)	Cr, TR (µg/L)	Co, T (µg/L)	Cu, T (µg/L)	Cu, TR (µg/L)	Flow (cfs)	Hardness (mg/L)	Fe, T (µg/L)
BRSW-12	8/12/1991	<8	<200	<200		<20					33	<8					16		4.2	163	340
BRSW-12	9/13/1991	<8	<200	<200		<20					36	<8					16		2.4	172	300
BRSW-12	11/13/1991	<8	<200	<200		<20					42	<8					20		1.9	201	290
BRSW-12	4/16/1992	<10	<200	<200		<8			<200		35	5		<10		<50	24		5.1	161	304
BRSW-12	5/5/1992	<10	<200	<200		<8			<200		27	<5		<10		<50	27		8.2	125	509
BRSW-12	5/19/1992	<10	<200	<200		<8			<200		17	<5		<10		<50	14		6.5	150	207
BRSW-12	6/2/1992	<10	<200	<200		<8			<200		33	<5		<10		<50	8.7		4.7	161	167
BRSW-12	6/2/1993		317	392							19	7					42		49.5	86	366
BRSW-12	10/25/1993	<2	<100	<100		<3			<200		22	2.4		<10		<50	13		9.4	104	106
BRSW-12	5/17/1994		110		160						24		2					25	23.5	109	
BRSW-12	10/26/1994		<50		134		<2				29		6					26	2.9	138	
BRSW-12	5/2/1995		<50		300		<2				23		6					60	12.4	107	
BRSW-12	10/23/1995		<50		<50		<2				28		3					8	1.5	132	
BRSW-12	5/20/1996		<50		120		<2				16		3					17	44.6	76	
BRSW-12	10/21/1996		<50		<50		<2				32		6					9	1.3	154	
BRSW-12	5/27/1997		<50		110		<2				13		2					20	68.3	60	
BRSW-12	10/20/1997		<50		<50		<2				30		4					10	2.0	141	
BRSW-12	5/5/1998		<50		75		<2				18		3					12	19.8	84	
BRSW-12	10/21/1998		<50		<50		<2				35		8					9	1.2	162	
BRSW-12	4/27/1999		<50		300		<2				24		7.5					66	25.7	113	
BRSW-12	5/28/1999		<50		50		<2				16		2.3					22	56.5	73	
BRSW-12	10/18/1999		<50		<50		<2				36		5					9	1.4	168	
BRSW-12	10/10/2000		<50		<50		<5				37		3					7	1.6	166	
BRSW-12	4/24/2001		<50		180		<5				37		6					22	5.9	162	
BRSW-12	5/21/2001		<50		120		<5				20		5					24	18.3	91	
BRSW-12	6/25/2001		<50		84		<5				21		4					17	16.1	98	
BRSW-12	10/4/2001																		1.5		
BRSW-12	10/16/2001		<50		<50		<5				42		4					8	0.8	187	
BRSW-12	6/6/2002		110		70		<5		150	<10	18.6		<1		<1			22	24.6	85	
470226112224501	9/7/1995						< 1		< 10		28		5					8	2.8	136	
470226112224501	11/2/1995						< 1		< 10		29		6					7	2.4	138	
470226112224501	4/19/1996						< 1				19		5					34	28	87	
470226112224501	6/20/1996						< 1				29		11					170	13	142	
470226112224501	8/21/1996						< 1				24		3					9	2.4	113	
470226112224501	10/24/1996						< 1				31		6					10	1.2	147	
470226112224501	4/14/1997						< 1				41.3		6.2					15.3	3	196	
470226112224501	5/30/1997						< 1				14.5		1.92					15	52	66	
NOTES:		= water quality standard exceedance																			

Segment Name:		Blackfoot River Above First Marsh (Below UBMC)																
Site	Sample Date	Fe, TR (µg/L)	Hg, T (µg/L)	Mg (mg/L)	Mn, T (µg/L)	Mn, TR (µg/L)	Mo, T (µg/L)	Ni, T (µg/L)	Ni, TR (µg/L)	pH	Pb, T (µg/L)	Pb, TR (µg/L)	Sb, T (µg/L)	Se, T (µg/L)	Se, TR (µg/L)	SO4 (mg/L)	Zn, T (µg/L)	Zn, TR (µg/L)
BRSW-12	8/12/1991		<0.5	19	960		<20			8.03	<10			<20		86	1600	
BRSW-12	9/13/1991		<0.5	20	890		<20			8.18	<10			<20		74	1700	
BRSW-12	11/13/1991		<0.5	23	560		<20			7.36	<10			<20		112	2500	
BRSW-12	4/16/1992		<0.5	18	332		<50	<20		7.33	11			<5		101	1550	
BRSW-12	5/5/1992		<0.5	14	264		<50	<20		7.31	15			<5		68	1430	
BRSW-12	5/19/1992		<0.5	31	637		<50	<20		7.22	5.2			<5		89	1697	
BRSW-12	6/2/1992		<0.5	19	718		<50	<20		7.82	<5			<5		93	1269	
BRSW-12	6/2/1993			9.3	302					6.86	73					34	1126	
BRSW-12	10/25/1993		<0.2	12	331		<50	<40		6.7	3		<60	<5		49	871	
BRSW-12	5/17/1994	110		12		200				6.05		5				31		720
BRSW-12	10/26/1994	144		16		378				7.63		7				73		1584
BRSW-12	5/2/1995	110		12		320				7.14		15				59		1500
BRSW-12	10/23/1995	100		15		200				7.18		5				69		1200
BRSW-12	5/20/1996	<50		8.7		300				7.44		10				34		860
BRSW-12	10/21/1996	42		18		660				6.81		<3				89		2200
BRSW-12	5/27/1997	170		6.6		150				6.28		13				17		470
BRSW-12	10/20/1997	<50		16		770				7.79		<3				80		980
BRSW-12	5/5/1998	55		9.5		180				7.69		6				47		760
BRSW-12	10/21/1998	<50		18		120				7.05		<3				137		2400
BRSW-12	4/27/1999	320		13		537				7.17		19				68		1680
BRSW-12	5/28/1999	90		8		158				6.97		13				24		480
BRSW-12	10/18/1999	82		19		110				7.74		<3				128		1700
BRSW-12	10/10/2000	<50		18		110				7.12		<3				126		810
BRSW-12	4/24/2001	330		17		420				7.39		8				136		1500
BRSW-12	5/21/2001	66		10		290				7.06		9				51		1000
BRSW-12	6/25/2001	<50		11		230				7.91		6				46		830
BRSW-12	10/4/2001									6.69								
BRSW-12	10/16/2001	41		20		140				7.41		<3				124		1300
BRSW-12	6/6/2002	40		9.3		210			<20	8.46		7.0			<50	32.9		748
470226112224501	9/7/1995	60		16		450				7.5		8				84		1600
470226112224501	11/2/1995	50		16		450				7.4		2				98		2100
470226112224501	4/19/1996	110		9.7		350				7.8		12				51		1300
470226112224501	6/20/1996	800		17		1600				7.7		9				90		3600
470226112224501	8/21/1996	80		13		220				8		3				56		850
470226112224501	10/24/1996	60		17		740				7.4		2				100		2300
470226112224501	4/14/1997	80		22.6		727				7.4		3				148		2450
470226112224501	5/30/1997	50		7.17		105				7.7		7				20		452
NOTES:	(shaded)	= water quality standard exceedance																

Segment Name: **Blackfoot River at Meadow Creek Road Bridge**

Site	Sample Date	Al, D (µg/L)	Al, TR (µg/L)	As, TR (µg/L)	Ca (mg/L)	Cd, TR (µg/L)	Cu, TR (µg/L)	Flow (cfs)	Hardness (mg/L)	Fe, TR (µg/L)	Mg (mg/L)	Mn, TR (µg/L)	pH	Pb, TR (µg/L)	SO4 (mg/L)	Zn, TR (µg/L)
BRSW-31	10/21/1998	<50	160	<2	29	2	18	3.4	134	580	15	290	7.21	<3	105	880
BRSW-31	4/26/1999	80	180	<2	20	2.4	18	35.3	91	330	10	105	7.19	3	58	760
BRSW-31	10/18/1999	<50	160	<2	28	1	19	2.9	128	750	14	280	7.95	<3	91	660
BRSW-31	10/10/2000	<50	150	<5	31	1	19	2.2	139	800	15	340	7.02	<3	115	450
BRSW-31	4/24/2001	<50	170	<5	30	1.7	14	8.2	137	700	15	220	7.39	<3	104	680
BRSW-31	5/21/2001	<50	110	<5	17	2	12	27.0	78	180	8.7	64	6.97	<3	50	630
BRSW-31	6/25/2001	<50	80	<5	18	1.7	9	21.2	82	160	9.1	60	7.75	<3	41	480
BRSW-31	10/16/2001	<50	160	<5	31	1.3	16	1.8	143	660	16	270	7.39	<3	97	560

NOTES: [shaded box] = water quality standard exceedance

Segment Name:	Blackfoot River at Head of Second Marsh																	
Site	Sample Date	Ag, T (µg/L)	Al, D (µg/L)	Al, T (µg/L)	Al, TR (µg/L)	As, T (µg/L)	As, TR (µg/L)	Ba, T (µg/L)	Ca (mg/L)	Cd, T (µg/L)	Cd, TR (µg/L)	Cr, T (µg/L)	Co, T (µg/L)	Cu, T (µg/L)	Cu, TR (µg/L)	Flow (cfs)	Hardness (mg/L)	Fe, T (µg/L)
BRSW-16	8/12/1991	<8	<200	<200		<20			30	<8				<8		3.5	141	220
BRSW-16	9/12/1991	<8	<200	<200		<20			32	<8				29		1.0	146	240
BRSW-16	11/12/1991	<8	<200	680		<20			31	<8				34		4.4	143	950
BRSW-16	4/15/1992	<10	<200	<200		<8		<200	28	<5		<10	<50	10		7.3	127	214
BRSW-16	5/4/1992	<10	<200	<200		<8		<200	23	<5		<10	<50	9.5		12.4	106	164
BRSW-16	5/18/1992	<10	<200	<200		<8		<200	27	<5		<10	<50	<8		7.5	127	133
BRSW-16	6/2/1992	<10	<200	<200		<8		<200	29	<5		<10	<50	<8		5.4	135	99
BRSW-16	6/3/1993		260	350					19	1.5				15		51.3	87	321
BRSW-16	10/24/1993	0.2	<100	<100		<3		<200	20	1		<10	<50	<10		9.6	91	155
BRSW-16	5/17/1994		110		170		3		23		1				12	43.2	107	
BRSW-16	10/25/1994		<50		50		<2		28		1				<5	4.4	132	
BRSW-16	5/2/1995		<50		130		<2		18		1				<5	21.0	84	
BRSW-16	10/23/1995		<50		140		<2		25		1				9	2.2	116	
BRSW-16	5/20/1996		<50		130		<2		14		1				8	79.2	64	
BRSW-16	10/21/1996		<50		<50		<2		25		1				<5	1.9	116	
BRSW-16	5/27/1997		<50		110		<2		13		1				12	88.4	60	
BRSW-16	10/20/1997		<50		<50		<2		23		1				7	4.3	107	
BRSW-16	5/5/1998		<50		110		<2		16		1				10	31.6	73	
BRSW-16	10/21/1998		<50		50		<2		28		1				5	1.3	132	
BRSW-16	4/26/1999		80		270		<2		18		1.8				16	42.8	82	
BRSW-16	10/18/1999		50		<50		<2		26		<1				5	1.1	123	
BRSW-16	10/10/2000		<50		<50		<5		30		0.9				5	1.5	137	
BRSW-16	4/24/2001		<50		300		<5		27		1.4				17	7.7	121	
BRSW-16	5/21/2001		<50		110		<5		17		2				9	30.5	78	
BRSW-16	6/25/2001		<50		74		<5		19		1.5				6	23.3	86	
NOTES:		= water quality standard exceedance																

Segment Name:	Blackfoot River at Head of Second Marsh															
Site	Sample Date	Fe, TR (µg/L)	Hg, T (µg/L)	Mg (mg/L)	Mn, T (µg/L)	Mn, TR (µg/L)	Mo, T (µg/L)	Ni, T (µg/L)	pH	Pb, T (µg/L)	Pb, TR (µg/L)	Sb, T (µg/L)	Se, T (µg/L)	SO4 (mg/L)	Zn, T (µg/L)	Zn, TR (µg/L)
BRSW-16	8/12/1991		<0.5	16	50		<20		8.15	<10			<20	60	320	
BRSW-16	9/12/1991		<0.5	16	54		<20		7.2	<10			<20	61	270	
BRSW-16	11/12/1991		<0.5	16	150		<20		7.51	<10			<20	80	490	
BRSW-16	4/15/1992		<0.5	14	51		<50	<20	7.49	<5			<5	80	396	
BRSW-16	5/4/1992		<0.5	12	30		<50	<20	7.11	11			<5	57	383	
BRSW-16	5/18/1992		<0.5	14	33		<50	<20	7.54	<5			<5	70	504	
BRSW-16	6/2/1992		<0.5	15	28		<50	<20	7.86	<5			<5	80	358	
BRSW-16	6/3/1993			9.5	68				6.2	4.1				38	541	
BRSW-16	10/24/1993		<0.2	10	40		<50	<40	6.75	<3		<60	<5	42	359	
BRSW-16	5/17/1994	180		12		26			6.41		<2			29		340
BRSW-16	10/25/1994	77		15		57			7.06		<2			115		407
BRSW-16	5/2/1995	220		9.4		38			6.99		<3			44		410
BRSW-16	10/23/1995	430		13		80			7.17		5			66		400
BRSW-16	5/20/1996	110		7.1		32			7.28		3			26		380
BRSW-16	10/21/1996	140		13		110			5.71		<3			67		490
BRSW-16	5/27/1997	210		6.7		40			6.1		8			19		380
BRSW-16	10/20/1997	200		12		180			7.55		3			65		360
BRSW-16	5/5/1998	250		8		66			6.99		3			38		400
BRSW-16	10/21/1998	220		15		79			6.78		<3			22		560
BRSW-16	4/26/1999	450		9		89			7.25		4			54		560
BRSW-16	10/18/1999	170		14		59			8.05		<3			86		460
BRSW-16	10/10/2000	100		15		80			6.26		<3			108		350
BRSW-16	4/24/2001	880		13		160			7.09		4			100		550
BRSW-16	5/21/2001	150		8.6		51			6.26		<3			49		550
BRSW-16	6/25/2001	120		9.3		39			8.1		<3			42		430

NOTES: [shaded cell] = water quality standard exceedance

Segment Name:		Blackfoot River at Highway 279																				
Site	**Sample Date**	**Ag, T (µg/L)**	**Ag, TR (µg/L)**	**Al, D (µg/L)**	**Al, T (µg/L)**	**Al, TR (µg/L)**	**As, T (µg/L)**	**As, TR (µg/L)**	**Ba, T (µg/L)**	**Ba, TR (µg/L)**	**Be, TR (µg/L)**	**Ca (mg/L)**	**Cd, T (µg/L)**	**Cd, TR (µg/L)**	**Cr, T (µg/L)**	**Cr, TR (µg/L)**	**Co, T (µg/L)**	**Cu, T (µg/L)**	**Cu, TR (µg/L)**	**Flow (cfs)**	**Hardness (mg/L)**	**Fe, T (µg/L)**
BRSW-17	8/12/1991	<8		<200	<200		<20					30	<8					<8		6.5	137	180
BRSW-17	9/12/1991	<8		<200	<200		<20					29	<8					14		7.2	130	320
BRSW-17	11/12/1991	<8		<200	<200		<20					27	<8					8		9.4	125	460
BRSW-17	4/15/1992	<10		<200	<200		<8		<200			27	<5		<10		<50	15		9.7	124	184
BRSW-17	5/20/1992	<10		<200	<200		<8		<200			26	<5		<10		<50	<8		11.3	117	110
BRSW-17	6/2/1992	<10		<200	<200		<8		<200			29	<5		<10		<50	<8		8.1	128	50
BRSW-17	10/24/1993	0.2		<100	<100		<3		<200			21	<1		<10		<50	10		15.7	98	100
BRSW-17	10/21/1998			<50		<50		<2				26		<1					<5	4.7	118	
BRSW-17	4/26/1999			80		170		<2				19		0.4					4	60.2	84	
BRSW-17	10/18/1999			<50		<50		<2				25		<1					<5	4.2	112	
CO3BKFTR01	6/19/2001		<3			<100		<3		131	<1	19		0.5		<1			3	66.4	85	
NOTES:		= water quality standard exceedance																				

Segment Name:		Blackfoot River at Highway 279																		
Site	**Sample Date**	**Fe, TR (µg/L)**	**Hg, T (µg/L)**	**Mg (mg/L)**	**Mn, T (µg/L)**	**Mn, TR (µg/L)**	**Mo, T (µg/L)**	**Ni, T (µg/L)**	**Ni, TR (µg/L)**	**pH**	**Pb, T (µg/L)**	**Pb, TR (µg/L)**	**Sb, T (µg/L)**	**Sb, TR (µg/L)**	**Se, T (µg/L)**	**Se, TR (µg/L)**	**SO4 (mg/L)**	**Tl, TR (µg/L)**	**Zn, T (µg/L)**	**Zn, TR (µg/L)**
BRSW-17	8/12/1991		<0.5	15	79		<20			8.03	<10				<20		32		93	
BRSW-17	9/12/1991		<0.5	14	100		<20			8.27	<10				<20		24		57	
BRSW-17	11/12/1991		<0.5	14	390		<20			7.27	<10				<20		40		150	
BRSW-17	4/15/1992		<0.5	13	68		<50	<20		7.48	<5				<5		63		151	
BRSW-17	5/20/1992		<0.5	13	56		<50	<20		7.53	<5				<5		52		179	
BRSW-17	6/2/1992		<0.5	14	66		<50	<20		7.73	<5				<5		54		143	
BRSW-17	10/24/1993		<0.2	11	36		<50	<40		6.82	<3		<60		<5		38		191	
BRSW-17	10/21/1998	250		13		130				7.1		<3					52			140
BRSW-17	4/26/1999	200		9		35				7.2		<3					34			200
BRSW-17	10/18/1999	180		12		120				7.73		<3					50			150
CO3BKFTR01	6/19/2001	80		9		24			<10	7.3		<2		<3		<1	82	<2		200
NOTES:	[shaded cell]	= water quality standard exceedance																		

Segment Name: Blackfoot River Upstream of Hogum Creek

Site	Sample Date	Ag, TR (µg/L)	Al, D (µg/L)	Al, TR (µg/L)	As, TR (µg/L)	Ba, TR (µg/L)	Be, TR (µg/L)	Ca (mg/L)	Cd, TR (µg/L)	Co, TR (µg/L)	Cr, TR (µg/L)	Cu, TR (µg/L)	Flow (cfs)	Hardness (mg/L)	Fe, TR (µg/L)	Hg, TR (µg/L)	Mg (mg/L)
SW-1.B	10/24/1989	<5			<5			30	<1			<10	24.13	127	50	<1	13
SW-1.B	3/1/1990	<5			<5			30	<1			<10		127	60	<1	13
SW-1.B	5/10/1990	<5			<5			18	<1			<10		78	110	<1	8
SW-1.B	8/22/1990	<5			<5			30	<1			<10	27.52	121	100	<1	11
SW-1.B	10/23/1990	<5			<5			31	<1			<10	21.11	130	70	<1	13
SW-1.B	2/14/1991	<5			<5			30	<1			<10	12.84	127	30	<1	13
SW-1.B	8/18/1992	<0.5			<5	300	<1	36	<0.1		<1	<1	8.77	151	<30	<0.1	15
SP-SW-1.B	10/24/1989	<5			<5			30	<1			<10	24.13	127	50	<1	13
SP-SW-1.B	3/1/1990	<5			<5			30	<1			<10		127	60	<1	13
SP-SW-1.B	5/10/1990	<5			<5			18	<1			<10		78	110	<1	8
SP-SW-1.B	8/22/1990	<5			<5			30	<1			<10	27.52	121	100	<1	11
SP-SW-1.B	10/23/1990	<5			<5			31	<1			<10	21.11	130	70	<1	13
SP-SW-1.B	2/14/1991	<5			<5			30	<1			<10	12.84	127	30	<1	13
SP-SW-1.B	8/18/1992	<3			<3	300	<1	36	<0.1		<1	<1	8.77	151	<30	<0.6	15
SP-SW-1.B	10/22/1992	<3			<3	300	<1	32	<0.1	<10	<1	<1	11	135	<30	<0.6	14
SP-SW-1.B	12/16/1992	<3			<3	300	<1	33	<0.1	<10	<1	<1		138	<30	<1	14
SP-SW-1.B	3/16/1993	<3		<100	<3	200	<1	31	<0.1	<10	<1	<1	9.09	131	40	<0.6	13
SP-SW-1.B	4/3/1993	<3		100	<3	200	<1	25	0.1	<10	1	<1	33.01	106	200	<0.6	11
SP-SW-1.B	4/19/1993	<3		100	<3	200	<1	25	<0.1	<10	<1	<1	54.71	104	180	<0.6	10
SP-SW-1.B	5/5/1993	<3		200	<3	200	<1	20	0.2	<10	<1	7	235.47	85	850	<0.6	8
SP-SW-1.B	5/19/1993	<3		<100	<3	200	<1	19	<0.1	<10	<1	1	205.49	78	100	<0.6	8
SP-SW-1.B	6/9/1993	<3		<100	<3	200	<1	20	0.1	<10	<1	1	178.36	87	120	<0.6	9
SP-SW-1.B	6/23/1993	<3		<100	<3	200	<1	20	0.1	<10	<1	2	162.77	86	90	<0.6	8
SP-SW-1.B	7/8/1993	<3		<100	<3	200	<1	24	0.1	<10	<1	2	89.41	100	80	<0.6	10
SP-SW-1.B	8/11/1993	<3		<100	<3	200	<1	25	<0.1	<10	<1	<1	57.45	103	80	<0.6	10
SP-SW-1.B	9/22/1993	<3		<100	<3	200	<1	23	<0.1	<10	<1	1	76.35	97	110	<0.6	10
SP-SW-1.B	10/14/1993	<3		<100	<3	200	<1	25	<0.1	<10	<1	<1	49.67	104	60	<0.6	11
SP-SW-1.B	2/1/1994	<3		<100	<3	200	<1	30	<0.1	<10	<1	<1	46.8853	125	50	<0.6	13
SP-SW-1.B	3/15/1994	<3		200	<3	200	<1	25	0.5	<10	1	3	68.222	106	360	<0.6	11
SP-SW-1.B	4/6/1994	<3		100	<3	200	<1	24	<0.1	<10	<1	2		97	180	<0.6	9
SP-SW-1.B	4/18/1994	<3	300		<3	200	<1	20	0.3	<10	<1	10	309.064	87	1680	<0.6	9
SP-SW-1.B	5/3/1994	<3	<100		<3	200	<1	21	0.1	<10	<1	2	213.7676	88	130	<0.6	8
SP-SW-1.B	5/16/1994	<3	<100		<3	200	<1	21	<0.1	<10	<1	1	144.9	90	90	<0.6	9
SP-SW-1.B	6/6/1994	<3	<100		<3	200	<1	25	<0.1	<10	<1	1	72.828	104	90	<0.6	10
SP-SW-1.B	6/20/1994	<3	<100		<3	200	<1	27	<0.1	<10	<1	<1	45.635	111	90	<0.6	11
SP-SW-1.B	7/20/1994	<3	<100		<3	300	<1	28	<0.1	<10	1	<1	27.26	116	60	<0.6	11
SP-SW-1.B	8/17/1994	<3	<100		<3	300	<1	30	<0.1	<10	<1	1	20.152	128	<30	<0.6	13
SP-SW-1.B	10/18/1994	<3	<100		<3	200	<1	29	<0.1	<10	<1	2	32.91	125	250	<0.6	13
SP-SW-1.B	12/8/1994	<3	<100		<3	<100	<1	<1	<1	<10	<1	<1		<1	<30	<0.6	<1
SP-SW-1.B	3/14/1995	<3	<100		<3	200	<1	25	<0.1		<1	1	37.90758839	109	160	<0.6	11
SP-SW-1.B	5/12/1995	<3	100		<3	100		18	0.2		<1	6		77	570	<0.6	8
SP-SW-1.B	6/23/1995	<3	<100		<3	200		21	0.2		<1	3	135.9582607	89	110	<0.6	9
SP-SW-1.B	11/13/1995	<3	<100	<100	<3	300		28	<0.1		<1	<1	25.21049063	120	60	<0.6	12
12334650	9/7/1995				<1			28	<1			<1	19	119	20		12
12334650	11/2/1995				<1			29	<1			<1	19	122	70		12
12334650	4/18/1996				<1			18	<1			3	320	76	210		7.6
12334650	6/20/1996				<1			24	<1			1	96	101	100		10
12334650	8/21/1996				<1			28	<1			<1	25	115	50		11
12334650	10/24/1996				<1			29	<1			<1	18	122	30		12
12334650	4/14/1997				<1			27.2	<1			1.1	28	116	90		11.7
12334650	5/30/1997				<1			17.4	<1			2.5	316	73	120		7.24

NOTES:
*** = value reported in database as 0 concentration
[shaded cell] = water quality standard exceedance
Data for sample dates prior to 1980 not included in summary table.

Segment Name:			Blackfoot River Upstream of Hogum Creek										
Site	**Sample Date**	**Mn, TR (µg/L)**	**Mo, TR (µg/L)**	**pH**	**Pb, TR (µg/L)**	**Ni, TR (µg/L)**	**Sb, TR (µg/L)**	**Se, TR (µg/L)**	**Sn, TR (µg/L)**	**SO4 (mg/L)**	**Tl, TR (µg/L)**	**V, TR (µg/L)**	**Zn, TR (µg/L)**
SW-1.B	10/24/1989			8	<10			<5		17			20
SW-1.B	3/1/1990			8.1	<2			<5		17			30
SW-1.B	5/10/1990			7.4	<10			<5		12			40
SW-1.B	8/22/1990			8.2	<10			<5		11			30
SW-1.B	10/23/1990			7.9	<10			<5		13			20
SW-1.B	2/14/1991			8.4	<10			<5		11			20
SW-1.B	8/18/1992	<5		8.2	<2	<5	<10	<1		14	<2		20
SP-SW-1.B	10/24/1989				<10			<5		17			20
SP-SW-1.B	3/1/1990				<3			<5		17			30
SP-SW-1.B	5/10/1990				<10			<5		12			40
SP-SW-1.B	8/22/1990				<10			<5		11			30
SP-SW-1.B	10/23/1990				<10			<5		13			20
SP-SW-1.B	2/14/1991				<10			<5		11			20
SP-SW-1.B	8/18/1992	<5			<3	<20	<10	<1		14	<3		20
SP-SW-1.B	10/22/1992	<5	<5	8.09	<3	<20	<10	<1	<100	14	<3	<100	20
SP-SW-1.B	12/16/1992	<5	<5	8.4	<3	<20	<10	<1	<100	13	<3	<100	<10
SP-SW-1.B	3/16/1993	11	<5	6.8	<3	<20	<10	<1	<100	14	<3	<20	<10
SP-SW-1.B	4/3/1993	20	<5	7.85	<3	<20	<10	<1	<100	26	<3	<20	40
SP-SW-1.B	4/19/1993	10	<5	7.09	<3	<20	<10	<1	<100	27	<3	<20	40
SP-SW-1.B	5/5/1993	200	<5	7.75	<3	<20	<10	<1	<100	22	<3	<20	120
SP-SW-1.B	5/19/1993	20	<5	7.96	<3	<20	<10	<1	<100	14	<3	<20	30
SP-SW-1.B	6/9/1993	20	<5	7.52	<3	<20	<10	<2	<100	16	<3	<20	70
SP-SW-1.B	6/23/1993	16	<5	7.52	<3	<20	<10	<1	<100	13	<3	<20	60
SP-SW-1.B	7/8/1993	10	<5	6.53	<3	<20	<10	<1	<100	16	<3	<20	30
SP-SW-1.B	8/11/1993	9	<5	7.36	<3	<20	<10	<1	<100	13	<3	<20	20
SP-SW-1.B	9/22/1993	13	<5	7.93	<3	<20	<10	<1	<100	15	<3	<20	80
SP-SW-1.B	10/14/1993	8	<5	8.09	<3	<20	<10	<1	<100	16	<3	<20	50
SP-SW-1.B	2/1/1994	7	<5	7.95	<3	<20	<10	<1	<100	18	<3	<20	88
SP-SW-1.B	3/15/1994	26	<5	7.52	<3	<20	<10	<1	<100	21	<3	<20	65
SP-SW-1.B	4/6/1994	14	<5	8.07	<3	<20	<10	<1	<100	17	<3	<20	60
SP-SW-1.B	4/18/1994	220	<5	7.5	4	<20	<10	<1	<100	12	<3	<20	150
SP-SW-1.B	5/3/1994	9	<5	7.78	<3	<20	<10	<1	<100	13	<3	<20	50
SP-SW-1.B	5/16/1994	9	<5	7.73	<3	<20	<10	<1	<100	11	<3	<20	48
SP-SW-1.B	6/6/1994	9	<5	7.51	<3	<20	<5	<1	<100	11	<3	<20	34
SP-SW-1.B	6/20/1994	8	<5	8.24	<3	<20	<10	<1	<100	13	<3	<20	<10
SP-SW-1.B	7/20/1994	<5	<5	7.3	<3	<20	<10	<1	<100	11	<3	<20	25
SP-SW-1.B	8/17/1994	<5	<5	7.7	<3	<20	<10	<1	<100	10	<3	<20	17
SP-SW-1.B	10/18/1994	5	<5	7.14	<3	<20	<10	<1	<100	18	<3	<20	15
SP-SW-1.B	12/8/1994	<5	<5	8.91	<3	<20	<10	<1	<100	<1	<3	<20	<10
SP-SW-1.B	3/14/1995	9	<5	9.21	<3	<20	<10	<1	<100	21		<20	32
SP-SW-1.B	5/12/1995	40		7.92	<3	<20	<10	<1		12			99
SP-SW-1.B	6/23/1995	11		7.03	<3	<20	<10	<1		11			71
SP-SW-1.B	11/13/1995	5		8	<3	<20	<5	<1		15			21
12334650	9/7/1995	<10		8.3	<1					11			<10
12334650	11/2/1995	<10		8.5	<1					12			<10
12334650	4/18/1996	20		8.2	<1					10			50
12334650	6/20/1996	10		8.1	<1					14			60
12334650	8/21/1996	<10		8.4	<1					9.1			<10
12334650	10/24/1996	<10		8.2	<1					12			<10
12334650	4/14/1997	<10		8.4	<1					17.4			18
12334650	5/30/1997	15		8.1	<1					7.7			56
NOTES:	***		= value reported in database as 0 concentration										
			= water quality standard exceedance										
			Data for sample dates prior to 1980 not included in summary table.										

Segment Name: **Blackfoot River at Aspen Grove Campground**

Site	Sample Date	Ag, T (µg/L)	Ag, TR (µg/L)	Al, D (µg/L)	Al, T (µg/L)	Al, TR (µg/L)	As, T (µg/L)	As, TR (µg/L)	Ba, T (µg/L)	Ba, TR (µg/L)	Be, TR (µg/L)	Ca (mg/L)	Cd, T (µg/L)	Cd, TR (µg/L)	Cr, T (µg/L)	Cr, TR (µg/L)	Co, T (µg/L)	Cu, T (µg/L)	Cu, TR (µg/L)	Flow (cfs)	Hardness (mg/L)	Fe, T (µg/L)
BRSW-18	8/12/1991	<8		<200	<200		<20					31	<8					<8		24.5	127	120
BRSW-18	9/12/1991	<8		<200	<200		<20					33	<8					27		18.5	136	61
BRSW-18	11/12/1991	<8		<200	<200		<20					33	<8					11		16.9	139	80
BRSW-18	4/16/1992	<10		<200	<200		<8		<200			28	<5		<10		<50	<8		30.2	118	132
BRSW-18	5/4/1992	<10		<200	<200		<8		<200			22	<5		<10		<50	<8		50.0	93	206
BRSW-18	5/18/1992	<10		<200	<200		<8		<200			24	<5		<10		<50	<8		32.8	102	134
BRSW-18	5/20/1992	<10		<200	<200		<8		<200			24	<5		<10		<50	<8		32.8	103	154
BRSW-18	6/2/1992	<10		<200	<200		<8		219			29	<5		<10		<50	<8		22.9	120	104
BRSW-18	10/24/1993	0.4		<100	<100		<3		212			24	1.7		<10		<50	<10		40.6	101	109
BRSW-18	10/21/1998			<50		360		3				30		<1					<5	15.2	349	
BRSW-18	4/26/1999			<50		480		<2				19		<0.1					4	253.0	80	
CO3BKFTR02	6/27/2001		<3			100		<3		212	<1	22		0.1		<1			2	91.9	92	
NOTES:		= water quality standard exceedance																				

Segment Name: **Blackfoot River at Aspen Grove Campground**

Site	Sample Date	Fe, TR (µg/L)	Hg, T (µg/L)	Mg (mg/L)	Mn, T (µg/L)	Mn, TR (µg/L)	Mo, T (µg/L)	Ni, T (µg/L)	Ni, TR (µg/L)	pH	Pb, T (µg/L)	Pb, TR (µg/L)	Sb, T (µg/L)	Sb, TR (µg/L)	Se, T (µg/L)	Se, TR (µg/L)	SO4 (mg/L)	Tl, TR (µg/L)	Zn, T (µg/L)	Zn, TR (µg/L)
BRSW-18	8/12/1991		<0.5	12	<8		<20			8.13	<10				<20		8.9		26	
BRSW-18	9/12/1991		<0.5	13	<8		<20			8.51	<10				<20		<2		22	
BRSW-18	11/12/1991		<0.5	14	<8		<20			8.47	<10				<20		12		10	
BRSW-18	4/16/1992		<0.5	12	9		<50	<20		8.27	<5				<5		17		15	
BRSW-18	5/4/1992		<0.5	9.3	14		<50	<20		8.1	<5				<5		17		22	
BRSW-18	5/18/1992		<0.5	10	10		<50	<20		7.97	7.6				<5		15		17	
BRSW-18	5/20/1992		<0.5	10	14		<50	<20		7.97	<5				<5		16		26	
BRSW-18	6/2/1992		<0.5	12	8.6		<50	<20		8.33	<5				<5		4.1		16	
BRSW-18	10/24/1993		<0.2	10	<15		<50	<40		6.85	3		<60		<5		16		36	
BRSW-18	10/21/1998	120		12		<10				7.68		<3					14			15
BRSW-18	4/26/1999	400		8		20				7.68		<3					15			50
CO3BKFTR02	6/27/2001	110		9		12			<10	7.3		<2		<3		<1	13	<2		40

NOTES: [shaded cell] = water quality standard exceedance

Segment Name:		Blackfoot River Downstream of Seven-Up Pete Creek															
Site	**Sample Date**	**Ag, TR (µg/L)**	**Al, D (µg/L)**	**Al, TR (µg/L)**	**As, TR (µg/L)**	**Ba, TR (µg/L)**	**Be, TR (µg/L)**	**Ca (mg/L)**	**Cd, TR (µg/L)**	**Co, TR (µg/L)**	**Cr, TR (µg/L)**	**Cu, TR (µg/L)**	**Flow (cfs)**	**Hardness (mg/L)**	**Fe, TR (µg/L)**	**Hg, TR (µg/L)**	**Mg (mg/L)**
SW-16.B	10/24/1989	<5			<5			35	<1			<10		141	<30	<1	13
SW-16.B	3/1/1990	<5			<5			35	<1			<10		137	<30	<1	12
SW-16.B	5/10/1990	<5			<5			25	<1			<10	418.7	101	60	<1	9
SW-16.B	8/22/1990	<5			<5			34	<1			<10	98.43	129	50	<1	11
SW-16.B	10/23/1990	<5			<5			35	<1			<10	40.04	139	<30	<1	13
SW-16.B	2/13/1991	<5			<5			33	<1			<10	6.55	130	<30	<1	12
SW-16.B	8/18/1992	<0.5			<1	300	<1	39	<0.1		<1	<1	24.57	154	<30	<0.1	14
SP-SW-16.B	10/24/1989	<5			<5			35	<1			<10	418.7	141	<30	<1	13
SP-SW-16.B	3/1/1990	<5			<5			35	<1			<10	98.43	137	<30	<1	12
SP-SW-16.B	5/10/1990	<5			<5			25	<1			<10	40.04	101	60	<1	9
SP-SW-16.B	8/22/1990	<5			<5			34	<1			<10	6.55	129	50	<1	11
SP-SW-16.B	10/23/1990	<5			<5			35	<1			<10	24.57	139	<30	<1	13
SP-SW-16.B	2/13/1991	<5			<5			33	<0.1			<10	13.6	130	<30	<1	12
SP-SW-16.B	8/18/1992	<3			<3	300	<1	39	<1		<1	<1	13.56	154	<30	<0.6	14
SP-SW-16.B	10/23/1992	<3			<3	<100	<1	<1	0.1	<10	<1	3	48.2		<30	<0.6	<1
SP-SW-16.B	4/3/1993	<3		<100	<3	200	<1	28	<0.1	<10	<1	<1	184.82	115	70	<0.6	11
SP-SW-16.B	4/19/1993	<3		100	<3	200	<1	27	<0.1	<10	<1	1	1014.77	110	80	<0.6	10
SP-SW-16.B	5/4/1993	<3		400	<3	200	1	25	0.3	<10	<1	6	239.62	100	1320	<0.6	9
SP-SW-16.B	5/19/1993	<3		200	<3	200	<1	27	<0.1	<10	<1	1	358.95	102	130	<0.6	9
SP-SW-16.B	6/10/1993	<3		<100	<3	200	<1	26	<0.1	<10	<1	<1	256.52	105	60	<0.6	9
SP-SW-16.B	6/24/1993	<3		<100	<3	200	<1	27	<0.1	<10	1	1	142.22	106	<30	<0.6	9
SP-SW-16.B	7/9/1993	<3		<100	<3	200	<1	29	<0.1	<10	<1	<1	171.72	114	<30	<0.6	10
SP-SW-16.B	8/10/1993	<3		<100	<3	200	<1	31	<0.1	<10	<1	<1	109.48	123	60	<0.6	11
SP-SW-16.B	9/23/1993	<3		<100	<3	200	<1	29	0.1	<10	<1	<1		117	30	<0.6	11
SP-SW-16.B	10/14/1993	<3		<100	<3	200	<1	32	<0.1	<10	<1	<1	38.3226	125	<30	<0.6	11
SP-SW-16.B	2/1/1994	<3		<100	<3	300	<1	36	<0.1	<10	<1	<1	68.2	143	<30	<0.6	13
SP-SW-16.B	3/15/1994	<3		100	<3	200	<1	30	0.5	<10	<1	4	299.87	120	150	<0.6	11
SP-SW-16.B	4/5/1994	<3		100	<3	200	<1	28	<0.1	<10	<1	1	394.98	109	150	<0.6	10
SP-SW-16.B	4/18/1994	<3	500		<3	200	<1	24	0.1	<10	<1	6	507.78	97	1190	<0.6	9
SP-SW-16.B	5/3/1994	<3	<100		<3	200	<1	28	<0.1	<10	<1	1	331.79	110	80	<0.6	10
SP-SW-16.B	5/16/1994	<3	<100		<3	200	<1	28	<0.1	<10	<1	<1	192.025	108	120	<0.6	10
SP-SW-16.B	6/6/1994	<3	<100		<3	200	<1	29	<0.1	<10	<1	<1	90.545	111	<30	<0.6	10
SP-SW-16.B	6/20/1994	<3	<100		<3	200	<1	30	<0.1	<10	<1	<1	42.364	118	<30	<0.6	10
SP-SW-16.B	7/19/1994	<3	<100		<3	300	<1	32	<0.1	<10	<1	<1	26.126	125	<30	<0.6	11
SP-SW-16.B	8/16/1994	<3	<100		<3	300	<1	36	0.1	<10	<1	<1		142	<30	<0.6	13
SP-SW-16.B	10/17/1994	<3	<100		<3	300	<1	33	<0.1	<10	<1	<1	36.77299286	133	<30	<0.6	12
SP-SW-16.B	3/13/1995	<3	<100		<3	200	<1	30	<0.1	<10	<1	<1	36.57723125	121	100	<0.6	12
SP-SW-16.B	5/12/1995	<3	<100		<3	200		24	<0.1		2	3		95	610	<0.6	9
SP-SW-16.B	11/14/1995	<3	<100	<100	<3	300		33	<0.1		<1	<1		133	<30	<0.6	12
12334700	9/5/1995				<1			32	<1			1	59	129	220		12
12334700	10/31/1995				<1			33	<1			<1	23	132	20		12
12334700	4/18/1996				<1			24	<1			2	574	96	170		8.8
12334700	6/19/1996				<1			26	<1			2	893	101	180		8.8
12334700	8/20/1996				<1			32	<1			<1	89	125	<10		11
12334700	10/23/1996				<1			33	<1			<1	33	132	<10		12
12334700	4/10/1997				<1			31.5	<1			<1	38	130	30		12.4
12334700	5/27/1997				<1			23.7	<1			2.8	1300	93	420		8.25
BFRSW-2	6/7/2002		<10		<50	150	<10	27.9	<1		<1	1	NM	105	190		8.5
NOTES:	***	= value reported in STORET database as 0 concentration															
	(shaded box)	= water quality standard exceedance															
		Data for sample dates prior to 1980 not included in summary table.															

Segment Name:	Blackfoot River Downstream of Seven-Up Pete Creek												
Site	**Sample Date**	**Mn, TR (µg/L)**	**Mo, TR (µg/L)**	**pH**	**Pb, TR (µg/L)**	**Ni, TR (µg/L)**	**Sb, TR (µg/L)**	**Se, TR (µg/L)**	**Sn, TR (µg/L)**	**SO4 (mg/L)**	**Tl, TR (µg/L)**	**V, TR (µg/L)**	**Zn, TR (µg/L)**
SW-16.B	10/24/1989			8.3	<10			<5		7			<10
SW-16.B	3/1/1990			8.3	<2			<5		8			10
SW-16.B	5/10/1990			7.7	<10			<5		6			40
SW-16.B	8/22/1990			8.3	<10			<5		6			<10
SW-16.B	10/23/1990			7	<10			<5		7			20
SW-16.B	2/13/1991			8.3	<10			<5		7			10
SW-16.B	8/18/1992	<5		8.3	<2	<5	<10	<1		6			6.6
SP-SW-16.B	10/24/1989				<10			<5		7			<10
SP-SW-16.B	3/1/1990				<3			<5		8			10
SP-SW-16.B	5/10/1990				<10			<5		6			40
SP-SW-16.B	8/22/1990				<10			<5		6			<10
SP-SW-16.B	10/23/1990				<10			<5		7			20
SP-SW-16.B	2/13/1991				<10			<5		7			10
SP-SW-16.B	8/18/1992	<5			<3	<20	<10	<1		6	<3		<10
SP-SW-16.B	10/23/1992	<5	<5	8.25	<3	<20	<10	<1	<100	<1	<3	<100	<10
SP-SW-16.B	4/3/1993	<5	<5	7.93	<3	<20	<10	<1	<100	16	<3	<20	10
SP-SW-16.B	4/19/1993	<5	<5	7.96	<3	<20	<10	<1	<100	19	<3	<20	10
SP-SW-16.B	5/4/1993	340	<5	8.02	<3	<20	<10	<1	<100	16	<3	<20	190
SP-SW-16.B	5/19/1993	20	<5	7.46	<3	<20	<10	<1	100	4	<3	<20	14
SP-SW-16.B	6/10/1993	5	<5	6.83	<3	<20	<10	<1	<100	8	<3	<20	30
SP-SW-16.B	6/24/1993	5	<5	7.85	<3	<20	<10	<1	<100	6	<3	<20	20
SP-SW-16.B	7/9/1993	<5	<5	7.43	<3	<20	<10	<1	<100	7	<3	<20	10
SP-SW-16.B	8/10/1993	<5	<5	8	<3	<20	<10	<1	<100	6	<3	<20	20
SP-SW-16.B	9/23/1993	<5	<5	7.06	<3	<20	<10	<1	<100	9	<3	<20	25
SP-SW-16.B	10/14/1993	<5	<5	7.86	<3	<20	<10	<1	<100	8	<3	<20	20
SP-SW-16.B	2/1/1994	<5	<5	8.95	<3	<20	<10	<1	<100	8	<3	<20	12
SP-SW-16.B	3/15/1994	6	<5	7.8	<3	<20	<10	<1	<100	15	<3	<20	39
SP-SW-16.B	4/5/1994	8	<5	7.56	<3	<20	<10	<1	<100	14	<3	30	40
SP-SW-16.B	4/18/1994	120	<5	7.65	<3	<20	<10	<1	<100	10	<3	<20	80
SP-SW-16.B	5/3/1994	<5	<5	8.61	<3	<20	<10	<1	<100	8	<3	<20	29
SP-SW-16.B	5/16/1994	6	<5	7.66	<3	<20	<10	<1	<100	4	<3	<20	12
SP-SW-16.B	6/6/1994	<5	<5	7.51	<3	<20	<5	<1	<100	4	<3	<20	<10
SP-SW-16.B	6/20/1994	<5	<5	7.19	<3	<20	<10	<1	<100	4	<3	<20	<10
SP-SW-16.B	7/19/1994	<5	<5	7.75	<3	<20	<10	<1	<100	6	<3	<20	13
SP-SW-16.B	8/16/1994	<5	<5	7.14	<3	<20	<5	<1	<100	5	<3	<20	<10
SP-SW-16.B	10/17/1994	<5	<5	7.51	<3	<20	<10	<1	<100	7	<3	<20	<10
SP-SW-16.B	3/13/1995	<5	<5	6.99	<3	<20	<10	<1	<100	14	<3	<20	26
SP-SW-16.B	5/12/1995	25		7.38	<3	<20	<10	<1		8			38
SP-SW-16.B	11/14/1995	<5		7.78	<3	<20	<5	<1		8			11
12334700	9/5/1995	20		8.4	<1					5			<10
12334700	10/31/1995	10		8.3	<1					5.8			<10
12334700	4/18/1996	10		8.1	<1					7.3			30
12334700	6/19/1996	10		8.3	<1					3.3			<10
12334700	8/20/1996	<10		8.4	<1					4.5			<10
12334700	10/23/1996	<10		7.1	<1					5.8			<10
12334700	4/10/1997	<10		8.4	<1					12.2			<10
12334700	5/27/1997	27		8.4	<1					3.9			16
BFRSW-2	6/7/2002	20		8.76	<1	<20		<50		3.64			<10
NOTES:	***	= value reported in STORET database as 0 concentration											
	(shaded cell)	= water quality standard exceedance											
		Data for sample dates prior to 1980 not included in summary table.											

Segment Name: **Blackfoot River at Dalton Mountain Road bridge, near Lincoln, Montana**

Site	Sample Date	Ag, TR (µg/L)	Al, D (µg/L)	Al, TR (µg/L)	As, TR (µg/L)	Ba, TR (µg/L)	Be, TR (µg/L)	Ca (mg/L)	Cd, TR (µg/L)	Co, TR (µg/L)	Cr, TR (µg/L)	Cu, TR (µg/L)	Flow (cfs)	Hardness (mg/L)	Fe, TR (µg/L)	Hg, TR (µg/L)
12334800	9/5/1995				<1			44	<1			<1	110	160	<10	
12334800	10/31/1995				<1			30	<1			<1	93	130	40	
12334800	4/18/1996				<1			31	<1			4	802	120	200	
12334800	6/19/1996				1			30	<1			2	1170	110	290	
12334800	8/20/1996				1			42	<1			<1	169	150	50	
12334800	10/23/1996				<1			45	<1			<1	98	170	40	
12334800	4/10/1997				<1			48	<1			<1	81	180	60	
12334800	5/29/1997				1			28	<1			3	1470	110	580	

NOTE: [shaded cell] = water quality standard exceedance
Data for sample dates prior to 1980

Segment Name: **Blackfoot River at Dalton Mountain Road bridge, near Lincoln, Montana**

Site	Sample Date	Mg (mg/L)	Mn, TR (µg/L)	Mo, TR (µg/L)	pH	Pb, TR (µg/L)	Ni, TR (µg/L)	Sb, TR (µg/L)	Se, TR (µg/L)	Sn, TR (µg/L)	SO4 (mg/L)	Tl, TR (µg/L)	V, TR (µg/L)	Zn, TR (µg/L)
12334800	9/5/1995	13	10		8.4	<1					5.8			<10
12334800	10/31/1995	14	20		8.2	<1					5.5			<10
12334800	4/18/1996	9.7	20		8	1					7.1			20
12334800	6/19/1996	9.2	20		8.2	<1					3.5			<10
12334800	8/20/1996	12	<10		8.3	<1					5.1			<10
12334800	10/23/1996	13	<10		7.8	<1					6.2			<10
12334800	4/10/1997	14	10		8.3	<1					6.5			<10
12334800	5/29/1997	8.7	40		8.3	<1					4.1			<10

NOTE [shaded cell] = water quality standard exceedance

Data for sample dates prior to 1980 not included in summary table.

Segment Name: **Blackfoot River above Nevada Creek, near Helmville, Montana**

Site	Sample Date	Ag, TR (µg/L)	Al, D (µg/L)	Al, TR (µg/L)	As, TR (µg/L)	Ba, TR (µg/L)	Be, TR (µg/L)	Ca (mg/L)	Cd, TR (µg/L)	Co, TR (µg/L)	Cr, TR (µg/L)	Cu, TR (µg/L)	Flow (cfs)	Hardness (mg/L)	Fe, TR (µg/L)	Hg, TR (µg/L)
12335100	9/5/1995				2			41	<1			<1	160	160	30	
12335100	11/1/1995				2			44	<1			<1	134	160	80	
12335100	4/17/1996				2			32	<1			5	956	120	760	
12335100	6/19/1996				2			31	<1			3	1710	110	630	
12335100	8/20/1996				1			41	<1			<1	226	150	50	
12335100	10/23/1996				<1			43	<1			<1	191	160	60	
12335100	4/10/1997				2			46	<1			<1	195	170	210	
12335100	5/29/1997				2			27	<1			4	2040	100	950	
12335100	4/9/2002		1	129	2			36	<0.1			1.7	221	140	270	
12335100	6/3/2002		3	694	2			28	0.3			6.8	1560	110	1210	
12335100	6/24/2002		4	545	2			28	<0.04			5.1	1570	110	890	
12335100	8/6/2002		1	18	2			40	<0.04			1	299	150	50	

NOTE [shaded cell] = water quality standard exceedance

Data for sample dates prior to 1980 not included in summary table.

Segment Name: **Blackfoot River above Nevada Creek, near Helmville, Montana**

Site	Sample Date	Mg (mg/L)	Mn, TR (µg/L)	Mo, TR (µg/L)	pH	Pb, TR (µg/L)	Ni, TR (µg/L)	Sb, TR (µg/L)	Se, TR (µg/L)	Sn, TR (µg/L)	SO4 (mg/L)	Tl, TR (µg/L)	V, TR (µg/L)	Zn, TR (µg/L)
12335100	9/5/1995	13	20		8.4	<1					5.1			<10
12335100	11/1/1995	13	30		8.3	<1					5.7			<10
12335100	4/17/1996	9.5	40		8.3	2					6.5			10
12335100	6/19/1996	9.1	50		8.2	<1					3.3			<10
12335100	8/20/1996	12	<10		8.4	<1					5.0			<10
12335100	10/23/1996	13	10		8	<1					5.5			<10
12335100	4/10/1997	14	30		8.4	<1					6.3			<10
12335100	5/29/1997	8.5	60		8.2	2					4.1			<10
12335100	4/9/2002	11	34		8.2	<1								2
12335100	6/3/2002	8.6	71		8.1	2								12
12335100	6/24/2002	8.6	55		8.3	2								9
12335100	8/6/2002	12	8		8.4	<1								5

NOTE: [shaded cell] = water quality standard exceedance

Data for sample dates prior to 1980 not included in summary table.

Segment Name: Copper Creek

Site	Sample Date	Ag, TR (µg/L)	Al, D (µg/L)	Al, TR (µg/L)	As, TR (µg/L)	B, TR (µg/L)	Ba, TR (µg/L)	Be, TR (µg/L)	Ca (mg/L)	Cd, TR (µg/L)	Co, TR (µg/L)	Cr, TR (µg/L)	Cu, TR (µg/L)	Flow (cfs)	Hardness (mg/L)	Fe, TR (µg/L)
SP-SW-41.C	8/19/1992								34					9.63	138	
SP-SW-41.C	10/24/1992								32					5.7	131	
SP-SW-41.C	12/17/1992								33					***	129	
SP-SW-41.C	4/4/1993	<3		<100	<3	<100	300	<1	30	<0.1	<10	<1	<1	10.4	121	<30
SP-SW-41.C	4/19/1993	<3		<100	<3	<100	<100	<1	<1	<0.1	<10	<1	<1	18.7	<1	<30
SP-SW-41.C	5/6/1993	<3		<100	<3	<100	200	<1	28	<0.1	<10	<1	1	68.7	109	170
SP-SW-41.C	5/19/1993	<3		<100	<3	<100	200	<1	22	<0.1	<10	<1	<1	274.7	85	<30
SP-SW-41.C	6/10/1993	<3		<100	<3	<100	200	<1	24	<0.1	<10	<1	<1	148.2	91	<30
SP-SW-41.C	6/24/1993	<3		<100	<3	<100	200	<1	24	<0.1	<10	1	1	106.2	92	<30
SP-SW-41.C	7/7/1993	<3		<100	<3	<100	200	<1	27	<0.1	<10	<1	<1	79.9	105	<30
SP-SW-41.C	8/12/1993	<3		<100	<3	<100	300	<1	30	<0.1	<10	<1	<1	35.1	119	<30
SP-SW-41.C	9/23/1993	<3		<100	<3	<100	<100	<1	<1	<0.1	<10	<1	<1	28.0	<1	<30
SP-SW-41.C	10/15/1993	<3		<100	<3	<100	300	<1	32	<0.1	<10	<1	<1	19.8	126	80
SP-SW-41.C	2/3/1994	<3		<100	<3	<100	300	<1	34	<0.1	<10	<1	<1	***	135	<30
SP-SW-41.C	3/16/1994	<3		<100	<3	<100	300	<1	33	<0.1	<10	<1	<1	9.0	130	<30
SP-SW-41.C	4/7/1994	<3		<100	<3	<100	300	<1	30	<0.1	<10	<1	<1	9.0	118	<30
SP-SW-41.C	4/19/1994	<3	200		<3	<100	200	<1	24	<0.1	<10	<1	2	42.6	96	180
SP-SW-41.C	5/4/1994	<3	<100		<3	<100	200	<5	31	<0.1	<10	<1	8	80.6	123	<30
SP-SW-41.C	5/18/1994	<3	<100		<3	<100	200	<1	28	<0.1	<10	<1	<1	168.7	106	<30
SP-SW-41.C	6/8/1994	<3	<100		<3	<100	200	<1	26	<0.1	<10	<1	<1	144.9	101	<30
SP-SW-41.C	6/22/1994	<3	<100		<3	<100	200	<1	25	<0.1	<10	<1	<1	94.3	95	30
SP-SW-41.C	7/20/1994	<3	<100		<3	<100	300	<1	29	<0.1	<10	<1	<1	34.5	115	<30
SP-SW-41.C	8/18/1994	<3	<100		<3	<100	300	<1	31	<0.1	<10	<1	15	20.5	122	<30
SP-SW-41.C	10/19/1994	<3	<100		<3	<100	300	<1	34	<0.1	<10	<1	2	10.4	135	<30
SP-SW-41.C	2/14/1995		<100											***		
SP-SW-41.C	3/15/1995	<3	<100		<3	<100	300	<1	32	<0.1	<10	<1	<1	19.0	127	<30
SP-SW-41.C	5/15/1995	<3	<100		<3		200		28	<0.1		<1	1	67.4	111	40
SP-SW-41.C	6/26/1995	<3	<100		<3		200		22	<0.1		2	<1	195.8	86	40
SP-SW-41.C	11/14/1995	<3	<100	<100	<3		300		33	<0.1		<1	<1	19.5	130	<30
SW-41.C	8/19/1992	<0.5			<1		300	<1	33	<0.1		<1	<1	3.33	144	<30
CCSW-1	6/7/2002		<10		<50		170	<10	22.9	<1		<1	2.0		88.1	50
CCSW-2	10/8/2002		<50		<5				30	<0.1			2	5.0	112	<30
CCSW-3	10/8/2002		<50		<5				11	<0.1			2	1.9	44	50
NOTES:	***	= value reported in database as 0 concentration														
	[shaded cell]	= water quality standard exceedance														

Segment Name: Copper Creek															
Site	**Sample Date**	**Hg, TR (µg/L)**	**Mg (mg/L)**	**Mn, TR (µg/L)**	**Mo, TR (µg/L)**	**Ni, TR (µg/L)**	**pH**	**Pb, TR (µg/L)**	**Sb, TR (µg/L)**	**Se, TR (µg/L)**	**Sn, TR (µg/L)**	**SO4 (mg/L)**	**Tl, TR (µg/L)**	**V, TR (µg/L)**	**Zn, TR (µg/L)**
SP-SW-41.C	8/19/1992		13				6.5					3			
SP-SW-41.C	10/24/1992		12				8.33					3			
SP-SW-41.C	12/17/1992		12				8.1					3			
SP-SW-41.C	4/4/1993	<0.6	11	<5	<5	<20	8.2	<3	<10	<1	<100	3	<3	<20	10
SP-SW-41.C	4/19/1993	<0.6	<1	<5	<5	<20	7.97	<3	<10	<1	<100	<1	<3	<20	<10
SP-SW-41.C	5/6/1993	<0.6	9	<5	<5	<20	7.45	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-41.C	5/19/1993	<0.6	7	<5	<5	<20	7.94	<3	<10	<1	<100	2	<3	<20	40
SP-SW-41.C	6/10/1993	<0.6	8	<5	<5	<20	8.1	<3	<10	<1	<100	3	<3	<20	10
SP-SW-41.C	6/24/1993	<0.6	8	<5	<5	<20	7.79	<3	<10	<1	<100	2	<3	<20	<10
SP-SW-41.C	7/7/1993	<0.6	9	<5	<5	<20	8	<3	<10	<1	<100	2	<3	<20	<10
SP-SW-41.C	8/12/1993	<0.6	11	<5	<5	<20	8.3	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-41.C	9/23/1993	<0.6	<1	<5	<5	<20	8.1	<3	<10	<1	<100	<1	<3	<20	11
SP-SW-41.C	10/15/1993	<0.6	11	<5	<5	<20	8.1	<3	<10	<1	<100	3	<3	<20	13
SP-SW-41.C	2/3/1994	<0.6	12	<5	<5	<20	8	<3	<10	<1	<100	3	<3	<20	13
SP-SW-41.C	3/16/1994	<0.6	12	<5	<5	<20	8.22	<3	<10	<1	<100	4	<3	<20	10
SP-SW-41.C	4/7/1994	<0.6	11	<5	<5	<20	8.37	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-41.C	4/19/1994	<0.6	9	6	<5	<20	8.34	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-41.C	5/4/1994	<0.6	11	<5	<5	<20	8.2	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-41.C	5/18/1994	<0.6	9	<5	<5	<20	8.3	<3	<10	<1	<100	2	<3	<20	<10
SP-SW-41.C	6/8/1994	<0.6	9	<5	<5	<20	9	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-41.C	6/22/1994	<0.6	8	<5	<5	<20	8.1	<3	<10	<1	<100	2	<3	<20	<10
SP-SW-41.C	7/20/1994	<0.6	10	<5	<5	<20	8.76	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-41.C	8/18/1994	<0.6	11	<5	<5	<20	8.96	<3	<10	<1	<100	3	<3	<20	26
SP-SW-41.C	10/19/1994	<0.6	12	<5	<5	<20	8.2	<3	<10	<1	<100	4	<3	<20	<10
SP-SW-41.C	2/14/1995														
SP-SW-41.C	3/15/1995	<0.6	12	<5	<5	<20	8.2	<3	<10	<1	<100	4	<3	<20	11
SP-SW-41.C	5/15/1995	<0.6	10	<5		<20	9.12	<3	<10	<1		3			15
SP-SW-41.C	6/26/1995	<0.6	7	<5		<20	8.98	<3	<10	<1		2			<10
SP-SW-41.C	11/14/1995	<0.6	12	<5		<20	8.46	<3	<5	<1		3			<10
SW-41.C	8/19/1992	<0.1	15	<5		<5	8.2	<2	<10	<1		13	<2		20
CCSW-1	6/7/2002		7.5	<10		<20	8.33	<1		<50					<10
CCSW-2	10/8/2002		9	<10			7.11	<2				2			<10
CCSW-3	10/8/2002		4	<10			8.7	<2				4			<10
NOTES:	***	= value reported in database as 0 concentration													
		= water quality standard exceedance													

Segment Name:		Hardscrabble Creek Upstream														
Site	Sample Date	Ag, TR (µg/L)	Al, D (µg/L)	Al, TR (µg/L)	As, TR (µg/L)	B, TR (µg/L)	Ba, TR (µg/L)	Be, TR (µg/L)	Ca (mg/L)	Cd, TR (µg/L)	Co, TR (µg/L)	Cr, TR (µg/L)	Cu, TR (µg/L)	Flow (cfs)	Hardness (mg/L)	Fe, TR (µg/L)
SP-SW-45.HS	23-Oct-92	<3			<3		400	<1	40	0.1	<10	<1	1	0.3	161	<30
SP-SW-45.HS	17-Dec-92	<3			<3		500	<1	42	<0.1	<10	<1	1	0.3	166	<30
SP-SW-45.HS	17-Mar-93	<3		<100	<3		400	<1	44	<0.1	<10	<1	<1	0.1	174	<30
SP-SW-45.HS	04-Apr-93	<3		500	<3		200	<1	23	<0.1	<10	2	<1	1.3	89	300
SP-SW-45.HS	20-Apr-93	<3		400	<3		300	<1	22	<0.1	<10	1	2	3.1	83	220
SP-SW-45.HS	06-May-93	<3		100	<3		200	<1	24	<0.1	<10	1	2	3.8	90	120
SP-SW-45.HS	20-May-93	<3		<100	<3		300	<1	25	<0.1	<10	<1	<1	1.6	95	140
SP-SW-45.HS	08-Jun-93	<3		<100	<3		300	<1	21	<0.1	<10	<1	3	1.6	82	120
SP-SW-45.HS	23-Jun-93	<3		<100	<3		300	<1	25	<0.1	<10	<1	2	2.7	95	140
SP-SW-45.HS	08-Jul-93	<3		200	<3		300	<1	28	<0.1	<10	<1	1	1.4	106	100
SP-SW-45.HS	11-Aug-93	<3		<100	<3		400	<1	33	<0.1	<10	<1	<1	0.7	132	50
SP-SW-45.HS	22-Sep-93	<3		<100	<3		400	<1	36	<0.1	<10	<1	1	0.4	137	60
SP-SW-45.HS	14-Oct-93	<3		<100	<3		400	<1	35	<0.1	<10	<1	<1	0.8	137	<30
SP-SW-45.HS	16-Mar-94	<3		<100	<3		300	<1	36	<0.1	<10	<1	<1	1.7	143	180
SP-SW-45.HS	06-Apr-94	<3		300	<3		200	<1	25	<0.1	<10	<1	1	1.7	95	250
SP-SW-45.HS	19-Apr-94	<3	1700		<3		200	<1	21	<0.1	<10	<1	3	8.2	82	580
SP-SW-45.HS	04-May-94	<3	400		<3		300	<1	24	<0.1	<10	<1	1	4.9	93	190
SP-SW-45.HS	18-May-94	<3	100		<3		300	<1	32	<0.1	<10	<1	<1	2.9	123	210
SP-SW-45.HS	08-Jun-94	<3	<100		<3		400	<1	30	<0.1	<10	<1	1	1.2	120	70
SP-SW-45.HS	21-Jun-94	<3	<100		<3		400	<1	34	<0.1	<10	<1	<1	0.7	135	50
SP-SW-45.HS	20-Jul-94	<3	<100		<3		400	<1	36	<0.1	<10	<1	1		143	80
SP-SW-45.HS	15-Mar-95	<3	500		<3		200	<1	21	<0.1	<10	<1	2	2.5	81	290
SP-SW-45.HS	15-May-95	<3	200		<3		200		22	<0.1		<1	3	5.5	83	150
SP-SW-45.HS	27-Jun-95	<3	<100	100	<3		300		27	<0.1		1	2	0.7	105	170
SP-SW-45.HS	14-Nov-95	<3	100		3		200		18	<0.1		<1	4	0.1	73	1240
NOTES:	(shaded)	= water quality standard exceedance														

Segment Name:		**Hardscrabble Creek Upstream**													
Site	**Sample Date**	**Hg, TR (µg/L)**	**Mg (mg/L)**	**Mn, TR (µg/L)**	**Mo, TR (µg/L)**	**Ni, TR (µg/L)**	**pH**	**Pb, TR (µg/L)**	**Sb, TR (µg/L)**	**Se, TR (µg/L)**	**Sn, TR (µg/L)**	**SO4 (mg/L)**	**Tl, TR (µg/L)**	**V, TR (µg/L)**	**Zn, TR (µg/L)**
SP-SW-45.HS	23-Oct-92	<0.6	15	<5	<5	<20	7.73	<3	<10	<1	<100	4	<3	<100	20
SP-SW-45.HS	17-Dec-92	<0.6	15	5	<5	<20	7.8	<3	<10	<1	<100	4	<3	<100	10
SP-SW-45.HS	17-Mar-93	<0.6	16	<5	<5	<20	6.75	<3	<10	<1	<100	5	<3	<20	13
SP-SW-45.HS	04-Apr-93	<0.6	8	10	<5	<20	7.09	<3	<10	<1	<100	6	<3	<20	10
SP-SW-45.HS	20-Apr-93	<0.6	7	<5	<5	<20	6.67	<3	<10	<1	<100	4	<3	<20	90
SP-SW-45.HS	06-May-93	<0.6	7	5	<5	<20	7.35	<3	<10	<1	<100	2	<3	<20	20
SP-SW-45.HS	20-May-93	<0.6	8	30	<5	<20	7.22	<3	<10	<1	<100	2	<3	<20	16
SP-SW-45.HS	08-Jun-93	<0.6	7	6	<5	<20	7.49	<3	<10	<1	<100	2	<3	<20	17
SP-SW-45.HS	23-Jun-93	<0.6	8	20	<5	<20	6.4	<3	<10	<1	<100	1	<3	<20	<10
SP-SW-45.HS	08-Jul-93	<0.6	9	10	<5	<20	6.95	<3	<10	<1	<100	1	<3	<20	<10
SP-SW-45.HS	11-Aug-93	<0.6	12	12	<5	<20	7.63	<3	<10	<1	<100	2	<3	<20	<10
SP-SW-45.HS	22-Sep-93	<0.6	11	30	<5	<20	7.37	<3	<10	<1	<100	1	<3	<20	20
SP-SW-45.HS	14-Oct-93	<0.6	12	<5	<5	<20	6.93	<3	<10	<1	<100	2	<3	<20	<10
SP-SW-45.HS	16-Mar-94	<0.6	13	57	<5	<20	7.2	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-45.HS	06-Apr-94	<0.6	8	9	<5	<20	7.29	<3	<10	<1	<100	2	<3	<20	<10
SP-SW-45.HS	19-Apr-94	<0.6	7	7	<5	<20	8.26	<3	<10	<1	<100	2	<3	<20	15
SP-SW-45.HS	04-May-94	<0.6	8	8	<5	<20	8.04	<3	<10	<1	<100	1	<3	<20	<10
SP-SW-45.HS	18-May-94	<0.6	11	14	<5	<20	8.52	<3	<10	<1	<100	1	<3	<20	<10
SP-SW-45.HS	08-Jun-94	<0.6	11	10	<5	<20	8.02	<3	<5	<1	<100	<1	<3	<20	<10
SP-SW-45.HS	21-Jun-94	<0.6	12	12	<5	<20	8.13	<3	<10	<1	<100	2	<3	<20	<10
SP-SW-45.HS	20-Jul-94	<0.6	13	33	<5	<20	8.3	<3	<10	<1	<100	2	<3	<20	<10
SP-SW-45.HS	15-Mar-95	<0.6	7	11	<5	<20	7.31	<3	<10	<1	<100	3	<3	<20	12
SP-SW-45.HS	15-May-95	<0.6	7	<5		<20	8.71	<3	<10	<1		2			20
SP-SW-45.HS	27-Jun-95	<0.6	9	25		<20	7.58	<3	<10	<1		<1			12
SP-SW-45.HS	14-Nov-95	<0.6	6	181		<20	8.06	<3	<5	<1		4			14
NOTES:		= water quality standard exceedance													

Segment Name: <u>Hardscrabble Creek @ Mouth</u>

Site	Sample Date	Ag, TR (µg/L)	Al, D (µg/L)	Al, TR (µg/L)	As, TR (µg/L)	B, TR (µg/L)	Ba, TR (µg/L)	Be, TR (µg/L)	Ca (mg/L)	Cd, TR (µg/L)	Co, TR (µg/L)	Cr, TR (µg/L)	Cu, TR (µg/L)	Flow (cfs)	Hardness (mg/L)	Fe, TR (µg/L)
37.HS	18-Aug-92	<3			<3		400	<1	47	<0.1		<1	<1	0.46	190	<30
37.HS	23-Oct-92	<3			<3	<100	400	<1	41	<0.1	<10	<1	<1	0.80	169	<30
37.HS	04-Apr-93	<3		100	<3	<100	300	<1	30	<0.1	<10	1	<1	3.67	118	120
37.HS	20-Apr-93	<3		300	<3	<100	300	<1	31	<0.1	<10	2	1	5.24	121	110
37.HS	06-May-93	<3		<100	<3	<100	300	<1	32	<0.1	<10	<1	1	4.07	123	90
37.HS	20-May-93	<3		<100	<3	<100	300	<1	34	<0.1	<10	<1	<1	3.04	134	60
37.HS	08-Jun-93	<3		<100	<3	<100	300	<1	29	<0.1	<10	<1	<1	3.10	115	70
37.HS	23-Jun-93	<3		<100	<3	<100	300	<1	33	<0.1	<10	<1	1	2.99	129	60
37.HS	08-Jul-93	<3		<100	<3	<100	300	<1	36	<0.1	<10	<1	1	2.24	139	50
37.HS	11-Aug-93	<3		<100	<3	<100	400	<1	38	<0.1	<10	<1	<1	1.25	150	60
37.HS	22-Sep-93	<3		<100	<3	<100	400	<1	41	<0.1	<10	<1	<1	1.33	160	30
37.HS	14-Oct-93	<3		<100	<3	<100	400	<1	39	<0.1	<10	<1	<1	1.34	155	<30
37.HS	16-Mar-94	<3		<100	<3	<100	300	<1	36	<0.1	<10	<1	<1		141	100
37.HS	06-Apr-94	<3		200	<3	<100	200	<1	33	<0.1	<10	<1	<1		124	160
37.HS	18-Apr-94	<3	600		<3	<100	300	<1	27	<0.1	<10	<1	2	10.71	107	350
37.HS	04-May-94	<3	100		<3	<100	300	<1	31	<0.1	<10	<1	31	7.02	123	110
37.HS	18-May-94	<3	<100		<3	<100	400	<1	35	<0.1	<10	<1	<1	4.51	134	80
37.HS	08-Jun-94	<3	<100		<3	<100	400	<1	36	<0.1	<10	<1	<1	2.36	145	70
37.HS	21-Jun-94	<3	<100		<3	<100	400	<1	40	<0.1	<10	<1	1	1.41	157	90
37.HS	20-Jul-94	<3	<100		<3	<100	400	<1	40	<0.1	<10	<1	<1	0.84	160	40
37.HS	17-Aug-94	<3	<100		<3	<100	400	<1	43	<0.1	<10	<1	3	0.88	174	70
37.HS	19-Oct-94	<3	<100		<3	<100	300	<1	41	0.1	<10	<1	<1	1.06	169	40
37.HS	14-Mar-95	<3	<100		<3	<100	300	<1	31	<0.1	<10	<1	3	4.04	126	90
37.HS	15-May-95	<3	<100		<3		300		29	<0.1		<1	3	5.72	116	90
37.HS	27-Jun-95	<3	<100		<3		400		37	<0.1		<1	1	2.85	150	130
37.HS	14-Nov-95	<3	<100	<100	<3		300		37	<0.1		<1	1	3.17	149	110

NOTES: [shaded cell] = water quality standard exceedance

Segment Name:		Hardscrabble Creek @ Mouth													
Site	Sample Date	Hg, TR (µg/L)	Mg (mg/L)	Mn, TR (µg/L)	Mo, TR (µg/L)	Ni, TR (µg/L)	pH	Pb, TR (µg/L)	Sb, TR (µg/L)	Se, TR (µg/L)	Sn, TR (µg/L)	SO4 (mg/L)	Tl, TR (µg/L)	V, TR (µg/L)	Zn, TR (µg/L)
37.HS	18-Aug-92	<0.6	18	<5		<20		<3	<10	<1		2	<3		20
37.HS	23-Oct-92	<0.6	16	<5	<5	<20	8.23	<3	<10	<1	<100	3	<3	<100	<10
37.HS	04-Apr-93	<0.6	11	9	<5	<20	8	<3	<10	<1	<100	5	<3	<20	36
37.HS	20-Apr-93	<0.6	11	6	<5	<20	7.29	<3	<10	<1	<100	4	<3	<20	24
37.HS	06-May-93	<0.6	11	8	<5	<20	8	<3	<10	<1	<100	3	<3	<20	<10
37.HS	20-May-93	<0.6	12	10	<5	<20	7.92	<3	<10	<1	<100	3	<3	<20	<10
37.HS	08-Jun-93	<0.6	11	8	<5	<20	6.75	<3	<10	<1	<100	3	<3	<20	10
37.HS	23-Jun-93	<0.6	12	5	<5	<20	7.28	<3	<10	<1	<100	2	<3	<20	10
37.HS	08-Jul-93	<0.6	12	6	<5	<20	7.03	<3	<10	<1	<100	2	<3	<20	<10
37.HS	11-Aug-93	<0.6	14	8	<5	<20	6.8	<3	<10	<1	<100	2	<3	<20	<10
37.HS	22-Sep-93	<0.6	14	<5	<5	<20	7.8	<3	<10	<1	<100	2	<3	<20	20
37.HS	14-Oct-93	<0.6	14	<5	<5	<20	7.1	<3	<10	<1	<100	2	<3	<20	12
37.HS	16-Mar-94	<0.6	13	8	<5	<20	7.49	<3	<10	<1	<100	3	<3	<20	11
37.HS	06-Apr-94	<0.6	10	9	<5	<20	7.82	<3	<10	<1	<100	3	<3	<20	<10
37.HS	18-Apr-94	<0.6	10	10	<5	<20	7.4	<3	<10	<1	<100	2	<3	<20	<10
37.HS	04-May-94	<0.6	11	9	<5	<20	8.37	<3	<10	<1	<100	2	<3	<20	<10
37.HS	18-May-94	<0.6	11	9	<5	<20	7.89	<3	<10	<1	<100	2	<3	<20	<10
37.HS	08-Jun-94	<0.6	13	9	<5	<20	7.98	<3	<5	<1	<100	3	<3	<20	<10
37.HS	21-Jun-94	<0.6	14	13	<5	<20	8.16	<3	<10	<1	<100	2	<3	<20	<10
37.HS	20-Jul-94	<0.6	15	<5	<5	<20	8.69	<3	<10	<1	<100	2	<3	<20	<10
37.HS	17-Aug-94	<0.6	16	<5	<5	<20	8.47	<3	<10	<1	<100	2	<3	<20	13
37.HS	19-Oct-94	<0.6	16	<5	<5	<20	7.19	<3	<10	<1	<100	3	<3	<20	<10
37.HS	14-Mar-95	<0.6	12	6	<5	<20	7.26	<3	<10	<1	<100	3	<3	<20	10
37.HS	15-May-95	<0.6	11	16		<20	9.21	<3	<10	<1		3			17
37.HS	27-Jun-95	<0.6	14	13		<20	7.13	<3	<10	<1		2			<10
37.HS	14-Nov-95	<0.6	14	17		<20	8.46	<3	<5	<1		3	3		<10
NOTES:		= water quality standard exceedance													

Segment Name: Hogum Creek

Site	Sample Date	Ag, TR (µg/L)	Al, D (µg/L)	Al, TR (µg/L)	As, TR (µg/L)	B, TR (µg/L)	Ba, TR (µg/L)	Be, TR (µg/L)	Ca (mg/L)	Cd, TR (µg/L)	Co, TR (µg/L)	Cr, TR (µg/L)	Cu, TR (µg/L)	Flow (cfs)	Hardness (mg/L)	Fe, TR (µg/L)
SP-SW-49.HG	17-Mar-94	<3		200	<3		100	<1	21	<0.1	<10	<1	<1		77	310
SP-SW-49.HG	06-Apr-94	<3		100	<3		100	<1	19	<0.1	<10	<1	<1		71	170
SP-SW-49.HG	18-Apr-94	<3	2200		<3		100	<1	14	<0.1	<10	2	2		53	1200
SP-SW-49.HG	03-May-94	<3	200		<3		<100	<1	12	<0.1	<10	<1	2	21.6	46	200
SP-SW-49.HG	16-May-94	<3	100		<3		100	<1	11	<0.1	<10	<1	<1	21.2	41	140
SP-SW-49.HG	07-Jun-94	<3	<100		<3		100	<1	14	<0.1	<10	<1	<1	8.6	55	160
SP-SW-49.HG	20-Jun-94	<3	<100		<3		100	<1	17	<0.1	<10	5	<1	5.4	62	170
SP-SW-49.HG	19-Jul-94	<3	<100		<3		200	<1	20	<0.1	<10	2	<1	1.7	76	350
SP-SW-49.HG	17-Aug-94	<3	<100		<3		200	<1	24	<0.1	<10	1	1	1.3	93	430
SP-SW-49.HG	18-Oct-94	<3	<100		<3		100	<1	22	<0.1	<10	<1	<1	2.3	85	370
SP-SW-49.HG	05-Apr-95	<3	<100		<3		100	<1	16	<0.1	<10	2	5	5.9	63	310
SP-SW-49.HG	24-Apr-95	<3	100		<3		100	<1	16	<0.1	<10	<1	1	6.2	62	160
SP-SW-49.HG	12-May-95	<3	200		<3		<100	<1	12	<0.1	<10	1	2	32.6	46	350
SP-SW-49.HG	23-May-95	<3	200		<3		<100	<1	10	<0.1	<10	<1	1	24.5	40	180
SP-SW-49.HG	11-Jun-95	<3	<100		<3		200	<1	33	<0.1	<10	1	2	27.9	124	200
SP-SW-49.HG	23-Jun-95	<3	100		<3		<100	<1	12	<0.1	<10	2	3	13.3	46	100
SP-SW-49.HG	14-Jul-95	<3	<100		<3		100	<1	17	<0.1	<10	<1	1	6.4	64	190
SP-SW-49.HG	08-Aug-95	<3	<100		<3		200	<1	21	<0.1	<10	<1	<1	2.4	81	370

NOTES: [shaded box] = water quality standard exceedance

Segment Name: Hogum Creek															
Site	Sample Date	Hg, TR (µg/L)	Mg (mg/L)	Mn, TR (µg/L)	Mo, TR (µg/L)	Ni, TR (µg/L)	pH	Pb, TR (µg/L)	Sb, TR (µg/L)	Se, TR (µg/L)	Sn, TR (µg/L)	SO4 (mg/L)	Tl, TR (µg/L)	V, TR (µg/L)	Zn, TR (µg/L)
SP-SW-49.HG	17-Mar-94	<0.6	6	20	<5	<20	7.83	<3	<10	<1	<100	8	<3	<20	13
SP-SW-49.HG	06-Apr-94	<0.6	6	7	<5	<20	7.64	<3	<10	<1	<100	8	<3	<20	<10
SP-SW-49.HG	18-Apr-94	<0.6	4	65	<5	<20	7.63	<3	<10	<1	<100	4	<3	<20	<10
SP-SW-49.HG	03-May-94	<0.6	4	7	<5	<20	8.02	<3	<10	<1	<100	4	<3	<20	<10
SP-SW-49.HG	16-May-94	<0.6	4	8	<5	<20	7.54	<3	<10	<1	<100	4	<3	<20	<10
SP-SW-49.HG	07-Jun-94	<0.6	5	8	<5	<20	8.36	<3	<5	<1	<100	4	<3	<20	<10
SP-SW-49.HG	20-Jun-94	<0.6	5	10	<5	<20	7.91	<3	<10	<1	<100	5	<3	<20	<10
SP-SW-49.HG	19-Jul-94	<0.6	6	9	<5	<20	8.64	<3	<10	<1	<100	5	<3	<20	<10
SP-SW-49.HG	17-Aug-94	<0.6	8	15	<5	<20	7.33	<3	<10	<1	<100	5	<3	<20	<10
SP-SW-49.HG	18-Oct-94	<0.6	7	14	<5	<20	9.07	<3	<10	<5	<100	7	<3	<20	<10
SP-SW-49.HG	05-Apr-95	<0.6	5	15	<5	<20	7.22	<3	<10	<1	<100	7	<3	<20	21
SP-SW-49.HG	24-Apr-95	<0.6	5	6	<5	<20	7.46	<3	<10	<1	<100	6	<3	<20	<10
SP-SW-49.HG	12-May-95	<0.6	4	16	<5	<20	7.94	<3	<10	<1	<100	4	<3	<20	<10
SP-SW-49.HG	23-May-95	<0.6	3	8	<5	<20	8.63	<3	<10	<1	<100	3	<3	<20	10
SP-SW-49.HG	11-Jun-95	<0.6	10	20	<5	<20	7.44	<3	<10	<1	100	2	<3	<20	19
SP-SW-49.HG	23-Jun-95	<0.6	4	7	<5	<20	7.23	<3	<10	<1	<100	4	<3	<20	24
SP-SW-49.HG	14-Jul-95	<0.6	5	8	<5	<20	8.66	<3	<10	<1	<100	4	<3	<20	13
SP-SW-49.HG	08-Aug-95	<0.6	7	9	<5	<20	7.81	<3	<10	<1	<100	5	<3	<20	<10
NOTES:			= water quality standard exceedance												

Segment Name:		Landers Fork above Copper Creek														
Site	**Sample Date**	**Ag, TR (µg/L)**	**Al, D (µg/L)**	**Al, TR (µg/L)**	**As, TR (µg/L)**	**B, TR (µg/L)**	**Ba, TR (µg/L)**	**Be, TR (µg/L)**	**Ca (mg/L)**	**Cd, TR (µg/L)**	**Co, TR (µg/L)**	**Cr, TR (µg/L)**	**Cu, TR (µg/L)**	**Flow (cfs)**	**Hardness (mg/L)**	**Fe, TR (µg/L)**
SP-SW-34.L	26-Jul-91	<5			<5		200	<5	35	<1		<20	<10		135	<30
SP-SW-34.L	17-Oct-91	<5			<5		300	<5	42	<1		<20	<10	7.5	167	50
SP-SW-34.L	16-Jan-92	<5			<5				37	<1		<1	<10		162	<30
SP-SW-34.L	13-Apr-92	<5			<5				34	<1			<10	8.3	133	<30
SP-SW-34.L	14-Jul-92	<3			<3			<1	59	<0.1			<1	38.4	199	430
SP-SW-34.L	19-Aug-92	<3			<3		200	<1	41	<0.1		<1	<1	6.0	164	<30
SP-SW-34.L	24-Oct-92	<3			<3		200	<1	38	0.1	<10	<1	1	3.6	152	<30
SP-SW-34.L	05-May-93	<3		<100	<3		100	<1	32	<0.1	<10	<1	1	67.8	120	50
SP-SW-34.L	19-May-93	<3		200	<3		100	<1	27	<0.1	<10	<1	2	270.4	103	200
SP-SW-34.L	10-Jun-93	<3		<100	<3		100	<1	30	<0.1	<10	<1	<1	152.4	116	<30
SP-SW-34.L	24-Jun-93	<3		<100	<3		100	<1	30	<0.1	<10	<1	<1	164.0	116	<30
SP-SW-34.L	07-Jul-93	<3		<100	<3		200	<1	33	<0.1	<10	<1	<1	82.2	126	<30
SP-SW-34.L	12-Aug-93	<3		<100	<3		200	<1	38	<0.1	<10	<1	<1	47.6	143	<10
SP-SW-34.L	23-Sep-93	<3		100	<3		200	<1	34	<0.1	<10	<1	<1	60.8	133	<30
SP-SW-34.L	15-Oct-93	<3		<100	<3		200	<1	36	<0.1	<10	<1	<1	32.5	140	<30
SP-SW-34.L	19-Apr-94	<3	<100		<3		200	<1	29	<0.1	<10	<1	2	114.1	111	290
SP-SW-34.L	04-May-94	<3	<100		<3		100	<1	35	0.1	<10	<1	<1	149.4	138	50
SP-SW-34.L	18-May-94	<3	<100		<3		100	<1	32	<0.1	<10	<1	<1	248.1	121	90
SP-SW-34.L	09-Jun-94	<3	<100		<3		100	<1	33	<0.1	<10	<1	<1	122.7	128	<30
SP-SW-34.L	22-Jun-94	<3	<100		<3		200	<1	33	<0.1	<10	<1	<1	68.0	126	<30
SP-SW-34.L	21-Jul-94	<3	<100		<3		200	<1	35	<0.1	<10	<1	<1	25.6	134	<30
SP-SW-34.L	18-Aug-94	<3	<100		<3		200	<1	36	<0.1	<10	<1	1	11.1	144	<30
SP-SW-34.L	19-Oct-94	<3	<100		<3		200	<1	40	<0.1	<10	<1	<1	7.4	162	<30
SP-SW-34.L	13-May-95	<3	<100		<3		100		30	<0.1		<1	2		117	330
SP-SW-34.L	26-Jun-95	<3	<100		<3		100		29	<0.1		<1	<1	258.5	111	100
SP-SW-34.L	24-Jul-95	<3	<100		<3		200		32	<0.1		<1	<1	78.1	127	40
SP-SW-34.L	04-Aug-95	<3	<100		<3		200		38	<0.1		<1	<1	52.4	147	40
SP-SW-34.L	11-Aug-95	<3	<100	<100	<3		200		37	0.1		<1	<1	37.7	145	<30
SP-SW-34.L	24-Aug-95	<3	<100	<100	<3		200		41	<0.1		<1	<1	21.2	160	<30
SP-SW-34.L	24-Sep-95	<3	<100	<100	<3		191		37	<0.1			<1	16.5	150	
SP-SW-34.L	20-Oct-95	<3	<100	<100	<3		200		37	<0.1		<1	<1	12.2	147	<30
SW-34.L	26-Jul-91	<5			<5		200	<5	35	<1		<20	<10		135	<30
SW-34.L	16-Jan-92	<5			<5				37	<1			<10		162	<30
SW-34.L	13-Apr-92	<5			<5				34	<1			<10	8.3	133	<30
SW-34.L	14-Jul-92	<0.5			<1			<1	59	<0.1		<1	<1	38.4	199	430
SW-34.L	19-Aug-92	<0.5			<1		200	<1	41	<0.1		<1	<1	6.0	164	<30
NOTES:		= water quality standard exceedance														

Segment Name:		Landers Fork above Copper Creek													
Site	Sample Date	Hg, TR (µg/L)	Mg (mg/L)	Mn, TR (µg/L)	Mo, TR (µg/L)	Ni, TR (µg/L)	pH	Pb, TR (µg/L)	Sb, TR (µg/L)	Se, TR (µg/L)	Sn, TR (µg/L)	SO4 (mg/L)	Tl, TR (µg/L)	V, TR (µg/L)	Zn, TR (µg/L)
SP-SW-34.L	26-Jul-91	<1	12	<20		<30		<10	<50	<5		3	<100		10
SP-SW-34.L	17-Oct-91	<1	15	<20		<30		<10	<50	<5		4	<100		<10
SP-SW-34.L	16-Jan-92	<1	17					<3		<5		5			<10
SP-SW-34.L	13-Apr-92	<1	12					<3		<5		4			10
SP-SW-34.L	14-Jul-92	<0.6	12			<20		<3		<5		4	<3		100
SP-SW-34.L	19-Aug-92	<0.6	15	<5		<20		<3	<10	<1		4	<3		10
SP-SW-34.L	24-Oct-92	<0.6	14	<5	<5	<20	8.14	<3	<10	<1	100	4	<3	<100	10
SP-SW-34.L	05-May-93	<0.6	10	<5	<5	<20	8.33	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-34.L	19-May-93	<0.6	9	35	<5	<20	8.28	<3	<10	<1	<100	2	<3	<20	15
SP-SW-34.L	10-Jun-93	<0.6	10	<5	<5	<20	6.98	<3	<10	<1	<100	3	<3	<20	10
SP-SW-34.L	24-Jun-93	<0.6	10	<5	<5	<20	7.9	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-34.L	07-Jul-93	<0.6	11	<5	<5	<20	7.41	<3	<10	<1	<10	3	<3	<20	<10
SP-SW-34.L	12-Aug-93	<0.6	12	<10	<5	<20	7.99	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-34.L	23-Sep-93	<0.6	12	<5	<5	<20	8.34	<3	<10	<1	<100	4	<3	<20	<10
SP-SW-34.L	15-Oct-93	<0.6	12	<5	<5	<20	7.76	<3	<10	<1	<100	4	<3	<20	12
SP-SW-34.L	19-Apr-94	<0.6	10	14	<5	<20	8.33	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-34.L	04-May-94	<0.6	12	<5	<5	<20	8.44	<3	<10	<1	<100	5	<3	<20	<10
SP-SW-34.L	18-May-94	<0.6	10	<5	<5	<20	8.17	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-34.L	09-Jun-94	<0.6	11	<5	<5	<20	7.94	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-34.L	22-Jun-94	<0.6	11	<5	<5	<20	7.12	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-34.L	21-Jul-94	<0.6	12	<5	<5	<20	9.09	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-34.L	18-Aug-94	<0.6	13	<5	<5	<20	9	<3	<10	<1	<100	4	<3	<20	<10
SP-SW-34.L	19-Oct-94	<0.6	15	<5	<5	<20	8.33	<3	<10	<1	<100	4	<3	<20	<10
SP-SW-34.L	13-May-95	<0.6	10	11		<20	9.04	<3	<10	<1		3			14
SP-SW-34.L	26-Jun-95	<0.6	10	<5		<20	8.84	<3	<10	<1		2			<10
SP-SW-34.L	24-Jul-95	<0.6	11	<5	<5	<20	8.07	<3	<10	<1		3			10
SP-SW-34.L	04-Aug-95	<0.6	13	<5	<5	<20	9.36	4	<10	<1		4			15
SP-SW-34.L	11-Aug-95	<1	13	<5	<5	<20	7.82	<3	<10	<1		4			<10
SP-SW-34.L	24-Aug-95	<1	14	<5	<5	<20	8.95	<3	<10	<1		3			<10
SP-SW-34.L	24-Sep-95	<0.6	14	<5	<5	<20	9.06	<3	<5	<1		4			<10
SP-SW-34.L	20-Oct-95	<0.6	14	<5	<5	<20	7.23	3	<10	<1		4			<10
SW-34.L	26-Jul-91	<1	12	<20		<30	8.5	<10	<50	<5		3	<100		10
SW-34.L	16-Jan-92	<1	17				8.2	<2		<5		5			<10
SW-34.L	13-Apr-92	<1	12				8.2	<2		<5		4			10
SW-34.L	14-Jul-92	<0.1	12			<5	8	<2		<5		4	<2		100
SW-34.L	19-Aug-92	<0.1	15	<5		<5	6.7	<2	<10	<1		4	<2		10
NOTES:			= water quality standard exceedance												

Segment Name:		Landers Fork @ Mouth																					
Site	Sample Date	Ag, TR (µg/L)	Al, D (µg/L)	Al, TR (µg/L)	As, TR (µg/L)	B, TR (µg/L)	Ba, TR (µg/L)	Be, TR (µg/L)	Ca (mg/L)	Cd, TR (µg/L)	Co, TR (µg/L)	Cr, TR (µg/L)	Cu, TR (µg/L)	Flow (cfs)	Hardness (mg/L)	Fe, TR (µg/L)	Fe, D (µg/L)	Hg, TR (µg/L)	Mg (mg/L)	Mn, TR (µg/L)	Mo, TR (µg/L)	Ni, TR (µg/L)	pH
SP-SW-15.L	01-Mar-90	<5			<5				38	<1			<10		145	<30		<1	13				
SP-SW-15.L	10-May-90	<5			<5				33	<1			<10		129	50		<1	11				
SP-SW-15.L	22-Aug-90	<5			<5				37	<1			<10	93.5	136	70		<1	11				
SP-SW-15.L	19-Aug-92	<3			<3		300	<1	40	<0.1		<1	1	40.4	158	<30		<0.6	14	<5		<20	
SP-SW-15.L	23-Oct-92	<3			<3	<100	300	<1	36	<0.1	<10	<1	<1	29.8	142	<30		<0.6	13	<5	<5	<20	8.32
SP-SW-15.L	16-Dec-92	<3			<3	<100	300	<1	36	<0.1	<10	<1	<1	14.5	137	<30		<0.6	12	<5	<5	<20	8.19
SP-SW-15.L	16-Mar-93	<3		<100	<3	<100	300	<1	35	<0.1	<10	<1	<1	17.2	133	<30		<0.6	11	<5	<5	<20	6.94
SP-SW-15.L	03-Apr-93	<3		<100	<3	<100	300	<1	37	<0.1	<10	<1	<1	12.5	142	<30		<0.6	12	<5	<5	<20	8.05
SP-SW-15.L	19-Apr-93	<3		<100	<3	<100	300	<1	36	<0.1	<10	<1	<1	16.4	138	<30		<0.6	12	<5	<5	<20	7.91
SP-SW-15.L	04-May-93	<3		200	<3	<100	200	<1	35	<0.1	<10	<1	<1	71.1	132	160		<0.6	11	20	<5	<20	7.4
SP-SW-15.L	18-May-93	<3		200	<3	<100	200	<1	29	<0.1	<10	<1	2	601.5	109	230		<0.6	9	30	<5	<20	7.9
SP-SW-15.L	10-Jun-93	<3		<100	<3	<100	200	<1	29	<0.1	<10	<1	<1	358.9	111	<30		<0.6	10	<5	<5	<20	7.75
SP-SW-15.L	23-Jun-93	<3		<100	<3	<100	200	<1	29	<0.1	<10	<1	<1	342.8	110	<30		<0.6	9	<5	<5	<20	7.49
SP-SW-15.L	09-Jul-93	<3		<100	<3	<100	200	<1	32	<0.1	<10	<1	<1	185.2	121	<30		<0.6	10	<5	<5	<20	7.7
SP-SW-15.L	10-Aug-93	<3		<100	<3	<100	200	<1	34	<1	<10	<1	<1	117.6	132	<30		<0.6	11	<5	<5	<20	7.96
SP-SW-15.L	21-Sep-93	<3		<100	<3	<100	200	<1	34	0.1	<10	<1	<1	113.9	135	<30		<0.6	12	<5	<5	<20	8.2
SP-SW-15.L	13-Oct-93	<3		<100	<3	<100	300	<1	36	<0.1	<10	<1	<1	85.4	138	<30		<0.6	12	<5	<5	<20	7.86
SP-SW-15.L	01-Feb-94	<3		<100	<3	<100	300	<1	37	<0.1	<10	<1	3	24.2	142	<30		<0.6	12	<5	<5	<20	8.64
SP-SW-15.L	15-Mar-94	<3		<100	<3	<100	300	<1	40	0.3	<10	<1	<1	23.3	152	<30		<0.6	13	<5	<5	<20	7.32
SP-SW-15.L	05-Apr-94	<3		<100	<3	<100	300	<1	40	<0.1	<10	<1	<1	22.1	146	<30		<0.6	12	<5	<5	<20	7.81
SP-SW-15.L	18-Apr-94	<3	400		<3	<100	200	<1	33	<0.1	<10	<1	2	107.6	127	400		<0.6	11	17	<5	<20	7.2
SP-SW-15.L	03-May-94	<3	<100		<3	<100	200	<1	34	0.1	<10	<1	2	269.1	129	30		<0.6	11	<5	<5	<20	8.49
SP-SW-15.L	16-May-94	<3	<100		<3	<100	200	<1	30	<0.1	<10	<1	<1	534.8	114	100		<0.6	10	5	<5	<20	7.48
SP-SW-15.L	06-Jun-94	<3	<100		<3	<100	200	<1	29	<0.1	<10	<1	<1	336.5	113	<30		<0.6	10	<5	<5	<20	8.09
SP-SW-15.L	20-Jun-94	<3	<100		<3	<100	200	<1	31	<0.1	<10	<1	<1	217.4	121	<30		<0.6	10	<5	<5	<20	7.73
SP-SW-15.L	19-Jul-94	<3	<100		<3	<100	300	<1	34	<0.1	<10	1	<1	90.5	131	<30		<0.6	11	<5	<5	<20	8.5
SP-SW-15.L	16-Aug-94	<3	<100		<3	<100	300	<1	39	<0.1	<10	<1	<1	48.3	149	<30		<0.6	13	<5	<5	<20	8.1
SP-SW-15.L	17-Oct-94	<3	<100		<3	<100	300	<1	36	<0.1	<10	<1	<1	25.6	140	120		<0.6	12	<5	<5	<20	8.03
SP-SW-15.L	06-Dec-94	<3	<100		<3	<100	300	<1	35	<0.1	<10	<1	<1	20.3	136	<30		<0.6	12	<5	<5	<20	7.88
SP-SW-15.L	15-Feb-95	<3	<100		<3	<100	300	<1	33	<0.1	<10	<1	<1	14.3	130	<30		<0.6	12	<5	<5	<20	7.17
SP-SW-15.L	14-Mar-95	<3	<100		<3	<100	300	<1	37	0.1	<10	<1	<1	24.0	144	<30		<0.6	13	<5	<5	<20	8.93
SP-SW-15.L	13-May-95	<3	<100		<3		200		32	<0.1		<1	3		123	280		<0.6	11	8		<20	9.08
SP-SW-15.L	14-Nov-95	<3	<100	<100	<3		300			<0.1		<1	<1	36.9	143	<30		<0.6	12	<5		<20	7.81
SW-15.L	01-Mar-90	<5			<5				37	<1			<10		144	<30		<1	12				8.2
SW-15.L	10-May-90	<5			<5				33	<1			<10		129	50		<1	11				7.7
SW-15.L	22-Aug-90	<5			<5				37	<1			<10	93.5	136	70		<1	11				7.6
SW-15.L	19-Aug-92	<0.5			<1		300	<1	40	<0.1		<1	1	40.4	158	<30		<0.1	14	<5		<5	6.5
SP-SW-43.L	22-Oct-92	<3			<3		300	<1	37	<0.1	<10	<1	<1	13.4	144	<30		<0.6	13	<5	<5	<20	8.38
SP-SW-43.L	16-Dec-92	<3			<3		300	<1	36	<0.1	<10	<1	<1	6.6	137	<30		<1	12	<5	<5	<20	7.88
SP-SW-43.L	16-Mar-93	<3		<100	<3		300	<1	33	<0.1	<10	<1	<1	3.5	126	<30		<0.6	11	<5	<5	<20	6.7
SP-SW-43.L	3-Apr-93	<3		<100	<3		300	<1	37	<0.1	<10	<1	<1	1.4	142	<30		<0.6	12	<5	<5	<20	7.98
SP-SW-43.L	19-Apr-93	<3		<100	<3		300	<1	36	<0.1	<10	<1	<1	7.3	137	<30		<0.6	12	<5	<5	<20	7.76
SP-SW-43.L	5-May-93	<3		<100	<3		200	<1	35	<0.1	<10	<1	<1	43.5	131	30		<0.6	11	<5	<5	<20	8.21
SP-SW-43.L	18-May-93	<3		200	<3		200	<1	29	<1	<10	<1	2	534.2	109	270		<0.6	9	40	<5	<20	8
SP-SW-43.L	9-Jun-93	<3		<100	<3		200	<1	29	<0.1	<10	<1	<1	190.6	113	<30		<0.6	10	<5	<5	<20	6.73
SP-SW-43.L	24-Jun-93	<3		<100	<3		200	<1	30	<0.1	<10	<1	<1	178.6	114	<30		<0.6	10	<5	<5	<20	7.9
SP-SW-43.L	8-Jul-93	<3		<100	<3		200	<1	33	<0.1	<10	<1	1	104.1	127	<30		<0.6	11	<5	<5	<20	7.77
SP-SW-43.L	12-Aug-93	<3		<100	<3		200	<1	35	<0.1	<10	<1	<1	58.7	134	<30		<0.6	12	<5	<5	<20	7.88
SP-SW-43.L	21-Sep-93	<3		<100	<3		200	<1	35	<0.1	<10	<1	<1	70.3	134	<30		<0.6	12	9	<5	<20	8.09
SP-SW-43.L	13-Oct-93	<3		<100	<3		300	<1	36	<0.1	<10	<1	<1	48.0	138	<30		<0.6	12	<5	<5	<20	7.68
SP-SW-43.L	2-Feb-94	<3		<100	<3		300	<1	37	<0.1	<10	<1	<1	9.8	144	<30		<0.6	12	<5	<5	<20	9.31
SP-SW-43.L	15-Mar-94	<3		<100	<3		300	<1	39	<0.1	<10	<1	2	9.4	147	<30		<0.6	12	<5	<5	<20	8.43
SP-SW-43.L	5-Apr-94	<3		<100	<3		300	<1	39	<0.1	<10	<1	<1	9.4	146	<30		<0.6	12	<5	<5	<20	7.13
SP-SW-43.L	18-Apr-94	<3	400		<3		200	<1	33	<0.1	<10	<1	4	158.2	126	380		<0.6	11	17	<5	<20	7.53
SP-SW-43.L	3-May-94	<3	<100		<3		200	<1	34	<0.1	<10	<1	<1	280.9	128	<30		<0.6	11	<5	<5	<20	8.35
SP-SW-43.L	16-May-94	<3	<100		<3		200	<1	30	<0.1	<10	<1	<1	540.5	114	120		<0.6	10	<5	<5	<20	7.78
SP-SW-43.L	6-Jun-94	<3	<100		<3		200	<1	29	<0.1	<10	<1	<1	340.7	113	<30		<0.6	10	<5	<5	<20	8.14
SP-SW-43.L	20-Jun-94	<3	<100		<3		200	<1	31	<0.1	<10	<1	<1	203.3	121	<30		<0.6	10	<5	<5	<20	7.27
SP-SW-43.L	19-Jul-94	<3	<100		<3		300	<1	34	<0.1	<10	<1	<1	89.6	131	<30		<0.6	11	<5	<5	<20	8.38
SP-SW-43.L	16-Aug-94	<3	<100		<3		300	<1	39	<0.1	<10	<1	<1	50.0	149	<30		<0.6	13	<5	<5	<20	7.65
SP-SW-43.L	17-Oct-94	<3	<100		<3		300	<1	36	<0.1	<10	<1	<1	22.5	140	<30		<0.6	12	<5	<5	<20	7.78
SP-SW-43.L	7-Dec-94	<3	<100		<3		300	<1	35	<0.1	<10	<1	<1	16.2	136	<30		<0.6	12	<5	<5	<20	7.24
SP-SW-43.L	13-Mar-95	<3	<100		<3		300	<1	39	<0.1	<10	<1	<1	15.0	151	<30		<0.6	13	<5	<5	<20	7.36
SP-SW-43.L	12-May-95	<3	<100		<3		200		31	<0.1		<1	2	368.6	120	570		<0.6	11	21		<20	7.82
SP-SW-43.L	23-Jun-95	<3	<100		<3		200		29	0.1		2	<1	360.0	113	120		<0.6	10	6		<20	7.41
SP-SW-43.L	14-Nov-95	<3	<100	<100	<3		300		37	<0.1		<1	<1	28.5	143	<30		<0.6	13	<5		<20	8.34
12334680	5-Sep-95			< 1		< 10			34	< 1			1	70		450	< 3		12	20			8.2
12334680	2-Nov-95			< 1		< 10			35	< 1			< 1.0	29		< 10	< 3		12	10			8.4
12334680	18-Apr-96			< 1					31	< 1			< 1.0	238		70			11	< 10			8.3
12334680	19-Jun-96			< 1					27	< 1			1	832		170			8.6	10			8.1
12334680	20-Aug-96			< 1					34	< 1			< 1.0	84		< 10			11	< 10			8.2
12334680	23-Oct-96			< 1					36	< 1			< 1.0	34		< 10			12	< 10			7.1
12334680	14-Apr-97			< 1					37.2	< 1			< 1.0	20		< 10			12.4	< 10			8.4
12334680	30-May-97			< 1					25.4	< 1			2.4	1050		690			8.29	40			8.2
NOTES:	[shaded]	= water quality standard exceedance																					

Segment Name:							Landers Fork @ Mouth		
Site	Sample Date	Pb, TR (µg/L)	Sb, TR (µg/L)	Se, TR (µg/L)	Sn, TR (µg/L)	SO4 (mg/L)	Tl, TR (µg/L)	V, TR (µg/L)	Zn, TR (µg/L)
SP-SW-15.L	01-Mar-90	<3		<5		4			<10
SP-SW-15.L	10-May-90	<10		<5		41			<10
SP-SW-15.L	22-Aug-90	<10		<5		4			50
SP-SW-15.L	19-Aug-92	<3	<10	<1		4	<3		20
SP-SW-15.L	23-Oct-92	<3	<10	<1	<100	3	<3	<100	90
SP-SW-15.L	16-Dec-92	<3	<10	<1	<100	3	<3	<100	<10
SP-SW-15.L	16-Mar-93	<3	<10	<1	<100	3	<3	<20	10
SP-SW-15.L	03-Apr-93	<3	<10	<1	<100	4	<3	<20	11
SP-SW-15.L	19-Apr-93	<3	<10	<1	<100	3	<3	<20	28
SP-SW-15.L	04-May-93	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-15.L	18-May-93	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-15.L	10-Jun-93	<3	<10	<1	<100	4	<3	<20	10
SP-SW-15.L	23-Jun-93	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-15.L	09-Jul-93	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-15.L	10-Aug-93	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-15.L	21-Sep-93	<3	<10	<1	<100	4	<3	<20	<10
SP-SW-15.L	13-Oct-93	<3	<10	<1	<100	4	<3	<20	10
SP-SW-15.L	01-Feb-94	<3	<10	<1	<100	3	<3	<20	13
SP-SW-15.L	15-Mar-94	<3	<10	<1	<100	4	<3	<20	11
SP-SW-15.L	05-Apr-94	<3	<10	<1	<100	3	<3	<20	10
SP-SW-15.L	18-Apr-94	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-15.L	03-May-94	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-15.L	16-May-94	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-15.L	06-Jun-94	<3	<5	<1	<100	2	<3	<20	<10
SP-SW-15.L	20-Jun-94	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-15.L	19-Jul-94	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-15.L	16-Aug-94	<3	<5	<1	<100	3	<3	<20	<10
SP-SW-15.L	17-Oct-94	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-15.L	06-Dec-94	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-15.L	15-Feb-95	<3	<10	<1	<100	5	<3	<20	<10
SP-SW-15.L	14-Mar-95	<3	<10	1	<100	3	<3		<10
SP-SW-15.L	13-May-95	<3	<10	<1		4			14
SP-SW-15.L	14-Nov-95	<3	<5	<1		3			<10
SW-15.L	01-Mar-90	<2		<5		4			20
SW-15.L	10-May-90	<10		<5		4.1			<10
SW-15.L	22-Aug-90	<10		<5		4			50
SW-15.L	19-Aug-92	<2	<10	<1		4	<2		20
SP-SW-43.L	22-Oct-92	<3	<10	<1	<100	4	<3	<100	<10
SP-SW-43.L	16-Dec-92	<3	<10	<1	<100	<1	<3	<100	<10
SP-SW-43.L	16-Mar-93	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-43.L	3-Apr-93	<3	<10	<1	<100	4	<3	<20	10
SP-SW-43.L	19-Apr-93	<3	<10	<1	<100	4	<3	<20	70
SP-SW-43.L	5-May-93	<3	<10	<1	<100	3	<3	<20	15
SP-SW-43.L	18-May-93	<3	<10	<1	100	3	<3	<20	<10
SP-SW-43.L	9-Jun-93	<3	<10	<1	<100	3	<3	<20	19
SP-SW-43.L	24-Jun-93	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-43.L	8-Jul-93	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-43.L	12-Aug-93	<3	<10	<1	<100	3	<3	<20	20
SP-SW-43.L	21-Sep-93	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-43.L	13-Oct-93	<3	<10	<1	<100	3	<3	<20	14
SP-SW-43.L	2-Feb-94	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-43.L	15-Mar-94	<3	<10	<1	<100	4	<3	<20	<10
SP-SW-43.L	5-Apr-94	<3	<10	<1	<100	4	<3	<20	10
SP-SW-43.L	18-Apr-94	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-43.L	3-May-94	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-43.L	16-May-94	<3	<10	<1	<100	2	<3	<20	<10
SP-SW-43.L	6-Jun-94	<3	<5	<1	<100	2	<3	<20	<10
SP-SW-43.L	20-Jun-94	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-43.L	19-Jul-94	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-43.L	16-Aug-94	<3	<5	<1	<100	3	<3	<20	<10
SP-SW-43.L	17-Oct-94	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-43.L	7-Dec-94	<3	<10	<1	<100	3	<3	<20	<10
SP-SW-43.L	13-Mar-95	<3	<10	<1	<100	4	<3	<20	<10
SP-SW-43.L	12-May-95	<3	<10	<1		3			10
SP-SW-43.L	23-Jun-95	<3	<10	<1		2			12
SP-SW-43.L	14-Nov-95	<3	<5	<1		3			<10
12334680	5-Sep-95	< 1				2.9			< 10
12334680	2-Nov-95	< 1				3			< 10
12334680	18-Apr-96	< 1				3.2			< 10
12334680	19-Jun-96	< 1				1.6			< 10
12334680	20-Aug-96	< 1				2.4			< 10
12334680	23-Oct-96	< 1				3			< 10
12334680	14-Apr-97	< 1				3.2			< 10
12334680	30-May-97	1				1.7			< 10
NOTES:							= water quality standard exceedance		

Segment Name: Mike Horse Creek

Site	Sample Date	Al, D (ug/L)	Al, T (ug/L)	Al, TR (ug/L)	As, D (ug/L)	As, T (ug/L)	As, TR (ug/L)	Ag, D (ug/L)	Ag, T (ug/L)	Ag, TR (ug/L)	Ba, D (ug/L)	Ba, T (ug/L)	Ca (mg/L)	Cd, D (ug/L)	Cd, T (ug/L)	Cd, TR (ug/L)	Co, D (ug/L)	Co, T (ug/L)	Cu, D (ug/L)	Cu, T (ug/L	Cu, TR (ug/L)	Cr, D (ug/L)	Cr, T (ug/L)	Flow (cfs)	Hardness (mg/L)	Fe, D (ug/L)
BRSW-4	8/12/1991	<200	220		<20	<20		<8	<8				28	13	14				120	150				0.09	123	41
BRSW-4	9/13/1991	<200	390		<20	<20		<8	<8				28	14	15				200	290				0.049	123	<20
BRSW-4	11/13/1991	<200	<200		<20	<20		9	<8				28	15	15				50	180				0.03	128	<20
BRSW-4	4/16/1992	<200	310		<8	<8		<10	<10		<200	<200	36	39	40		<50	<50	250	320		<10	<10	0.1037	172	<50
BRSW-4	5/5/1992	<200	<200		<8	<8		<10	<10		<200	<200	24	12	13		<50	<50	95	125		<10	<10	0.3396	105	<50
BRSW-4	5/19/1992	<200	<200		<8	<8		<10	<10		<200	<200	24	11	10		<50	<50	89	88		<10	<10	0.2691	105	<50
BRSW-4	6/3/1992	<200	<200		<8	<8		<10	<10		<200	<200	27	9.1	9.3		<50	<50	87	90		<10	<10	0.1232	117	<50
BRSW-4	10/27/1993	<100	389		<3	<3		<0.2	0.2		<200	<200	27	36	36		<50	<50	225	526		<10	<10	0.011	129	<100
BRSW-4	10/22/1998	<50		84	<2		<2						35	39		37			560		600			0.0447	157	<50
BRSW-4	4/29/1999	260		5180	<2		<2						68	184		186			3510		4450			0.112	330	<10
BRSW-4	5/21/1999	<50		3000	<2		<2						30	65.3		62.7			1010		1780			0.83	149	<10
BRSW-4	10/21/1999	50		240	<2		<2						32	28		28			385		491			0.021	146	<30
BRSW-4	10/12/2000	52		170	<5		<5	310		490			31	26		26			310		490				139	<50
BRSW-4	4/26/2001	1500		6100	<5		<5						37	110		110			4200		4200			0.13	208	<50
BRSW-4	5/23/2001	130		390	<5		<5						21	14		16			180		300			0.97	98	<50
BRSW-4	6/27/2001	72		710	<5		<5						24	25		27			280		480			0.37	113	<50
BRSW-4	10/17/2001	<50		340	<5		<5						34	35		35			400		450			0.021	159	<20
BRSW-22	10/26/1993	<100	130		<3	5		0.3	0.3		<200	<200	92	28	30		<50	<50	<10	82		<10	<10	0.24	477	717
BRSW-22	5/18/1994	100		560									68	29		35			49		480			1.31	347	44
BRSW-22	10/26/1994	<50		2421	<2		13						181	86		99			25		393			0.085	979	3301
BRSW-22	5/2/1995	<50		1100	<2		<2						81	120		110			350		900			0.29	396	79
BRSW-22	10/23/1995	<50		70	<2		<2						76	35		33			48		63			0.02	346	<30
BRSW-22	5/22/1996	<50		360	<2		<2						54	29		25			110		190			1.94	287	<50
BRSW-22	10/21/1996	<50		<50	<2		<2						300	160		150			100		170			0.113	1556	100
BRSW-22	2/26/1997	<100		<100	<5		<5						111	38		37			30		50			0.004	483	<30
BRSW-22	5/27/1997	<50		300	<2		<2						21	13		12			110		190			2.55	90	<30
BRSW-22	10/22/1997	87		<50	<2		<2						98	88		87			78		88			0.0781	426	<50
BRSW-22	5/5/1998	<50		76	<2		<2						29	20		18			47		71			0.464	126	<30
BRSW-22	10/22/1998	<50		<50	<2		<2						50	20		19			64		61			0.037	211	<50
BRSW-22	4/29/1999	<50		3780	<2		<2						60	125		128			1910		3150			0.322	282	<10
BRSW-22	5/21/1999	<50		2330	<2		2						28	43.5		40.6			251		1020			1.66	128	<10
BRSW-22	10/19/1999	<50		<50	<2		<2						48	14		14			21		24			0.041	198	<50
BRSW-22	10/12/2000	<50		<50	<5		<5	25		34			87	27		28			25		34			0.034	345	<50
BRSW-22	4/26/2001	91		1200	<5		<5						108	120		110			120		240			0.26	443	<50
BRSW-22	5/22/2001	75		310	<5		<5						24	16		17			140		230			0.67	109	<50
BRSW-22	5/23/2001	90		270	<5		<5						24	15		16			140		220			0.8	105	<50
BRSW-22	6/26/2001	80		430	<5		<5						28	22		26			140		280			0.47	128	<50
BRSW-22	10/17/2001	<50		<50	<5		<5						83	22		22			21		24			0.029	335	<20
BRSW-35	10/22/1998	<50		55	<2		<2						49	21		20			47		55			0.041	213	<50
BRSW-35	4/29/1999	80		3930	<2		<2						74	120		119			1880		1850			0.57	387	<10
BRSW-35	5/21/1999	<50		1230	<2		22						26	21.7		20.8			107		456			4.4	127	<10
BRSW-35	10/19/1999	<50		<50	<2		<2						49	15		15			24		28			0.025	209	<50
BRSW-35	10/12/2000	<50		<50	<5		<5	18		29			80	24		25			18		29			0.005	327	<50
BRSW-35	4/26/2001	380		3500	<5		<5						106	170		160			600		840			0.57	487	220
BRSW-35	5/22/2001	73		200	<5		<5						21	8		9			61		93			2.2	102	<50
BRSW-35	6/26/2001	59		170	<5		<5						22	8.2		8.6			46		82			2	104	<50
BRSW-35	10/17/2001	<50		62	<5		<5						80	22		23			19		43			0.038	332	<20

NOTES: [shaded cell] = water quality standard exceedance

Segment Name: Mike Horse Creek

Site	Sample Date	Fe, T (ug/L)	Fe, TR (ug/L)	Hg, T (ug/L)	Mg (mg/L)	Mn, D (ug/L)	Mn, T (ug/L)	Mn, TR (ug/L)	Mo, D (ug/L)	Mo, T (ug/L)	Ni, D (ug/L)	Ni, T (ug/L)	pH	Pb, D (ug/L)	Pb, T (ug/L)	Pb, TR (ug/L)	Sb, D (ug/L)	Sb, T (ug/L)	Se, D (ug/L)	Se, T (ug/L)	SO4 (mg/L)	Zn, D (ug/L)	Zn, T (ug/L)	Zn, TR (ug/L)
BRSW-4	8/12/1991	45		<0.5	13	95	100		<20	<20			7.9	11	11				<20	<20	18	1500	1700	
BRSW-4	9/13/1991	130		<0.5	13	120	130		<20	<20			7.7	18	37				<20	<20	22	2000	2100	
BRSW-4	11/13/1991	100		<0.5	14	55	83		<20	<20			7.3	<10	23				<20	<20	40	2400	2400	
BRSW-4	4/16/1992	123		<0.5	20	963	965		<50	<50	<20	<20	6.9	6	18				<5	<5	118	6610	6670	
BRSW-4	5/5/1992	181		<0.5	11	192	194		<50	<50	<20	<20	7.1	17	<5				<5	<5	29	1950	2000	
BRSW-4	5/19/1992	61		<0.5	11	111	100		<50	<50	<20	<20	8	<5	8.8				<5	<5	21	1542	1495	
BRSW-4	6/3/1992	<50		<0.5	12	68	67		<50	<50	<20	<20	8	<5	7				<5	<5	22	1288	1282	
BRSW-4	10/27/1993	<100		<0.2	15	419	439		<50	<50	<40	<40	7.4	4	26		<60	<60	<5	<5	93	4788	5557	
BRSW-4	10/22/1998		90		17	830		750					7.7	38		44					85	4200		4100
BRSW-4	4/29/1999		20		39	6630		7400					6.3	111		199					328	26300		27600
BRSW-4	5/21/1999		800		18	2860		2800					6.9	10		217					123	8360		8450
BRSW-4	10/21/1999		<50		16	690		730					7.4	31		48					83	3510		3700
BRSW-4	10/12/2000		<50		15	580		570					7.6	32		47					100	3300		3100
BRSW-4	4/26/2001		190		28	5600		5400					5.3	72		110					281	14000		14000
BRSW-4	5/23/2001		<50		11	590		620					7.8	9		50					30	1700		1800
BRSW-4	6/27/2001		<50		13	1000		1100					7.2	12		35					49	2900		3200
BRSW-4	10/17/2001		<50		18	1000		1000					7.3	31		54					101	4700		4900
BRSW-22	10/26/1993	6717		<0.2	60	8645	8170		<50	<50	<41	<40	7.4	<3	49		<60	<60	<5	<5	920	13247	14142	
BRSW-22	5/18/1994		2200		43	3600		4000					7.6	<2		49					212	8500		11000
BRSW-22	10/26/1994		14740		128	17590		17660					7	<2		868					1046	33530		39200
BRSW-22	5/2/1995		1200		47	6200		6600					7.2	10		160					403	28000		27000
BRSW-22	10/23/1995		250		38	840		830					7.9	63		79					258	11000		11000
BRSW-22	5/22/1996		470		37	6900		6700					7.5	7		41					413	11000		12000
BRSW-22	10/21/1996		840		196	43000		40000					7.2	<3		55					1614	73000		67000
BRSW-22	2/26/1997		370		50	690		640					7.2	90		140					430	13300		12000
BRSW-22	5/27/1997		66		9.2	330		340					7.7	18		43					32	2100		2000
BRSW-22	10/22/1997		<50		44	4800		4700					7.4	33		37					385	14000		14000
BRSW-22	5/5/1998		72		13	440		440					7.6	23		36					80	3300		3300
BRSW-22	10/22/1998		130		21	200		190					7.8	16		17					144	4000		4000
BRSW-22	4/29/1999		110		32	4460		4740					6.4	48		123					288	19600		19800
BRSW-22	5/21/1999		940		14	1590		1610					7.1	11		214					105	6210		5680
BRSW-22	10/19/1999		<50		19	99		97					7.2	12		15					114	3600		3600
BRSW-22	10/12/2000		<50		31	220		270					7.8	13		16					373	5800		6300
BRSW-22	4/26/2001		950		42	3200		3100					7.3	27		140					520	20000		20000
BRSW-22	5/22/2001		<50		12	510		530					7.7	12		26					56	2200		2300
BRSW-22	5/23/2001		<50		11	480		500					7.7	11		24					47	2100		2200
BRSW-22	6/26/2001		<50		14	730		750					7.3	15		36					78	2800		3000
BRSW-22	10/17/2001		<50		31	110		120					7.5	11		12					243	5300		5400
BRSW-35	10/22/1998		160		22	360		340					7.5	46		57					152	4100		4000
BRSW-35	4/29/1999		990		49	4870		5420					6.3	75		192					401	19700		20800
BRSW-35	5/21/1999		620		15	1090		1100					7.3	10		127					83	3530		3430
BRSW-35	10/19/1999		<50		21	300		300					7.2	48		56					156	3800		3800
BRSW-35	10/12/2000		<50		31	390		410					7.7	19		29					386	5100		5100
BRSW-35	4/26/2001		2100		54	6400		6200					6.5	120		420					620	29000		29000
BRSW-35	5/22/2001		84		12	420		410					7.8	19		40					48	1300		1300
BRSW-35	6/26/2001		<50		12	330		340					7.4	18		34					43	1200		1300
BRSW-35	10/17/2001		250		32	250		320					7.6	26		70					284	5200		5700

NOTES: [shaded cell] = water quality standard exceedance

Segment Name: Poorman Creek

Site	Sample Date	Al, D (µg/L)	As, T (µg/L)	As, TR (µg/L)	Ba, TR (µg/L)	Be, TR (µg/L)	Ca (mg/L)	Cd, TR (µg/L)	Co, TR (µg/L)	Cu, D (µg/L)	Cu, T (µg/L)	Cu, TR (µg/L)	Cr, TR (µg/L)	Flow (cfs)	Hardness (mg/L)	Fe, D (µg/L)	Fe, T (µg/L)
4226PO01	3/5/1973		<1				36			<10	<10			1.3	131	10	<10
4226PO01	8/20/1973		<10				34			<10	<10				123	10	>29.99
4226PO01	5/8/1974													35.7			
4128PO02	6/13/1996			4			42.2	<0.2				1		17.66	142		
4128PO01	6/13/1996			1			21.5	0.5				10		0.79	67		
PCSW-6	10/7/2002	<50		<5			27	0.1				4		0.156	66		
4127PO02	6/13/1996			2			33.6	<0.2				1		59.05	114		
4127PO01	6/13/1996			2			35.5	<0.2				2		56.97	119		
C03POORC01	6/28/2001			<3	104	<1	24	<0.1				3	1	0.67	102		
C03POORC02	6/28/2001			4	103	<1	38	<0.1				2	<1	12.9	133		
C03POORC03	6/28/2001			<3	97	<1	33	<0.1				1	<1	23.5	117		
25-208-SW-1	9/1/1993			7.15	62.9			<2.57	<9.7			21.3	11.9		90.9		
25-208-SW-2	9/1/1993			3.92	88.8			<2.57	<9.7			15.2	12.6		79.2		
PCSW-1	6/6/2002	<10		<50	210	<10	47.2	<1				1	<1	32.8	166		
PCSW-1	10/7/2002	<50		<5			43	<0.1				2		14.8	157		
PCSW-2	6/6/2002	<10		<50	80	<10	34.5	<1				1	<1	24.7	120		
PCSW-2	10/7/2002	<50		<5			37	<0.1				<1		1.7	134		
PCSW-3	6/6/2002	10		<50	80	<10	38	<1				1	<1	12.6	130		
PCSW-3	10/7/2002	<50		<5			43	<0.1				2		3.5	149		
PCSW-4	6/6/2002	40		<50	80	<10	21.3	<1				<1	<1	0.47	92.8		
PCSW-5	6/7/2002	<10		<50	60	<10	37.7	<1				<1	<1	5.8	131		
PCSW-5	10/7/2002	<50		<5			45	<0.1				2		1.3	158		
011				2				<0.2				2		8.92	118		
PCSW-7	10/7/2002	<50		<5			39	<0.1				2		1.2	126		

NOTES: [shaded cell] = water quality standard exceedance (shaded in the table: Cd, TR 0.5 for 4128PO01; Cu, TR 10 for 4128PO01, 21.3 for 25-208-SW-1, 15.2 for 25-208-SW-2)

Segment Name: Poorman Creek

Site	Sample Date	Fe, TR (µg/L)	Hg, TR (µg/L)	Mg (mg/L)	Mn, TR (µg/L)	Ni, TR (µg/L)	pH	Pb, D (µg/L)	Pb, T (µg/L)	Pb, TR (µg/L)	Sb, TR (µg/L)	Se, TR (µg/L)	SO4 (mg/L)	Zn, D (µg/L)	Zn, T (µg/L)	Zn, TR (µg/L)
4226PO01	3/5/1973			10			8	<10	<10				12	10	<10	
4226PO01	8/20/1973			9.2			8.5	<10	<10					<10	<10	
4226PO01	5/8/1974						8.4									
4128PO02	6/13/1996	40		8.9			8.53			1			6			0.3
4128PO01	6/13/1996	50		3.1			8.17			8			6.3			2
PCSW-6	10/7/2002	<30		3	<10		7.14			<2			5			<10
4127PO02	6/13/1996	70		7.3			8.42			1			7.2			0.8
4127PO01	6/13/1996	20		7.4			8.49			1			7.3			0.2
C03POORC01	6/28/2001	200		10	19	<10	7.1			2		1	15			20
C03POORC02	6/28/2001	10		9	<5	<10	8.2			<2		<1	7			<10
C03POORC03	6/28/2001	20		8	<5	<10	7.4			<2		<1	9			<10
25-208-SW-1	9/1/1993	265	<0.12		17.5	<12.7				4.32	<30.7		10			9.5
25-208-SW-2	9/1/1993	19.4	<0.12		4.13	<12.7				2.53	<30.7		9			7.6
PCSW-1	6/6/2002	60		11.6	<10	<20	8.4			<1		<50	9.08			<10
PCSW-1	10/7/2002	30		12	<10		8.52			<2			8			<10
PCSW-2	6/6/2002	30		8.3	<10	<20	8.22			<1		<50	9.74			<10
PCSW-2	10/7/2002	40		10	<10		8.18			<2			9			<10
PCSW-3	6/6/2002	40		8.5	<10	<20	8.76			1		<50	6.61			<10
PCSW-3	10/7/2002	<30		10	<10		8.63			<2			7			<10
PCSW-4	6/6/2002	160		9.6	10	<20	8.53			<1		<50	16			<10
PCSW-5	6/7/2002	30		8.9	<10	<20	8.81			<1		<50				<10
PCSW-5	10/7/2002	<30		11	<10		8.42			<2			7			<10
011		40					8.46			2			7.6			0.6
PCSW-7	10/7/2002	<30		7	<10		8.63			<2			8			<10

NOTES: [shaded cell] = water quality standard exceedance

Segment Name: **Sandbar Creek**

Site	Sample Date	Ag, TR (µg/L)	Al, D (µg/L)	Al, TR (µg/L)	As, TR (µg/L)	Ba, TR (µg/L)	Be, TR (µg/L)	Ca (mg/L)	Cd, TR (µg/L)	Cr, TR (µg/L)	Cu, TR (µg/L)	Flow (cfs)	Hardness (mg/L)	Fe, TR (µg/L)	Mg (mg/L)
4229SA01	6/11/1996				<1			9.5	<0.2		18		42	580	4.4
C03SNDBC01	6/18/2001	<3		<100	<3	94	<1	9	<0.1	<1	5	5.9	37	70	4
SCSW-2	10/7/2002		<50		<5			17	<0.1		5	0.103	71	40	7
C03SNDBC02	6/18/2001	<3		<100	<3	78	<1	8	<0.1	<1	11	6.4	35	260	4
SCSW-1	6/6/2002		110		<50	80	<10	9.6	<1	<1	13	2.1	41.3	430	4.2
SCSW-1	10/7/2002		<50		<5			13	<0.1		22	0.222	56.5	1020	6
SCSW-3	10/7/2002		<50		<5			20	<0.1		1	0.056	87	<30	9

NOTES: [shaded box] = water quality standard exceedance

Segment Name: Sandbar Creek										
Site	**Sample Date**	**Mn, TR (µg/L)**	**Ni, TR (µg/L)**	**pH**	**Pb, TR (µg/L)**	**Sb, TR (µg/L)**	**Se, TR (µg/L)**	**SO4 (mg/L)**	**Tl, TR (µg/L)**	**Zn, TR (µg/L)**
4229SA01	6/11/1996			7.95	<1			13.7		7
C03SNDBC01	6/18/2001	<5	<10	6.0	<2	<3	<1	7	<2	<10
SCSW-2	10/7/2002	<10		8.5	<2			15		<10
C03SNDBC02	6/18/2001	15	<10	6.3	<2	<3	<1	10	<2	<10
SCSW-1	6/6/2002	30	<20	7.61	<1		<50	13		<10
SCSW-1	10/7/2002	120		8.66	<2			33		20
SCSW-3	10/7/2002	<10		8.06	<2			12		10
NOTES:		= water quality standard exceedance								

Segment Name:		Seven-Up Pete Creek											
Site	Sample Date	Ag, TR (µg/L)	Al, D (µg/L)	As, TR (µg/L)	Ba, TR (µg/L)	Be, TR (µg/L)	Ca (mg/L)	Cd, TR (µg/L)	Co, TR (µg/L)	Cr, TR (µg/L)	Cu, TR (µg/L)	Fe, TR (µg/L)	Flow (cfs)
SW-10.S	10/20/1989	<5		<5			43	<1			<10	240	0.28
SW-10.S	3/7/1990	<5		<5			13	<1			<10	80	0.5
SW-10.S	5/11/1990	<5		<5			7	<1			<10	50	2.61
SW-10.S	8/24/1990	<5		<5			33	<1			<10	110	0.21
SW-10.S	10/24/1990	<5		<5			34	<1			<10	50	0.26
SW-12.S	3/7/1990	<5		<5			30	<1			<10	**400**	0.25
SW-12.S	8/23/1990	<5		<5			44	<1			<10	**340**	0.01
SW-12.S	10/24/1990	<5		<5			43	<1			<10	**1090**	0.02
SW-12.S	2/14/1991	<5		<5			40	<1			<10	150	0.01
SW-12.S	5/22/1991	<5		<5			13	<1			<10	**930**	0.4
SW-13.S	10/19/1989	<5		<5			36	<1			<10	<30	0.53
SW-14.S	10/19/1989	<5		<5			36	<1			<10	<30	0.52
SW-14.S	3/2/1990	<5		<5			37	**2**			<10	<30	0.23
SW-14.S	3/9/1990	<5		<5			31	<1			<10	70	
SW-14.S	5/10/1990	<5		<5			11	<1			<10	120	4.91
SW-14.S	8/22/1990	<5		<5			33	<1			<10	<30	0.63
SW-14.S	10/24/1990	<5		<5			34	<1			<10	<30	0.55
SW-9.S	10/20/1989	<5		<5			15	<1			<10	40	
SW-9.S	3/7/1990	<5		<5			22	<1			<10	50	0.38
SW-9.S	5/11/1990	<5		<5			6	**2**			<10	50	1.83
SW-9.S	8/24/1990	<5		<5			13	<1			<10	30	0.06
SW-9.S	10/24/1990	<5		<5			17	<1			<10	40	0.07
25-020-SW-1	9/7/1993			3.97	202			<3	<10	<7	**11**	**1300**	
25-020-SW-2	9/7/1993			5.41	<128			**2.93**	<10	<7	11.7	**395**	
SPSW-1	6/10/2002		**110**	<50	90	<10	16.9	<1		<10	1	80	3.3
NOTES:	[shaded]	=water quality standard exceedance											

Segment Name:		**Seven-Up Pete Creek**									
Site	**Sample Date**	**Hardness (mg/L)**	**Hg, TR (µg/L)**	**Mg (mg/L)**	**Ni, TR (µg/L)**	**pH**	**Pb, TR (µg/L)**	**Sb, TR (µg/L)**	**Se, TR (µg/L)**	**SO4 (mg/L)**	**Zn, TR (µg/L)**
SW-10.S	10/20/1989	142	<1	8		7.9	<10		<5	65	10
SW-10.S	3/7/1990	48	<1	4		7.5	<2		<5	6	10
SW-10.S	5/11/1990	24	<1	1		6.9	<10		<5	3	<10
SW-10.S	8/24/1990	105	<1	6		7.5	<10		<5	26	<10
SW-10.S	10/24/1990	114	<1	7		7.6	<10		<5	31	20
SW-12.S	3/7/1990	95	<1	5		7.8	<2		<5	15	<10
SW-12.S	8/23/1990	136	<1	6		7.9	<10		<5	22	<10
SW-12.S	10/24/1990	134	<1	7		7.9	<10		<5	22	20
SW-12.S	2/14/1991	122	<1	6		8.3	<10		<5	19	10
SW-12.S	5/22/1991	44	<1	3		7.6	2		<5	6	30
SW-13.S	10/19/1989	123	<1	8		7.9	<10		<5	40	20
SW-14.S	10/19/1989	124	<1	9		8.1	<10		<5	37	20
SW-14.S	3/2/1990	143	<1	12		7.7	<2		<5	22	<10
SW-14.S	3/9/1990	104	<1	7		8.0	<2		<5	30	10
SW-14.S	5/10/1990	40	<1	3		6.7	<10		<5	7	<10
SW-14.S	8/22/1990	111	<1	7		7.6	<10		<5	18	<10
SW-14.S	10/24/1990	118	<1	8		7.6	<10		<5	22	20
SW-9.S	10/20/1989	56	<1	5		7.6	<10		<5	8	<10
SW-9.S	3/7/1990	79	<1	6		7.8	<2		<5	4	<10
SW-9.S	5/11/1990	20	<1	1		6.7	<10		<5	2	<10
SW-9.S	8/24/1990	48	<1	4		6.9	<10		<5	6	<10
SW-9.S	10/24/1990	62	<1	5		7.4	<10		<5	6	20
25-020-SW-1	9/7/1993	100	0.19		17.1		3.4	<31		12	16.6
25-020-SW-2	9/7/1993	130	<0.12		25.3		3.8	<31		42	21.4
SPSW-1	6/10/2002	60.9		4.6	<20	7.11	<1		<50	5.22	<10
NOTES:		=water quality standard exceedance									

Segment Name: Willow Creek

Site	Sample Date	Ag, TR (µg/L)	Al, D (µg/L)	Al, TR (µg/L)	As, T (µg/L)	As, TR (µg/L)	Ba, TR (µg/L)	Be, TR (µg/L)	Ca (mg/L)	Cd, D (µg/L)	Cd, T (µg/L)	Cd, TR (µg/L)	Cu, D (µg/L)	Cu, T (µg/L)	Cu, TR (µg/L)	Cr, TR (µg/L)	Flow (cfs)	Hardness (mg/L)	Fe, D (µg/L)
4328WI01	3/7/1973				<10				18				<10	<10				78	200
4328WI01	5/14/1973								11	<10	<10		<10	<10				49	200
4328WI01	8/17/1973				<10				19				<10	<10				81	180
4328WI01	5/12/1989				***						***			***			40		
C03WILLC01	6/19/2001	<3		<100		<3	116	<1	12			<0.1			1	<1	14.5	55	
C03WILLC02	6/19/2001	<3		<100		<3	87	<1	11			<0.1			2	<1	34.4	48	
WCSW-1	6/6/2002		<10			<50	110	<10	12.6			<1			<1	<10	8.3	57.3	
WCSW-2	6/6/2002		10			<50	80	<10	10.4			<1			1	<10	22.9	45.3	

NOTES:
*** = value reported in database as 0 concentration
(shaded cell) = water quality standard exceedance

Segment Name: Willow Creek

Site	Sample Date	Fe, T (µg/L)	Fe, TR (µg/L)	Mg (mg/L)	Mn, TR (µg/L)	Ni, TR (µg/L)	pH	Pb, D (µg/L)	Pb, T (µg/L)	Pb, TR (µg/L)	Sb, TR (µg/L)	Se, TR (µg/L)	SO4 (mg/L)	Tl, TR (µg/L)	Zn, D (µg/L)	Zn, T (µg/L)	Zn, TR (µg/L)
4328WI01	3/7/1973	>200		8			8.0	<10	<10				21		<10	<10	
4328WI01	5/14/1973	>200		5.2			8.0	<10	<10				11		<10	<10	
4328WI01	8/17/1973	>290		8			8.2	<10	<10						<10	<10	
4328WI01	5/12/1989								***							***	
C03WILLC01	6/19/2001		110	6	7	<10	6.3			<2	<3	<1	6	<2			<10
C03WILLC02	6/19/2001		210	5	12	<10	6.3			<2	<3	<1	4	<2			<10
WCSW-1	6/6/2002		130	6.3	<10	<20	8.83			<1		<50	3.94				<10
WCSW-2	6/6/2002		230	4.7	10	<20	8.47			<1		<50	5.09				<10

NOTES: *** = value reported in database as 0 concentration
(shaded cell) = water quality standard exceedance

October 2002 Sediment Metals Data from Poorman Creek					
	Concentrations in ppm				
	PCSW-8	**PCSW-7**	**PCSW-3**	*****	
As	7	7	26	28	
Cd	<2	<2	3	3	
Cu	43	84	172	224	
Pb	46	185	313	353	
Ni	25	13	17	13	
Zn	95	84	155	137	
	PCSW-8	Poorman Creek upstream of confluence with Swansea Gulch			Upstream
	PCSW-7	Poorman Creek upstream of confluence with South Fork			Middle
	PCSW-3	Poorman Creek above confluence with Little Davis Gulch			Downstream
	*	June 2001 data from CO3POORC02- same as PCSW-3			

StationID	StationName	Medium	CollectDate	Analyte	RESULT	UNITS	QUALIFIER	DetectionLimit
C03ARRAC01	Arrasta Creek 1-1.5 mi d/s of FS boundary	Sediment	25-Jun-01	Aluminum, Nitric Digestion	14600	ug/g		5
C03ARRAC01	Arrasta Creek 1-1.5 mi d/s of FS boundary	Sediment	25-Jun-01	Antimony, Nitric Digestion	<5	ug/g		5
C03ARRAC01	Arrasta Creek 1-1.5 mi d/s of FS boundary	Sediment	25-Jun-01	Arsenic, Nitric Digestion	16	ug/g		5
C03ARRAC01	Arrasta Creek 1-1.5 mi d/s of FS boundary	Sediment	25-Jun-01	Barium, Nitric Digestion	409	ug/g		5
C03ARRAC01	Arrasta Creek 1-1.5 mi d/s of FS boundary	Sediment	25-Jun-01	Beryllium, Nitric Digestion	<5	ug/g		5
C03ARRAC01	Arrasta Creek 1-1.5 mi d/s of FS boundary	Sediment	25-Jun-01	Cadmium, Nitric Digestion	<1	ug/g		1
C03ARRAC01	Arrasta Creek 1-1.5 mi d/s of FS boundary	Sediment	25-Jun-01	Chromium, Nitric Digestion	20	ug/g		5
C03ARRAC01	Arrasta Creek 1-1.5 mi d/s of FS boundary	Sediment	25-Jun-01	Copper, Nitric Digestion	101	ug/g		5
C03ARRAC01	Arrasta Creek 1-1.5 mi d/s of FS boundary	Sediment	25-Jun-01	Iron, Nitric Digestion	18800	ug/g		5
C03ARRAC01	Arrasta Creek 1-1.5 mi d/s of FS boundary	Sediment	25-Jun-01	Lead, Nitric Digestion	16	ug/g		5
C03ARRAC01	Arrasta Creek 1-1.5 mi d/s of FS boundary	Sediment	25-Jun-01	Manganese, Nitric Digestion	585	ug/g		5
C03ARRAC01	Arrasta Creek 1-1.5 mi d/s of FS boundary	Sediment	25-Jun-01	Nickel, Nitric Digestion	14	ug/g		5
C03ARRAC01	Arrasta Creek 1-1.5 mi d/s of FS boundary	Sediment	25-Jun-01	Nitric Digestion				
C03ARRAC01	Arrasta Creek 1-1.5 mi d/s of FS boundary	Sediment	25-Jun-01	Selenium, Nitric Digestion	<5	ug/g		5
C03ARRAC01	Arrasta Creek 1-1.5 mi d/s of FS boundary	Sediment	25-Jun-01	Silver, Nitric Digestion	<5	ug/g		5
C03ARRAC01	Arrasta Creek 1-1.5 mi d/s of FS boundary	Sediment	25-Jun-01	Thallium, Nitric Digestion	<5	ug/g		5
C03ARRAC01	Arrasta Creek 1-1.5 mi d/s of FS boundary	Sediment	25-Jun-01	Zinc, Nitric Digestion	75	ug/g		5
C03ARRAC02	Arrasta Creek above Hwy 200 bridge	Sediment	25-Jun-01	Aluminum, Nitric Digestion	12500	ug/g		5
C03ARRAC02	Arrasta Creek above Hwy 200 bridge	Sediment	25-Jun-01	Antimony, Nitric Digestion	<5	ug/g		5
C03ARRAC02	Arrasta Creek above Hwy 200 bridge	Sediment	25-Jun-01	Arsenic, Nitric Digestion	7	ug/g		5
C03ARRAC02	Arrasta Creek above Hwy 200 bridge	Sediment	25-Jun-01	Barium, Nitric Digestion	296	ug/g		5
C03ARRAC02	Arrasta Creek above Hwy 200 bridge	Sediment	25-Jun-01	Beryllium, Nitric Digestion	<5	ug/g		5
C03ARRAC02	Arrasta Creek above Hwy 200 bridge	Sediment	25-Jun-01	Cadmium, Nitric Digestion	<1	ug/g		1
C03ARRAC02	Arrasta Creek above Hwy 200 bridge	Sediment	25-Jun-01	Chromium, Nitric Digestion	17	ug/g		5
C03ARRAC02	Arrasta Creek above Hwy 200 bridge	Sediment	25-Jun-01	Copper, Nitric Digestion	66	ug/g		5
C03ARRAC02	Arrasta Creek above Hwy 200 bridge	Sediment	25-Jun-01	Iron, Nitric Digestion	12100	ug/g		5
C03ARRAC02	Arrasta Creek above Hwy 200 bridge	Sediment	25-Jun-01	Lead, Nitric Digestion	17	ug/g		5
C03ARRAC02	Arrasta Creek above Hwy 200 bridge	Sediment	25-Jun-01	Manganese, Nitric Digestion	163	ug/g		5
C03ARRAC02	Arrasta Creek above Hwy 200 bridge	Sediment	25-Jun-01	Nickel, Nitric Digestion	12	ug/g		5
C03ARRAC02	Arrasta Creek above Hwy 200 bridge	Sediment	25-Jun-01	Nitric Digestion				
C03ARRAC02	Arrasta Creek above Hwy 200 bridge	Sediment	25-Jun-01	Selenium, Nitric Digestion	<5	ug/g		5
C03ARRAC02	Arrasta Creek above Hwy 200 bridge	Sediment	25-Jun-01	Silver, Nitric Digestion	<5	ug/g		5
C03ARRAC02	Arrasta Creek above Hwy 200 bridge	Sediment	25-Jun-01	Thallium, Nitric Digestion	<5	ug/g		5
C03ARRAC02	Arrasta Creek above Hwy 200 bridge	Sediment	25-Jun-01	Zinc, Nitric Digestion	66	ug/g		5
C03POORC01	Poorman Creek u/s of 1st switchback going up Stemple Pass	Sediment	29-Jun-01	Aluminum, Nitric Digestion	21100	ug/g		5
C03POORC01	Poorman Creek u/s of 1st switchback going up Stemple Pass	Sediment	29-Jun-01	Antimony, Nitric Digestion	<5	ug/g		5
C03POORC01	Poorman Creek u/s of 1st switchback going up Stemple Pass	Sediment	29-Jun-01	Arsenic, Nitric Digestion	12	ug/g		5
C03POORC01	Poorman Creek u/s of 1st switchback going up Stemple Pass	Sediment	29-Jun-01	Barium, Nitric Digestion	518	ug/g		5
C03POORC01	Poorman Creek u/s of 1st switchback going up Stemple Pass	Sediment	29-Jun-01	Beryllium, Nitric Digestion	<5	ug/g		5
C03POORC01	Poorman Creek u/s of 1st switchback going up Stemple Pass	Sediment	29-Jun-01	Cadmium, Nitric Digestion	<1	ug/g		1
C03POORC01	Poorman Creek u/s of 1st switchback going up Stemple Pass	Sediment	29-Jun-01	Chromium, Nitric Digestion	23	ug/g		5
C03POORC01	Poorman Creek u/s of 1st switchback going up Stemple Pass	Sediment	29-Jun-01	Copper, Nitric Digestion	27	ug/g		5
C03POORC01	Poorman Creek u/s of 1st switchback going up Stemple Pass	Sediment	29-Jun-01	Iron, Nitric Digestion	17300	ug/g		5
C03POORC01	Poorman Creek u/s of 1st switchback going up Stemple Pass	Sediment	29-Jun-01	Lead, Nitric Digestion	54	ug/g		5
C03POORC01	Poorman Creek u/s of 1st switchback going up Stemple Pass	Sediment	29-Jun-01	Manganese, Nitric Digestion	595	ug/g		5

StationID	StationName	Medium	CollectDate	Analyte	RESULT	UNITS	QUALIFIER	DetectionLimit
C03POORC01	Poorman Creek u/s of 1st switchback going up Stemple Pass	Sediment	29-Jun-01	Nickel, Nitric Digestion	37	ug/g		5
C03POORC01	Poorman Creek u/s of 1st switchback going up Stemple Pass	Sediment	29-Jun-01	Nitric Digestion				
C03POORC01	Poorman Creek u/s of 1st switchback going up Stemple Pass	Sediment	29-Jun-01	Selenium, Nitric Digestion	<5	ug/g		5
C03POORC01	Poorman Creek u/s of 1st switchback going up Stemple Pass	Sediment	29-Jun-01	Silver, Nitric Digestion	<5	ug/g		5
C03POORC01	Poorman Creek u/s of 1st switchback going up Stemple Pass	Sediment	29-Jun-01	Thallium, Nitric Digestion	<5	ug/g		5
C03POORC01	Poorman Creek u/s of 1st switchback going up Stemple Pass	Sediment	29-Jun-01	Zinc, Nitric Digestion	89	ug/g		5
C03POORC02	Poorman Creek -first stream crossing d/s of SF	Sediment	28-Jun-01	Aluminum, Nitric Digestion	15800	ug/g		5
C03POORC02	Poorman Creek -first stream crossing d/s of SF	Sediment	28-Jun-01	Antimony, Nitric Digestion	<5	ug/g		5
C03POORC02	Poorman Creek -first stream crossing d/s of SF	Sediment	28-Jun-01	Arsenic, Nitric Digestion	28	ug/g		5
C03POORC02	Poorman Creek -first stream crossing d/s of SF	Sediment	28-Jun-01	Barium, Nitric Digestion	243	ug/g		5
C03POORC02	Poorman Creek -first stream crossing d/s of SF	Sediment	28-Jun-01	Beryllium, Nitric Digestion	<5	ug/g		5
C03POORC02	Poorman Creek -first stream crossing d/s of SF	Sediment	28-Jun-01	Cadmium, Nitric Digestion	3	ug/g		1
C03POORC02	Poorman Creek -first stream crossing d/s of SF	Sediment	28-Jun-01	Chromium, Nitric Digestion	15	ug/g		5
C03POORC02	Poorman Creek -first stream crossing d/s of SF	Sediment	28-Jun-01	Copper, Nitric Digestion	224	ug/g		5
C03POORC02	Poorman Creek -first stream crossing d/s of SF	Sediment	28-Jun-01	Iron, Nitric Digestion	11900	ug/g		5
C03POORC02	Poorman Creek -first stream crossing d/s of SF	Sediment	28-Jun-01	Lead, Nitric Digestion	353	ug/g		5
C03POORC02	Poorman Creek -first stream crossing d/s of SF	Sediment	28-Jun-01	Manganese, Nitric Digestion	365	ug/g		5
C03POORC02	Poorman Creek -first stream crossing d/s of SF	Sediment	28-Jun-01	Nickel, Nitric Digestion	13	ug/g		5
C03POORC02	Poorman Creek -first stream crossing d/s of SF	Sediment	28-Jun-01	Nitric Digestion				
C03POORC02	Poorman Creek -first stream crossing d/s of SF	Sediment	28-Jun-01	Selenium, Nitric Digestion	<5	ug/g		5
C03POORC02	Poorman Creek -first stream crossing d/s of SF	Sediment	28-Jun-01	Silver, Nitric Digestion	<5	ug/g		5
C03POORC02	Poorman Creek -first stream crossing d/s of SF	Sediment	28-Jun-01	Thallium, Nitric Digestion	<5	ug/g		5
C03POORC02	Poorman Creek -first stream crossing d/s of SF	Sediment	28-Jun-01	Zinc, Nitric Digestion	137	ug/g		5
C03POORC03	Poorman Creek stream crossing 0.8 mi d/s of FS boundary	Sediment	28-Jun-01	Aluminum, Nitric Digestion	21500	ug/g		5
C03POORC03	Poorman Creek stream crossing 0.8 mi d/s of FS boundary	Sediment	28-Jun-01	Antimony, Nitric Digestion	<5	ug/g		5
C03POORC03	Poorman Creek stream crossing 0.8 mi d/s of FS boundary	Sediment	28-Jun-01	Arsenic, Nitric Digestion	24	ug/g		5
C03POORC03	Poorman Creek stream crossing 0.8 mi d/s of FS boundary	Sediment	28-Jun-01	Barium, Nitric Digestion	297	ug/g		5
C03POORC03	Poorman Creek stream crossing 0.8 mi d/s of FS boundary	Sediment	28-Jun-01	Beryllium, Nitric Digestion	<5	ug/g		5
C03POORC03	Poorman Creek stream crossing 0.8 mi d/s of FS boundary	Sediment	28-Jun-01	Cadmium, Nitric Digestion	<1	ug/g		1
C03POORC03	Poorman Creek stream crossing 0.8 mi d/s of FS boundary	Sediment	28-Jun-01	Chromium, Nitric Digestion	21	ug/g		5
C03POORC03	Poorman Creek stream crossing 0.8 mi d/s of FS boundary	Sediment	28-Jun-01	Copper, Nitric Digestion	140	ug/g		5
C03POORC03	Poorman Creek stream crossing 0.8 mi d/s of FS boundary	Sediment	28-Jun-01	Iron, Nitric Digestion	17500	ug/g		5
C03POORC03	Poorman Creek stream crossing 0.8 mi d/s of FS boundary	Sediment	28-Jun-01	Lead, Nitric Digestion	68	ug/g		5
C03POORC03	Poorman Creek stream crossing 0.8 mi d/s of FS boundary	Sediment	28-Jun-01	Manganese, Nitric Digestion	451	ug/g		5
C03POORC03	Poorman Creek stream crossing 0.8 mi d/s of FS boundary	Sediment	28-Jun-01	Nickel, Nitric Digestion	22	ug/g		5
C03POORC03	Poorman Creek stream crossing 0.8 mi d/s of FS boundary	Sediment	28-Jun-01	Nitric Digestion				
C03POORC03	Poorman Creek stream crossing 0.8 mi d/s of FS boundary	Sediment	28-Jun-01	Selenium, Nitric Digestion	<5	ug/g		5
C03POORC03	Poorman Creek stream crossing 0.8 mi d/s of FS boundary	Sediment	28-Jun-01	Silver, Nitric Digestion	<5	ug/g		5
C03POORC03	Poorman Creek stream crossing 0.8 mi d/s of FS boundary	Sediment	28-Jun-01	Thallium, Nitric Digestion	<5	ug/g		5
C03POORC03	Poorman Creek stream crossing 0.8 mi d/s of FS boundary	Sediment	28-Jun-01	Zinc, Nitric Digestion	91	ug/g		5
C03SNDBC01	Sandbar Creek d/s of forks	Sediment	18-Jun-01	Aluminum, Nitric Digestion	17300	ug/g		5
C03SNDBC01	Sandbar Creek d/s of forks	Sediment	18-Jun-01	Antimony, Nitric Digestion	<5	ug/g		5
C03SNDBC01	Sandbar Creek d/s of forks	Sediment	18-Jun-01	Arsenic, Nitric Digestion	54	ug/g		5
C03SNDBC01	Sandbar Creek d/s of forks	Sediment	18-Jun-01	Barium, Nitric Digestion	629	ug/g		5
C03SNDBC01	Sandbar Creek d/s of forks	Sediment	18-Jun-01	Beryllium, Nitric Digestion	<5	ug/g		5

StationID	StationName	Medium	CollectDate	Analyte	RESULT	UNITS	QUALIFIER	DetectionLimit
C03SNDBC01	Sandbar Creek d/s of forks	Sediment	18-Jun-01	Cadmium, Nitric Digestion	8	ug/g		1
C03SNDBC01	Sandbar Creek d/s of forks	Sediment	18-Jun-01	Chromium, Nitric Digestion	9	ug/g		5
C03SNDBC01	Sandbar Creek d/s of forks	Sediment	18-Jun-01	Copper, Nitric Digestion	685	ug/g		5
C03SNDBC01	Sandbar Creek d/s of forks	Sediment	18-Jun-01	Iron, Nitric Digestion	33200	ug/g		5
C03SNDBC01	Sandbar Creek d/s of forks	Sediment	18-Jun-01	Lead, Nitric Digestion	166	ug/g		5
C03SNDBC01	Sandbar Creek d/s of forks	Sediment	18-Jun-01	Manganese, Nitric Digestion	2310	ug/g		5
C03SNDBC01	Sandbar Creek d/s of forks	Sediment	18-Jun-01	Nickel, Nitric Digestion	31	ug/g		5
C03SNDBC01	Sandbar Creek d/s of forks	Sediment	18-Jun-01	Nitric Digestion				
C03SNDBC01	Sandbar Creek d/s of forks	Sediment	18-Jun-01	Selenium, Nitric Digestion	<5	ug/g		5
C03SNDBC01	Sandbar Creek d/s of forks	Sediment	18-Jun-01	Silver, Nitric Digestion	<5	ug/g		5
C03SNDBC01	Sandbar Creek d/s of forks	Sediment	18-Jun-01	Thallium, Nitric Digestion	<5	ug/g		5
C03SNDBC01	Sandbar Creek d/s of forks	Sediment	18-Jun-01	Zinc, Nitric Digestion	685	ug/g		5
C03WARDC01	Ward Creek 3.0 mi above Hwy 200 turnoff	Sediment	20-Jun-01	Aluminum, Nitric Digestion	11600	ug/g		5
C03WARDC01	Ward Creek 3.0 mi above Hwy 200 turnoff	Sediment	20-Jun-01	Antimony, Nitric Digestion	<5	ug/g		5
C03WARDC01	Ward Creek 3.0 mi above Hwy 200 turnoff	Sediment	20-Jun-01	Arsenic, Nitric Digestion	25	ug/g		5
C03WARDC01	Ward Creek 3.0 mi above Hwy 200 turnoff	Sediment	20-Jun-01	Barium, Nitric Digestion	649	ug/g		5
C03WARDC01	Ward Creek 3.0 mi above Hwy 200 turnoff	Sediment	20-Jun-01	Beryllium, Nitric Digestion	<5	ug/g		5
C03WARDC01	Ward Creek 3.0 mi above Hwy 200 turnoff	Sediment	20-Jun-01	Cadmium, Nitric Digestion	<1	ug/g		1
C03WARDC01	Ward Creek 3.0 mi above Hwy 200 turnoff	Sediment	20-Jun-01	Chromium, Nitric Digestion	16	ug/g		5
C03WARDC01	Ward Creek 3.0 mi above Hwy 200 turnoff	Sediment	20-Jun-01	Copper, Nitric Digestion	19	ug/g		5
C03WARDC01	Ward Creek 3.0 mi above Hwy 200 turnoff	Sediment	20-Jun-01	Iron, Nitric Digestion	15800	ug/g		5
C03WARDC01	Ward Creek 3.0 mi above Hwy 200 turnoff	Sediment	20-Jun-01	Lead, Nitric Digestion	15	ug/g		5
C03WARDC01	Ward Creek 3.0 mi above Hwy 200 turnoff	Sediment	20-Jun-01	Manganese, Nitric Digestion	395	ug/g		5
C03WARDC01	Ward Creek 3.0 mi above Hwy 200 turnoff	Sediment	20-Jun-01	Nickel, Nitric Digestion	18	ug/g		5
C03WARDC01	Ward Creek 3.0 mi above Hwy 200 turnoff	Sediment	20-Jun-01	Nitric Digestion				
C03WARDC01	Ward Creek 3.0 mi above Hwy 200 turnoff	Sediment	20-Jun-01	Selenium, Nitric Digestion	<5	ug/g		5
C03WARDC01	Ward Creek 3.0 mi above Hwy 200 turnoff	Sediment	20-Jun-01	Silver, Nitric Digestion	<5	ug/g		5
C03WARDC01	Ward Creek 3.0 mi above Hwy 200 turnoff	Sediment	20-Jun-01	Thallium, Nitric Digestion	<5	ug/g		5
C03WARDC01	Ward Creek 3.0 mi above Hwy 200 turnoff	Sediment	20-Jun-01	Zinc, Nitric Digestion	75	ug/g		5
C03WARDC02	Ward Creek First Stream crossing above Browns Lake	Sediment	20-Jun-01	Aluminum, Nitric Digestion	12600	ug/g		5
C03WARDC02	Ward Creek First Stream crossing above Browns Lake	Sediment	20-Jun-01	Antimony, Nitric Digestion	<5	ug/g		5
C03WARDC02	Ward Creek First Stream crossing above Browns Lake	Sediment	20-Jun-01	Arsenic, Nitric Digestion	18	ug/g		5
C03WARDC02	Ward Creek First Stream crossing above Browns Lake	Sediment	20-Jun-01	Barium, Nitric Digestion	489	ug/g		5
C03WARDC02	Ward Creek First Stream crossing above Browns Lake	Sediment	20-Jun-01	Beryllium, Nitric Digestion	<5	ug/g		5
C03WARDC02	Ward Creek First Stream crossing above Browns Lake	Sediment	20-Jun-01	Cadmium, Nitric Digestion	<1	ug/g		1
C03WARDC02	Ward Creek First Stream crossing above Browns Lake	Sediment	20-Jun-01	Chromium, Nitric Digestion	10	ug/g		5
C03WARDC02	Ward Creek First Stream crossing above Browns Lake	Sediment	20-Jun-01	Copper, Nitric Digestion	34	ug/g		5
C03WARDC02	Ward Creek First Stream crossing above Browns Lake	Sediment	20-Jun-01	Iron, Nitric Digestion	18100	ug/g		5
C03WARDC02	Ward Creek First Stream crossing above Browns Lake	Sediment	20-Jun-01	Lead, Nitric Digestion	16	ug/g		5
C03WARDC02	Ward Creek First Stream crossing above Browns Lake	Sediment	20-Jun-01	Manganese, Nitric Digestion	547	ug/g		5
C03WARDC02	Ward Creek First Stream crossing above Browns Lake	Sediment	20-Jun-01	Nickel, Nitric Digestion	12	ug/g		5
C03WARDC02	Ward Creek First Stream crossing above Browns Lake	Sediment	20-Jun-01	Nitric Digestion				
C03WARDC02	Ward Creek First Stream crossing above Browns Lake	Sediment	20-Jun-01	Selenium, Nitric Digestion	<5	ug/g		5
C03WARDC02	Ward Creek First Stream crossing above Browns Lake	Sediment	20-Jun-01	Silver, Nitric Digestion	<5	ug/g		5
C03WARDC02	Ward Creek First Stream crossing above Browns Lake	Sediment	20-Jun-01	Thallium, Nitric Digestion	<5	ug/g		5

StationID	StationName	Medium	CollectDate	Analyte	RESULT	UNITS	QUALIFIER	DetectionLimit
C03WARDC02	Ward Creek First Stream crossing above Browns Lake	Sediment	20-Jun-01	Zinc, Nitric Digestion	75	ug/g		5
C03WILLC01	Willow Creek u/s of Sandbar Cr below FS Rd number 4108	Sediment	19-Jun-01	Aluminum, Nitric Digestion	15600	ug/g		5
C03WILLC01	Willow Creek u/s of Sandbar Cr below FS Rd number 4108	Sediment	19-Jun-01	Antimony, Nitric Digestion	<5	ug/g		5
C03WILLC01	Willow Creek u/s of Sandbar Cr below FS Rd number 4108	Sediment	19-Jun-01	Arsenic, Nitric Digestion	116	ug/g		5
C03WILLC01	Willow Creek u/s of Sandbar Cr below FS Rd number 4108	Sediment	19-Jun-01	Barium, Nitric Digestion	722	ug/g		5
C03WILLC01	Willow Creek u/s of Sandbar Cr below FS Rd number 4108	Sediment	19-Jun-01	Beryllium, Nitric Digestion	<5	ug/g		5
C03WILLC01	Willow Creek u/s of Sandbar Cr below FS Rd number 4108	Sediment	19-Jun-01	Cadmium, Nitric Digestion	2	ug/g		1
C03WILLC01	Willow Creek u/s of Sandbar Cr below FS Rd number 4108	Sediment	19-Jun-01	Chromium, Nitric Digestion	11	ug/g		5
C03WILLC01	Willow Creek u/s of Sandbar Cr below FS Rd number 4108	Sediment	19-Jun-01	Copper, Nitric Digestion	101	ug/g		5
C03WILLC01	Willow Creek u/s of Sandbar Cr below FS Rd number 4108	Sediment	19-Jun-01	Iron, Nitric Digestion	59400	ug/g		5
C03WILLC01	Willow Creek u/s of Sandbar Cr below FS Rd number 4108	Sediment	19-Jun-01	Lead, Nitric Digestion	53	ug/g		5
C03WILLC01	Willow Creek u/s of Sandbar Cr below FS Rd number 4108	Sediment	19-Jun-01	Manganese, Nitric Digestion	2050	ug/g		5
C03WILLC01	Willow Creek u/s of Sandbar Cr below FS Rd number 4108	Sediment	19-Jun-01	Nickel, Nitric Digestion	18	ug/g		5
C03WILLC01	Willow Creek u/s of Sandbar Cr below FS Rd number 4108	Sediment	19-Jun-01	Nitric Digestion				
C03WILLC01	Willow Creek u/s of Sandbar Cr below FS Rd number 4108	Sediment	19-Jun-01	Selenium, Nitric Digestion	<5	ug/g		5
C03WILLC01	Willow Creek u/s of Sandbar Cr below FS Rd number 4108	Sediment	19-Jun-01	Silver, Nitric Digestion	<5	ug/g		5
C03WILLC01	Willow Creek u/s of Sandbar Cr below FS Rd number 4108	Sediment	19-Jun-01	Thallium, Nitric Digestion	<5	ug/g		5
C03WILLC01	Willow Creek u/s of Sandbar Cr below FS Rd number 4108	Sediment	19-Jun-01	Zinc, Nitric Digestion	158	ug/g		5
C03WILLC02	Willow Creek at mouth, abv cnfl w/ Blackfoor River	Sediment	19-Jun-01	Aluminum, Nitric Digestion	13600	ug/g		5
C03WILLC02	Willow Creek at mouth, abv cnfl w/ Blackfoor River	Sediment	19-Jun-01	Antimony, Nitric Digestion	<5	ug/g		5
C03WILLC02	Willow Creek at mouth, abv cnfl w/ Blackfoor River	Sediment	19-Jun-01	Arsenic, Nitric Digestion	30	ug/g		5
C03WILLC02	Willow Creek at mouth, abv cnfl w/ Blackfoor River	Sediment	19-Jun-01	Barium, Nitric Digestion	535	ug/g		5
C03WILLC02	Willow Creek at mouth, abv cnfl w/ Blackfoor River	Sediment	19-Jun-01	Beryllium, Nitric Digestion	<5	ug/g		5
C03WILLC02	Willow Creek at mouth, abv cnfl w/ Blackfoor River	Sediment	19-Jun-01	Cadmium, Nitric Digestion	1	ug/g		1
C03WILLC02	Willow Creek at mouth, abv cnfl w/ Blackfoor River	Sediment	19-Jun-01	Chromium, Nitric Digestion	8	ug/g		5
C03WILLC02	Willow Creek at mouth, abv cnfl w/ Blackfoor River	Sediment	19-Jun-01	Copper, Nitric Digestion	80	ug/g		5
C03WILLC02	Willow Creek at mouth, abv cnfl w/ Blackfoor River	Sediment	19-Jun-01	Iron, Nitric Digestion	30600	ug/g		5
C03WILLC02	Willow Creek at mouth, abv cnfl w/ Blackfoor River	Sediment	19-Jun-01	Lead, Nitric Digestion	33	ug/g		5
C03WILLC02	Willow Creek at mouth, abv cnfl w/ Blackfoor River	Sediment	19-Jun-01	Manganese, Nitric Digestion	2530	ug/g		5
C03WILLC02	Willow Creek at mouth, abv cnfl w/ Blackfoor River	Sediment	19-Jun-01	Nickel, Nitric Digestion	16	ug/g		5
C03WILLC02	Willow Creek at mouth, abv cnfl w/ Blackfoor River	Sediment	19-Jun-01	Nitric Digestion				
C03WILLC02	Willow Creek at mouth, abv cnfl w/ Blackfoor River	Sediment	19-Jun-01	Selenium, Nitric Digestion	<5	ug/g		5
C03WILLC02	Willow Creek at mouth, abv cnfl w/ Blackfoor River	Sediment	19-Jun-01	Silver, Nitric Digestion	<5	ug/g		5
C03WILLC02	Willow Creek at mouth, abv cnfl w/ Blackfoor River	Sediment	19-Jun-01	Thallium, Nitric Digestion	<5	ug/g		5
C03WILLC02	Willow Creek at mouth, abv cnfl w/ Blackfoor River	Sediment	19-Jun-01	Zinc, Nitric Digestion	163	ug/g		5

APPENDIX D
PRIMARY CLEANUP/RESTORATION OPTIONS FOR MINE OPERATIONS OR OTHER SOURCES OF METALS CONTAMINATION

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

1.0 The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

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

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

Cleanup actions under CERCLA must be based on professionally developed plans and can be categorized as either Removal or Remedial. Removal actions can be used to address the immediate need to stabilize or remove a threat where an emergency exists. Removal actions can also be non-time critical.

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

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

2.0 The Montana Comprehensive Cleanup and Responsibility Act (CECRA)

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

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

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

Currently, 208 facilities on the CECRA Priority List remain to be addressed; current actions are being conducted at 59 of those facilities. To date, 79 facilities are delisted because they are cleaned up or being addressed by another program. CECRA facilities are ranked maximum, high, medium, low and operation and maintenance priority based on the severity of contamination at the facility and the actual and potential impacts of contamination to public health, safety, and welfare and the environment. The Department maintains database narratives that explain contamination problems and status of work at each state Superfund facility. As of November 2001, final cleanup had been completed at 49 CECRA facilities, and interim cleanups had been completed at 78 facilities.

2.1 The Controlled Allocation of Liability Act (CALA)

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

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

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

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

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

2.2 The Voluntary Cleanup and Redevelopment Act (VCRA)

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

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

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

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

The Department has produced a VCRA Application Guide to assist applicants in preparing a new application; this guide is not a regulation and adherence to it is not mandatory.

As of November 2001, the Department has approved twenty voluntary clean plans for 19 facilities, including mining, manufactured gas, wood treating, dry cleaning, salvage, pesticide, fueling, refining, metal plating, defense, and automotive repair facilities. Applicants have expressed interest and/or submitted applications for voluntary cleanup at fifteen other facilities. The Department maintains a registry of VCRA facilities.

3.0 Abandoned Mine Lands Cleanup

The purpose of the Abandoned Mine Lands Reclamation (AML) Program is to protect human health and the environment from the effects of past mining and mineral processing activities. Funding for cleanup is via the Federal Abandoned Mine Fund, which is distributed to the State of Montana via a grant program. The Abandoned Mine Fund is generated by a per ton fee levied on coal producers and the annual grant is based on coal production. Expenditures under the abandoned mine program can only be made on "eligible" abandoned mine sites. For a site to be eligible, mining must have ceased prior to August 4, 1977 (private lands, other dates apply to federal lands). In addition, there must be no continuing reclamation responsibility under any state or federal law. No continuing reclamation responsibility can mean that no mining bonds or permits have been issued for the site, however, it has also been interpreted to mean that there can be no viable responsible party under State or Federal laws such as CERCLA or CECRA. While lands eligible for the Abandoned Mine Funds include hard rock mines and gravel pits, abandoned coal mines have the highest priority for expenditures from the Fund. Cleanup of any eligible site is prioritized based primarily on human health, which can include health risks such as open shafts, versus risks only associated with hazardous substances, as is the case under CERCLA.

Montana's AML Program maintains an inventory of all potential cleanup sites, and has a list of priority sites from which to work from. This includes the Swansea Mine and Mill Complex discussed within this report. The Montana Department of Environmental Quality conducts cleanups under the Abandoned Mine Funds as public works contracts utilizing professional engineers for design purposes and private construction contractors to perform the actual work.

Mitigating impacts associated with discharging adits can be included within the cleanup, although ongoing water treatment is not pursued as a reclamation option to avoid long-term operational commitments, which are outside the scope of the program and funding source. Therefore, even after cleanup, an abandoned mine site could still represent a source of contaminant loading to a stream, especially if there is a discharging adit associated with the site. Where discharging adits are not of concern, cleanup may generally represent efforts to achieve all reasonable land, water, and soil conservation practices for that site.

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

4.0 Permitted or Bonded Sites

Newer mining sites that are or have been in recent operation are required to post bonds as part of their permit conditions. These bond and permit conditions help ensure cleanup to levels that will satisfy Montana Water Quality Standards during operation and after completion of a mining operation. Such sites also include larger placer mines greater than 5 acres in size.

5.0 State Emergency Actions

Where a major emergency exists, the State can undertake remedial actions and then pursue reimbursement from a responsible party. This situation does not exist in the Blackfoot Headwaters Planning Area.

APPENDIX E
METALS SOURCE ANALYSES IN SUPPORT OF TMDL DEVELOPMENT FOR SANDBAR CREEK AND POORMAN CREEK DRAINAGES

Sandbar Creek Metals Source Analysis

In order to further quantify possible metals source areas, a metals loading analysis was performed for Sandbar Creek. In a metals loading analysis, the mass, or load (lb/day), of one or more metals is calculated using the measured streamflow rate (cubic feet per second) and corresponding metals concentrations determined from water quality samples collected at various points along a stream. By comparing the metal loads at various points, downstream changes in metals loads, or loading trends, can be determined. An increase in a metal load between two points indicates a source of metals loading exists between those two points. In this way a metals loading analysis can help identify specific loading sources within a drainage and aid in restoration planning.

Streamflow measurements were recorded and water quality samples collected at monitoring sites C03SNDBC01 and C03SNDBC02 on June 18, 2001, and at SCSW-1, SCSW-2 and SCSW-3 on October 7, 2002 (Figure 2-1 of Restoration Plan). Copper, iron and manganese loads were calculated for each sampling event since these metals were present at detectable concentrations at most sites. Sulfate loads were also calculated since sulfate can be an indicator of mine drainage resulting from oxidation of metal sulfide minerals.

The June 2001 metals and sulfate loads show consistent increases between upstream monitoring site C03SNDBC01 and downstream site C03SNDBC02 (Table E-1). This increase in loading, which is accompanied by a small increase in streamflow between the two sites (5.9 to 6.4 cfs), indicates the presence of one or more metals loading sources in this stream reach. The presence of copper in excess of the chronic aquatic criteria at upstream monitoring site SCSW-2 indicates one or more metals loading sources exist upstream of this point, such as the upstream mine dump and/or the apparent mine waste road fill (Figure 2-1).

The October 2002 metals concentrations trends are similar to the June trends although the October concentrations are lower. Copper, iron and sulfate loads consistently increase in a downstream direction, especially between downstream sites SCSW-1 and SCSW-2 resulting in water quality exceedences at SCSW-1. The smaller load increases observed between the two upstream sites indicate that the upstream sources (the upper mine dump and/or area of mine waste in road) continue to contribute metals to the creek during low flow, but at rates too low to cause water quality standards to be exceeded. The general lack of metals at upstream site SCSW-3 indicates an absence of upstream sources during low flow conditions.

Table E-1 Metals Loading Trends in Sandbar Creek for June 2001 and October 2002

	June 2001				October 2002					
	C03SNDBC01 (5.9 cfs)		C03SNDBC02 (6.4 cfs)		SCSW-3 (0.06 cfs)		SCSW-2 (0.10 cfs)		SCSW-1 (0.22 cfs)	
	Conc. µg/L	**Load lb/day**	Conc. µg/L	**Load lb/day**	Conc. µg/L	**Load lb/day**	Conc. µg/L	**Load lb/day**	Conc. µg/L	**Load lb/day**
Copper	5	**0.159**	11	**0.379**	1	**0.0003**	5	**0.0027**	22	**0.026**
Iron	70	**2.22**	260	**8.96**	<30	**<0.01**	40	**0.02**	1,020	**1.21**
Manganese	<5	**<0.151**	15	**0.517**	<10	**<0.003**	10	**<0.005**	120	**0.14**
Sulfate	7000	**222**	10	**344**	12000	**3.9**	15000	**8.1**	33000	**39**

Sites shown in upstream to downstream order.
Site locations shown on Figure 2-1

In summary, the metals loading analysis supports the previous findings that two mine waste dumps and a segment of road containing mine waste are likely sources of metals loading to Sandbar Creek. The downstream mine acts as the dominant source of metals loading under both high flow and low flow conditions, with low flow water quality exceedences restricted to the stream reach downstream of this mine. Based on the more extensive October 2002 sampling, no other upstream sources are believed to significantly affect water quality in Sandbar Creek, at least under low flow conditions.

Metals loading mechanisms may include leaching of dissolved metals from the mine waste to surface waters via infiltration of snowmelt/rainfall or contact with shallow groundwater, or transfer of particulate metals to the creek through erosion of the mine waste. The greater metals concentrations recorded under high flow as compared to low flow suggest erosion of particulate metals may be the dominant loading mechanism. More detailed water sampling immediately upstream and downstream of each source would be required to better quantify the relative load contributions from each source, and to assist with reclamation planning and prioritization.

Poorman Creek Metals Source Analysis

In order to identify general metals source areas, a metals loading analysis was performed for Poorman Creek. Table E-2 shows copper, iron and sulfate loading trends in Poorman Creek drainage as determined from the June 1996 water sampling data. The June 1996 sampling represents the most extensive high flow sampling event conducted in Poorman Creek drainage. Iron and copper were included in the loading analysis since these metals were consistently present at detectable concentrations in all water samples. Sulfate is included in the loading analysis as well since sulfate can be released from mine waste through the oxidation of metal-sulfide minerals, and therefore can be an indicator of mine drainage. Although extensive sampling was performed in Poorman Creek drainage in October 2002 (the only low flow data available from the majority of the drainage), a general lack of detectable metals concentrations in these samples precludes performance of a low flow loading analysis.

Table E-2 Metals and Sulfate Loading Trends in Poorman Creek Drainage for June 13, 1996

SITE	Description	Flow (cfs)	Copper (lb/day)	Iron (lb/day)	Sulfate (lb/day)
4128PO014	Swansea Gulch above Stemple Rd	0.79	0.043	0.21	26.8
011	Poorman Ck upstream of S. Fork	8.92	0.096	1.92	365
4128PO02	S. Fork Poorman Ck near mouth	17.66	0.095	3.81	571
4127PO01	Poorman Ck below McClellan Ck	56.97	0.614	6.14	2,240
4127PO02	Poorman Ck at NF boundary	59.05	0.318	22.3	2,290

Site listed in downstream order, locations shown on Figure 3-1.

Following is a summary of the June 1996 loading trends. Sampling locations are shown on Figure 3-1 of the Restoration Plan.

- June 1996 sampling sites include, in upstream to downstream order: Swansea Gulch near the confluence with Poorman Creek (site 4128PO014), Poorman Creek above the confluence with the South Fork (011), South Fork near the confluence with Poorman Creek (4128PO02), Poorman Creek below McClellan Creek (4127PO01), and Poorman Creek at the National Forest Boundary (4127PO02).

- Despite having the highest metals concentrations in the drainage (and the only exceedences of metals-related numeric water quality criteria), metals and sulfate loads in Swansea Gulch were low compared to other monitoring sites. This is due to the low flow rate (0.79 cfs), and thus lower dilution potential of Swansea Gulch, in comparison to Poorman Creek.

- Loads of copper, iron and sulfate were all greater at site 011 (Poorman Creek above South Fork) than those measured in Swansea Gulch. This indicates that loading sources in addition to Swansea Gulch exist upstream of site 011. Despite the higher loads, no water quality criteria were exceeded at 011 due to the higher flows (and greater dilution) in Poorman Creek.

- The South Fork (site 4128PO02) contained about twice the flow and iron load as compared to the mainstem above the confluence (site 011). The South Fork also contained a higher sulfate load while the copper load was almost identical between the South Fork and the mainstem.

- The Poorman Creek copper load increases by approximately 300% and the sulfate load approximately 400% between the confluence with the South Fork and site 4127PO01 (Poorman Creek downstream of McClellan Creek). The iron load through this reach was relatively unchanged. The copper load increase indicates the presence of one or more loading sources along this stream reach. The increase in sulfate load suggests sulfidic mine waste as the source.

- Between McClellan Creek and the National Forest Boundary (site 4127PO01 to 4127PO02), the copper load decreases, sulfate load and streamflow remain constant, and iron increases from 6.1 to 22.3 lbs/day (Table E-2). The decrease in copper load most likely reflects chemical precipitation of copper hydroxide (or other complexes) from the water column to the streambed. The large increase in iron load coupled with the stable sulfate load suggests an iron source other than sulfidic mine waste, possibly resuspension or dissolution of iron hydroxide precipitates previously deposited on the streambed.

Although the metals loading analysis indicates that multiple metals loading sources may exist throughout the drainage under high flow conditions, available water quality data indicate that only a small portion of the drainage (Swansea Gulch), is impaired due to elevated metals concentrations in the water column. As previously discussed however, elevated concentrations of some metals in Poorman Creek sediments, along with the available biological data, indicate that portions of Poorman Creek mainstem are impaired from metals.

Swansea Gulch contains a number of relatively large historic mines including the Swansea Mine/Tailings Complex and Silver Belle Mine (Figure 3-1 of Restoration Plan). This group of mines and support facilities, referred to here as the Swansea Gulch mines, represents the only currently identified source of metals-related water quality impairment in Poorman Creek drainage. Therefore, the first phase of TMDL development, load allocation, and restoration planning in Poorman Creek drainage focuses on Swansea Gulch, with allocations and restoration plans developed in subsequent phases once additional information on mainstem and tributary conditions becomes available.

Due to the importance of Swansea Gulch in development of a metals TMDL for Poorman Creek drainage, a brief summary of relevant available source assessment information from the drainage is presented below.

Swansea Gulch Water Quality

The former Montana Department of State Lands performed a preliminary evaluation of the Swansea Mine in 1993 as part of the state’s ranking of Abandoned Hardrock Mine Priority Sites (MDSL, 1995). The evaluation identified an estimated 3,700 cubic yards of mine tailings and an estimated 15,000 yards of mine waste rock, and one discharging adit. Cadmium, lead, zinc, copper, manganese, antimony and mercury were identified as being present at elevated concentrations (three or more times background levels) in the tailings and/or waste rock.

Water samples were collected from the adit discharge, and from Swansea Gulch upstream and downstream of the mine. Analytical results from the adit discharge revealed no exceedences of human health or aquatic criteria, although the analytical detection limits utilized for cadmium and mercury were greater than the corresponding numeric criteria. Interestingly, sampling results from Swansea Gulch upstream and downstream of the mine revealed that metals concentrations were generally greatest in the upstream sample. The upstream sample exceeded the acute aquatic and chronic aquatic criteria for copper and lead, while the downstream sample exceeded these criteria for copper only. The MDSL preliminary evaluation concluded that there were no observed releases to Swansea Gulch and no exceedences of numeric water quality standards attributable to the Swansea tailings based on the information collected, although the evaluation did indicate a potential upstream source, which was not identified during the September 1993 investigation.

In addition to the 1993 water samples, one sample was collected in June 1996 (by MDEQ) and one in October 2002 (by Hydrometrics) near the mouth of Swansea Gulch. Metals concentrations in the 2001 sample exceeded applicable water quality standards for cadmium, copper and lead (0.5, 10, and 8 μg/L, respectively). Concentrations in the October 2002 sample were all below applicable standards. Water quality data from Poorman Creek drainage is included in Appendix C.

APPENDIX F
RESPONSE TO PUBLIC COMMENTS

1) COMMENT: Mike Horse Creek is the location of the largest historic mining operation in the Upper Blackfoot headwaters. This mining operation is responsible for the construction of the tailings impoundment located at the confluence of Beartrap Creek and Mike Horse Creek, which is the source of extensive downstream tailings deposition as a result of the 1975 breach of the dam. Furthermore, as your research reveals, Mike Horse Creek accounts for "an average of 73% of the downstream metal loads at Beartrap Creek site BRSW-23, and 61% of the load at Beartrap Creek site BRSW-38" during high flow conditions. Additional investigation, including that by the Resource Protection Planning Bureau, would prove invaluable to understanding the sources of loading in the Mike Horse segment. As with the other listed segments currently under the Temporary Water Quality Standards petition for the Upper Blackfoot headwaters, the Mike Horse Creek segment already affords the TMDL planning effort a wealth of data from which to work. Additionally, the fieldwork to collect surface water monitoring data will continue until at least 2008 under the current Temporary Water Quality Standards petition. This provides an opportunity to better understand the dynamics of Mike Horse Creek and its influence on the Blackfoot headwaters.

Listing Mike Horse Creek simply as a "source" limits both the documentation of load-source origins and the assessment of performance-based load allocations within this half-mile stream stretch. Furthermore, stream restoration for Mike Horse Creek is not addressed under its current designation, either with the macroinvertebrate and periphyton-communities research, or with the formulation of a stream restoration plan that could include recommendations for physical restoration as well as the biological restoration. For these reasons, the Remediation Division is perplexed and concerned as to why this segment of Mike Horse Creek currently listed as part of the Temporary Water Quality Standards for the Upper Blackfoot Mining Complex is not included (listed) as impaired in the Water Quality Restoration Plan for Metals in the Blackfoot Headwaters TMDL Planning Area. We request that Mike Horse Creek be listed as impaired and not be listed as a source.

> **RESPONSE:** The performance-based allocation approach for Beartrap Creek (Section 4.4.3) in the public review document did specifically address the Mike Horse Creek drainage and associated metals loading sources within this drainage. Given the very high metals loading from Mike Horse Creek and the significant flow contributions from Mike Horse Creek to Beartrap Creek, it would be impossible to meet the restoration goals in Beartrap Creek without performing substantial cleanup of identified sources in the Mike Horse Creek drainage. This could require significant investigations into possible contributing metals loading sources beyond those identified in Section 4.4.3 as would be the case for any contributing drainage or source area where B-1 standards cannot be met by addressing currently identified loading sources. Nevertheless, it is possible to meet B-1 standards within Beartrap Creek and still be above the standards in Mike Horse Creek. Under such a scenario, the development of TMDLs and the application of restoration targets in Mike Horse Creek may result in the need for more stringent cleanup and investigation measures for metals loading sources in the Mike Horse Creek drainage. Therefore, the development of restoration targets, TMDLs, and allocations specific to

Mike Horse Creek has been added to Section 4.0 as suggested. Such an approach is consistent with the existing temporary water quality standards that also apply to Mike Horse Creek (ARM 17.30.630(d)(i)).

The physical habitat related impairment conditions within Mike Horse and Beartrap Creeks will be addressed in the *Blackfoot Headwaters Planning Area Water Quality and Habitat Restoration Plan and TMDL Submittal*, which is currently under development.

2) COMMENT: Citing the beneficial use support guidelines for determining reference condition is inappropriate. This report only gives guidelines on how to determine reference condition. It does not provide any numerical criteria for targets. Besides there are several approaches for determining reference condition. Which approach did you use? Are you comparing to regional reference condition or using an internal reference site? Are you using a paired watershed approach or modeling? Are you comparing to historical data or is reference condition based on what you found in the literature or are you relying on some expert's best professional judgment? What is your target based on? Are you using a multimetric index approach or the Shannon diversity index or something else?

RESPONSE: The incorrect citation has been corrected, with updated information on reference condition approaches to be used and MDEQ protocol. This information is included within Appendix A under *Aquatic Life Support Restoration Targets*.

3) COMMENT: Do these streams have an important fishery? Are the fish impacted by elevated metals? If so, did you consider using some measure of fish assemblages or populations as a target?

RESPONSE: Targets have been developed with focus on two types of biota: macroinvertebrate and periphyton, in addition to water quality chemistry and sediment chemistry related targets. These targets are sufficient for protection of the fishery resource relative to the pollutants of concern and are consistent with standard MDEQ field monitoring procedures often used for obtaining sufficient credible data and making beneficial use determinations.

4) COMMENT: The selection of targets is appropriate but the TMDL plan did not provide enough detail. For example, the sediment metals target was described but not specified. The target should not be left open ended. Can't you specify the target while acknowledging the uncertainty and then describe how the target can be adjusted in the future when there is more certainty? You must have some idea what the target should be?

The biological targets have the same problem. What do you mean by 75% of reference condition? How did you determine reference condition? How certain are you about reference condition? What is the biological target? Should more data be collected to refine the biological targets? If so, how should this be done?

RESPONSE: Additional details concerning the sediment metals concentration target and how it is applied have been added to Section 1.2.3 and Appendix A, with examples on its application within target setting Sections 2.4.1, 2.5.1 and 2.5.2, 3.4.1, 4.4.1, and 5.4.1. No specific values have been used due to a high level of uncertainty concerning the use of any such value at this time, in part due to the wide range of literature values associated with toxic conditions for any given metals concentration in sediment.

The use of 75% of reference condition has been eliminated in the target setting sections identified above in favor of wording that states that biological targets (macroinvertebrate and periphyton) must meet existing MDEQ protocol for making full support conclusions for beneficial uses, as discussed within *Aquatic Life Support Restoration Targets* within Appendix A. It is pointed out in this section of Appendix A that the goal is to be equal to the reference condition, but the use of 75% value accounts for variations in natural systems and analytical methods used to compare conditions in one stream with conditions in another. Even though existing MDEQ protocol (MDEQ, 2002) utilizes a 75% value to represent anticipated variations associated with naturally occurring conditions among streams, not specifically including this 75% value in the target recognizes that future protocols and improved reference condition information could lead to the use of a value greater than 75% if less variability is anticipated between the target and reference stream. Nevertheless, more data is not a requirement for determining reference conditions given the existence of regional reference conditions as discussed in Appendix A.

5) COMMENT: Concerning the metals target: I believe that the SCD criteria states that any chronic criteria exceedance cannot be more than 10%. This should be confirmed.

RESPONSE: We agree with the above noted criteria and have made changes to all of the target sections in the document to reflect this criteria.

6) COMMENT: (in reference to Sections 2.4.3 and 3.4.3) The Water Quality Restoration Plan includes two categories of nonpoint source metals impairment potentially requiring load allocations. The first category is identified sources and the second is other potential sources not yet identified. Please address the rationale for moving "natural background metals loading" from Category Two into Category One. This move is confusing in the load allocations sections for Sandbar Creek, Poorman Creek and Swansea Gulch since the only natural background metals-loading documentation cited in the plan is for Paymaster Creek.

RESPONSE: The reason for shifting natural background to Category One is because it is of unknown value. Even if very small, it has to be in Category One. Including it in Category Two is a potential problem since that would mean that all of the allowable load is already allocated to the known sources in Category One at a loading rate that equals the TMDL and thus equals the standard. The natural background load would then need to equal zero to avoid exceeding the standard and associated TMDL targets. Even if very low, natural background loading needs to either go in Category One or the allowable/allocated load to human sources needs to be reduced by the natural background load, which is unknown in most cases and therefore must be combined with known human loading to equal the TMDL.

7) COMMENT: The Remediation Division would like to clarify that, under CECRA, cleanup levels for soils, sediments, and waters are typically established through human health and ecological risk assessments and compliance with environmental laws. Therefore, compliance with the restoration targets (i.e. macroinvertebrate and periphyton communities, and the assumptions that achieving the TMDLs is expected to address sediment toxicity issues) identified in the TMDL document does not mean that additional cleanup will not be necessary under CECRA.

> **RESPONSE:** This comment has been addressed by adding the following wording throughout the target setting sections: "It is important to note that the above targets represent minimum requirements for protecting beneficial uses identified within Montana's Surface Water Quality Standards, and are based on interpretations of available data presented within this plan. Other regulatory programs with water quality protection responsibilities may impose additional requirements to ensure full compliance with all appropriate local, State and Federal laws."

8) COMMENT: Page 5-13, Section 5.3.3.2 (5.3.2.2?), last paragraph: Please explain the rationale for the change from identifying these tributaries "as sources of metals loading" to "tributaries containing detectable concentrations that periodically exceed the numeric water quality standards."

> **RESPONSE:** Both terms appropriately describe the noted tributaries. Under the Remaining Sources allocations discussion within Section 5.4.3.2, these tributaries are described as sources of metals loading to the Blackfoot River, although the data indicate that the restoration targets could be met in the Blackfoot River without requiring any load reductions in these tributaries. Nevertheless, load allocations equal to B-1 numeric standards are applied for the metals of concern as a margin of safety and in recognition of the need to possibly pursue detailed restoration planning in one or more of these tributary drainages.

9) COMMENT: Pages 6-8 and 6-9, Section 6.3.2.1: The Remediation Division understands the purpose of the additional monitoring from a TMDL perspective. We want to clarify that this sampling may not fulfill CECRA sampling requirements to determine the extent of and risk posed by contamination and evaluating remedial actions and that potentially liable persons may need to conduct additional sampling.

> **RESPONSE:** Wording has been added to this and other sections within the document to stress the above point (reference response to Comment 7 above). The following wording has been added to Section 6.3.2 to help clarify the purpose of Sections 6.3.2.1 and 6.3.2.2 and further incorporate the above comment: "The focus of the ...... monitoring is to address water quality and beneficial use support per Montana's State Surface Water Quality Standards within the context of TMDL development and implementation. Specific monitoring requirements beyond those discussed .... will typically be imposed as part of any regulatory cleanup effort such as efforts associated with the UBMC and/or efforts associated with any of the regulatory options discussed in Section 6.2.1. These monitoring requirements may be associated with the protection and cleanup of surface

waters in addition to other media such as soils or ground water, and may impose significant additional sampling requirements to further determine the extent of and risk posed by contamination in addition to requiring evaluation of specific remediation actions."

10) COMMENT: The monitoring strategy description appears to have a tremendous amount of uncertainty. It mostly describes current data collection efforts or provides a very general recommendation about what data "should" be collected in the future. It does not describe in very much detail how the data will be collected and assessed for making future decisions about sources, implementation success, beneficial use support, etc. DEQ should provide more guidance for future water quality monitoring. This could include a study design framework that clearly describes a well thought-out iterative and/or tiered approach to data collection that identifies data needs and specifies how the data should be collected and assessed for making future adaptive management decisions.

DEQ should also provide more guidance for effectiveness monitoring. This should include a study design that describes the location of sampling sites, data collection methods, data collection frequency, and a detailed description of how the data shall be assessed. There appears to be a tremendous amount of uncertainty in this portion of the document. Effectiveness monitoring is not necessarily equivalent to post-implementation monitoring. It is often also needed during implementation in order to determine the speed of recovery, trends, or to document success or failure before a restoration activity is fully implemented throughout the entire watershed. In other words, effectiveness monitoring can also provide data for making adaptive management decisions.

RESPONSE: We agree that the above recommendations should be part of any monitoring plans developed to satisfy the monitoring strategy as defined in this document, but many of these additional details are outside the intended scope of Section 6.3 *Monitoring Strategy*. Additional responses to the above comments are divided into the three parts of this section of the document:

1) UBMC Water Monitoring Requirements (Section 6.3.1) - This section of the document does reference detailed water quality monitoring and source assessment as required by the temporary standards process and the MPDES permit.
2) Monitoring Strategy for the Remainder of the Blackfoot Headwaters Planning Area: Monitoring Needed for Further Source Assessment and Restoration Planning (Section 6.3.2.1) - The intent of this portion of the monitoring strategy is to provide direction on general locations and monitoring goals from which to develop the detailed studies and plans as envisioned in the above comment. Additional detail is provided where appropriate, and some additional detail concerning monitoring goals has been added. To help ensure that future work is done in a manner consistent with MDEQ protocols and information needed for making impairment determinations, the following language is included at the beginning of this section: "At a minimum, any monitoring plans and activities that address this part of the monitoring strategy should be reviewed by MDEQ to ensure consistency with the goals of this plan, MDEQ

monitoring and assessment protocols, data requirements for beneficial use determinations, and data requirements associated with specific remediation programs."

3) Monitoring Strategy for the Remainder of the Blackfoot Headwaters Planning Area: Implementation Monitoring (Section 6.3.2.2) – A primary focus of TMDL implementation monitoring is to track progress toward meeting restoration targets. Table 6-1 has been added to this section to summarize target related monitoring locations and parameters from throughout the document. Additional details for other forms of implementation monitoring specific to individual sources are not provided. As stated in this section: "Efforts to assess the effectiveness of specific restoration activities focused on individual sources or source areas will tend to be an inherent part of the specific regulatory program/approach utilized ...... At this time it would not be appropriate to identify all of these monitoring details, although it is expected that there would be some overlap with efforts to evaluate attainment of the restoration targets discussed below."

11) COMMENT: Is Asarco doing anything to correct its problems?

> **RESPONSE:** This document provides a description of significant ASARCO planning and related cleanup efforts underway within the UBMC.

12) SPECIFIC LEGAL AND TECHNICAL COMMENTS: The following comments address specific legal and technical considerations. Changes were made as noted:

- **COMMENT:** Page 1-10, Section 1.4, 1st paragraph, last sentence: "Legal boundaries" as defined through CECRA (any site or area where a hazardous or deleterious substance has been deposited, stored, disposed of, placed, or otherwise come to be located, §75-10-701(4)(a)(ii) MCA) may be more appropriate than "formal geographic boundaries." ARCO and ASARCO have not completed the RI/FS that will delineate the UBMC facility boundaries.

  RESPONSE: The suggested change was made.

- **COMMENT:** Page 2-5, Section 2.4.1, 1st paragraph: The document (including Appendix A) intermingles the terms "domestic use standards," "guidance," and "narrative standards" when referring to the WQB-7 standards for iron and manganese. One term should be used consistently to avoid confusion, and "narrative standards" is the most appropriate term.

  RESPONSE: The terminology used in this document varies depending on the context, although the term "guidance" is the preferred terminology consistent with WQB-7. Nevertheless, some changes were made to provide better consistency.

- **COMMENT:** Page 4-13, Section 4.4.3, Mike Horse Creek Drainage, 1st paragraph, 4th sentence: The USFS/ASARCO ongoing negotiations only impact the Lower Mike Horse Creek Mine Waste because of its location on USFS property. The Upper Mike Horse Seepage Area reclamation activities are located on ASARCO property and, therefore, are currently bound by the 2004 deadline as outlined in Table 4-1 (Appendix B) of the

Temporary Water Quality Standards for the Upper Blackfoot Mining Complex. Please revise to reflect this difference in ownership.

RESPONSE: This sentence has been removed since it is not a critical component of this plan.

- **COMMENT:** Page 5-9, Section 5.3.2.1, 1st paragraph, 2nd sentence and Page 5-12, Section 5.3.3.2, 1st paragraph, 1st sentence: Please change "downstream boundary of UBMC" to "UBMC mine reclamation program boundary under the Implementation Plan." DEQ's Remediation Division has not established a facility boundary at the UMBC.

  RESPONSE: The term "UBMC Implementation Plan boundary" has been applied to address this concern throughout the document.

- **COMMENT:** Page 5-11, Section 5.3.2.1, last bullet, 3rd sentence: For clarification, please note that only portions of the Paymaster Voluntary Cleanup Plan were approved by DEQ. A number of issues including groundwater and its impacts to Paymaster Creek still remain unresolved.

  RESPONSE: An additional sentence reflecting this note has been added to the above referenced section.

- **COMMENT:** Page 5-12, Section 5.3.3.2, 2nd paragraph, 1st sentence: Please note that this information, as it pertains to CECRA, establishes portions of the Blackfoot River downstream from Pass Creek as part of the UBMC. Please refer to Specific Comment 1.

  RESPONSE: A sentence has been added to Section 5.3.2.2 to reflect this fact.

- **COMMENT:** Appendix D, Page 6-5, Section 2.2, 1st paragraph: As a result of the new Brownsfields legislation, it is doubtful there will be an MOA and therefore, the current draft is moot. Please delete this paragraph.

  RESPONSE: The paragraph has been removed.

13) EDITORIAL COMMENTS: There were a number of minor technical, regulatory, and editorial corrections where changes to the document were made as suggested.

14) COMMENT (no response required): This document is very well written and easy to read. Excellent job!