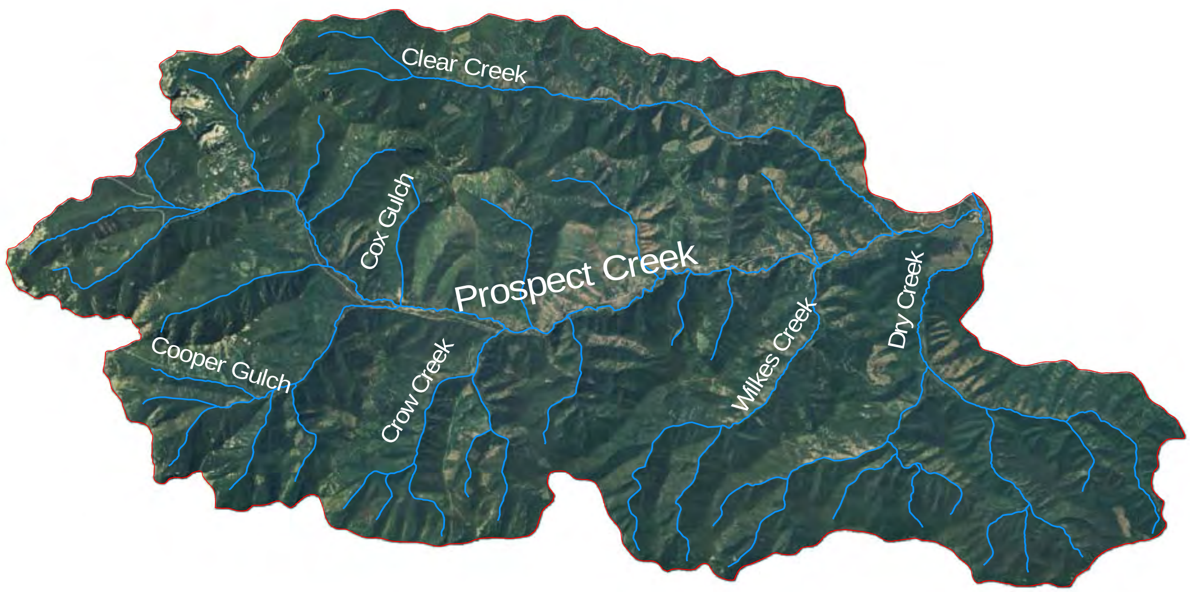
TOTAL MAXIMUM DAILY LOADS FOR METALS IN PROSPECT CREEK WATERSHED
SANDERS COUNTY, MONTANA



October 2006

Montana Department of
ENVIRONMENTAL QUALITY

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Table of Contents

List of Figures

List of Tables

EXECUTIVE SUMMARY

A TMDL is the maximum amount of a particular pollutant that a water body can assimilate without causing applicable water quality standards to be exceeded. Section 303 of the Federal Clean Water Act and Section 75-5-703 of the Montana Water Quality Act require TMDLs be developed for water bodies that are not meeting State water quality standards (impaired waters). Section 303(d) of the Clean Water Act requires states develop a list of impaired water bodies or stream segments (known as a 303(d) list) for submittal to the U.S. Environmental Protection Agency (U.S. EPA) every two years for review. A number of stream segments in the Prospect Creek Watershed, located in Sanders County, Montana, have been identified on the State's 303(d) list as impaired due to elevated concentrations of metals. This document presents a water quality assessment and total maximum daily loads (TMDLs) for metals-related impairment in Prospect Creek Watershed, Sanders County, Montana. This report compliments a separate study and pending report addressing development of TMDLs for nonmetals-related water quality impairment in Prospect Creek Watershed.

Three stream segments, or water bodies, in the Prospect Creek Watershed are listed as impaired due to metals on the Final 2004 303(d) List prepared by MDEQ. The three stream segments are:

1. Prospect Creek from the headwaters to the mouth;
2. Antimony Creek from the headwaters to the mouth;
3. Cox Gulch from the headwaters to the mouth.

Information provided in this report confirms that these water bodies are impaired due to elevated metals concentrations, and are in need of TMDL development for metals. Identified or suspected sources of metals-impairment in the drainage include:

- The U.S. Antimony Corp. facilities, an operating metallurgical plant and inactive underground mine located in the vicinity of Cox Gulch and Antimony Creek;
- Historic mining disturbances located throughout the watershed; and
- Possible natural background sources associated with exposed mineralized bedrock or recharge of mineralized ground water to area streams.

The Prospect Creek Watershed water quality restoration targets, TMDLs, and Load/Waste Load Allocations are summarized in Table E-1. The restoration targets are the water quality targets, or goals, deemed necessary for attainment of water quality standards in the impaired water bodies. The restoration targets are primarily based on numeric water quality criteria for specific impairment-causing metals in each water body, adjusted for water hardness where applicable. In addition, two general restoration targets addressing metals concentrations in stream sediments and protection of biological communities are assigned to each water body. The metals TMDLs are presented as loading equations allowing calculation of the maximum allowable load of a specific metal based on the streams assimilative capacity at any time and under any conditions (Table E-1). Defining the metals TMDLs in this way accounts for the seasonal variability in the streams assimilative capacity, or TMDL, due to varying streamflow and water hardness conditions.

A Source Area and Source Category approach was utilized for metals load allocation for the Prospect Creek Watershed. The Source Area and Source Category approach allows the TMDLs to be allocated among known and/or suspected sources of metals impairment, while accounting for uncertainties inherent to the watershed-wide source assessment and TMDL development process. The Source Category allocation strategy was used in Cox Gulch and Antimony Creek, with the entire load allocation applied to historic mining and background sources, plus, in the case of Cox Gulch, sources associated with the U.S. Antimony Corporation facilities. The Source Area allocation approach was utilized for Prospect Creek, with the entire load allocation applied to three specific source areas: Antimony Creek drainage, Cox Gulch Drainage, and the remainder of Prospect Creek drainage (further divided into three sub-source areas). In all cases, the waste load allocation is zero since there are no point source discharges of metals regulated under the Montana Pollutant Discharge Elimination System permitting program in Prospect Creek Watershed. Also, no load is specifically allocated for the Margin of Safety since the Margin of Safety is handled implicitly in development of the Prospect Creek Watershed TMDLs.

It is recognized 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 /or natural background sources or metals loading. For this reason, an adaptive management approach is specifically identified for all metals targets within the drainage. Any modification to targets would then require a consistent modification to the allocations developed to meet the targets.

A Restoration Strategy is presented outlining actions and opportunities to be pursued to ensure compliance with the prescribed TMDLs and load allocations. Restoration strategies for the U.S. Antimony facilities rely on reclamation and water quality protection requirements stipulated in the USAC operating permit, which include, among others:

- Following facility shutdown, the remaining tailings impoundments will be capped with synthetic liners and three feet of soil, and revegetated.
- Monitoring, and if necessary, water treatment will be sustained until all water quality standards have been met or until calculated pre-mining baseline has been reached.

A number of regulatory programs and mechanisms are outlined as potential means for restoration of historic mining sources, including the Montana Mine Waste Cleanup Bureau Abandoned Mine Reclamation Program, and the Montana Comprehensive Environmental Cleanup and Responsibility Act (CECRA). An environmental monitoring strategy is also presented for the purpose of evaluating the effectiveness of future restoration efforts in meeting the TMDL targets and goals, and to further quantify metals-related impairment conditions and sources in the watershed, if necessary. Finally, an Adaptive Management Strategy is presented outlining procedures to be followed should attainment of the restoration targets prove impractical due to the potential presence of non-controllable human-caused sources and/or natural background sources of metals loading in Prospect Creek Watershed.

Table E-1. Prospect Creek Watershed Metals TMDL Summary Information.

Metals-Impaired Water Bodies[1]	**Metals Impairment Causes**	**Water Quality Restoration Goal**	**TMDL**	**Allocations (Load Allocations; Wasteload Allocations)**	**Supporting Documentation** (not an exhaustive list of supporting documents)
Prospect Creek 18.9 miles	Antimony	≤ 6 µg/L (all flows)	Presented as loading equation based on water body assimilative capacity, restoration target (corrected for hardness where applicable), and streamflow: **TMDL=** *X µg/L)(Y cfs)(0.0054) Where X = applicable water quality numeric standard (target); y=flow; 0.0054=conversion factor*	Source Area Allocation Approach: Load Allocations: 100% of the load is allocated to three source areas, each representing a separate load allocation. These source areas are "Antimony Creek Drainage", "Cox Gulch Drainage", and "Remainder of Prospect Creek Drainage"; all loading reductions are to come from mining related sources to achieve the standard unless further study shows that this is not a reasonable expectation (part of adaptive management) WLA=0 MOS addressed implicitly	"United States Antimony Corp., 1999 Plan of Operations and Reclamation Plan, Operating Permit 00045A. Prepared for MDEQ, Hard Rock Mining Bureau" "The Effects of U.S. Antimony's Disposal Ponds on an Alluvial Aquifer and Prospect Creek, Western Montana. University of Montana Department of Geology Project # G-853-03"
	Lead	≤ 0.54 µg/L all flows			
	Zinc	≤ 37 µg/L (all flows)			
	All metals	Metals concentrations in stream sediments must not impede aquatic life use support or other beneficial uses. Periphyton and macroinvertabrate communities must be comparable to those for reference conditions for metals indicators using standard MDEQ protocol and impairment criteria.			
Antimony Creek 2.0 miles	Antimony	≤ 6 µg/L (all flows)	Presented as loading equation based on water body assimilative capacity, restoration	Source Category Allocation Approach Load Allocation: 100% allocated to combined	"United States Antimony Corp., 1999 Plan of Operations and Reclamation Plan, Operating Permit 00045A.
	Arsenic	≤ 18 µg/L (all flows			
	Lead	≤0.54 µg/L high flows; ≤1.3 µg/L low flows:			

Table E-1. Prospect Creek Watershed Metals TMDL Summary Information.

Metals-Impaired Water Bodies[1]	**Metals Impairment Causes**	**Water Quality Restoration Goal**	**TMDL**	**Allocations (Load Allocations; Wasteload Allocations)**	**Supporting Documentation** (not an exhaustive list of supporting documents)
	All metals	Metals concentrations in stream sediments must not impede aquatic life use support or other beneficial uses. Periphyton and macroinvertabrate communities must be comparable to those for reference conditions for metals indicators using standard MDEQ protocol and impairment criteria.	target (corrected for hardness), and streamflow: **TMDL=** *X µg/L)(Y cfs)(0.0054)* *Where X = applicable water quality numeric standard (target); y=flow; 0.0054=conversion factor*	"historic mine" and "background" source categories; all loading reductions are to come from mining related sources to achieve the standard unless further study shows that this is not a reasonable expectation (part of adaptive management) WLA=0 MOS addressed implicitly	Prepared for MDEQ, Hard Rock Mining Bureau" "The Effects of U.S. Antimony's Disposal Ponds on an Alluvial Aquifer and Prospect Creek, Western Montana. University of Montana Department of Geology Project # G-853-03"
Cox Gulch 3.0 miles	Antimony	≤ 6 µg/L (all flows)	Presented as loading equation based on water body assimilative capacity, restoration target (corrected for hardness), and streamflow: **TMDL=** X µg/L)(Y cfs)(0.0054) *Where X = applicable water quality numeric standard (target); y=flow; 0.0054=conversion factor*	<u>Source Category Allocation Approach</u> Load Allocation: 100% allocated to combined "historic mine", "U.S. Antimony Corp" and "background" source categories; all loading reductions are to come from mining related sources to achieve the standard unless further study shows that this is not a reasonable expectation (part of adaptive management) WLA=0 MOS addressed implicitly	"United States Antimony Corp., 1999 Plan of Operations and Reclamation Plan, Operating Permit 00045A. Prepared for MDEQ, Hard Rock Mining Bureau" "The Effects of U.S. Antimony's Disposal Ponds on an Alluvial Aquifer and Prospect Creek, Western Montana. University of Montana Department of Geology Project # G-853-03"
	Lead	≤ 0.54 µg/L all flows			
	All metals	Metals concentrations in stream sediments must not impede aquatic life use support or other beneficial uses. Periphyton and macroinvertabrate communities must be comparable to those for reference conditions for metals indicators using standard MDEQ protocol and impairment criteria.			

1-All three water bodies included on the State's Section 303(d) list of water bodies in need of TMDLs for metals; metals impairment confirmed through TMDL development process.
All metals targets are based on total recoverable fraction.

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 (U.S. 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 water bodies appearing on the 303(d) list as impaired or threatened (MCA 75-5-703) by a pollutant.

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 numeric and narrative criteria 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 a required load reduction. TMDLs account for loads from point and nonpoint sources in addition to natural background sources, and are presented within water body or watershed specific documents that provide the technical details necessary for TMDL development, as well as future implementation and monitoring recommendations.

This document provides the Total Maximum Daily Loads (TMDL) for metals impairments in the Prospect Creek watershed. The overall goal of this document is to identify a scientifically valid approach to improve water quality to a level where beneficial uses are not impaired by metals for all water bodies in the watershed, and to ensure that Montana's metals-related water quality standards are not violated. Non-metals-related causes of water quality impairment in the watershed (e.g., siltation, habitat alterations) are addressed in a separate Water Quality and Habitat Restoration Plan/TMDL. This document was prepared based on existing information including existing water quality data, review of relevant reports and MDEQ files, and discussion with individuals knowledgeable about the Prospect Creek watershed. No new data collection was undertaken for preparation of this TMDL document.

The remainder of this introduction describes issues intrinsic to the TMDL development process including: water quality standards applicable to Prospect Creek and it's tributaries, with focus on metals related standards; 303(d) listing information; and general sources of metals-related water quality impairment.

1.1 Applicable Water Quality Standards

Montana surface water quality standards, including water body classifications, designated beneficial uses, and numeric and narrative standards are established in Title 17, Chapter 30, subchapter 6 of the Administrative Rules of Montana (ARM 17.30.600 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. Appendix A provides a more detailed summary of the applicable metals related standards for the Prospect Creek Watershed.

1.1.1 Numeric and Narrative Water Quality Standards

As discussed in Appendix A, WQB-7 lists numeric water quality standards for protection of aquatic life uses and human health. For most metals, aquatic life standards are established for both acute and chronic conditions, with the chronic standard usually lower than the acute standard (although for some metals the two are equal). Conversely, for some metals there is only a chronic standard (i.e., iron), or only an acute standard (silver). While the water quality standards state that the acute aquatic life standard may not be exceeded in B-1 classified waters at any time, the chronic aquatic life standard 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 life standard (MDEQ, WQB-7, Footnote 4). Following are some notes regarding the application of the WQB-7 water quality standards toward the development of TMDL targets within Section 4.1 of this document.

- Based on the B-1 classification - designated beneficial uses (Appendix A), both the human health standard and aquatic life standard apply to surface waters within Prospect Creek watershed. When evaluating impairment conditions and establishing TMDL targets in this plan, water quality data were compared to either the aquatic life standard or human health standard, whichever was lower (more protective).
- When comparing in-stream metal concentrations to the aquatic life standards, the more stringent chronic aquatic standard (as opposed to the acute standard) was used. Lacking detailed metals concentration trends over any 96-hour or longer period in Prospect Creek watershed, the application of the chronic standard assumes that metal concentrations in any one water sample are 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, such as for Antimony Creek, stream water hardness decreases significantly with increasing flow during spring runoff, resulting in lower applicable aquatic life standards during spring runoff periods. To account for this, example restoration targets are established for both high flow and low flow periods for Prospect Creek, Antinomy Creek, and Cox Gulch to help ensure that these goals will be protective of designated beneficial uses under various hydrologic conditions. In addition to the numeric water quality standards included in WQB-7, narrative water quality standards for B-1 classification waters are included in various sections of the Administrative Rules of Montana. Narrative water quality standards utilized in development of this TMDL, along with certain definitions, are included in Appendix A.

1.1.2 Stream Sediment Metals Criteria

Similar to the water column, elevated metals concentrations in stream sediments can negatively impact aquatic life uses (and other beneficial uses) in surface water, and thus contributes to water quality impairment. Elevated metal concentrations in stream sediments can also be an indicator of more severe water quality impacts that may occur under conditions when metals are released from the sediment. Unlike surface waters, no standards in WQB-7 currently exists 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 TMDL targets (Section 4.1), sediment chemistry results in a given stream must be compared to published guidance values prior to concluding that a stream is not impaired due to metals, as discussed in Appendix A. Although no sediment chemistry data is available for the metals impaired streams in the Prospect Creek watershed, the following describes how the sediment chemistry target is to be applied in conjunction with the other targets. Where water column chemistry and/or biological results show an impairment condition, then the sediment chemistry results can be used to help define the level of impairment and metals of concern. If water column metals (both high and low flow conditions) and biological results (two assemblages that are sensitive to metals impacts, e.g. periphyton, macroinvertebrates, or fish.) do not indicate an impairment condition, then it can be concluded that the water body is not impaired by metals even if some sediment metals concentrations are greater than published guidance values. In such cases however, additional investigation may be warranted to determine if the elevated metals concentrations are an indication of upstream metals-loading sources and potential upstream impairments. Under this scenario, it may be concluded that more data is needed in the upper segments of the watershed to verify that metals do not impact beneficial uses. Additional collection of data further upstream in close proximity to potential metals-loading sources should be pursued under these conditions. Data collection should include biological (e.g., both periphyton and macroinvertebrate) and water column chemistry sampling. The type and extent of sampling required should be based on the extent to which the sediment metals concentrations exceed published guidance values, the presence and estimated severity of upstream loading sources, watershed characteristics, and the availability of relevant data throughout the watershed.

1.2 303(d) Listing and Metals of Concern

An impaired water body is a water body that does not meet state water quality standards. The Water Quality Standards include designated beneficial uses, which are the goals for the water body, and numeric and narrative criteria to protect beneficial uses. 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 (U.S. EPA) every two years. The 303(d) list records the beneficial uses that are impaired and the probable causes (i.e., the pollutant such as metals) and the probable sources of the impairment (such as mining or roads). In the interim between published 303(d) lists, additional data may be collected or supplied to the MDEQ that provides relevant and valid information which can lead to changes in impairment status, probable causes listing, or probable sources listing for a particular water body.

Montana’s 2004 303(d) List (MDEQ, 2004b) is the most current U.S. EPA-approved list and is based on a higher level of scientific analyses in comparison to past 303(d) lists (1998 and older). 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 the MDEQ to address each pollutant (probable cause) and water body combination identified in the 1996 list or any subsequent lists. The exception to writing a TMDL is where supplemental data and assessment work has determined that the water body is in fact not impaired for the pollutant of concern.

Three stream segments within the Prospect Creek Watershed have metals listed as the probable cause of impairment in the Final 2004 Water Quality Integrated Report prepared by the Montana Department of Environmental Quality (MDEQ) for the U.S. Environmental Protection Agency (U.S. EPA). The three stream segments are:

1. Prospect Creek from the headwaters to the mouth;
2. Antimony Creek from the headwaters to the mouth; and
3. Cox Gulch from the headwaters to the mouth.

Antimony Creek and Cox Gulch are both tributaries to Prospect Creek. The three listed stream segments are shown on Figure 1-1 and 303(d) listing information is summarized in Table 1-1 below. Note that all three streams are identified with metals impairments on the 2004 303(d) List. TMDL development needs associated with Probable Causes other than metals (as shown in Table 1-1) are being addressed through a separate planning effort. This other TMDL information will be incorporated into a separate document.

Table 1-1. Prospect Creek Watershed 303(d) Listing Information.

303(d) List	Streams Listed	Beneficial Uses not Fully Supported or Threatened	Probable Causes[1]	Probable Sources
1996	Prospect Ck	Coldwater fishery	Flow alterations; Other habitat alterations; Thermal modifications	Agriculture; Silviculture;
2002	Prospect Ck 18.9 miles	Aquatic life support; Coldwater fishery; Drinking Water Supply	**Metals**; Other habitat Alterations; Salinity/TDS/Sulfates	Agriculture; Silviculture; Resource extraction (mill tailings)
2004	Prospect Ck 18.9 miles	Aquatic life support; Coldwater fishery; Drinking Water Supply	**Metals;** Other habitat alterations	Agriculture; Silviculture; Resource extraction (mine tailings)
	Antimony Ck 2 miles	Aquatic life support; Coldwater fishery; Drinking Water Supply	**Metals -Arsenic, Lead**	Resource extraction (mill tailings)
	Cox Gulch 3 miles	Agriculture; Aquatic life support; Coldwater fishery; Drinking Water Supply	**Metals -Lead**	Resource extraction (mill tailings)

1 – Arsenic and lead are "sub-causes" under the metals "cause" category

The information provided in Table 1-1 suggests that all three water bodies listed are in need of TMDL development for metals-related impairment. A detailed assessment of the current status of metals-related water quality impairment in Prospect Creek watershed is provided in Section 3.1. This detailed assessment, based on a review of all available relevant information, confirms and validates the water quality impairment status information for metals presented in Table 1-1.

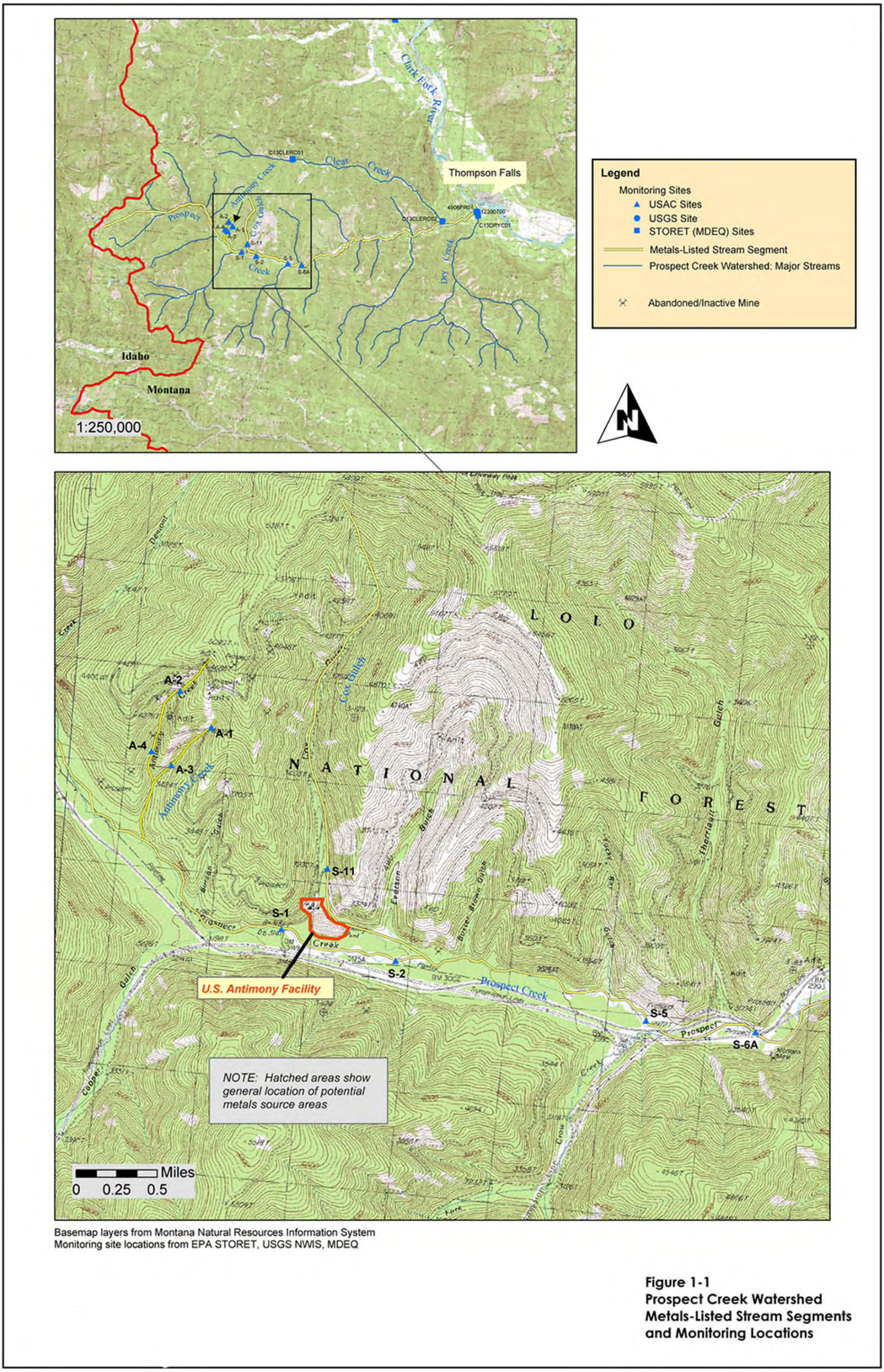

Figure 1-1. Prospect Creek Watershed Metals Listed Stream Segments and Monitoring Locations.

1.2.1 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 standard in Antimony Gulch, Cox Gulch, and Prospect Creek. Specific metals exceeding the numeric water quality standard in one or more of the stream segments include antimony, arsenic, lead and zinc. Section 3.1 provides a detailed assessment of metals-related water quality impairment in Prospect Creek watershed.

1.3 General Sources of Metals-Related Impairment

Three general potential sources of metals-related water quality impairment have been identified in Prospect Creek watershed. The sources include historic mining activities dating back to the late 1800s, recent mining and metals processing activities conducted by U.S. Antimony Corporation, and natural background loading.

Historic mining activity is evident throughout the Prospect Creek watershed and especially in Antimony Gulch and Cox Gulch. Figure 1-1 shows the abundance and distribution of mine prospects and adits throughout the watershed. Mining activity began in the watershed in the late 1800s with relatively minor production in the early years. Mining activity increased during World War I and again during World War II. Although a detailed accounting of historic mining activity in the watershed is not available, all historic activities have been underground and focused on development of antimony ore in the form of stibnite (antimony sulfide).

U.S. Antimony Corporation (USAC) operates an antimony mining and milling facility in Prospect Creek watershed near the mouth of Cox Gulch (Figure 1-1). USAC began operations in 1970 with the reopening of the Stibnite Hill underground mine. Mining operations continued until 1983 concurrent with operation of a flotation mill and metal refining operation. Although mining ceased in 1983, USAC currently operates a furnace for production of antimony oxides from imported antimony concentrate. Previous studies (Woessner et al., 1985) identified three tailings impoundment associated with the USAC operation acting as sources of metals contamination to shallow ground water and surface water in the vicinity of the plant at the time of that investigation (the one unlined impoundment cell has since been reclaimed). The USAC operation is described further in Section 2.0.

Although documentation has not been obtained, natural background loading of antimony (and possibly other metals) is a clear possibility in Prospect Creek watershed. As discussed in the Stibnite Hill Mine Plan of Operations (USAC, 1999), stibnite veins occur at or near the surface throughout Antimony Creek and Cox Gulch drainages. The veins are known conduits for ground water flow, as many vein locations are marked by the presence of springs. Also, many veins are reported to contain arsenic “blooms”, a green arsenic oxide mineral. The presence of oxide minerals suggests that oxidation of the sulfide ore has occurred, which typically is accompanied by natural leaching of metals to the environment. Although a detailed evaluation of natural water chemistry in Prospect Creek watershed is beyond the scope of this document, the above information suggests that some level of background loading of antimony and possibly other metals may be occurring in Prospect Creek watershed, and especially in Antimony Creek and Cox Gulch.

1.4 Document Organization

The remainder of this document is devoted to characterization of metals-related impairment and TMDL planning in Prospect Creek watershed.

- Section 2.0 includes a description of the Prospect Creek watershed (Watershed Characterization).
- Section 3.0 includes a compilation of available data, and a water quality impairment status update.
- Section 4.0 describes development of restoration targets, TMDLs, and load allocations.
- Section 5.0 includes a restoration strategy for metals-related impairment in Prospect Creek watershed. 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 5.0 also includes recommendations for additional environmental monitoring intended to provide information to further refine beneficial use support determinations, and for more detailed source area delineation and load allocations where detailed data is currently lacking. Section 5.0 also outlines a monitoring strategy 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 Prospect Creek watershed. Appendix A also details the relevant standards and applicable criteria for metals in the Prospect Creek watershed. Readers likely will benefit by reviewing Appendix A prior to reading Section 3.0.
- Appendix B contains all available metals-related water quality data from the drainages of interest. This data was used to document the current status of metals-related impairment in the watershed, in development of the TMDLs, and in water quality restoration planning.
- Appendix C provides supporting information for the restoration strategy.
- Appendix D includes a preliminary environmental monitoring plan designed to further define metals impairment conditions and restoration needs in Prospect Creek watershed.
- Appendix E provides source assessment and loading analysis.

SECTION 2.0
WATERSHED CHARACTERIZATION

This watershed characterization is taken largely from that prepared by River Design Group for the Prospect Creek sediment and habitat TMDL and habitat restoration plan currently in preparation.

2.1 Watershed and Subbasin Location

The Prospect Creek watershed drains 182 square miles (108,160 acres) located on the eastern face of the Bitterroot Mountains. Draining northeast from its headwaters near the Montana-Idaho border, mainstem Prospect Creek (a fifth order stream) joins the Clark Fork River at Noxon Reservoir 0.5 miles from the town of Thompson Falls in Sanders County, Montana (Figure 1-1). The planning area comprises the entire Prospect Creek 5th Hydrologic Unit Code (17010213) in the Lower Clark Fork Watershed in the Columbia Basin.

2.2 Land Ownership

The U.S. Forest Service is the dominant landowner in the Prospect Creek watershed, with private landowners owning a fraction of the overall watershed area (Table 2-1). Private land is primarily located in the valley bottoms adjacent to the stream corridor.

Table 2-1. USFS Land Ownership Summary for the Prospect Creek Watershed (from USFS 2000).

6th Code HUC	FS Ownership (mi^2)	Percent of HUC in FS Ownership
Clear Creek	26.3	91.9
Cooper Creek	15.7	99.4
Crow Creek	14.7	99.5
Dry Creek	32.7	91.4
Lower Prospect	36.5	90.6
Upper Prospect	29.2	98.6
Wilkes Creek	15.2	96.0

2.3 Geology and Soils

The geology of the area is characterized by Belt series metasedimentary rock of middle Proterozoic age (Woessner and Shapley, 1985; USAC, 1999). Major rocks are comprised of quartzite, siltite, and argillite. Surficial deposits of glacial till, outwash, and lacustrine sediments mantle the underlying bedrock. Overlying loess is influenced by volcanic ash delivered by the eruption of Mt. Mazama in southwestern Oregon approximately 6,800 years ago.

Bedrock in the vicinity of Antimony and Cox Gulch has been folded into an anticline with the axis coincident with Cox Gulch drainage. The Thompson Pass fault, a right lateral strike-slip fault, traverses the Prospect Creek watershed bottom in the vicinity of Antimony and Cox Gulch.

Economic mineralization in Antimony and Cox Gulch occurs as individual veins ranging from 1 to 15 feet wide within argillite of the Precambrian Prichard Formation. The veins typically extend for considerable distances and generally strike N 30° E and dip 20° to 25° NW. The main mineral of economic interest is stibnite, an antimony sulfide mineral, although antimony also occurs in several other forms. Arsenopyrite, an iron-arsenic sulfide mineral, occurs throughout the veins. Arsenic "bloom," an arsenic oxide mineral, also occurs within the veins (USAC, 1999).

Glaciers occupied tributary valleys in the Lower Clark Fork River basin repeatedly during the Pleistocene Epoch. Unconsolidated rocks in the valley were partly removed and ground up to form a mixture of sandy clay and cobbles, referred to as "till." Underlying the ice, the till was mounded into terraces and plastered against the lower walls. Glacial melt water carried some of the till southward, sorting and depositing it as outwash in the Prospect Creek valley and as deltaic deposits in the waters of glacial Lake Missoula. Lacustrine sediments deposited during the repeated inundations of the Prospect Creek valley by glacial Lake Missoula form a distinctive soil unit (soil type #112) critical to surface water retention in the watershed.

Outwash, material derived from the erosion of till by melt water, forms the coarse-grained deposits comprising terraces in the Prospect Creek watershed. Outwash sorting is a function of the distance between the material's origin and location at the time of settling. Alluvium, defined as material eroded from older rocks and deposited by streams and rivers, is prevalent in the basin. The composition of the alluvium depends on the origin of the eroded material, often times differing between and within subwatersheds as a function of eroded parent materials. Alluvium permeability is dependent on the composition of the parent material and the frequency of clay- and silt-sized particles in the alluvium.

2.4 Climate

The climate of the Prospect Creek watershed is characterized as a combination of modified Pacific maritime and continental climates. Annual precipitation totals vary from about 30 inches along the Clark Fork River Valley to about 60 inches at the highest elevations of the Bitterroot Mountains. The nearest weather station, located at the Thompson Falls Dam Powerhouse, has recorded a long-term average precipitation of 23.07 inches per year (NOAA, 2000). January has the highest monthly average precipitation at 2.75 inches and September has the lowest at 1.2 inches (NOAA, 2000). Temperatures in the area are moderate. During the summer months, minimum (night-time) temperatures are in the 50 to 60 degree Fahrenheit (°F) range. Winter cold waves occur, but mild weather is more common. Temperature and precipitation extremes are more pronounced in the higher elevations of the Prospect Creek watershed relative to the Clark Fork Valley floor.

2.5 Topography

The northwest-southeast trending Bitterroot Mountains are the dominant topographic feature influencing the Prospect Creek watershed. Prospect Creek watershed elevations range from approximately 6,600 feet at the watershed divide, to approximately 2,400 feet at the confluence with the Clark Fork River near Thompson Falls, Montana. The area's topography is a function of the underlying rock types, rock structure, and geologic history.

Alpine glaciation influenced the Prospect Creek watershed similar to other side tributaries in the Lower Clark Fork River watershed. Glacially-derived sediments historically transported by glacial melt water, and more recently by alluvial processes, filled the valley bottom. Reworking of these materials by Prospect Creek shapes and redistributes sediments.

2.6 Hydrography and Hydrology

Bounded by the Bitterroot Mountains, Prospect Creek flows in a northeasterly direction before joining the Clark Fork River at the Noxon Reservoir, just downstream from Thompson Falls Dam. Primary tributaries in the watershed include Dry, Clear, Wilkes, and Crow creeks and Cooper Gulch. Multiple smaller tributaries, or gulches, occur throughout the watershed and generally reflect seasonal intermittency.

The streamflow regime (i.e. timing, magnitude, and duration), and in particular spring runoff, is periodically influenced by rain-on-snow and rain-on-snowmelt events that can occur anytime during the winter months in response to warm air temperatures and rain. Typically, however, the peak flow event occurs in May or early June.

High magnitude flood events have occurred in the Prospect Creek watershed over the past 40 years, most notably in 1974 and 1996. These events were attributed to multiple factors including high snowfall and seasonal precipitation, and rain-on-snow events in the spring.

A stream gaging station has been maintained by the U.S. Geological Survey (#12390700) on Prospect Creek since 1956. Based on the daily records, the mean annual discharge is 244 cfs. A maximum discharge of 5,490 cfs was measured in January 1974. A minimum discharge of 25 cfs was measured on multiple days in February 2001. Recurrence interval flood series flows based on two methods are presented in Table 2-2.

Table 2-2. Estimated Recurrence Interval Flood Series for Prospect Creek.

Recurrence Interval (Years)*	Instantaneous Peak Flow Method (cfs)	USGS Regional Equations (cfs)
$Q_{1.5}$	1,304	1,318
Q_2	1,580	1,441
Q_5	2,310	1,984
Q_{10}	2,681	2,523
Q_{25}	4,893	2,929
Q_{50}	5,167	3,377
Q_{100}	5,629	3,688

* A Q5, for example, is the maximum flow that occurs on average once every 5 years.

Prospect Creek is characterized by both intermittent and perennial flow sections. Stream intermittency may have been exacerbated by extensive sediment deposition linked to the fires of 1889 and 1910 and the large magnitude floods that followed in 1916. During summer when surface flows decrease, Prospect Creek becomes intermittent in multiple reaches of up to 2.5 miles in length (Woessner and Shapley, 1985). Surface flows discharge to the alluvial valley ground water system particularly where valley fill depths are greatest. Ground water recharge to the channel is typically associated with decreasing valley fill depths and/or semi-impermeable soil layers that force shallow ground water to the surface.

2.7 Land Use

Land use in the Prospect Creek watershed has transitioned over time although timber harvest remains a secondary land use in the headwaters of the watershed. Valley bottom land uses include irrigated pasture, grazing, and timber harvest. As of the 2000 Montana census, the population of Sanders County totaled 10,227 people. The largest town in the county, Thompson Falls (population 1,319), is located about 6 miles southeast of Prospect Creek and outside the Prospect Creek watershed. Scattered residential homes exist within the Prospect Creek Watershed and are typically located at an elevation higher than the Prospect Creek floodplain. Other land uses include transportation, recreational hunting and fishing, and off-highway vehicle operation. Table 2-3 and Figure 2-1 include additional land use summary information focused on timber production and continued recreational use of forest roads.

The largest significant land use in the watershed in terms of metals-related water quality impairment is historic and recent mining activities. Mining began in Prospect Creek watershed in the 1860s with development of the Black Jack vein in Antimony Gulch (USAC, 1999). Mining continued on a relatively small scale until World War I when mining activity increased in response to the war effort. Mining activity continued sporadically between WWI and WWII, when mining activity again increased. The largest mine in the district in terms of production is the Stibnite Hill Mine, which is a series of underground mine workings exploiting individual antimony sulfide veins in Antimony and Cox Gulch. U.S. Antimony Corporation purchased the Stibnite Hill Mine in 1969 and developed a milling and metallurgical facility nears the mouth of Cox Gulch (Figure1-1). Mining ended in 1983 at the Stibnite Hill Mine, although processing of imported antimony concentrates continues to this day. None of the historic mines in the Prospect

Creek watershed are included on the State of Montana abandoned hardrock mine priority list (MDSL, 1995).

Table 2-3. Land Use Activities in the Prospect Creek Watershed (USFS, 2000).

6th level HUC[1]	Watershed Area (mi^2)/ Stream Length (mi)	Road Density (mi/mi^2)	Percent Sensitive LTA[2] w/in HUC	Road Density w/in Sensitive LTAs (mi/mi^2)	Percent of Stream with Road w/in 300 ft	Percent of Stream with Road w/in 125 ft
Clear Creek	28.6/51.6	3.8	0	0	34.6	13.1
Cooper Creek	15.8/32.2	1.2	0	0	17.3	6.5
Crow Creek	14.8/28.6	3.5	0.27	3.25	25.4	10.9
Dry Creek	35.8/78.7	0.7	0	0	15.3	6.1
Lower Prospect	40.3/84.7	3.7	1.14	0.11	35.3	15.6
Upper Prospect	29.6/61.2	1.4	0	0	15.5	5.8
Wilkes Creek	15.8/30.6	1.4	0	0	9.7	3.6

[1] Hydrologic unit code – Note: Statistics are represented for the entire HUC which equates to the watershed for the creek of interest, not only the individual creek.
[2] Landtype Association.

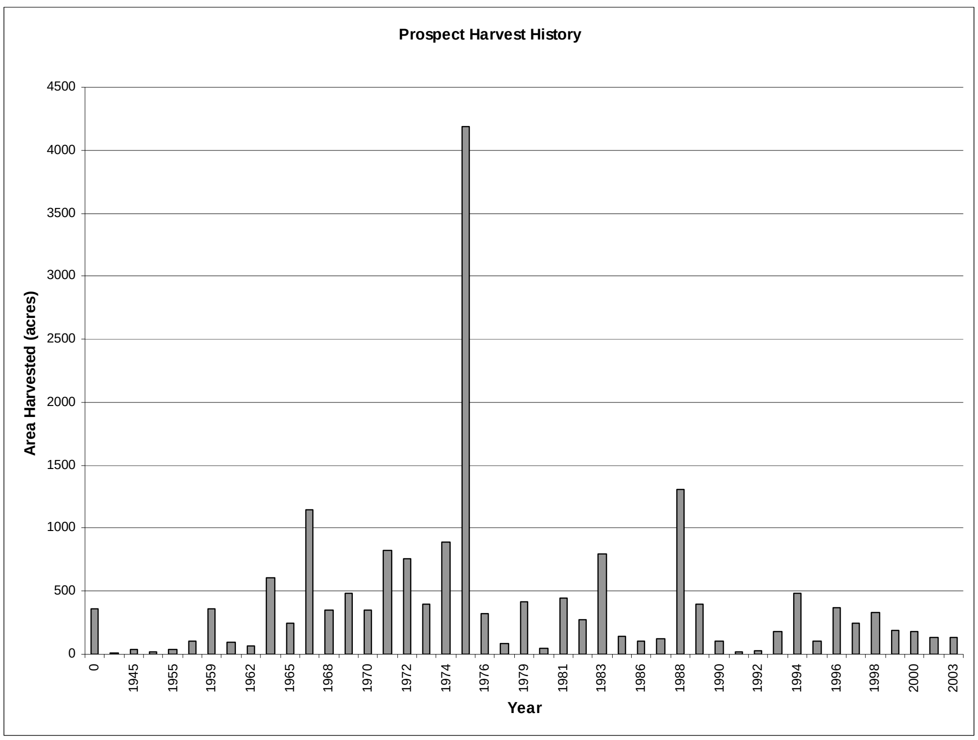

Figure 2-1. Acres of Timber Harvest Activity Recorded for National Forest Land During the Twentieth Century. Peak of Activity in the 1970's is Related to the Salvage Logging After the Tri-Creek Fire of Early 1970's.

2.8 Vegetation Cover

The Lower Clark Fork River basin is identified as a moist forest climate. This region is a transitional zone between drier, lower elevation forests and moister, higher subalpine forests. Moist forest types are characterized by high soil moisture in the spring and drought stress through late summer and early fall (USFS, 2000). Historical vegetation composition for the moist forest type consisted of a mixed seral, shade intolerant species composition comprised of western white pine (*Pinus monticola*), western larch (*Larix occidentalis*), ponderosa pine (*Pinus ponderosa*), and lodgepole pine (*Pinus contorta*).

Natural and human-caused fires have played a role in changing the character of vegetation in the Prospect Creek watershed. The moist forest type was dependent upon a frequent fire return interval to maintain the mixed seral species composition (USFS, 2000). Intense fires in 1889 and 1910 followed by modern fire suppression have resulted in a transition to shade tolerant species and a reduced mixed seral component. Fire suppression has also promoted overstocked stands more prone to intense and severe fires than was historically common.

Vegetation changes have also occurred in response to human activates associated with a variety of land uses including agriculture (grazing, hay production) and timber harvest as discussed above. In particular, land uses have affected the character of the riparian community.

2.9 Stream Geomorphology

The channel morphology of Prospect Creek transitions along a longitudinal gradient from its headwaters along the Montana-Idaho divide to Prospect Creek's confluence with the Lower Clark Fork River. The primary tributaries in the watershed are likewise influenced by the geology, vegetation condition, and historical land uses.

This section provides a generalized overview of channel morphology and existing stream channel conditions in the Prospect Creek watershed. Detailed assessments are presented in an existing document entitled Final Prospect Creek Watershed Assessment and Water Quality Restoration Plan (RDG, 2004), and will be further discussed as part of the ongoing TMDL development addressing other pollutants within the watershed.

Mainstem Prospect Creek is a fourth and fifth order stream, approximately 24 miles long. The stream channel along the mainstem transitions from a steep, confined reach in the upper watershed to moderate to low gradient reaches through most of the middle and lower watershed. Inclusions of braided reaches are found in the middle and lower watershed where channel instability is greatest as a result of land use activities. A few small inclusions of steeper, more confined reaches are found in the lower watershed, particularly the reach immediately above the confluence with the Clark Fork River.

The mainstem Prospect Creek has been subject to both natural and human-caused disturbances dating back to the late 19th century. The combined effects of wildfire, floods, clearing and conversion of riparian vegetation, utility corridor and gas pipeline installation and associated maintenance activities, and highway encroachments have impacted the river corridor. Currently, the middle reaches of Prospect Creek from Clear Creek upstream to Evans Gulch depart from their potential stable state (RDG, 2004). This is reflected in the braided channel condition and altered riparian floristics relative to the historical riparian forest composition.

2.10 Fisheries and Aquatic Life

The Prospect Creek watershed fish community was originally comprised of nine native species, with bull trout (Salvelinus confluentus) and westslope cutthroat trout (Oncorhynchus clarki lewisi) the representative trout species. Introductions of brown trout, rainbow and brook trout in the early twentieth century have likely impacted the native fish assemblage and increased competition for food and habitat among species throughout the watershed. The Prospect Creek watershed is considered core habitat for bull trout (MBTRT, 2000) and was proposed by the U.S. Fish and Wildlife Service (2002) as critical bull trout habitat. Bull trout are federally listed as threatened by the U.S. Fish and Wildlife Service, and classified as a sensitive species by the U.S. Forest Service. Westslope cutthroat trout are recognized by the State of Montana as a Species of Special Concern (Roedel, 1999).

The RDG 2004 document Section 2.8 provides a thorough discussion of fisheries in the Prospect Creek watershed. In addition, the most recent fisheries reports from Avista Corporation (an energy company who maintains and operates nearby hydroelectric dams on the Clark Fork River) presents fish abundance results for 2003 (RDG, 2004).

2.11 U.S. Antimony Corporation Operations

The predominant ongoing activity in Prospect Creek watershed with implications for metals-related water quality impairment is the Stibnite Hill Mine. The Stibnite Hill Mine was discovered in the 1860s with production of the Black Jack vein in Antimony Gulch. Subsequent mining exploited numerous antimony sulfide (stibnite) veins through development of underground workings. Mining activity continued intermittently through the decades with the greatest production occurring during the 1920s and 1940s in support of the war efforts. Mining was focused primarily in Antimony and Cox Gulches on the north side of Prospect Creek watershed.

U.S. Antimony Corporation (USAC) is the current owner and operator of the Stibnite Hill Mine and Mill facilities. USAC began mining operations in Antimony Gulch and Cox Gulch in 1970. USAC developed workings on several different stibnite veins through 22 new or reopened mine adits. USAC produced approximately 7,800 tons of antimony metal between 1970 and 1983, when mining activities ceased.

The Stibnite Hill operation includes ore milling and refining facilities. USAC constructed a 75 ton/day flotation Mill near the mouth of Cox Gulch drainage in the early 1970s for processing antimony ore into concentrate. Three tailings impoundments totaling 12.7 acres were constructed on the alluvial drainage bottom to store the mine tailings effluent from the mill. Tailings ponds 1 and 2 are bentonite lined and have a combined footprint area of 8.1 acres. Tailings pond 3 covers 4.6 acres and was unlined. Approximately 200,000 tons of mill tailings containing 0.1 to 1.0% antimony were placed in the tailings impoundment between the early 1970s and 1983. Woessner and Shapley (1985) conducted an investigation of ground water resources in the vicinity of the

USAC mill facility and concluded that the tailings impoundment was a source of antimony and arsenic detected in downgradient alluvial ground water. Tailings from all three ponds were reclaimed in the late 1990's. Tailings from pond 3 were excavated and placed in ponds 1 and 2, which were then covered with a liner followed by a soil cover which was revegetated. The only unreclaimed area remaining is a storm water pond located between these tailing ponds and the mill/refinery area. There does exist the potential that runoff collected within the storm water pond may leach into the groundwater, however this storm water pond does not have any direct outlet to surface water. This pond is expected to be lined at a later date. The mill has been shut down since 1983 but would resume operation if mining activities resume.

In 1975, a hydrometallurgical batch leach operation was initiated at the site for refinement of antimony concentrates to finished products. The concentrate was leached in a solution water, sodium hydroxide and sodium sulfide to produce sodium antimonite. Waste products included pyrite, arsenopyrite and other secondary minerals and were discarded in the tailings impoundment. An electrowinning circuit was also used for a short period for production of cathode antimony metal from the leach solution, but was discontinued in 1983 due to associated loss of antimony to the environment through this process.

SECTION 3.0
DATA COMPILATION

This section presents a summary of available and relevant water quality data for Prospect Creek and its tributaries. The compiled water quality data are used in this section to document the status of metals-related water quality impairment in Prospect Creek watershed. The Data Compilation and Source Assessment & Loading Analysis (Appendix E) are then used for development of TMDLs and gross load allocations in Section 4.0. In addition, the review of available data and establishment of potential loading sources is used in Section 5.0 as a framework to develop a monitoring program for the watershed intended to more fully define impairment conditions and loading sources.

Tables B-1 through B-12, Appendix B, presents the data compilation results. Surface water monitoring sites identified through review of data provided by MDEQ, as well as searches of U.S. EPA's STORET database and the USGS National Water Information System (NWIS) database, are listed in Table 3-1 and shown on Figure 3-1. Table 3-1 also identifies the period of record for each monitoring site, and indicates which datasets were located in the U.S. EPA STORET system, and/or referenced in MDEQ's Sufficient Credible Data/Beneficial Use Determination (SCD/BUD) data spreadsheet for the Prospect Creek watershed, located on the Montana EnviroNet website at:

http://www.nris.state.mt.us/wis/environet/DataBaseChoice2.html

The primary data source for metals in the Prospect Creek watershed is the U.S. Antimony Corporation (USAC) water quality monitoring program stipulated in the USAC Stibnite Hill Mine Operating Permit. The USAC monitoring program includes Antimony Creek (sites A-1, A-2, A-3, A-4), Cox Gulch (site S-11), and Prospect Creek (sites S-1, S-2, S-5, S-6A) (Figure 3-1). Water quality data from this program provides a good overview of metals concentrations, and water quality standard exceedances in Antimony Creek and Cox Gulch, and in Prospect Creek in the vicinity of the USAC facilities (Figure 3-1). Additional metals data is limited to one sample from site 4906PR01 (the mouth of Prospect Creek) collected in 1974, and two sites on Clear Creek (C13CLERC01 and C13CLERC02) and one site on Dry Creek (C13DRYC01) (both tributaries to Prospect Creek) collected in August 2003 by MDEQ. No metals data is available for the USGS site located at the mouth of Prospect Creek (12390700). Individual sample water quality standard exceedances for metals are shown in Tables B-1 through B-12 and are summarized in Tables 3-2 through 3-4.

Table 3-1. Prospect Creek Watershed Water Chemistry and Field Parameter Monitoring Sites.

	Description	Source of Data/Comments	Data Period	In STORET	In SCD/BUD
A1	Upper east fork Antimony Gulch	USAC	1998-2003	No	Yes
A2	Upper west fork Antimony Gulch	USAC	1998-2003	No	Yes
A3	Lower east fork Antimony Gulch	USAC	1998-2003	No	Yes
A4	Lower west fork Antimony Gulch	USAC	1998-2003	No	Yes
S1	Prospect Creek above USAC mill site at bridge	USAC	1987-2003	No	Yes
S11	Cox Gulch above mill	USAC	1986-2003	No	Yes
S2	Prospect Creek opposite mouth of Everson Gulch	USAC	1995-2003	No	Yes
S5	Prospect Creek above Crow Creek confluence	USAC	1994-2003	No	Yes
S6A	Prospect Creek below Therriault Gulch	USAC	1997-2003	No	Yes
12390700	Prospect Creek at mouth	USGS – no metals data, real-time gage	1982-2003	No	Yes
4906PR01	Prospect Creek at mouth	STORET (MDEQ) – 1974-1991 data, metals in 1974 only	1974-1991	Yes	Yes
C13CLERC02	Clear Creek Lower 200 yds upstream from mouth	STORET (MDEQ) – August 2003	2003	Yes	Yes
C13CLERC01	Clear Creek upper 9.7 mi upstream from mouth	STORET (MDEQ) – August 2003	2003	Yes	Yes
C13DRYC01	Dry Creek 150 yds upstream of Prospect Cr road	STORET (MDEQ) – August 2003	2003	Yes	Yes

NOTE: USAC = data collected by U.S. Antimony Corp.

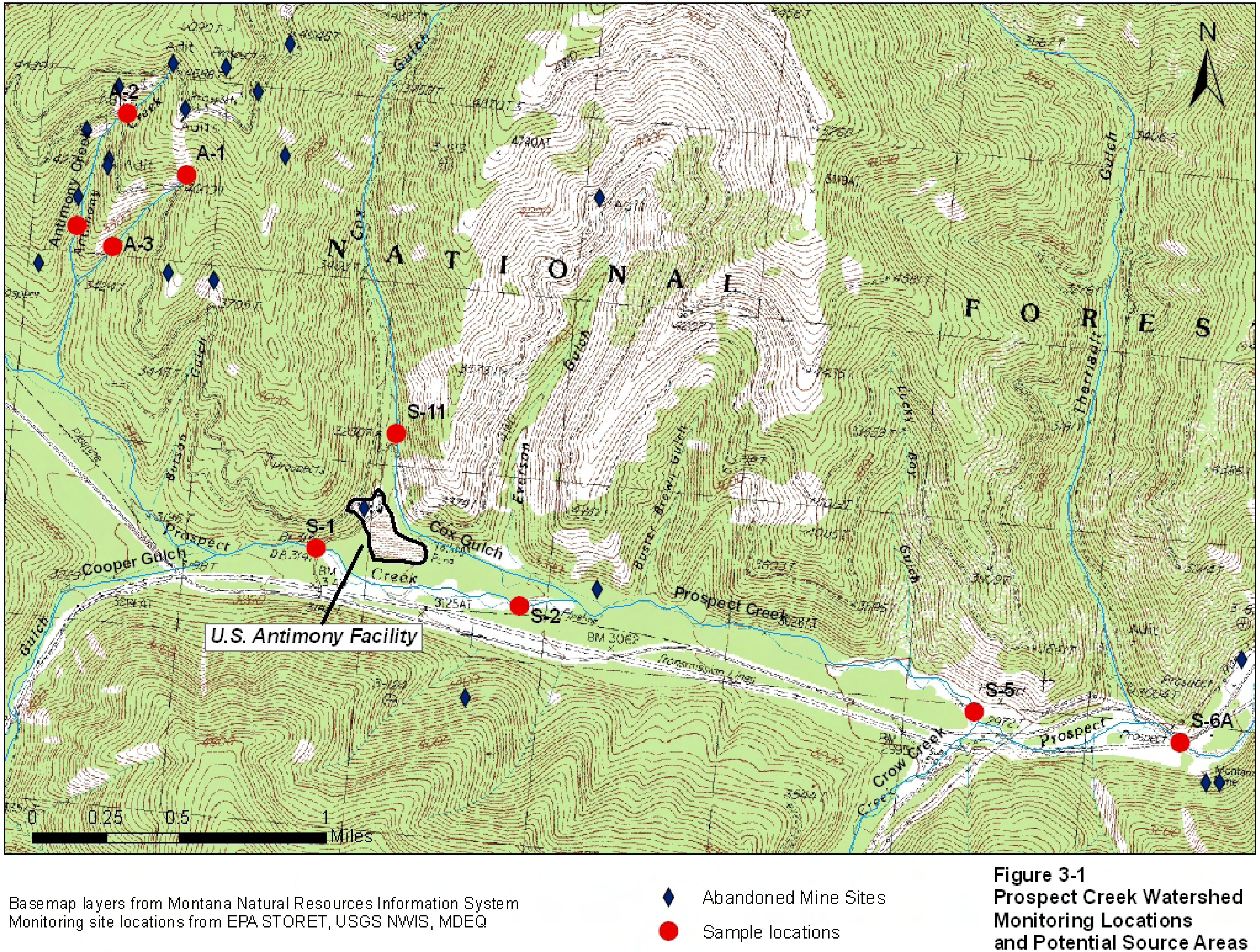

Figure 3-1. Prospect Creek Watershed Monitoring Locations and Potential Source Areas.

Although USAC has been collecting water quality data from Antimony Creek, Cox Gulch, and Prospect Creek in the vicinity of the USAC facilities since the 1980s, much of the earlier data was determined to be of questionable quality and deemed unacceptable for TMDL development purposes. Therefore, based on the known errors and documented data quality issues associated with the USAC monitoring program prior to 1998, only the 1998-2003 data were used for development of this TMDL. The 1998 to 2003 dataset (Appendix B) is believed to provide a current and representative picture of metals-related water quality conditions in Antimony Creek, Cox Gulch, and Prospect Creek in the vicinity of the USAC facility, and forms the basis for subsequent TMDL development. The exception to using the 1998 to 2003 data set is one data point for Prospect Creek (site S5) during a high flow event on April 24, 1997 that shows zinc at 42 µg/L vs. the standard of 37 µg/L. Since there is no other data from a similar high flow event at this site, and limited sediment and aquatic life data in Prospect Creek, a zinc TMDL will still be developed for Prospect Creek. In doing so, the TMDLs provide water quality protection and ensure further sampling that would detect problems in aquatic life or stream sediments from any past elevated values in both streams, or detect high flow zinc concentration problems in Prospect Creek.

The associated Figures 3-2 through 3-5 plot the sampled concentration values versus flow, and compare them to the Montana WQB-7 listed standard. These plots were derived for antimony and arsenic for those streams that have sampled exceedances. Lead and zinc standards are a function of flow and water hardness and therefore prohibit the use of a simple two-dimensional plot (x vs. y axis) to illustrate concentration values above and below their respective standards. “Less than” values indicate that on a specific sampling event, the method used to detect a metal could only determine a concentration to a certain minimum value, and that the sampled value was below that limit. In these cases, for graphing purposes the value was plotted at half the detection limit for that sample (e.g. <6µg/L is graphed at 3µg/L). Some of the monitoring events were completed at times of extremely low flow where actual cfs values were not able to be directly recorded. In such instances, other methods for calculating flow were conducted and then converted to cfs. This is reflected in the values of cfs that appear in the figures that are represented as being less than one. Overall, the tables and figures show that metals standards are not met during both high and low flow seasons, particularly for antimony.

3.2 Antimony Creek Data Summary:

Table 3-2. Antimony Creek Seasonal Metals Impairment Summary.

Metal	Season	N	E_A	E_H	Concentration Range (µg/L)
Antimony Creek					
antimony (Sb)	high flow	20	NA	20	13 to 550
	low flow	39	NA	34	<3 to 1090
arsenic (As)	high flow	20	0	13	<1 to 29
	low flow	39	0	11	<1 to 80
lead (Pb)	high flow	20	1	1	<1 to 18
	low flow	39	2	3	<1 to 60
zinc (Zn)	high flow	12	0	0	<10 to 14
	low flow	22	0	0	<10 to 62

NOTES: N = number of values.
E_A = number of chronic aquatic life standard exceedances.

E_H = number of human health standard exceedances.
NA = Not Applicable; no aquatic life standard exists for antimony.
Antimony Creek: high flow = April through June; low flow = July through March; data from sites A-1 through A-4.

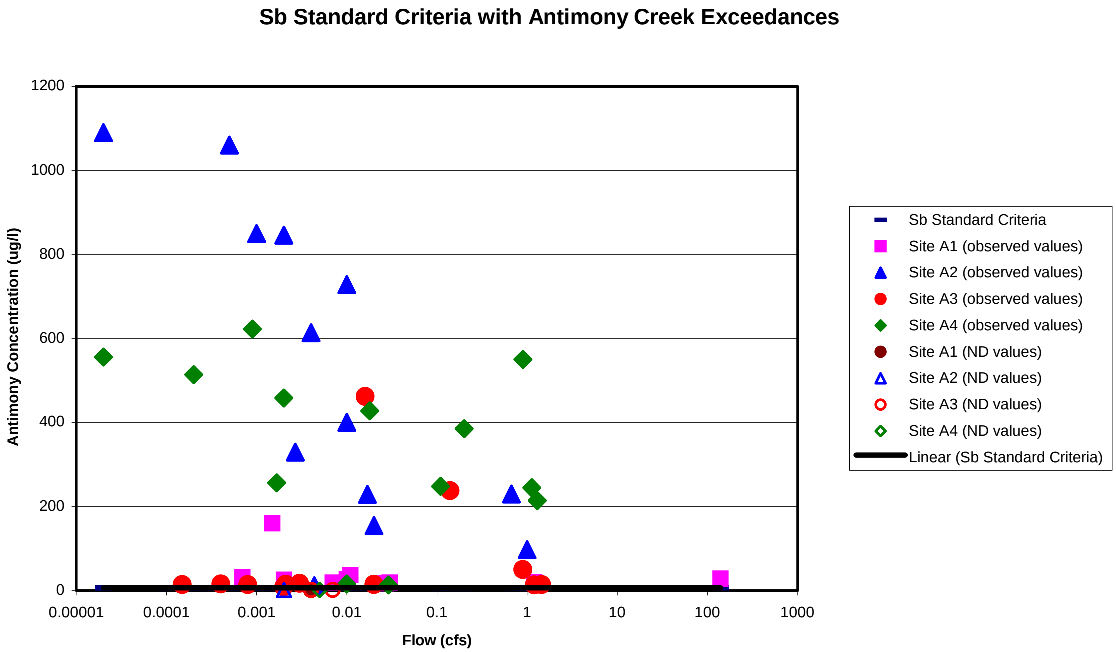

Figure 3-2. Sb Standard Criteria with Antimony Creek Exceedances.

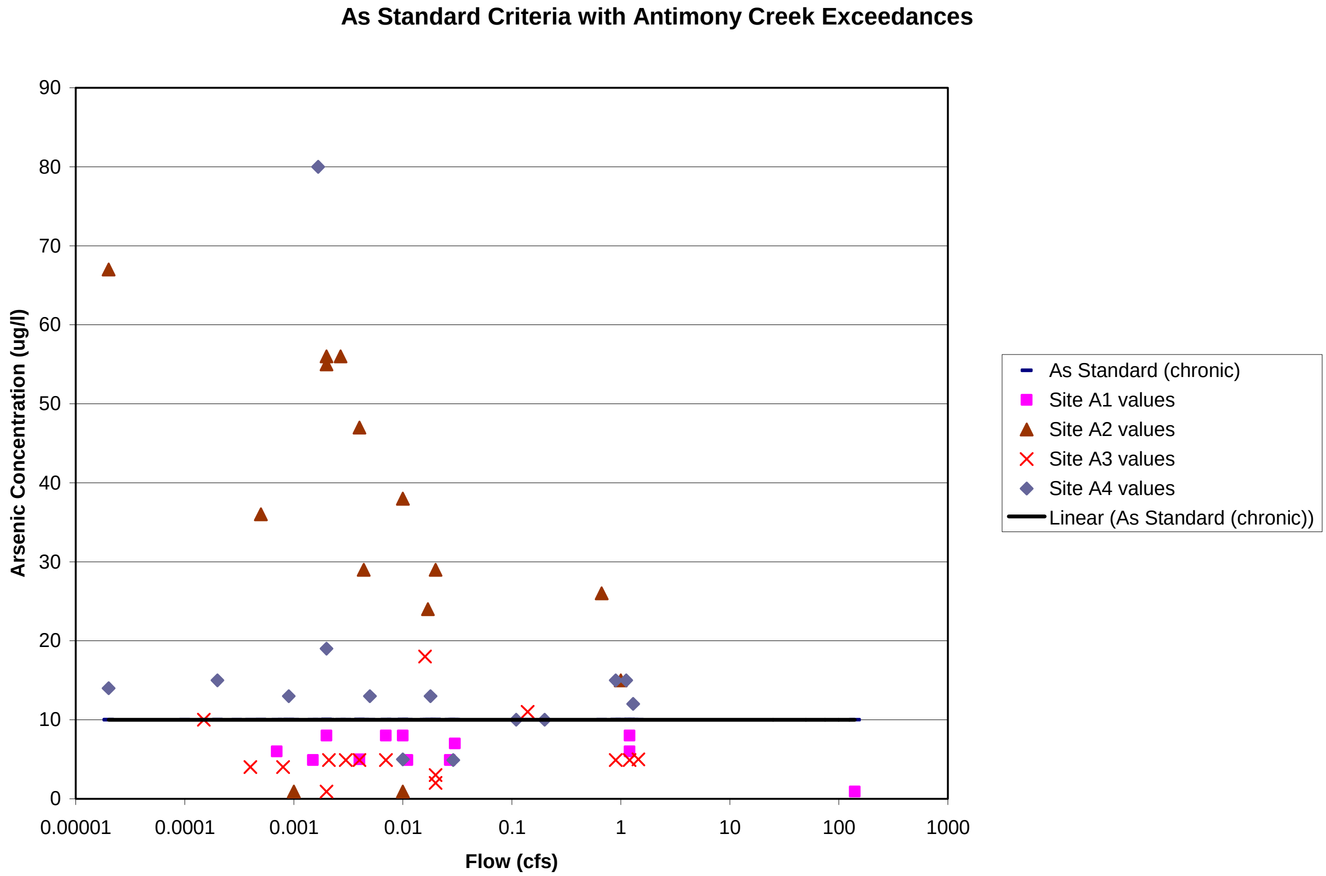

Figure 3-3. As Standard Criteria with Antimony Creek Exceedances.

3.3 Cox Gulch Data Summary:

Table 3-3. Cox Gulch Seasonal Metals Impairment Summary.

Metal	Season	N	E_A	E_H	Concentration Range (µg/L)
Cox Gulch					
antimony (Sb)	high flow	11	NA	2	1 to 15
	low flow	31	NA	6	1 to 22
arsenic (As)	high flow	9	0	0	<1 to <5
	low flow	19	0	0	<1 to <5
lead (Pb)	high flow	7	1	1	<1 to 45
	low flow	13	0	0	<1 to <2
zinc (Zn)	high flow	5	0	0	6 to <20
	low flow	9	0	0	<4 to 34

NOTES: N = number of values.
E_A = number of chronic aquatic life standard exceedances.
E_H = number of human health standard exceedances.
NA = Not Applicable; no aquatic life standard exists for antimony.
Cox Gulch: high flow = April through June; low flow = July through March; data from site S-11.

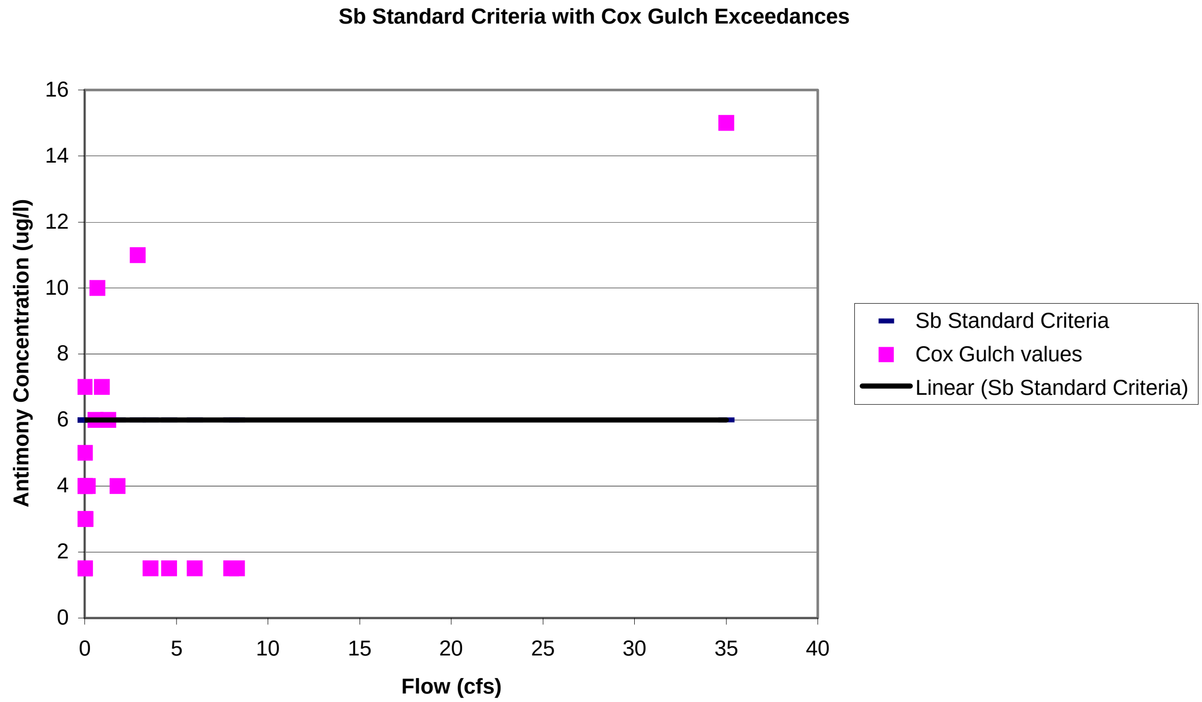

Figure 3-4 Sb Standard Criteria with Cox Gulch Exceedances.

3.4 Prospect Creek Data Summary:

Table 3-4. Prospect Creek Seasonal Metals Impairment Summary.

Metal	Season	N	E_A	E_H	Concentration Range (µg/L)
Prospect Creek					
antimony (Sb)	high flow	64	NA	18	<3 to 31
	low flow	68	NA	11	<1 to 28
arsenic (As)	high flow	50	0	0	<1 to <40
	low flow	38	0	0	1 to <40
cadmium (Cd)	high flow	2	0	0	<0.1 to <0.1
	low flow	10	0	0	0.1 to <0.2
lead (Pb)	high flow	45	4	2	<1 to 40
	low flow	34	2	0	<1 to 3
zinc (Zn)	high flow	34	1	0	<4 to 42
	low flow	23	0	0	<2 to 37

NOTES: N = number of values.
E_A = number of chronic aquatic life standard exceedances.
E_H = number of human health standard exceedances.
NA = Not Applicable; no aquatic life standard exists for antimony.
Prospect Creek: high flow = April through June; low flow = July through March; data from sites S-1, S-2, S-5, S-6A.

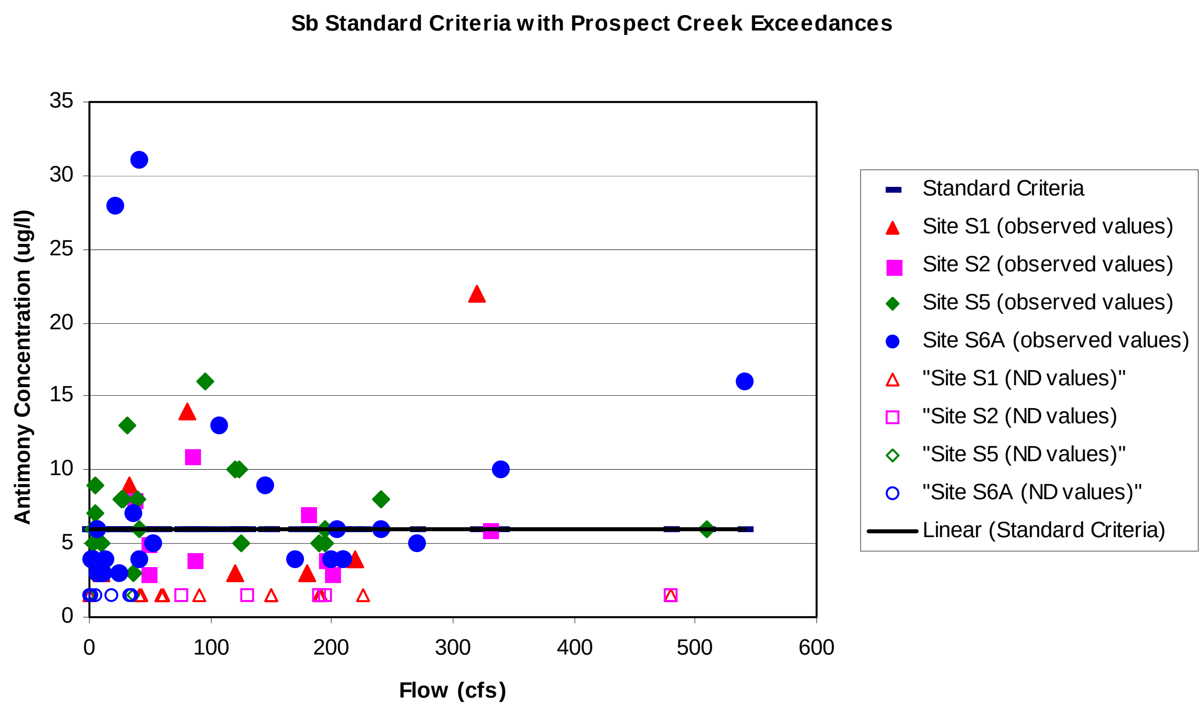

Figure 3-5. Sb Standard Criteria with Prospect Creek Exceedances.

In addition to water chemistry data analysis, assessment of aquatic macroinvertebrate data was conducted by MDEQ staff using the MDEQ Metals Biological Index (MBI) to determine the impact of metals upon the aquatic macroinvertebrate community. This process results in a score between 0 - >5, with 0 - <3 indicating no impairment from metals, and >5 indicating that metals within the stream have a significant and detrimental effect on the ability for metal sensitive species to survive in that environment. The MBI is only one component of a suite of metrics used to assess aquatic macroinvertebrate communities. The compilation and processing of scores from the various metrics provide a rating of overall aquatic macroinvertebrate community diversity and sensitivity to pollution. For the purposes of this TMDL, only the MBI metric was used to provide a general indication of the presence or absence of metal sensitive species.

Aquatic macroinvertebrate data from Prospect Creek, Crow Creek, Cooper Creek, and Dry Creek were analyzed using the MBI. The results of the MBI for all locations and sampling events received a score of <3, which indicate that metals are not having an influence on the aquatic macroinvertebrate community. This is not surprising given that Dry and Clear Creeks do not appear to have metals impairment and the majority of elevated metals concentrations relative to water quality standards in Prospect Creek are related to the human health standard for antimony.

3.5 Water Quality Impairment Status Update

Tables 3-2 through 3-4 and Figures 3-2 through 3-5 summarize seasonal (high and low flow) metals-related water quality standard exceedances identified for Antimony Creek, Cox Gulch, and Prospect Creek. Exceedances for antimony and arsenic are based on the human health standards for these metals as published in MDEQ WQB Circular 7, while exceedances for lead and zinc are based on comparison to the aquatic life standards (Tables 3-2 through 3-4). As shown in the tables, exceedances are most frequent for antimony under both high and low flow conditions. Exceedances for other metals (arsenic, lead, and zinc) are less frequent, and are always accompanied by exceedances for antimony. The information presented in Tables 3-2 through 3-4, along with the existence of potential metals loading sources as identified in Section 1.3 and further defined in Appendix E, justify the metals impairment determinations and the need for TMDL development for Antimony Creek, Cox Gulch and Prospect Creek.

SECTION 4.0 TARGETS, TMDLS, AND ALLOCATIONS

4.1 Targets

TMDL targets for metals were developed based on currently available information and State of Montana numeric and narrative water quality standards. Based on the compilation and review of existing water quality data, metals that consistently or periodically exceed applicable numeric water quality standards in one or more water bodies include antimony, arsenic, lead and zinc. Restoration targets for these metals are derived from the numeric water quality criteria listed in WQB-7. In cases where both human health standards and aquatic life standards are provided in WQB-7, the lower of these values was used. In cases where the numeric water quality standard is dependent on the water hardness, actual water hardness measurements for high flow and low conditions in the three listed stream segments (Appendix B) were used to develop TMDL target values. For instances where the measured water hardness is consistently less than 25 mg/L, as in Cox Gulch and Prospect Creek, a hardness of 25 was used to calculate TMDL targets since this is the minimum value to be used in calculation of hardness-dependent water quality standards (MDEQ, 2004a). In reality, the actual target will vary slightly with the water hardness at any given time. Table 4-1 summarizes the TMDL targets. Additional detail concerning the application of the numeric water quality standards for targets are provided in Section 1.1.2 and in Appendix A. Section 3.0, Tables 3-2 through 3-4 and Figures 3-2 through 3-5 show the sampled metal concentration data with a comparison to the standard (target) for antimony and arsenic.

Table 4-1. Metal Targets in Prospect Creek Watershed.

Parameter	Target	Applicable Water Quality Standard
Water Chemistry Targets (Concentrations as Total Recoverable)		
Antimony	≤ 6 µg/L (all flows)	WQB-7 Human health criteria
Arsenic[1]	≤ 10 µg/L (all flows)	WQB-7 Human health criteria
Lead[2]	Antimony Ck: ≤0.54 µg/L high flows; ≤1.3 µg/L low flows: Prospect Ck and Cox Gulch: ≤ 0.54 µg/L all flows	WQB-7 Chronic Aquatic life criteria
Zinc[2]	≤ 37 µg/L (all flows)	WQB-7 Chronic Aquatic life criteria
Sediment Chemistry Target		
Metals	Metals concentrations in stream sediments must not impede aquatic life use support or other beneficial uses.	17.30.637(1)(b)
Biological Target		
Macroinvertebrate and Periphyton communities	Periphyton and macroinvertebrate communities must be comparable to those for reference conditions for metals indicators using standard MDEQ protocol and impairment criteria.	Direct indicator of use B-1 aquatic life support

1. Note that the federal drinking water standard for arsenic is scheduled to be revised downward to 10 µg/L in 2/06.
2. Lead and zinc targets based on hardness of 25 mg/L for high flow and 50 mg/L for low flow in Antimony Creek, and 25 mg/L for all flows in Prospect Creek and Cox Gulch (see hardness data in Appendix B). These targets will vary from those shown if water hardness varies from the assumed values.

In addition to the surface water chemistry targets, other metals restoration targets have been incorporated into this restoration plan for TMDL development. This includes a target of no stream sediment metals concentrations that may impede aquatic life support. The specific application of this target is defined in Section 1.1.2. Another target is based on maintenance of appropriate biological assemblages (periphyton and macroinvertebrate communities) in the listed streams. Macroinvertebrate and periphyton assemblages in the three streams as determined through appropriate monitoring must be comparable to reference conditions and appropriate biological metrics using standard MDEQ protocol and impairment criteria as discussed in Appendix A.

These targets are intended to lend an added level of assurance that metal-related impairment in Prospect Creek watershed is ultimately eliminated.

4.2 TMDLs for Metals

Based on the summary of water quality standards exceedances, TMDL development requirements for individual water bodies are as follows:

Water Body	Metals Requiring TMDL Development
Prospect Creek	antimony, lead, zinc
Cox Gulch	antimony, lead
Antimony Creek	antimony, arsenic, lead

As discussed in Appendix A, the TMDLs represent the maximum amount of each metal that a stream can assimilate without exceeding the numeric aquatic life and human health criteria that are in Montana's 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 standard). 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 (except for intermittent streams when there is no flow). The TMDL equation is as follows:

Equation 4-1: *Total Maximum Daily Load (lb/day) = (X µg/L)(Y cfs)(0.0054)*
where:
X = the applicable water quality numeric standard (target) in µg/L with hardness adjustments where applicable;
Y = streamflow in cubic feet per second;
(0.0054) = conversion factor

Figures 4-1 through 4-3 show the TMDL curves for antimony under the various flow conditions. However, since changes in hardness alter the TMDL for a given flow for some metals, no figures are provided to illustrate a TMDL curve for zinc and lead. In their case, the three variables (concentration, flow, and hardness) prohibit the use of a simple two-dimensional visual interpretation. Table 4-2 includes example high flow and low flow TMDLs for Prospect Creek, Antimony Creek and Cox Gulch based on currently available data. These TMDLs were calculated from Equation 4-1, using typical high and low stream flow rates, hardness values and the TMDL targets presented in Table 4-1. Measured streamflows from site S-11 were used to estimate typical high and low flow for Cox Gulch. Streamflow data from site S-6A was used to determine high and low flow rates for Prospect Creek. Typical high and low flow rates for Antimony Creek were estimated by combining the applicable flows from site A-3 (lower east fork) and A-4 (lower west fork) to approximate main channel flows downstream of the confluence of the two forks. In all cases, high flow is primarily taken as the average of all flows measured from April through June, and low flow is the average of flows from all other times of the year. (Exceptions to this method were incorporated for a few minimal occurrences when a flow from late March was closer to the high flow range and therefore included in the high flow calculation, or when measurements in late June were anomalously low and were included in the low flow average calculation.) Some of the monitoring events were completed at times of extremely low flow where actual cfs values were not able to be directly recorded. In such instances, other methods for calculating flow were conducted and then converted to cfs. This is reflected in the values of cfs that appear in the figures that are represented as being less than one. The calculated TMDLs represent the maximum load (lbs/day) of each metal that the creek can accommodate without exceeding applicable water quality standards for the specified streamflow conditions, water hardness, and restoration targets.

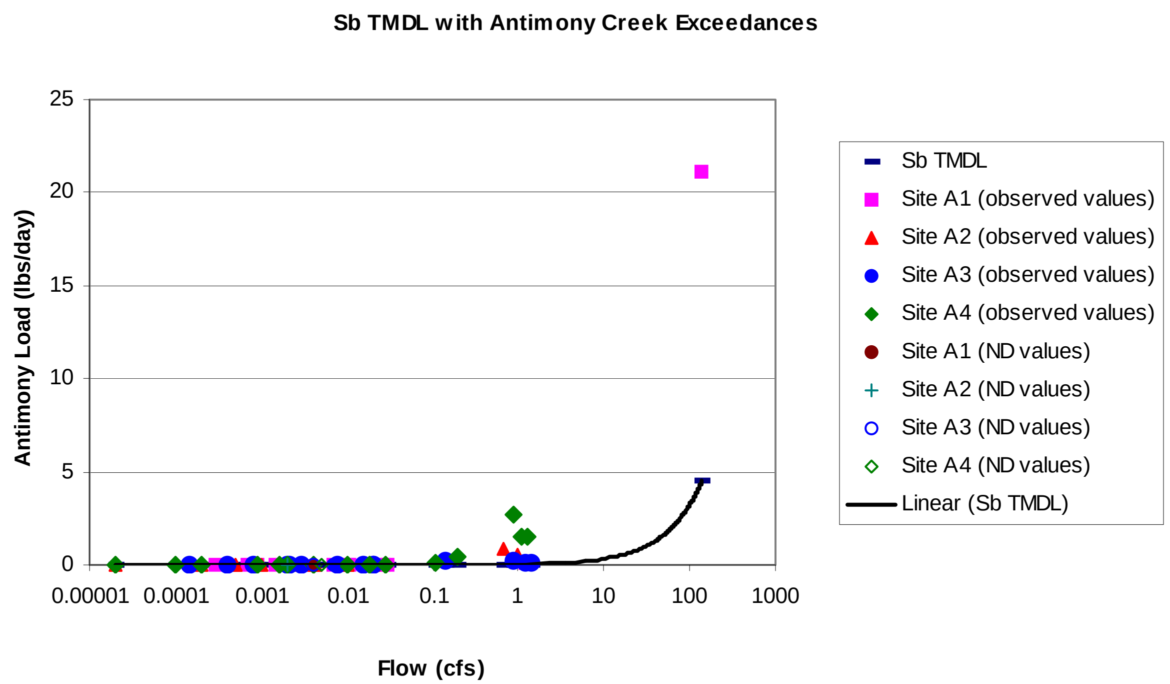

Figure 4-1. Sb TMDL with Antimony Creek Exceedances

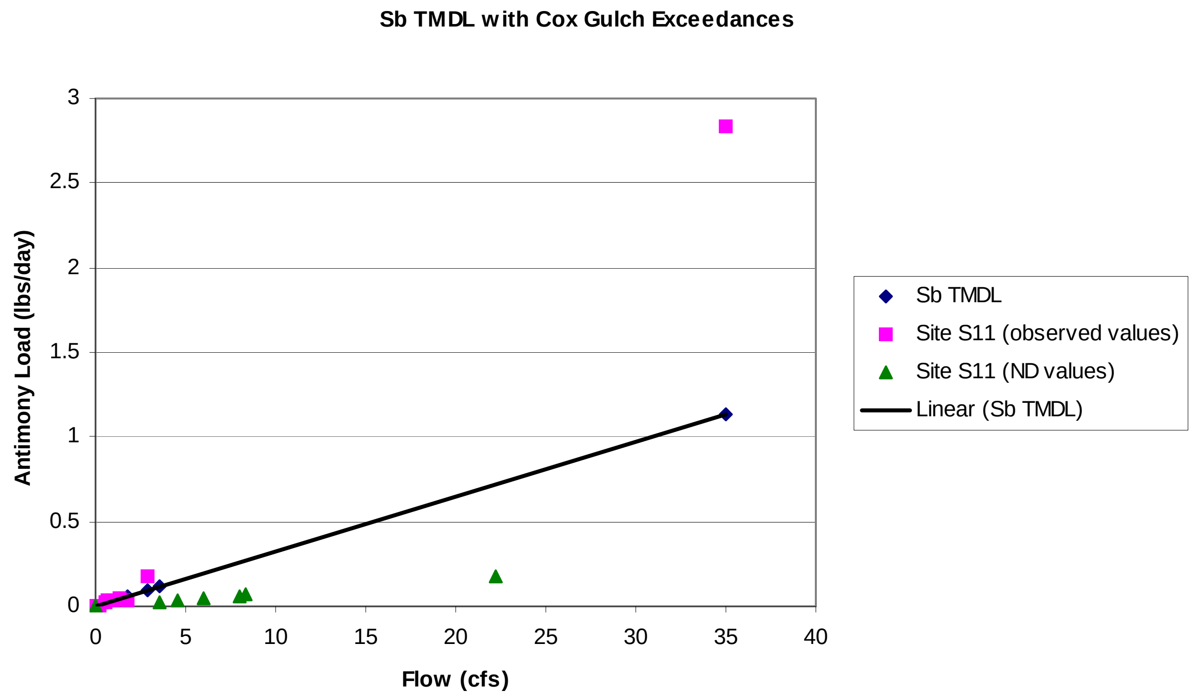

Figure 4-2. Sb TMDL with Cox Gulch Exceedances.

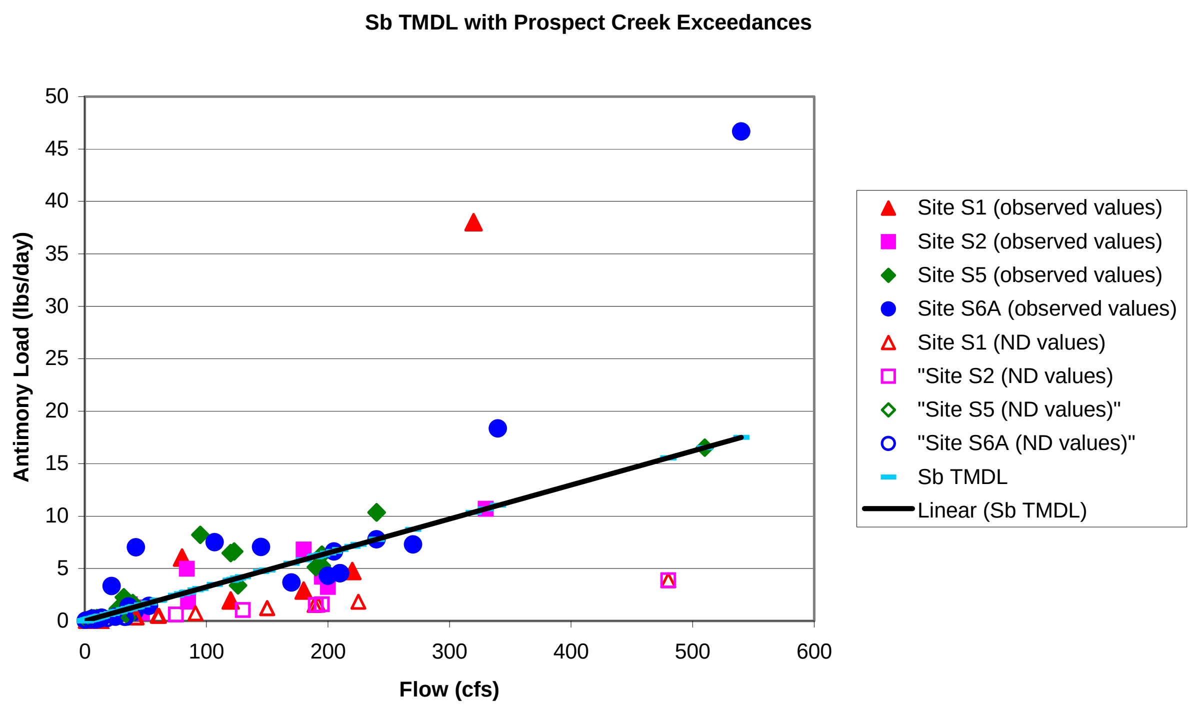

Figure 4-3. Sb TMDL with Prospect Creek Exceedances.

The right hand column in Table 4-2 illustrates the maximum range of percent load reductions that were necessary, given the metal concentrations found during specific sampling events in the listed streams. Because a load for metals is directly related to flow (and hardness in the case of lead and zinc), the TMDL for any given point in time can be variable. The data has shown that in the case of the Prospect Creek watershed, exceedances for various metals have occurred at both high and low flow conditions, suggesting that there are various mechanisms responsible for the transport of metals in the watershed. For example, high flow exceedances may indicate metals entering the stream through overland runoff, while low flow exceedances may imply metals contamination through ground water, possibly as a result of flooded mine adits.

The largest required load reductions that were observed for a given sampling event include: 80.6% (high flow) and 78.6% (low flow) for antimony, and 98.6% (high flow) and 81.8% (low flow) for lead in Prospect Creek; 60.0% (high flow) and 14.3 % (low flow) for antimony, and 98.8% (high flow) and 71.3% (low flow) for lead in Cox Gulch; and 99.3% (high flow) and 99.4% (low flow) for antimony, 78.7% (high flow) and 85.1% (low flow) for arsenic, and 97.9% (high flow) and 80.0% (low flow) for lead in Antimony Creek.

Table 4-2. Example Metals TMDLs For Prospect Creek, Antimony Creek And Cox Gulch.

Drainage	Pollutant	Target Concentration	Typical Flow Rates (cfs)	TMDLs (lbs/day)	Percent Load Reductions Required Under Sampled Target Exceedance Conditions
Prospect Ck (at site 6A)	Antimony	6.0 µg/L (all flows)	200 cfs (high flow) 20 cfs (low flow)	6.4 (high flow) 0.64 (low flow)	80.6% (high flow) 78.6% (low flow)
	Lead	0.54 µg/L (all flows)	200 cfs (high flow) 20 cfs (low flow)	0.58 (high flow) 0.058 (low flow)	98.6% (high flow) 81.8% (low flow)
	Zinc	37 µg/L (all flows)	200 cfs (high flow) 20 cfs (low flow)	40 (high flow) 4.0 (low flow)	0.0% (high flow) 0.0% (low flow)
Cox Gulch (at site S-11)	Antimony	6.0 µg/L (all flows)	8.3 cfs (high flow) 0.6 cfs (low flow)	0.27 (high flow) 0.02 (low flow)	60.0% (high flow) 14.3% (low flow)
	Lead	0.54 µg/L (all flows)	8.3 cfs (high flow) 0.6 cfs (low flow)	0.024 (high flow) 0.0017 (low Flow)	98.8% (high flow) 71.3% (low flow)
Antimony Ck (mainstem below two forks)	Antimony	6.0 µg/L (all flows)	0.95 cfs (high flow) 0.024 cfs (low flow)	0.03 (high flow) 0.0008 (low flow)	99.3% (high flow) 99.4% (low flow)
	Arsenic	18 µg/L (all flows)	0.95 cfs (high flow) 0.024 cfs (low flow)	0.09 (high flow) 0.0025 (low flow)	78.7% (high flow) 85.1% (low flow)
	Lead	0.54 µg/L (high flows) 1.3 µg/L (low flow)	0.95 cfs (high flow) 0.024 cfs (low flow)	0.003 (high flow) 0.0002 (low flow)	97.9% (high flow) 80.0% (low flow)

High and low flows based on average of all available flow measurements; high flow- March through June; low flow- July through Feb.
Antimony Creek flows based on combined flows from east fork (A-4) and west fork (A-3). Calculated TMDLs intended for mainstem Antimony Ck and are based on combined flows.

Some additional notes concerning the Table 4-2 TMDLs and the target conditions they are intended to satisfy include:

- Although elevated sediment metals concentrations have not been documented at this time, meeting the antimony, arsenic, lead and zinc TMDLs is expected to satisfy the target associated with potential sediment toxicity for two reasons. First, restoration activities designed to address existing sources of these metals (believed to primarily be either historic mining or USAC operations-related) would also eliminate any potential source(s) of elevated metals concentrations in sediments. Because other metals which may occur at elevated concentrations in sediments are likely derived from the same sources as antimony, arsenic, lead and zinc, meeting the TMDLs for these metals is expected to address potential sediment toxicity issues related for other metals in Prospect Creek watershed.

- Meeting the metals TMDLs should eliminate any metals-related impediments to meeting the target for macroinvertebrate and periphyton communities as defined in Table 4-1.

The metals TMDLs and required load reductions presented in Table 4-2 apply to specific streamflow conditions (and water hardness in the case of lead and zinc) 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 watershed is uncertain. It is expected that TMDLs calculated from future high flow and low flow data would vary from the examples presented here. Ultimately, the TMDL is the load of a particular pollutant that the specific water body (Antimony Gulch, Cox Gulch, Prospect Creek) can support without exceeding B-1 water quality standards at any time as determined from Equation 4-1. General information on calculations of TMDLs is included in Appendix A. All water quality data used in calculations of TMDLs and load reduction requirements are in Appendix B.

4.3 Load Allocations

A TMDL is the sum of all of the load allocations (nonpoint sources) plus all of the waste load allocations (point sources) for a water body, plus a margin of safety (MOS). Because there are no point source discharges subject to the Montana Pollutant Discharge Elimination System permit program in Prospect Creek watershed, no waste load allocations are required. Furthermore, as discussed in Section 4.4, the margin of safety is addressed implicitly in this TMDL, through incorporation of various safety factors and contingencies incorporated into the TMDL development process (as discussed in Section 4.4.2), as opposed to allotting a specific portion of the TMDL to the MOS. Since no waste load allocations or explicit margin of safety are required, the metals TMDLs for Prospect Creek watershed consist solely of the nonpoint source load allocations in the watershed.

4.3.1 Load Allocation Development Strategy

Three potential sources of metals loading have been identified in Prospect Creek watershed, including:

- Drainage from abandoned mines located within portions of the watershed;
- Possible seepage from the USAC tailings impoundment, runoff from the plant site, and/or drainage from the USAC Stibnite Hill mine workings; and
- Natural background loading from mineralized bedrock.

Because limited information is available for these potential sources (especially abandoned mines and background), a generalized approach has been adopted for metals load allocation in Prospect Creek watershed. Under this restoration plan, specific portions of the total allowable load (the TMDL) for each listed stream (Prospect Creek, Antimony Creek, and Cox Gulch) have been assigned to metals loading sources areas and/or source categories identified through the metals loading analysis (Section 3.0). This approach to load allocation will ultimately account for all potential sources of metals-related impairment in the three listed drainages, while recognizing the current lack of detailed information on specific metals loading sources. The allocation strategy is based on certain premises, such as natural background conditions will not preclude attainment of water quality standards, and that restoration of active and abandoned mines can reduce metal loading to levels necessary for attainment of water quality standards. If future data collection shows this to not be the case, this TMDL and water quality restoration plan will be modified in accordance with the Adaptive Management Strategy outlined in Section 4.5. The following sections discuss the load allocation process for each metals-listed water body.

4.3.2 Source Category Load Allocations for Antimony Creek and Cox Gulch

Load allocations in Cox Gulch and Antimony Creek drainages follow the source category approach, where the allowable load for a given metal, or TMDL for that metal in pounds per day, is distributed among the known or suspected categories (or types) of metals loading sources. The source category allocation approach is particularly useful for situations like Prospect Creek watershed where impairment conditions are adequately defined, but quantitative information on specific metals loading sources is lacking. In these situations, a source category allocation scheme provides a “first cut” at load allocation and ultimate water quality restoration, while recognizing the potential need for additional water quality information and detailed source delineation before water quality restoration can be assured. Section 5.0 of this document presents a conceptual environmental monitoring plan designed to provide this information. Section 4.5 also presents an Adaptive Management Strategy outlining an iterative process of load allocation, restoration implementation, and monitoring. The Adaptive Management Strategy provides a framework for refinement of the allocation and restoration process based on future data collection, to help ensure that water quality impairments are addressed and water quality standards are ultimately attained.

As previously described, suspected sources of metals loading to Antimony Creek and Cox Gulch include historic mines (those outside of the current USAC mining and refining activities), and potentially natural background metals loading. In addition, the USAC facility located along the Prospect Creek drainage bottom near the confluence with Cox Gulch has the potential to contribute to metals-related impairment in the lower segment of Cox Gulch.

The entire allowable loads, or TMDLs, for applicable metals in Antimony Creek are allocated to the historic mining and natural background source categories. Due to a lack of detailed water quality data, more detailed delineation of loads between these source categories is not possible, and the entire Antimony Creek TMDLs are allocated to the combined historic mine/background category. The Antimony Creek metals allocations are based on the assumption that background loading alone will not result in exceedances of applicable water quality standards and associated

TMDLs, and that reclamation of abandoned mines can achieve the reductions necessary for compliance with the TMDLs throughout the year.

For Cox Gulch, the entire TMDL for each applicable metal is allocated to the combined historic mining sources, potential USAC contributions, and natural background categories. The Cox Gulch metals TMDLs are based on the assumption that background loading rates are less than the Cox Gulch TMDLs, and that restoration of abandoned mines and the USAC facilities in the drainage can achieve the load reductions necessary for compliance with the TMDLs throughout the year.

The source category allocations for Antimony Creek and Cox Gulch based on the example high flow and low flow TMDLs (Section 4.2) are listed in Table 4-3. It should be noted that the TMDLs and load allocations shown in Table 4-3 apply for the specific streamflow conditions and restoration targets used in the TMDL calculations (Table 4-2), and apply at those specific locations used in the TMDL calculations (SW-11 in Cox Gulch; the confluence of the east and west forks in Antimony Creek). Specific TMDLs, and thus load allocations for any given point in time, will vary based on specific streamflow and water chemistry conditions existing at that time.

Table 4-3. Metals Load Allocation Examples for Cox Gulch and Antimony Creek.

Drainage/ Metal	Historic Mining and Natural Background Source Category Allocation	Historic Mining, Natural Background and USAC Source Category Allocations
Cox Gulch		
Antimony	NA	0.27 (high flow) 0.02 (low flow)
Lead	NA	0.024 (high flow) 0.0017 (low Flow)
Antimony Creek		
Antimony	0.03 (high flow) 0.0008 (low flow)	NA
Arsenic	0.09 (high flow) 0.0025 (low flow)	NA
Lead	0.003 (high flow) 0.0002 (low flow)	NA

Example allocations apply at specific locations and to specific flow and water chemistry conditions utilized in TMDL development as specified in Table 4-2. Values presented are in lbs/day.
NA- Not Applicable.

4.3.3 Source Area Allocations for the Prospect Creek Metals TMDL

Load allocations have been developed for the mainstem of Prospect Creek based on the “source area” allocation approach, with focus on ultimate attainment of metals-related water quality standards throughout Prospect Creek. Based on available information (Section 3.0), the load allocation for Prospect Creek recognizes three potential metals loading source areas, including:

- Source Area 1: Antimony Creek drainage;
- Source Area 2: Cox Gulch drainage; and

- Source Area 3: the remainder of Prospect Creek watershed, which is divided into Prospect Creek upstream of Antimony Creek, Prospect Creek downstream of Antimony Creek, and other tributaries (Figure 3-1).

The total allowable load in Prospect Creek, or the TMDL, is divided among these three source areas. For instance, the example high flow TMDL for antimony at Prospect Creek site S-6A, 6.4 lbs/day (Section 4.2), is divided between Antimony Creek drainage, Cox Gulch drainage, and the remainder of the Prospect Creek watershed upstream of site S-6A (including the mainstem Prospect Creek and all other tributary drainages) with the allocations based on the example TMDLs as presented in Table 4-2. All of these drainages or stream segments have been identified through the metals loading analysis (Section 3.0) as potential metals loading source areas, although quantification of specific loading sources is not possible based on currently available data. This load allocation strategy also accounts for “other tributaries” (other than Cox Gulch and Antimony Creek), which may act as sources of metals loading to Prospect Creek, and could require load reductions, although this cannot be verified based on available information. The “other tributaries” portion of Source Area 3 includes Cooper Gulch, a large tributary drainage located upstream of site S-6A which contains a number of mine prospects, for which metals-related water quality data is not currently available. The load allocated to each Prospect Creek source area applies to all potential loading sources within that source area. These loading sources fall within the categories of mining-related sources and natural background sources.

In general, the TMDL for each metal as applied at Prospect Creek site S-6A can be defined as:

TMDL = Antimony Creek load + Cox Gulch load + load within remainder of watershed;
= Source Area 1 load + Source Area 2 load + Source Area 3 load.

The sum of the load allocation for each source area must be less than the total allowable load (TMDL) for Prospect Creek under all flow conditions. The source area allocation for Antimony Creek and the Cox Gulch drainage are the same as the TMDL allocations for each as defined above in Section 4.3.2, with the addition of load allocations for zinc based on the applicable water quality standard and flow conditions within each tributary. Table 4-4 shows the source area load allocations under the example high flow TMDL conditions with focus on meeting the TMDLs and water quality standards in each segment of Prospect Creek (including load allocations for Cox Gulch and Antimony Creek equivalent to the corresponding TMDLs for these drainages).

Based on the metals load reductions required for attainment of the Prospect Creek TMDLs (Table 4-2), and the relatively small loads allocated to Cox Gulch and Antimony Creek (Table 4-4), it is apparent that attainment of metals TMDLs in Cox Gulch and Antimony Creek alone will not result in full attainment of the Prospect Creek TMDLs. Therefore, additional load reductions will be necessary for full TMDL compliance. The additional load reductions could come in part from currently identified potential sources, such as the USAC facility, although available data suggests that at least a portion of these reductions will come from Source Area 3. The most likely sources of excess metals loads in Source Area 3, based on drainage area and distribution of mining features on the USGS maps, include Prospect Creek watershed upstream of Antimony Creek and/or Cooper Gulch drainage (Figure 3-1).

Table 4-4. Metal Load Allocation Example for Prospect Creek.

Metals TMDLs for Prospect Ck at Site S-6A			Allocations (lb/day)		
Metal	**Flow Conditions**	**TMDL (lb/day)**	**Source Area 1: Antimony Creek**	**Source Area 2: Cox Gulch**	**Source Area 3: TMDL - (Source Area 1 + Source Area 2)**
Antimony	High Flow	6.4	0.03*	0.27*	6.1
	Low Flow	0.64	0.0008*	0.02*	0.62
Lead	High Flow	0.58	0.003*	0.024*	0.55
	Low Flow	0.058	0.0002*	0.0017*	0.056
Zinc	High Flow	40	0.19	1.66	38.15
	Low Flow	4.0	0.0087	0.12	3.87

Prospect Creek allocations apply at monitoring site S-6A and for specific flow and water chemistry conditions utilized in TMDL development as specified in Table 4-2.
* Allocation corresponds to applicable TMDL

Because of its location (Figure 3-1), the USAC Stibnite Hill Mine has the potential to contribute metals loading to both Source Area 2 and Source Area 3. Because this is a permitted facility, an additional component of the allocation strategy is the inclusion of a performance-based load allocation for the USAC Stibnite Hill Mine operation. Under the performance-based approach, ongoing and/or future restoration activities mandated under formal regulatory programs are recognized in lieu of actual load allocations to this facility. The performance-based allocation applies to metals loading sources that may be attributable to mining and milling activities conducted by U.S. Antimony Corporation and covered under their operating permit (Permit #00045A). Reclamation requirements and water quality protections addressed in USAC's reclamation plan (included in the facility Operating Permit) are incorporated into this water quality restoration plan as the allocations for this facility. Relevant reclamation plan requirements include:

- The facility Plan of Operations states that following facility shutdown, the tailings impoundments will be capped with synthetic liners and three feet of soil, and revegetated.
- The facility Plan of Operations states that all process water will be discharged to lined ponds for recycling (i.e., no discharge).
- The facility Plan of Operations states that "monitoring, and if necessary, water treatment, will be sustained until all water quality standards have been met or until calculated pre-mining baseline has been reached."
- The facility Plan of Operations states that all reclamation will be completed within two years of shutdown.
- The facility Plan of Operations states that all mine portals have already been closed with 20-foot soil plugs and portal areas reclaimed.
- USAC conducts quarterly surface water and ground water monitoring at approximately five surface water sites and 12 ground water sites. This monitoring will continue for at least 10 years after facility shutdown.
- USAC operates under mine Operating Permit (#00045A) and associated reclamation plan administered by the Montana Department of Environmental Quality Hardrock Mining Bureau, and as such, is subject to applicable provisions and requirements of the Metal Mine Reclamation Act (MCA 82-4-3 and ARM 17.24.101 through 189). However,

portions of the operation predating promulgation of the MMRA are exempt, although all facets of the operation are subject to requirements of the Clean Water Act.

The performance-based allocation is based on the premise that implementation of the MDEQ-administered reclamation plan will result in the attainment of reasonable land, soil, and water conservation practices for this facility and thus serve the same purpose as meeting any required load allocations for this facility and related operations. Future monitoring and decision-making as outlined in the Adaptive Management Approach to Restoration (Section 4.5) will be used to determine future compliance with the performance-based allocation.

Metal loading associated with sediment that has historically reached the stream and is within bottom sediments is not included within the allocations and is not identified as a unique source of loading to the stream. It is recognized that the metals associated to sediment transport that has been occurring over the last several decades will continue to transport this metals load in a downstream direction. The allocations and Adaptive Management Approach to Restoration are intended to reduce metals loading from anthropogenic sources that are currently increasing metals concentrations, or have the potential to increase metals concentrations, to surface water within the Prospect Creek watershed. The allocations are not intended to require instream or floodplain metals restoration work unless a specific problem area is encountered or later identified, such as an old mine waste pile along a stream bank or within the floodplain. Under these circumstances, the allocations linked to historical mining would apply and some form of remediation may be necessary to mitigate or remove this threat. It is also recognized that there may be natural sources along some stream locations where a metals bearing vein intersects the stream bed and impacts to these types of locations should be avoided to the extent possible.

4.3.4 Allocation Summary

The source area allocation strategy for Prospect Creek and the source category allocation strategy for Cox Gulch and Antimony Creek represent an initial budgeting tool for metals loading in Prospect Creek watershed based on currently available information. This strategy accounts for all known potential loading sources within the watershed, and compensates for the current lack of detailed information on individual loading sources. The strategy also provides a framework to allow for a more detailed allocation of sources in the future, if warranted, based on information obtained during future data collection efforts. The performance-based allocation applied to the USAC operations accounts for existing reclamation requirements associated with the USAC operating permit and water quality restoration obligations established in the watershed. The monitoring strategy outlined in Section 5.0 is intended, in part, to provide additional information on specific metals loading sources for refinement of load allocations, if necessary, and to ensure that the performance-based allocation at the USAC facility is appropriate, adequate, and consistent with the goals of this water quality restoration plan.

4.4 Seasonality and Margin of Safety

All TMDL/Water Quality Restoration Planning documents must consider the seasonal variability, or seasonality, on water quality impairment conditions, maximum allowable pollutant loads in a stream (TMDLs), and load allocations. TMDL development must also incorporate a margin safety into the load allocation process to account for uncertainties in pollutant sources and other watershed conditions, and ensure (to the degree practicable) that the TMDL components and requirements are sufficiently protective of water quality and beneficial uses. This section describes in detail considerations of seasonality and a margin of safety in the Prospect Creek watershed metals TMDL development process.

4.4.1 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 restoration targets, TMDLs, and allocation schemes, and/or the pollutant controls. As with most metals TMDLs, seasonality is critical due to varying metals loading pathways and varying water hardness during high and low flow conditions. 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 for both high flow and low flow conditions.
- 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.
- Biological sampling will be conducted during low flow conditions within a given seasonal time period based on MDEQ sampling protocols.
- Sediment chemistry sampling will be conducted during low flow conditions after runoff and deposition of potentially excess metal pollutants.

4.4.2 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 (U.S. EPA, 1999). The margin of safety is addressed in several ways as part of this document:

- Compliance with targets, refinement of load allocations, and, in some cases, impairment determinations are all based on an adaptive management approach that relies on future monitoring and assessment for updating planning and implementation efforts.
- The numeric water quality criteria used as restoration targets in this TMDL include built in margins of safety to assure protection of beneficial uses.

- The most protective numeric standard (typically the chronic aquatic life support standard) 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 bioassessments using periphyton and macroinvertebrates.
- Sediment chemistry targets are developed to help ensure that potential upstream areas of metals impairment and source loading are not overlooked, and to help ensure that episodic loading that normal sampling events may miss are factored in since the sediment chemistry can be an indicator of these types of loading occurrences.
- A portion of the Prospect Creek TMDL is allocated to all other potential source areas that may be identified through future monitoring to ensure that all loading is accounted for.

4.5 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 unalterable human-caused sources and/or natural background sources of metals loading. For this reason, an adaptive management approach is adopted for all metals targets within the watershed. 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 restoration activities have been undertaken in a manner consistent with all reasonable land, soil and water conservation practices. 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. Under this scenario, site-specific water quality standards and/or a reclassification of the water body may be necessary.
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 that should allow applicable beneficial uses to be supported to the extent considered achievable. The determination of whether or not a given metal falls within Category 1 or 2, particularly Category 2 will require approval from the MDEQ Remediation Division, the MDEQ Standards Program, and the MDEQ TMDL Program personnel. 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.

It is acknowledged that construction or maintenance activities related to restoration, construction/maintenance, and future development may result in short term increase in surface water metal concentrations. For any activities that occur within the stream or floodplain, all appropriate permits should be obtained before execution of the activity. Federal and State permits necessary to conduct work within a stream or stream corridor are intended to protect the resource and reduce, if not completely prohibit, pollutant loading or degradation from the permitted activity. The permit requirements typically have mechanisms that allow for some short term impacts to the resource, as long as all appropriate measures are taken to reduce impact to the least amount possible.

SECTION 5.0 RESTORATION STRATEGY

This section outlines strategies for addressing metals loading sources in need of restoration activities within Prospect Creek watershed. The restoration strategies focus on regulatory mechanisms and/or programs applicable to the potential source types present within the watershed, which for the most part are associated with mining and metals processing activities, and possibly natural conditions. The following discussion focuses on two general potential sources; the U.S. Antimony Corporation facilities near the mouth of Cox Gulch and associated mining properties, and historic or abandoned mines.

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 future reclamation activities associated with the USAC operations. The monitoring plan also includes provisions for assessing stream segments not listed as impaired for metals, but which available data show may act as metals loading sources to Prospect Creek.

5.1 Restoration Strategy for Potential USAC Sources

Woessner and Shaply (1985) concluded that the USAC tailings impoundment leached metals, including antimony and arsenic, to the Prospect Creek alluvial aquifer. However, this study was conducted shortly after the 1983 shutdown of mining and milling operations, and prior to reclamation of tailings pond #3. Nevertheless, the USAC Stibnite Hill Mine operations still constitutes a potential current or future source of metals loading.

The TMDL restoration strategy for the USAC facility relies on implementation of the USAC reclamation plan requirements. As described in Section 4.0, elements of the reclamation plan include:

- The facility plan of operations states that following facility shutdown, the remaining tailings impoundments will be capped with synthetic liners and three feet of soil, and revegetated.
- The facility plan of operations states that all process water will be discharged to lined ponds for recycling (i.e., no discharge).
- The facility plan of operations states that “monitoring, and if necessary, water treatment, will be sustained until all water quality standards have been met or until calculated pre-mining baseline has been reached.”
- All reclamation will be completed within two years of shutdown.
- All mine portals have been closed with 20-foot soil plugs and portal areas reclaimed.

Effectiveness of the USAC reclamation actions will be evaluated through the post closure water quality monitoring as described in Section 5.3, and compliance with the Clean Water Act. The MDEQ Hardrock Mining Bureau and U.S. Forest Service will be involved in this process, as will personnel from the MDEQ TMDL section.

5.2 Restoration Strategy for Non-USAC Sources

Potential metals loading sources not associated with the USAC facility may include abandoned mining disturbances, including potential discharging mine adits and mine waste materials. Following is a discussion of general restoration programs and funding mechanisms that may be applicable to this potential source category. Additional program detail is provided in Appendix C. It should be noted however, that metals loading from abandoned mine facilities has not been documented at this time. The need for further characterization of impairment conditions and loading sources in some stream segments is addressed in Section 5.3 under the water quality monitoring program.

5.2.1 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 a potential source of metals loading to Antimony Gulch, Cox Gulch and Prospect Creek. Some regulatory programs and approaches considered most applicable to Prospect Creek watershed 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).

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. The MWCB abandoned mine reclamation program may be a viable alternative for addressing certain metals loading sources in Prospect Creek watershed.

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 C.

Currently, none of the abandoned mines in Prospect Creek watershed are on the MWCB's priority list of sites to be reclaimed with SMCRA funds (MDSL, 1995). However, it is possible that these sites could be eligible for reclamation with SMCRA funding in the future 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. Currently there are no CECRA-listed facilities in Prospect Creek watershed.

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 C.

It is possible that any historic mining-related metals loading sources identified in the watershed in the future 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 made by any person to the department containing the required information.

5.2.2 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 U.S. 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. 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 40% 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 in Prospect Creek watershed. State and Federal agencies are often able to provide some assessment-related support. Where sufficient funding can be obtained, the detailed assessment and cleanup such as might occur under VCRA, could be pursued.

5.3 Monitoring Strategy

The monitoring strategy for metals in the Prospect Creek watershed includes efforts to evaluate future restoration implementation, including future compliance with water quality standards with emphasis on (but not exclusively) those metals for which TMDLs have been developed. The monitoring strategy also includes efforts to further quantify metals sources and impairment conditions. Monitoring efforts to assess water quality improvements within this plan should be coordinated with other water quality activities in the watershed including USAC permit-required monitoring, and monitoring linked to the Habitat and Water Quality Restoration Plan for the Prospect Creek Watershed that is currently under development. This plan includes sediment and temperature TMDLs and may also have biological monitoring goals linked to implementation monitoring. Furthermore, monitoring should be coordinated through local stakeholders given the significant water quality improvement activities pursued by the Prospect Creek Watershed Council, the Green Mountain Conservation District, the Lower Clark Fork Watershed Group, AVISTA, and local agency support personnel.

5.3.1 Implementation Monitoring

As defined by Montana State Law (§§75-5-703(7) & (9)), MDEQ is required to evaluate progress toward meeting TMDL goals and satisfying water quality standards associated with beneficial use support at least every five years, starting at the time of approval. Implementation monitoring is, therefore, necessary to assess progress toward meeting the targets developed in Section 4.0. Where targets are not being met, additional implementation monitoring may be necessary. This additional implementation monitoring may evaluate the progress toward meeting allocations, and could result in modifications to the targets as part of adaptive management (Section 5.4).

Table 5-1 identifies minimum metals target monitoring and assessment recommendations for the Prospect Creek Watershed. All monitoring efforts are to be done using standard MDEQ sampling and analyses protocols where applicable or sampling and analyses protocols approved by MDEQ. The monitoring recommendations, particularly the monitoring locations, may be modified and expanded based on the results from any additional source and impairment quantification monitoring (Section 5.3.2) and based on the application of the targets where additional upstream monitoring may be necessary to ensure compliance with water quality standards.

MDEQ efforts to evaluate progress toward meeting TMDL goals and satisfying water quality standards does not always need to include monitoring of all targets and indicators. In some situations, the MDEQ may determine that insufficient progress or opportunity for stream recovery has been made to warrant evaluations of all targets and/or indicators. This determination could be based for example on a lack of progress toward mine reclamation or restoration.

Table 5-1. Monitoring Locations and Parameters for Evaluation of Target Compliance and Beneficial Use Support.

Water Body	Parameter (s)	Desired Location(s)	Sample Method	Sample Period
Prospect Creek, Antimony Creek, Cox Gulch	Metals Chemistry (antimony, arsenic, zinc, and lead)	Prospect Creek: S-6A, S-1, above Antimony Gulch Antimony Creek: A-3, A-4, mouth of Antimony Creek Cox Gulch: S-11 and mouth of Cox Gulch	Standard MDEQ protocol or equivalent per MDEQ approval	High and low flow
Prospect Creek, Antimony Creek, Cox Gulch	Macroinvertebrate and Periphyton Assemblages (see discussion in Appendix A)	Two to three locations for each impaired water body.	Standard MDEQ protocol or equivalent per MDEQ approval	Low flow, summer to early fall; between June 21 to September 21 per existing MDEQ protocol
Prospect Creek, Antimony Creek, Cox Gulch	Sediment Chemistry (see discussion in Appendix A)	Two to three locations for each impaired water body.	Standard MDEQ protocol or equivalent per MDEQ approval	Low flow after summer runoff and prior to freezing conditions

5.3.2 Monitoring to Further Quantify Metals Sources and Impairment Conditions

Based on the metals loading analysis and preliminary source assessment presented in Section 3.0, a number of metals-related data gaps have been identified in Prospect Creek watershed. If in the future, it is deemed necessary to collect additional information to develop a more refined source assessment and final load/waste load allocation, the following data gaps may be addressed:

Surface Water Sampling Needs:

Additional surface water quality sampling would be beneficial for better delineation of metals loading trends through the stream segments of interest (Antimony Creek, Cox Gulch, and Prospect Creek in the vicinity of these two tributaries), and to allow for more specific load allocations for metals. Based on the loading analysis conducted for antimony, high and low flow surface water quality data should be collected from the three drainages as follows:

- Antimony Creek: Existing sites A-1 through A-4, plus one additional site at the mouth of Antimony Creek;
- Cox Gulch: Existing site S-11, plus one site near the head of Cox Gulch, one site approximately midway between the drainage head and existing site S-11, and one site near the mouth (below the tailings storage facility);
- Prospect Creek: Existing sites S-1, S-2, S-5 and S-6A, plus one site above the confluence with Antimony Creek, two sites between existing sites S-2 and S-5 (one below the confluence with Buster Brown Gulch and the second below the confluence with Lucky Boy Gulch);

- Additional Tributaries: The mouth of three tributaries, Cooper Gulch, Crow Creek and Therriault Gulch, which enter Prospect Creek between monitoring sites S-5 and S-6A;
- Additional sampling and monitoring is recommended for Prospect Creek watershed streams in the vicinity of all known or suspected abandoned mine sites to better characterize potential loading from these sources. If resources allow, monitoring above and below known or suspected mine sites to "bracket" source areas will likely aid in the development of a restoration strategy.

Details on the sampling schedule and list of parameters recommended for filling the surface water quality data gaps are provided in Appendix D.

Stream Sediment Sampling:

Stream sediment sampling for total metals concentration analyses would aid in determining if stream sediment metals concentrations are elevated and may act as a source of metals loading to the water column through metals leaching or resolublization of metal hydroxide precipitates, or contribute directly to impairment conditions through impacts to aquatic life. Stream sediment sampling is recommended at five locations including:

- The mouth of Antimony Creek;
- The mouth of Cox Gulch; and
- Existing sites S-2 and S-5, and a new site proposed below the confluence with Buster Brown Gulch on Prospect Creek.

Sediment sample analyses could be limited to the metals, antimony, arsenic, lead and zinc since these are the metals showing consistent or periodic exceedances of water quality standards. In addition to helping delineate potential metals loading sources, and the subsequent allocation of loads, the sediment metals data can also be used to better define impairment conditions related to metals, and in restoration planning. The proposed sediment sampling locations would also serve as appropriate macroinvertebrate sampling points if such data is deemed necessary. Additional information regarding a schedule and methodology for stream sediment sampling is provided in Appendix D. As more information is gathered regarding potential sources, more sediment metals sampling locations may be added to better characterize stream and source conditions.

5.3.3 USAC Reclamation Effectiveness Monitoring

U.S. Antimony Corporation's ongoing water quality monitoring plan is recognized as an integral component of the TMDL monitoring strategy. USAC collects streamflow and water quality data from nine stream sites and 12 ground water sites on a quarterly basis as required by the facility Plan of Operations. Water samples are submitted to an analytical laboratory for analysis of, at a minimum, antimony, arsenic, lead and pH. USAC monitoring locations are listed in Table 5-2. USAC's Plan of Operations specifies that they will continue their water monitoring program for a minimum of 10 years following facility shutdown. USAC submits their data to the MDEQ-Hardrock Mining Bureau on an annual basis. This data should also be reviewed by MDEQ TMDL personnel for use in assessing the status of impairment conditions and for tracking TMDL implementation in the watershed.

Table 5-2. U.S. Antimony Corp List of Water Quality Monitoring Stations.

STATION	DESCRIPTION
SURFACE WATER	
S-1	Prospect Ck at bridge
S-2	Prospect Ck ½ mile below ponds
S-5	Prospect Ck above bridge at Crow Creek
S-6A	Prospect Ck opposite MT Standard
S-11	Cox Gulch above plant
A-1	East branch Antimony Gulch above FS Road 2179
A-2	West branch Antimony Gulch above FS Road 2179
A-3	East branch Antimony Gulch above FS Road 16194
A-4	West branch Antimony Gulch above FS Road 16194
GROUND WATER	
USB-2	Monitoring well; 72 ft deep
USB-8	Monitoring well; 45 ft deep
USB-9	Monitoring well; 90 ft deep
USB-10	Monitoring well; 90 ft deep
USB-11	Monitoring well; 90 ft deep
USB-12	Monitoring well; 45 ft deep
USB-13	Monitoring well; 45 ft deep
USB-14	Monitoring well; 90 ft deep
USB-15	Monitoring well; 90 ft deep
USB-16	Monitoring well; 45 ft deep
Supply Well 1	Water supply well; 100 ft deep
Supply Well 2	Water supply well; 100 ft deep

SECTION 6.0
PUBLIC & STAKEHOLDER INVOLVEMENT

Public and stakeholder involvement is a component of water quality restoration planning and TMDL development. This involvement is supported by U.S. EPA guidelines, the Federal Clean Water Act and Montana State Law. Public and stakeholder involvement is desirable to ensure development of high quality, feasible plans and increase public acceptance.

Stakeholders including Green Mountain Conservation District, U.S. Antimony Corporation (Stibnite Hill Mine), Lolo National Forest, Avista Corporation, Montana Fish Wildlife and Parks and others were involved with initial project planning.

Development of this plan was facilitated through the Green Mountain Conservation District (GMCD) via a grant funded through Section 319 of the Clean Water Act. The GMCD has been and will continue to encourage ongoing involvement by the public and stakeholders in the implementation of water quality protection activities in the Prospect Creek watershed, including the implementation of this TMDL.

A stakeholder review draft was subsequently provided to the above identified stakeholders for review. This review also included additional internal peer reviews by MDEQ, TMDL personnel, a MDEQ water quality standards representative, and a MDEQ mine permit program representative. Significant stakeholder comments were provided and addressed, and during development of the final public review draft, several stakeholders were consulted in their areas of expertise on specific sections of the document.

A review and comment period was also made available to the public from (November 14, 2005 – December 16, 2005). Each public comment received regarding the content of this document has been addressed. Comments and associated responses are found in Appendix F.

It is anticipated that further study to refine targets and allocations provided in this plan, and any restoration activities as defined in Appendix C will involve stakeholder input.

MDEQ also provides an opportunity for public comment during the biennial review of the 303(d) list. This includes public meetings and opportunities to submit comments either electronically or through traditional mail. MDEQ announces the public comment opportunities through several media including press release and the internet.

SECTION 7.0
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APPENDIX A

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

APPENDIX A
TOTAL MAXIMUM DAILY LOAD (TMDL) DEFINITION, PURPOSE, AND CALCULATION & METALS STANDARDS FOR PROSPECT CREEK WATERSHED

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 a required pollutant load reduction.

"**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 (U.S. 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 Prospect Creek watershed 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.

TMDL Development for Prospect Creek Watershed

Section 303(d) of the Federal Clean Water Act requires that TMDLs be established 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 Prospect Creek watershed 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 (µg/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 Standards

Applicable Water Quality Standards

Water quality standards include; the uses designated for a water body, the legally enforceable standards that ensure that the uses are supported, and a nondegradation policy that protects the high quality of a water body. The ultimate goal of this TMDL document, once implemented, is to ensure that all designated beneficial uses are fully supported and all standards with regard to metals are met. Water quality standards form the basis for the targets described in Section 4.1. Pollutants addressed in this TMDL document include metals. This section provides a summary of the applicable water quality standards for metals in the Prospect Creek watershed.

Classification and Beneficial Uses

Classification is the assignment (designation) of a single or group of uses to a water body based on the potential of the water body to support those uses. Designated Uses or Beneficial Uses are simple narrative descriptions of water quality expectations or water quality goals. There are a variety of "uses" of state waters including: growth and propagation of fish and associated aquatic life; drinking water; agriculture; industrial supply; and recreation and wildlife. The Montana Water Quality Act (WQA) directs the Board of Environmental Review (BER, i.e., the state) to establish a classification system for all waters of the state that includes their present (when the Act was originally written) and future most beneficial uses (Administrative Rules of Montana (ARM) 17.30.607-616) and to adopt standards to protect those uses (ARM 17.30.620-670).

Montana, unlike many other states, uses a watershed based classification system with some specific exceptions. As a result, *all* waters of the state are classified and have designated uses and supporting standards. All classifications have multiple uses and in only one case (A-Closed) is a specific use (drinking water) given preference over the other designated uses. Some waters may not actually be used for a specific designated use, for example as a public drinking water supply, however the quality of that water body must be maintained suitable for that designated use. When natural conditions limit or preclude a designated use, permitted point source discharges or nonpoint source discharges may not make the natural conditions worse.

Modification of classifications or standards that would lower a water's classification or a standard (i.e., B-1 to a B-3), or removal of a designated use because of natural conditions can only occur if the water was originally miss-classified. All such modifications must be approved by the BER, and are undertaken via a Use Attainability Analysis (UAA) that must meet U.S. EPA requirements (40 CFR 131.10(g), (h) and (j)). The UAA and findings presented to the BER during rulemaking must prove that the modification is correct and all existing uses are supported. An existing use cannot be removed or made less stringent.

Descriptions of Montana's surface water classifications and designated beneficial uses are presented in Table A-1. All water bodies within the Prospect Creek Watershed are classified as B-1.

Table A-1. Montana Surface Water Classifications and Designated Beneficial Uses.

Classification	Designated Uses
A-CLOSED CLASSIFICATION:	Waters classified A-Closed are to be maintained suitable for drinking, culinary and food processing purposes after simple disinfection.
A-1 CLASSIFICATION:	Waters classified A-1 are to be maintained suitable for drinking, culinary and food processing purposes after conventional treatment for removal of naturally present impurities.

Table A-1. Montana Surface Water Classifications and Designated Beneficial Uses.

Classification	Designated Uses
B-1 CLASSIFICATION:	Waters classified B-1 are to be maintained suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.
B-2 CLASSIFICATION:	Waters classified B-2 are to be maintained suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.
B-3 CLASSIFICATION:	Waters classified B-3 are to be maintained suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.
C-1 CLASSIFICATION:	Waters classified C-1 are to be maintained suitable for bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.
C-2 CLASSIFICATION:	Waters classified C-2 are to be maintained suitable for bathing, swimming and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.
C-3 CLASSIFICATION:	Waters classified C-3 are to be maintained suitable for bathing, swimming and recreation; growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers. The quality of these waters is naturally marginal for drinking, culinary and food processing purposes, agriculture and industrial water supply.
I CLASSIFICATION:	The goal of the State of Montana is to have these waters fully support the following uses: drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and propagation of fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

Standards

In addition to the Use Classifications described above, Montana's water quality standards include numeric and narrative criteria as well as a nondegradation policy.

Numeric surface water quality standards have been developed for many parameters to protect human health and aquatic life. These standards are in the Department Circular WQB-7 (MDEQ, 2004a). The numeric human health standards have been developed for parameters determined to be toxic, carcinogenic, or harmful and have been established at levels to be protective of long-term (i.e., life long) exposures as well as through direct contact such as swimming.

The numeric aquatic life standards include chronic and acute values that are based on extensive laboratory studies including a wide variety of potentially affected species, a variety of life stages and durations of exposure. Chronic aquatic life standards are protective of long-term exposure to a parameter. The protection afforded by the chronic standards includes detrimental effects to reproduction, early life stage survival and growth rates. In most cases the chronic standard is more stringent than the corresponding acute standard. Acute aquatic life standards are protective of short-term exposures to a parameter and are not to be exceeded.

High quality waters are afforded an additional level of protection by the nondegradation rules (ARM 17.30.701 et. seq.,) and in statute (75-5-303 MCA). Changes in water quality must be "non-significant" or an authorization to degrade must be granted by the Department. However under no circumstance may standards be exceeded. It is important to note that, waters that meet or are of better quality than a standard are high quality for that parameter, and nondegradation policies apply to new or increased discharges to that the water body.

Narrative standards have been developed for substances or conditions for which sufficient information does not exist to develop specific numeric standards. The term "Narrative Standards" commonly refers to the General Prohibitions in ARM 17.30.637 and other descriptive portions of the surface water quality standards. The General Prohibitions are also called the "free from" standards; that is, the surface waters of the state must be free from substances attributable to discharges, including thermal pollution, that impair the beneficial uses of a water body. Uses may be impaired by toxic or harmful conditions (from one or a combination of parameters) or conditions that produce undesirable aquatic life. Undesirable aquatic life includes bacteria, fungi and algae.

The standards applicable to the metals are addressed below.

Metals

Numeric criteria for metals in Montana include specific standards for the protection of both aquatic life and human health. As described above, acute and chronic criteria have been established for the protection of aquatic life. The criteria for some metals vary according to the hardness of the water. The standards for cadmium, copper, chromium (III), lead, nickel, silver and zinc vary according to the hardness of the water. These standards have an inverse relationship to toxicity (decreasing hardness causes increased toxicity). The applicable numeric criteria for the metals of concern in the Prospect Creek Watershed are presented in Table 3-3.

It should be noted that recent studies have indicated some metals concentrations vary through out the day because of diel pH and alkalinity changes. In some cases the variation can cross the standard threshold (both ways) for a metal. Montana water quality standards are not time of day dependent.

Table A-2. Montana Numeric Surface Water Quality Standards for Metals.

Parameter	Aquatic Life (acute) (µL)[a]	Aquatic Life (chronic) (µL)[b]	Human Health (µL)[a]
Antimony	None	None	6
Arsenic (TR)	340	150	18
Lead (TR)	82 @ 100 mg/L hardness[c]	3.2 @ 100 mg/L hardness[c]	15
Zinc (TR)	67 @ 50 mg/L hardness[c]	67 @ 50 mg/L hardness[c]	2,000

[a]Maximum allowable concentration.
[b]No 4-day (96-hour) or longer period average concentration may exceed these values.
[c]Standard is dependent on the hardness of the water, measured as the concentration of $CaCO_3$ (mg/L) (see Appendix B for the coefficients to calculate the standard).
Note: TR – total recoverable.

In addition, the narrative criteria identified in Table A-3 can be applied such as in situations where excess metals loading from human activities is impacting aquatic life via elevated metals concentrations in sediment (17.30.637(1)(b). Also, narrative criteria can apply where this same type of metals loading is causing objectionable sludge deposits or emulsions in the stream.

Table A-3. Applicable Narrative Rules for Metals Related Pollutants.

Rule(s)	Standard
17.30.637(1)	State surface waters must be free from substances attributable to municipal, industrial, agricultural practices or other discharges that will.
17.30.637(1)(a)	Settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines.
17.30.637(1)(d)	Create concentrations or combinations of materials that are toxic or harmful to human, animal, plant, or aquatic life.

Water Hardness/Water Quality Restoration Target Interdependence

As discussed above, the aquatic water quality criteria are dependent on the water hardness (MDEQ, 2004a, Reference WQB-7; Note 12) for lead and zinc. The chronic aquatic life standard equation for these metals is identified below (WQB-7 also provides the applicable equation for acute aquatic life standards):

$$(X\ \mu g/L) = \exp\{mc[\ln(\text{hardness})] + bc\}$$

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 antimony and arsenic, the standard and associated targets are not a function of hardness.

Aquatic Life Support Restoration Targets

In addition to the numeric water quality standards, TMDL 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.

Stream Sediment Metals Concentration Targets

Since there are no numeric limits for metals in sediments as there are for water, the above narrative standard can be used to justify TMDL targets to address potential excess metals concentrations in sediments. 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.

APPENDIX B

PROSPECT CREEK WATERSHED
METALS-RELATED DATA COMPILATION

Table B-1. **Monitoring Data for Site A1**

Location: Upper West Fork Antimony Creek

Site	Sample Date	Alkalinity (mg/L as CaCO3)	As (µg/L)	Ca (mg/L)	Cd (µg/L)	Flow (cfs)	Hardness (mg/L as CaCO3)	Mg (mg/L)	Na (mg/L)	Pb (µg/L)	pH	Sb (µg/L)	SC (µS/cm)	SO4 (mg/L)	Zn (µg/L)
A1	25-Nov-98	21.5	<5			0.0015	30.6		3.33	<2	6.96	160	100	28.5	<20
A1	27-Apr-99	10.5	6			1.2	22.6		2.28	<2	6.99	19	45	12.1	<10
A1	25-Jun-99	14.5	<5			0.011	21.2		3.43	40	7.06	37	87		<10
A1	25-Aug-99					0.0003									
A1	12-Nov-99	24	5			0.004	55.4		2.76	<2	7.47	<3	143		<10
A1	26-Apr-00	10	8			1.2	28		2.55	<2	7.06	20	61		14
A1	29-Jun-00	18.5	8			0.007	49		3.48	<2	7.25	19	115	31.3	<10
A1	19-Sep-00	26	8			0.002	66.4		4.06	<2	6.95	26	147	42.9	<10
A1	28-Nov-00					dry									
A1	25-Apr-01		7			0.03			2.78	2	7.31	19	76	19.9	<10
A1	2-Aug-01					dry									
A1	23-Nov-01					0.0009									
A1	9-May-02		<5			0.027				<2	6.75	17			
A1	2-Jul-02		8			0.01				<2	7.3	27			
A1	29-Aug-02		6			0.0007				<2	7.53	32			
A1	17-Nov-02		13			0				<2	7.22	37			
A1	23-Apr-03		<1			140				<1	7.22	28			
A1	24-Aug-03		6.7							<1		32			

NOTES: [shaded box] = water quality exceedance

Metals data collected after 1993 is presumed to be expressed as total recoverable; prior to 1993 presumed to be total.

Table B-2. **Monitoring Data for Site A2**

Location: Upper East Fork Antimony Creek

Site	Sample Date	Alkalinity (mg/L as CaCO3)	As (µg/L)	Ca (mg/L)	Cd (µg/L)	Flow (cfs)	Hardness (mg/L as CaCO3)	Mg (mg/L)	Na (mg/L)	Pb (µg/L)	pH	Sb (µg/L)	SC (µS/cm)	SO4 (mg/L)	Zn (µg/L)
A2	25-Nov-98	38.5	56			0.002685	54.4		3.31	<2	7.43	330	126	28.4	<20
A2	27-Apr-99	9.5	15			1	11.6		1.84	<2	7.1	97	31	5.87	<10
A2	25-Jun-99	28	29			0.00438	44.8		2.86	<2	6.83	12	84		<10
A2	25-Aug-99					0.0002									
A2	12-Nov-99	33.5	56			0.002	59.2		3.42	<2	7.27	<3	149		<10
A2	26-Apr-00	11	26			0.667	30		2.01	<2	7.08	230	38		<10
A2	06/29100	31.5	47			0.004	40.2		2.81	<2	7.32	614	96	14.5	18
A2	19-Sep-00	42.5	55			0.002	56.4		3.25	<2	6.04	846	116	20	<10
A2	28-Nov-00					dry									
A2	25-Apr-01		29			0.02			1.91	18	7.12	155	35	5.5	<10
A2	08/28101					dry									
A2	23-Nov-01					0.0005									
A2	9-May-02		24			0.017				<2	6.53	229			
A2	2-Jul-02		38			0.01				<2	6.82	728			
A2	29-Aug-02		36			0.0005				<2	7.05	1060			
A2	17-Nov-02		67			0.00002				<2	7.05	1090			
A2	23-Apr-03		<1			0.01				<1	7.26	400			
A2	29-Jun-03		<1			0.001				3	7.03	850			
A2	24-Aug-03		34							<1		1030			

NOTES: [shaded cell] = water quality exceedance

Metals data collected after 1993 is presumed to be expressed as total recoverable; prior to 1993 presumed to be total.

Table B-3. **Monitoring Data for Site A3**

Location: Lower West Fork Antimony Creek

Site	Sample Date	Alkalinity (mg/L as CaCO3)	As (µg/L)	Ca (mg/L)	Cd (µg/L)	Flow (cfs)	Hardness (mg/L as CaCO3)	Mg (mg/L)	Na (mg/L)	Pb (µg/L)	pH	Sb (µg/L)	SC (µS/cm)	SO4 (mg/L)	Zn (µg/L)
A3	25-Nov-98	30	<5			0.004003	27		2.61	3	7.18	<3	57	8.46	<20
A3	27-Apr-99	11	<5			1.2	18		2.25	<2	7.12	13	47	10.3	<10
A3	25-Jun-99	18.5	<5			0.0021	28.4		3.17	<20	7.05	15	76		<10
A3	25-Aug-99														
A3	12-Nov-99	21	<5			0.007	41		3.23	<2	7.03	<3	110		11
A3	26-Apr-00	16	5			1.45	32.2		2.49	<2	7.12	14	46		11
A3	29-Jun-00	34	18			0.016	54.4		2.83	<2	7.48	462	120	25.6	<10
A3	19-Sep-00	27	<5			0.003	52.2		4.32	<2	7.17	17	123	35.6	<10
A3	28-Nov-00	24.5	10			0.00015	49.6		3.83	<2	7.08	14	106	29.1	18
A3	25-Apr-01		<5			0.9			2.62	<2	6.88	50	62	12.7	<10
A3	28-Aug-01					dry									
A3	23-Nov-01					0.008									
A3	9-May-02		11			0.14				<2	7.33	238			
A3	2-Jul-02		2			0.02				<2	7.18	15			
A3	29-Aug-02		4			0.0008				<2	7.24	14			
A3	17-Nov-02		4			0.0004				<2	7.18	16			
A3	23-Apr-03		3			0.02				<1	7.32	14			
A3	29-Jun-03		<1			0.002				<1	6.25	9			

NOTES: [shaded cell] = water quality exceedance

Metals data collected after 1993 is presumed to be expressed as total recoverable; prior to 1993 presumed to be total.

Table B-4. **Monitoring Data for Site A4**

Location: Lower East Fork Antimony Creek

Site	Sample Date	Alkalinity (mg/L as CaCO3)	As (µg/L)	Ca (mg/L)	Cd (µg/L)	Flow (cfs)	Hardness (mg/L as CaCO3)	Mg (mg/L)	Na (mg/L)	Pb (µg/L)	pH	Sb (µg/L)	SC (µS/cm)	SO4 (mg/L)	Zn (µg/L)
A4	25-Nov-98	24	<5			0.02906	40		3.19	2	7.34	13	87	22.9	<20
A4	27-Apr-99	16.5	12			1.3	22		1.98	<2	7.38	214	54	10.6	<10
A4	25-Jun-99	32	80			0.00167	48		3.21	60	7.19	257	111		<10
A4	25-Aug-99					0.0001									
A4	12-Nov-99	30.5	13			0.005	54.4		2.99	<2	7.35	<3	136		11
A4	26-Apr-00	17.5	15			1.12	22		2.11	<2	7.18	245	64		12
A4	29-Jun-00	18	5			0.01	38.4		3.44	<2	7.23	16	92	21.9	<10
A4	19-Sep-00	45	19			0.002	68.2		3.43	<2	7.2	458	141	35.8	<10
A4	28-Nov-00	31.5	15			0.0002	57		3.19	<2	7.28	514	119	31.7	62
A4	25-Apr-01		15			0.9			2.28	<2	7.37	550	93	19.2	<10
A4	28-Aug-01					dry									
A4	23-Nov-01					0.004									
A4	9-May-02		10			0.11				<2	6.79	248			
A4	2-Jul-02		10			0.2				<2	7.24	385			
A4	29-Aug-02		13			0.0009				<2	7.31	622			
A4	17-Nov-02		14			0.00002				<2	7.19	556			
A4	23-Apr-03		13			0.018				<1	7.49	428			
A4	29-Jun-03		9.9							14	7.02	525			

NOTES: [shaded box] = water quality exceedance

Metals data collected after 1993 is presumed to be expressed as total recoverable; prior to 1993 presumed to be total.

Table B-5. **Monitoring Data for Site S1**

Location: Prospect Creek above USAC Mill Site at bridge

Site	Sample Date	Alkalinity (mg/L as CaCO3)	As (µg/L)	Ca (mg/L)	Cd (µg/L)	Flow (cfs)	Hardness (mg/L as CaCO3)	Mg (mg/L)	Na (mg/L)	Pb (µg/L)	pH	Sb (µg/L)	SC (µS/cm)	SO4 (mg/L)	Zn (µg/L)
S1	1-Jun-87		<5								6.00	<10	29		
S1	1-Jul-87					dry									
S1	1-Jun-87					dry									
S1	1-Sep-87					dry									
S1	1-Oct-87					dry									
S1	1-Nov-87					dry									
S1	1-Dec-87					dry									
S1	21-Jan-88					dry									
S1	23-Mar-88										7.09	<20	30		
S1	21-Apr-88										7.02	<20	32		
S1	26-May-88										7.01	<20	33		
S1	9-Sep-89					dry									
S1	29-Mar-90		<40			20.88					7.67	<50	3.93		
S1	29-Jun-90		<40								7.01	<60	21.2		
S1	17-Nov-93		<40									**11.4**			
S1	8-Aug-94					dry									
S1	16-Mar-95	8.5	<1	2.2	0.1		6.03	0.614	1.01	<1	6.58	4	24	1.9	5.1
S1	21-Oct-95	8.2	<1		<0.2	11.42	7.36		1.32		6.3	1	22.2	2.3	
S1	9-Jan-96	8.9	<3	2.47	<0.2	13.48	9.24	<.002	1.16	<3	6.43	<3	26	2.9	3
S1	24-Apr-96	6.8	<1	1.94		too swift	7.45	0.633	1.07		6.6	2	26.4	1.7	
S1	13-Aug-96					dry									
S1	4-Dec-96					dry									
S1	24-Apr-97	7.8	<1	1.88		232	6.95	0.0527	1.37	<1	6.68	**20**	23.7	2	11
S1	25-Jun-97	7	<1	1.59		105	5.78	0.437	0.84	<1	6.52	<2	18.6	1.3	<4
S1	19-Aug-97					dry									
S1	25-Sep-97					dry									
S1	13-Dec-97					dry									
S1	17-Jan-98					dry									
S1	17-Apr-98	11.2	<5			80	8.2			<2	6.94	**14**	20	2.15	<20
S1	22-Jun-98	17	<5			61	10		1.29	<2	6.93	<3	19	2.18	<20
S1	11-Sep-98					dry								.	
S1	25-Sep-98					dry									
S1	13-Oct-98					dry							i1/t		
S1	25-Nov-98					dry									
S1	15-Dec-96					dry									
S1	26-Jan-99					42.75						<3			
S1	23-Feb-99					dry									
S1	29-Mar-99					189						<3			
S1	28-Apr-99	9	<5			192	7.8		1.18	**2**	7.12	<3	15	1.97	<10
S1	27-May-99					480						<3			
S1	25-Jun-99	8	<5			320	3.8		0.965	**23**	6.52	**22**	13		<10
S1	29-Jul-99					33.3						**9**			
S1	26-Aug-99					dry									
S1	27-Sep-99					dry									
S1	17-Nov-99	11.5	<5			9.6	9		2.17	<2	6.83	3	25		<10
S1	13-Dec-99					60						<3			
S1	26-Apr-00	10	<5			225	52.2		1.1	<2	6.91	<3	15		<10
S1	29-May-00					180						3			
S1	29-Jun-00	10.5	<5			150	9.8		1.04	<2	6.78	<3	17	1.45	<10
S1	28-Jul-00					0.67						<3			
S1	19-Sep-00					dry									
S1	28-Nov-00					dry									
S1	26-Apr-01		<5			91			1.32	<2	6.87	<3	19	2.1	<10
S1	28-Aug-01					dry									
S1	23-Nov-01					13									
S1	9-May-02		<5			120				<2	2.01	3			
S1	2-Jul-02		<2			150				<2	6.81	<3			
S1	29-Aug-02					dry									
S1	17-Nov-02					dry									
S1	23-Apr-03		<1			220				<1	6.74	4			
S1	29-Jun-03		<1			41.6				<1	6.89	<3			

NOTES: [shaded box] = water quality exceedance

Metals data collected after 1993 is presumed to be expressed as total recoverable; prior to 1993 presumed to be total.

Table B-8. **Monitoring Data for Site S6A**

Location: Prospect Creek below Therriault Gulch

Site	Sample Date	Alkalinity (mg/L as CaCO3)	As (µg/L)	Ca (mg/L)	Cd (µg/L)	Flow (cfs)	Hardness (mg/L as CaCO3)	Mg (mg/L)	Na (mg/L)	Pb (µg/L)	pH	Sb (µg/L)	SC (µS/cm)	SO4 (mg/L)	Zn (µg/L)
S6A	13-Dec-97	14.3	<1	3.45		20.7	12.7	1	1.84	<1	6.75	<2	38.7	3.3	<4
S6A	17-Jan-98					0.86						<3			
S6A	17-Apr-98	13.2	<5			107	10.8			4	6.99	13	29	3.89	<20
S6A	22-Jun-98	28	<5			41	14		2.19	<2	6.91	4	35	4.21	<20
S6A	11-Sep-98	21	<5			9.38	19.5		1.88	<2	6.82	3	41	2.5	<20
S6A	25-Sep-98					6						3			
S6A	13-Oct-98					0.05						<3			
S6A	25-Nov-98	23.5	<5			18.75	25.6		1.71	<2	6.44	<3	34	4.03	<20
S6A	15-Dec-98					32.57						<3			
S6A	26-Jan-99					53						5			
S6A	23-Feb-99					25.2						3			
S6A	29-Mar-99					240						6			
S6A	28-Apr-99	11.5	<5			210	11.6		1.54	<2	7.0	4	23	2.53	13
S6A	27-May-99					540						16			
S6A	25-Jun-99	10	<5			340	8.2		1.09	<2	6.51	10	18		<10
S6A	29-Jul-99					36						7			
S6A	26-Aug-99	17	<5			12.3	12		1.55	<2	6.83	3	34.6	1.97	<10
S6A	27-Sep-99					6.3						6			
S6A	1-Nov-99					4.9						<3			
S6A	17-Nov-99	16	<5			14	14.2		1.35	<2	6.53	4	36		<10
S6A	13-Dec-99					nlm						6			
S6A	26-Apr-00	11.5	<5			270	58.2		1.32	<2	6.86	5	23		<10
S6A	29-May-00					210						4			
S6A	29-Jun-00	15	<5			145	9.8		1.25	<2	6.95	9	25	1.76	<10
S6A	28-Jul-00					2.9						4			
S6A	19-Sep-00	16	<5			1.1	13		1.6	<2	6.36	4	30	2.52	<10
S6A	24-Oct-00					0.45						<3			
S6A	28-Nov-00	12	<5			0	12.6		1.9	<2	6.3		28	3.5	37
S6A	26-Apr-01		<5			42			1.63	<2	7.01	31	41	2.48	<10
S6A	28-Aug-01		<5			8				<2	6.97	3			
S6A	23-Nov-01					0.7									
S6A	8-May-02		<5			205				<2	6.56	6			
S6A	2-Jul-02		<2			170				<2	6.83	4			
S6A	29-Aug-02		<1			22				<2	7.09	28			
S6A	17-Nov-02		1							<2	6.67	<3			
S6A	23-Apr-03		<1			200				<1	6.88	4			
S6A	29-Jun-03		<1			34				<1	6.89	<3			
S6A	24-Aug-03		<1							<1		14			

NOTES: [shaded box] = water quality exceedance

Metals data collected after 1993 is presumed to be expressed as total recoverable; prior to 1993 presumed to be total.

Table B-7. **Monitoring Data for Site S5**

Location: Prospect Creek above Crow Creek confluence

Site	Sample Date	Alkalinity (mg/L as CaCO3)	As (µg/L)	Ca (mg/L)	Cd (µg/L)	Flow (cfs)	Hardness (mg/L as CaCO3)	Mg (mg/L)	Na (mg/L)	Pb (µg/L)	pH	Sb (µg/L)	SC (µS/cm)	SO4 (mg/L)	Zn (µg/L)
S5	8-Aug-94					fenced									
S5	16-Mar-95	7.7	<1	2.31	<0.1		8.56	<0.002	1.63	<1	6.54	6	28.5	3.97	4.1
S5	25-Oct-95	20.8	<1		<0.2		15.2	<0.0009	1.3	<1		<1	37.7	2	<1.9
S5	9-Jan-96	8.9	<3	2.84	<0.2	27.57	10.6	0.861	1.88	<3	6.48	6	33.9	6.5	3
S5	24-Apr-96		<1			Too swift					6.58	4	29.4	2	
S5	12-Jun-95		<1		<0.1					<1		11			<5
S5	13-Aug-96		<1			37.35				<1		5	45.4	1.8	<2
S5	21-Oct-95		<1		<0.2	0.5					6.48	<1	37.7	2	
S5	4-Dec-96					dry									
S5	24-Apr-97	10.8	<1	3.28		300	11.4	0.778	1.54	<1	6.61	6	31.7	2.4	42
S5	25-Jun-97	7.1	<1	1.61		165	5.95	0.471	1.14	<1	6.51	5	20.4	1.7	<4
S5	21-Aug-97					25						6			
S5	25-Sep-97	11	<1	2.62		6.66	9.53	0.728	1.57	3	6.68	<3		2	7
S5	13-Dec-97	11.9	<1	2.72		16.7	10.1	0.811	1.92	<1	6.53	3	32	2.1	7
S5	17-Jan-98					0.78						<3			
S5	17-Apr-98	10.8	<5			95	9.2			<2	6.96	16	25	3.7	<20
S5	22-Jun-98	22	<5			32	7		2	<2	6.91	13	21	2.45	<20
S5	11-Sep-98	13	<5			5.6	9.4		1.62	3	6.54	9	25.4	2.25	<20
S5	25-Sep-98					2.5						6			
S5	13-Oct-98					0.046						<3			
S5	25-Nov-98					dry									
S5	15-Dec-98					28.57						8			
S5	26-Jan-99					39.375						8			
S5	23-Feb-99					9.41						5			
S5	29-Mar-99					195						6			
S5	28-Apr-99	10	<5			195	7.6		1.5	<2	6.86	5	19	2.36	<10
S5	27-May-99					510						6			
S5	25-Jun-99	9	<5			240	6		1.36	<20	6.37	8	16		<10
S5	29-Jul-99					27						8			
S5	29-Aug-99	14	<5			7.6	10		1.67	<2	6.26	6	26.8	2.03	<10
S5	27-Sep-99					3.75						4			
S5	1-Nov-99					0.42						<3			
S5	17-Nov-99	11	<5			10	9.8		1.49	<2	6.55	5	26		<10
S5	13-Dec-99					41						6			
S5	26-Apr-00	9.5	<5			240	44.2		1.27	<2	6.81	8	16		<10
S5	29-May-00					190						5			
S5	29-Jun-00	8	<5			123	7.6		1.38	<2	6.8	10	16	1.64	<10
S5	28-Jul-00					2.5						5			
S5	19-Sep-00	10	<5			0.9	9.2		1.33	<2	6.4	4	22	2.11	<10
S5	24-Oct-00					0.4						<3			
S5	28-Nov-00					dry									
S5	26-Apr-01		<5			36			1.42	<2	6.62	3	30	2.83	<10
S5	28-Aug-01		<5			5				<2	6.45	7			
S5	23-Nov-01					1									
S5	9-May-02		<5			120				<2	6.6	10			
S5	2-Jul-02		<2			126				<2	6.67	5			
S5	29-Aug-02		<1			11				<2	6.68	3			
S5	17-Nov-02					dry									
S5	23-Apr-03		<1			195				<1	6.72	6			
S5	29-Jun-03		<1			36				<1	6.51	<3			
	24-Aug-03		<1							<1		<3			

NOTES: [shaded box] = water quality exceedance

Metals data collected after 1993 is presumed to be expressed as total recoverable; prior to 1993 presumed to be total.

Table B-6. **Monitoring Data for Site S2**

<u>Location:</u> Prospect Creek opposite mouth of Everson Gulch

Site	Sample Date	Alkalinity (mg/L as CaCO3)	As (µg/L)	Ca (mg/L)	Cd (µg/L)	Flow (cfs)	Hardness (mg/L as CaCO3)	Mg (mg/L)	Na (mg/L)	Pb (µg/L)	pH	Sb (µg/L)	SC (µS/cm)	SO4 (mg/L)	Zn (µg/L)
S2	16-Mar-95	7.7	<1	2.31	<0.1		8.56	<0.0020	1.63	<1	6.54	6	28.5	3.97	4.1
S2	12-Jun-95		<1		<0.1					<1		11			<5
S2	25-Oct-95	20.8	<1		<0.2		15.2	<0.0009	1.3	<1		<1	37.7	2	<1.9
S2	9-Jan-96	8.9	<3	2.84	<0.2	27.57	10.6	0.861	1.88	<3	6.48	6	33.9	6.5	3
S2	24-Apr-96		<1			Too swift					6.58	4	29.4	2	
S2	20-Aug-97														
S2	25-Sep-97														
S2	13-Dec-97														
S2	18-Jan-98					dry									
S2	17-Jan-98					dry									
S2	17-Apr-98	11.4	<5			84	7.2			<2	7.06	11	20	2.22	<20
S2	22-Jun-98	18	<5			47	8.5		1.3	<2	7.04	5	19	2.02	<20
S2	11-Sep-98					dry									
S2	25-Sep-98					dry									
S2	13-Oct-98					dry									
S2	25-Nov-98					dry									
S2	15-Dec-98					dry									
S2	26-Jan-99					dry									
S2	23-Feb-99					dry									
S2	29-Mar-99					195						<3			
S2	28-Apr-99	9	<5			195	6.6		1.3	<2	7.01	4	15	1.77	<10
S2	27-May-99					480						<3			
S2	25-Jun-99	6.5	<5			330	7.8		0.926	40	6.5	6	12		<10
S2	29-Jul-99					dry									
S2	26-Aug-99					dry									
S2	27-Sep-99					dry									
S2	17-Nov-99					dry									
S2	13-Dec-99					37						8			
S2	26-Apr-00	8	<5			200	25.4		1.18	<2	6.84	3	15		<10
S2	29-May-00					180						7			
S2	29-Jun-00	8.5	<5			75	8.2		1.05	<2	6.9	<3	15	1.36	<10
S2	28-Jul-00					dry									
S2	19-Sep-00					dry									
S2	28-Nov-00					dry									
S2	26-Apr-01		<5			47			1.3	<2	7.03	3	19	1.71	<10
S2	28-Aug-01					dry									
S2	23-Nov-01					dry									
S2	9-May-02		<5			85				<2	6.29	4			
S2	2-Jul-02		<2			130				<2	6.71	<3			
S2	29-Aug-02					dry									
S2	17-Nov-02					dry									
S2	23-Apr-03		<1			190				<1	6.66	<3			
S2	29-Jun-03					dry									

NOTES: [shaded box] = water quality exceedance

Metals data collected after 1993 is presumed to be expressed as total recoverable; prior to 1993 presumed to be total.

Table B-9. **Monitoring Data for Site S11**

Location: Cox Gulch above mill

Site	Sample Date	Alkalinity (mg/L as CaCO3)	As (µg/L)	Ca (mg/L)	Cd (µg/L)	Flow (cfs)	Hardness (mg/L as CaCO3)	Mg (mg/L)	Na (mg/L)	Pb (µg/L)	pH	Sb (µg/L)	SC (µS/cm)	SO4 (mg/L)	Zn (µg/L)
S11	8/21/1986		<5									<10			
S11	3/16/1995	6.5	<1	1.81	<0.1		7.01	0.606	1.62			22		25	
S11	6/12/1995		1		<1		.					1		46	
S11	10/21/1995		<1		<0.2	0.031					7.53	1		44	
S11	1/9/1996		<3		<0.2	3.48						<3	4	30.2	
S11	4/24/1996		<1			23.5						1		27	
S11	5/23/1996	<10	1	1.5			6	0.5	1.4	<1	7.43	2	26	<6	6
S11	8/13/1996		<1			2						9		60.3	
S11	12/4/1996					dry									
S11	4/24/1997	6.4	<1	1.58		12.5	6.2	0.543	1.64			<2		25.2	
S11	6/25/1997	8.1	<1	2		1.25	7.82	0.688	1.62	<1	6.52	<2	28.2	3.7	<4
S11	8/21/1997					0.04						<3			
S11	9/25/1997					dry									
S11	12/13/1997	8.4	<1	2.66		<.01	10.5	0.945	2.33	<1	6.41	8	37	6.6	<4
S11	1/17/1998					0						<3			
S11	4/17/1998	9.2	<5			2.9	4.4			<2	6.86	11	23	3.68	<20
S11	6/22/1998	23	<5			0.69	7		2.13	<2	6.85	10	29	4.36	<20
S11	9/11/1998					dry									
S11	9/25/1998					dry									
S11	10/13/1998					dry									
S11	11/25/1998	15.5	<5			0.031	12.4		2.3	<2	6.54	4	37	6.76	<20
S11	12/15/1998					0.047						3			
S11	1/26/1999					0.6						6			
S11	2/23/1999					0.022						<3			
S11	3/29/1999					4.6						<3			
S11	4/28/1999	7	<5			8	13.2		1.47	45	6.96	<3	16	2.89	<10
S11	5/27/1999					22.23						<3			
S11	6/25/1999	9.5	<5			0.95	9.4		1.85	<2	6.46	7	23		<10
S11	7/29/1999					0.01						5			
S11	9/27/1999					0.002						7			
S11	11/1/1999					0.008						3			
S11	11/12/1999	8.5	<5			0.002	12.8		2.21	<2	6.02	<3	43		<10
S11	12/13/1999					0.17						4			
S11	4/26/2000	8.5	<5			6	52.8		1.59	<2	6.81	<3	17		<10
S11	5/29/2000					1.8						4			
S11	6/29/2000	12	<5			1.3	14		1.97	<2	6.93	6	28	4.72	<10
S11	7/28/2000			nil		0.002						<3			
S11	9/19/2000	15	<5			0.004	14.6		2.36	<2	6.21	<3	39	618	<10
S11	10/24/2000					0.001						<3			
S11	11/28/2000	9.5	<5			0.002	13		2.25	<2	6.23	<3	36	7.86	34
S11	4/26/2001		<5			8.3			1.62	<2	6.85	<3	20	3.49	<10
S11	8/8/2001														
S11	11/23/2001														
S11	5/9/2002		<5			35				<2	6.52	15			
S11	7/2/2002		<2							<2	6.68	<3			
S11	8/29/2002		<1			0.002				<2	6.37	4			
S11	11/17/2002		1			0.001				<2	6.15	<3			
S11	4/23/2003		<1			3.6				<1	6.89	<3			
S11	6/26/2003		<1			0.017				<1	6.32	<3			

NOTES: [shaded box] = water quality exceedance

Metals data collected after 1993 is presumed to be expressed as total recoverable; prior to 1993 presumed to be total.

Table B-10. **Monitoring Data for Site 4906PR01**

Location: Prospect Creek at mouth

Site	Sample Date	Carbonate Alkalinity (mg/L as CaCO3)	As,T (µg/L)	Bicarbonate (mg/L)	Ca (mg/L)	Cd, T (µg/L)	Cl (mg/L)	Cu (T (µg/L)	Dissolved O2 (mg/L)	Fe, T (µg/L)	Fecal Coliform (#/100 mL)	Flow (cfs)	Hardness (mg/L as CaCO3)	K (mg/L)	Mg (mg/L)	Mn, T (µg/L)	Na (mg/L)	NH3 (mg/L)
4906PR01	3/27/74	21	<10	25	5.6	<1	0.5	<10		>100			20		1.5	<10	2.1	0.01
4906PR01	7/31/74	24		29	5.1		0	<10	10.2	>50	70	150.2	21		1.9	<10	1.6	
4906PR01	3/22/83	22		27	6.1		0.6					254	21	0.4	1.3		2.5	<DL
4906PR01	7/14/88																	<DL
4906PR01	8/18/88																	<DL
4906PR01	9/15/88																	<DL
4906PR01	10/13/88																	<DL
4906PR01	11/17/88																	<DL
4906PR01	12/15/88																	<DL
4906PR01	1/18/89																	<DL
4906PR01	3/23/89																	<DL
4906PR01	4/6/89																	<DL
4906PR01	4/19/89																	<DL
4906PR01	5/3/89																	<DL
4906PR01	5/17/89																	<DL
4906PR01	5/31/89																	<DL
4906PR01	6/15/89																	<DL
4906PR01	6/28/89																	<DL
4906PR01	7/20/89																	<DL
4906PR01	8/17/89																	<DL
4906PR01	9/20/89																	<DL
4906PR01	10/18/89																	<DL
4906PR01	11/16/89																	<DL
4906PR01	12/13/89																	<DL
4906PR01	1/16/90																	<DL
4906PR01	2/6/90																	<DL
4906PR01	3/14/90																	<DL
4906PR01	4/11/90																	0.01
4906PR01	4/24/90																	<DL
4906PR01	5/8/90																	0.02
4906PR01	5/22/90																	<DL
4906PR01	6/7/90																	<DL
4906PR01	6/19/90																	<DL
4906PR01	7/18/90																	<DL
4906PR01	8/8/90																	<DL
4906PR01	9/11/90																	<DL
4906PR01	10/16/90																	<DL
4906PR01	11/13/90																	<DL
4906PR01	12/19/90																	<DL
4906PR01	1/16/91											161						<DL
4906PR01	2/12/91											235						<DL
4906PR01	3/13/91																	<DL
4906PR01	4/11/91																	<DL
4906PR01	4/25/91																	<DL
4906PR01	5/15/91																	<DL
4906PR01	5/29/91																	<DL
4906PR01	6/12/91																	<DL
4906PR01	6/27/91																	<DL

Table B-10. **Monitoring Data for Site 4906PR01** (continued)

Location: Prospect Creek at mouth

Site	Sample Date	NO2+NO3 as N (mg/L)	P (total) (mg/L)	PO4 (mg/L)	Pb, T (µg/L)	pH	SC (µS/cm)	SO4 (mg/L)	TOC (mg/L)	TKN (mg/L)	Turbidity (JCU)	Water Temp (°C)	Zn, T (µg/L)
4906PR01	3/27/74				<10	7.3	50	4.5	2		1	6.8	<10
4906PR01	7/31/74		0.28			7.45	60	2			0.5	12.5	<10
4906PR01	3/22/83	0.01	<DL			7.05	60	5.5			0.7	4.0	
4906PR01	7/14/88	0.02	<DL							<DL		12.8	
4906PR01	8/18/88	0.02	0.01	0.1						0.2		12.5	
4906PR01	9/15/88	0.02	0.01	0.1						0.1		13.1	
4906PR01	10/13/88	0.02	0.01							<DL		8.7	
4906PR01	11/17/88	<DL	0.01							<DL		6.1	
4906PR01	12/15/88	0.05	0.01							<DL		2.6	
4906PR01	1/18/89	0.03	0.01							0.2		5.4	
4906PR01	3/23/89	0.02	0.01							0.5			
4906PR01	4/6/89	0.03	0.03	<DL						0.4			
4906PR01	4/19/89	0.04	0.01							0.5			
4906PR01	5/3/89	0.02	0.02							<DL			
4906PR01	5/17/89	0.06	0.01							0.2			
4906PR01	5/31/89	<DL	0.01							<DL			
4906PR01	6/15/89	<DL	0.01							<DL			
4906PR01	6/28/89	0.02	0.01							0.4			
4906PR01	7/20/89	0.02	0.01	<DL						<DL			
4906PR01	8/17/89	0.02	0.01							<DL			
4906PR01	9/20/89	<DL	0.01							<DL			
4906PR01	10/18/89	0.02	0.01							<DL			
4906PR01	11/16/89	0.03	0.01							<DL			
4906PR01	12/13/89	0.02	0.01							<DL			
4906PR01	1/16/90	0.02	0.01	0.1						<DL			
4906PR01	2/6/90	0.01	0.01							0.1			
4906PR01	3/14/90	0.01	0.01							0.2			
4906PR01	4/11/90	0.01	0.01							0.2			
4906PR01	4/24/90	0.01	0.01							0.1			
4906PR01	5/8/90	<DL	0.01	0.1						<DL			
4906PR01	5/22/90	0.01	0.01							<DL			
4906PR01	6/7/90	0.01	0.01							<DL			
4906PR01	6/19/90	<DL	0.01							0.1			
4906PR01	7/18/90	<DL	0.01							<DL			
4906PR01	8/8/90	<DL	0.01							<DL			
4906PR01	9/11/90	<DL	0.01							<DL			
4906PR01	10/16/90	0.01	0.01							<DL			
4906PR01	11/13/90	0.02	0.01							<DL			
4906PR01	12/19/90	0.03	0.01							<DL			
4906PR01	1/16/91	<DL	0.01							<DL			
4906PR01	2/12/91	0.01	0.01							<DL			
4906PR01	3/13/91	0.02	0.01							0.1			
4906PR01	4/11/91	0.02	0.01							<DL			
4906PR01	4/25/91	0.02	0.01							0.1			
4906PR01	5/15/91	<DL	0.01							0.2			
4906PR01	5/29/91	0.02	0.01							0.9			
4906PR01	6/12/91	<DL	0.02	0.1						0.2			
4906PR01	6/27/91	<DL	0.01							<DL			

Table B-11.	Monitoring Data for Site 12390700			
Location:	Prospect Creek at mouth			
Site	**Sample Date**	**Flow (cfs)**	**SC (µS/cm)**	**Water Temp (°C)**
12390700	7-Oct-82	63	86	8
12390700	24-Nov-82	50	82	2
12390700	25-Jan-83	0.12	56	2
12390700	18-Mar-83	327	51	3
12390700	5-May-83	467	47	7
12390700	26-May-83	1210	35	8
12390700	22-Jun-83	282	53	9
12390700	3-Aug-83	107	71	11
12390700	5-Oct-83	57	80	7
12390700	17-Nov-83	52	71	5.5
12390700	11-Jan-84	111	55	3.5
12390700	7-Mar-84	92	52	4
12390700	24-Apr-84	408	49	5
12390700	24-May-84	725	43	6
12390700	26-Jun-84	412	34	13
12390700	28-Aug-84	68	78	10
12390700	2-Oct-84	52	76	8.5
12390700	27-Nov-84	58	64	3
12390700	18-Jan-85	46	69	3
12390700	7-Mar-85	42	73	3
12390700	18-Apr-85	870	38	4
12390700	24-May-85	1130	35	6.5
12390700	16-Jul-85	128	69	14
12390700	21-Aug-85	79	80	12
12390700	2-Oct-85	57	81	6
12390700	4-Dec-85	109	54	2
12390700	4-Feb-86	91	60	4
12390700	5-Mar-86	728	40	5
12390700	16-Apr-86	462	57	8
12390700	27-May-86	834	31	10
12390700	14-Jul-86	105	74	12
12390700	4-Sep-86	52	82	11.5
12390700	2-Oct-86	45	84	9.5
12390700	19-Nov-86	42	75	3
12390700	6-Jan-87	55	70	4
12390700	17-Feb-87	48	67	5
12390700	8-Apr-87	331	45	8
12390700	4-May-87	636	34	6.5
12390700	18-Jun-87	129	62	11
12390700	15-Jul-87	77	76	16
12390700	3-Sep-87	50	85	12
12390700	7-Oct-87	35	79	7.5
12390700	17-Nov-87	30	81	3.5
12390700	5-Jan-88	32	80	2
12390700	6-Jan-88	28	86	2.5
12390700	18-Feb-88	36	78	4
12390700	6-Apr-88	270	48	8
12390700	24-May-88	522	35	6.5

Table B-11. (continued)				
	Monitoring Data for Site 12390700			
Location:	Prospect Creek at mouth			
Site	**Sample Date**	**Flow (cfs)**	**SC (µS/cm)**	**Water Temp (°C)**
12390700	29-Jun-88	135	65	9.5
12390700	18-Aug-88	62	80	12
12390700	5-Oct-88	36	78	8
12390700	22-Nov-88	41	73	6
12390700	10-Jan-89	70	61	2.5
12390700	22-Feb-89	63	60	4.5
12390700	2-May-89	584	45	6.5
12390700	8-Jun-89	600	39	8
12390700	20-Jul-89	110	85	12.5
12390700	29-Aug-89	68	77	12
12390700	4-Oct-89	49	75	8.5
12390700	15-Nov-89	269	39	4.5
12390700	8-Jan-90	189	46	5.5
12390700	26-Feb-90	156	57	4.5
12390700	2-Apr-90	493	47	9
12390700	30-May-90	855	32	6.5
12390700	26-Jun-90	431	103	8.5
12390700	20-Jul-90	129	64	9
12390700	30-Aug-90	75	106	9
12390700	24-Sep-90	59	75	8.5
12390700	16-Oct-91	52	94	8
12390700	10-Dec-91	54	80	4
12390700	19-Feb-92	116	144	6
12390700	7-May-92	573	34	12
12390700	9-Jun-92	144	48	14.5
12390700	21-Jul-92	78	59	15.5
12390700	1-Sep-92	49	68	15
12390700	7-Oct-92	36	71	8.5
12390700	3-Dec-92	35	61	1
12390700	10-Feb-93	35	74	4
12390700	1-Apr-93	222	45	7
12390700	5-May-93	533	44	10
12390700	19-May-93	886	29	10.5
12390700	16-Jun-93	204	46	11
12390700	18-Aug-93	89	57	10.5
12390700	6-Oct-93	53	116	8
12390700	18-Nov-93	41	69	5
12390700	17-Feb-94	37	72	4
12390700	30-Mar-94	109	56	8
12390700	12-May-94	610	34	11
12390700	22-Jun-94	121	52	12
12390700	27-Jul-94	66	61	18
12390700	6-Oct-94	29	77	10
12390700	7-Dec-94	39	69	3
12390700	22-Feb-95	990	33	5
12390700	20-Apr-95	272	56	4

Table B-11. (continued)				
	Monitoring Data for Site 12390700			
Location:	Prospect Creek at mouth			
Site	**Sample Date**	**Flow (cfs)**	**SC (µS/cm)**	**Water Temp (°C)**
12390700	1-Jun-95	597	36	11
12390700	26-Jul-95	91	56	13.5
12390700	20-Sep-95	51	66	11
12390700	21-Nov-95	340	74	4.5
12390700	1-Dec-95	2570	28	6
12390700	8-Feb-96	1160	45	3
12390700	1-Mar-96	388	45	1
12390700	11-Apr-96	1360	41	5.5
12390700	20-May-96	1030	43	7
12390700	20-Jun-96	393	54	7
12390700	23-Jul-96	128	67	11.5
12390700	10-Oct-96	52	84	8
12390700	3-Dec-96	42	81	0
12390700	14-Jan-97	153	57	0
12390700	26-Mar-97	647	50	1
12390700	9-May-97	1120	42	5.5
12390700	21-Aug-97	99	61	12
12390700	7-Oct-97	68	71	8
12390700	3-Dec-97	87	58	4
12390700	18-Mar-98	101	54	6
12390700	30-Apr-98	641	34	9.5
12390700	2-Feb-99	121	57	4
12390700	17-Mar-99	172	62	7
12390700	12-May-99	402	51	8.5
12390700	31-Aug-99	79	61	11
12390700	7-Oct-99	57	131	6
12390700	25-Feb-00	110	63	5
12390700	28-Mar-00	261	169	
12390700	18-May-00	739	87	8
12390700	14-Jun-00	445	69	8.5
12390700	27-Jul-00	100	75	11
12390700	30-Aug-00	62	100	12.5
12390700	28-Sep-00	49	79	10
12390700	12-Dec-00	32	89	0.5
12390700	20-Mar-01	38	98	2.5
12390700	27-Apr-01	88	65	8
12390700	7-May-01	251	73	8.5
12390700	15-May-01	577	55	8.5
12390700	20-Jun-01	142	63	6
12390700	30-Jul-01	71	60	8.5
12390700	20-Sep-01	34	76	9
12390700	9-Oct-01	31	88	7.5
12390700	14-Nov-01	30	81	6.5
12390700	15-Jan-02	142	83	2
12390700	26-Mar-02	149	75	5
12390700	17-Apr-02	964	39	5.5
12390700	22-May-02	1670	43	6
12390700	28-Jun-02	719	36	8
12390700	14-Aug-02	99	71	14.5

Table B-12. **Monitoring Data for Sites C13DRYC01, C13CLERC01, C13CLERC02**

Location: Tributaries to Prospect Creek

Site	Sample Date	Ag, TR (µg/L)	Al, TR (µg/L)	As, TR (µg/L)	Alkalinity (mg/L as CaCO3)	Ba, TR (µg/L)	Be, TR (µg/L)	Ca (mg/L)	Cd, TR (µg/L)	Cl (mg/L)	Cr, TR (µg/L)	Cu, TR (µg/L)	Dissolved O2 (mg/L)	Fe, TR (µg/L)	Flow (cfs)	Hardness (mg/L as CaCO3)	K (mg/L)	Mg (mg/L)	Mn, TR (µg/L)	Na (mg/L)	Ni, TR (µg/L)	NO2+NO3 as N (mg/L)	P (tot) (mg/L)	Pb, TR (µg/L)	pH	Sb, TR (µg/L)	SC (µS/cm)	Se, TR (µg/L)	SO4 (mg/L)	TDS (mg/L)	TKN (mg/L)	Tl, TR (µg/L)	TSS (mg/L)	Water Temp (°C)	Zn, TR (µg/L)
C13DRYC01	8/8/2003	<1	<10	8	84	28	<1	23	<0.1	<1	<1	<1	16.55	10	13	82.3	0.6	6.0	<5	1.6	<10	0.03	0.006	<1	7.42	<1	140	<2	1.58	89	<0.1	<1	1.1	7.21	<1
Dry Creek at mouth																																			
C13CLERC01	8/9/2003	<1	10	<1	12	19	<1	2.2	<0.1	<1	<1	<1	12.67	10	6	7.6	0.3	0.5	<5	1.5	<10	<0.01	0.008	<1	6.1	<1		<2	1.63	19	<0.1	<1	<1	13.4	<1
Upper Clear Creek (9.7 miles from mouth)																																			
C13CLERC02	8/9/2003	<1	30	<1	12	17	<1	2.4	<0.1	<1	<1	<1	12.47	30		8.8	0.3	0.7	<5	1.5	<10	<0.01	0.01	<1	5.2	<1		<2	1.68	26.5	<0.1	<1	1	13.9	<1
Lower Clear Creek (150 yards upstream of Prospect Creek road)																																			

Sediment Sample Results

		Total Concentrations (µg/g)															
Site	**Sample Date**	**Ag**	**Al**	**As**	**Ba**	**Be**	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Sb**	**Se**	**Tl**	**Zn**
C13DRYC01	8/8/2003	<0.25	10,400	1.58	140	<0.5	<0.25	7.41	16	10,800	165	9.5	15	0.36	1.31	0.81	47.4
Dry Creek at mouth																	

APPENDIX C

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

APPENDIX C
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 tend to address petroleum.

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

Cleanup actions under CERCLA must be based on professionally developed plans and can be categorized as either Removal or Remedial. Removal actions can be used to address the immediate need to stabilize or remove a threat where an emergency exists. 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. Any remaining threats or impacts would tend to be associated with wildlife, aquatic life, or aesthetic impacts to the environment or aesthetic impacts to drinking water supplies versus threats or impacts to human health. A site could, therefore, still be a concern from a water quality restoration perspective, even after CERCLA removal activities have been completed.

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

2.0 The Montana Comprehensive Cleanup and Restoration Act (CECRA)

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

The 1987 Montana Legislature passed a bill creating a delayed funding mechanism that appropriated 4 percent of the Resource Indemnity Trust (RIT) interest money for Department activities at non-National Priority List facilities beginning in July 1989 (§ 15-38-202 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 Responsible Parties (PRP) to petition for an allocation of liability as an alternative to the strict, joint and several liability scheme included in CECRA. CALA provides a streamlined alternative to litigation that involves negotiations designed to allocate liability among persons involved at facilities requiring cleanup, including bankrupt or defunct persons. Cleanup of these facilities must occur concurrently with the CALA process and CALA provides the funding for the orphan share of the cleanup. Since CECRA cleanups typically involve historical contamination, liable persons often include entities that are bankrupt or defunct and not affiliated with any viable person by stock ownership. The share of cleanup costs for which these bankrupt or defunct persons are responsible is the orphan share. Department represents the interests of the orphan share throughout the CALA process.

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

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

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

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

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 it 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 coalmines 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 also has a list of priority sites from which to work from. Currently, there are no mine sites from Prospect Creek drainage on the priority list. 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 Prospect Creek drainage.

APPENDIX D

PRELIMINARY WATER AND SEDIMENT SAMPLING PLAN TO ADDRESS IDENTIFIED DATA GAPS

TOTAL MAXIMUM DAILY LOAD (TMDL) DEVELOPMENT FOR METALS PROSPECT CREEK WATERSHED SUPPLEMENTAL MONITORING PLAN

1.0 Objectives

Prospect Creek, a tributary to the Clark Fork River, is located in northwest Montana west of Thompson Falls. This Supplemental Monitoring Plan for the Prospect Creek Watershed outlines proposed surface water data collection activities to support development of a metals TMDL for the watershed. The objectives of these monitoring activities include:

- Fill data gaps identified during the Data Compilation/Source Assessment portion of the TMDL process;
- Further delineate metals loading sources and trends in the watershed; and
- Better quantify seasonal water quality criteria exceedances in the watershed under current conditions.

These objectives are intended to achieve the overall goal of obtaining a set of representative water quality data to complement the existing database for the Prospect Creek watershed, allowing refinement of the metals TMDL for Prospect Creek. The general nature and location of potential metals source areas were identified in the Data Compilation and Source Assessment based on the current dataset; however, the additional data collection activities proposed in this plan address uncertainties in source delineation as follows:

- Additional surface water monitoring locations are proposed to better delineate metals loading trends in Prospect Creek and to provide data on potential metals loading from significant tributary drainages;
- Analysis of both total recoverable and dissolved metals is proposed, to aid in determining the potential contribution of metals-bearing groundwater to surface water metals loads; and
- Stream sediment sampling is proposed to evaluate the potential for bed sediments to act as a source of metals loading under certain conditions, and/or contribute to impairment conditions.

2.0 Monitoring Sites

Proposed monitoring sites for the supplemental monitoring in the Prospect Creek Watershed are shown on Figure D-1. A total of 19 surface water monitoring sites are proposed, including nine existing surface water sites sampled during previous monitoring activities, and nine new sites. The new sites are categorized as primary (seven sites) and secondary (three sites), with the primary sites considered to be most critical for filling data gaps (Figure D-1). Primary sites are located in lower Antimony Creek, upper and lower Cox Gulch, at the mouth of Crow Creek and Cooper Gulch, and on the mainstem Prospect Creek above the confluence with Antimony Creek and downstream of the confluence with Buster Brown Gulch. Secondary sites include middle Cox Gulch, lower Therriault Gulch, and mainstem Prospect Creek upstream of Lucky Boy Gulch. In combination with the nine existing monitoring sites, this monitoring network will greatly increase current knowledge of the nature and distribution of metals loading sources in the drainage, and allow for more specific load allocations.

In addition to the surface water monitoring, four sediment sampling sites are proposed. The proposed sediment sampling sites correspond with existing surface water monitoring sites S-2 and S-5, and the proposed sites in lower Antimony Creek and lower Cox Gulch. All proposed monitoring locations are described in Table D-1. If macroinvertebrate sampling is pursued in conjunction with the sediment sampling, then standard MDEQ sampling and analysis protocol will be used.

3.0 Analytical Parameters

The analytical parameter list for water and sediment samples is shown in Table D-2. The laboratory parameter list for water includes total recoverable and dissolved metals (to assist in identification of metals loading sources), calcium and magnesium (for hardness calculations to evaluate hardness-dependent water quality criteria), sulfate (a relatively conservative constituent potentially indicative of mining-related sources), and total dissolved solids. Field-analyzed parameters will include pH, specific conductance (SC), dissolved oxygen, water temperature, and flow. Sediment samples will be analyzed for total metals.

4.0 Monitoring Schedule

Synoptic surface water monitoring will be conducted at all locations under both high and low flow conditions to further assess seasonal variability in metals concentrations and loads, and to evaluate the relative impact of loading sources during high and low flow conditions. Based on the hydrograph obtained from the USGS gage at the mouth of Prospect Creek, high flow sampling would be conducted in April or May, and low flow sampling in August or September. It is likely that some of the monitoring sites will be dry during the low flow sampling event.

5.0 Quality Control/Quality Assurance

During each monitoring event, field quality control (QC) samples will be collected to aid in the evaluation of data quality. Field QC samples will include:

- One field duplicate sample pair; and
- One blank sample.

The duplicate sample pair will consist of two sets of sample bottles, labeled with different sample code numbers, and collected from the same sampling location at the same time. The laboratory will not be made aware that the two samples are from the same location.

The field blank sample will consist of deionized (reagent-free) water, collected in sample bottles and preserved as appropriate for the desired analysis. The blank sample for dissolved metals will be filtered using the same type of filtration equipment used for surface water samples.

Additional quality assurance for data collection activities will be provided by adherence to Standard Operating Procedures (SOPs) for surface water sampling available from MDEQ at http://www.deq.state.mt.us/wqinfo/monitoring/SOP/sop.asp. Laboratories selected to analyze samples collected under this plan will also be required to analyze and provide results for standard laboratory QC samples, including laboratory blanks, duplicates, control standards, and spike samples.

Table D-1. Prospect Creek Supplemental Surface Water Monitoring Locations

Existing Site	New Site*	Description	Rationale for New Sites
S-6A		Prospect Creek below Therriault Gulch	
	S	Mouth of Therriault Gulch	Assess potential loading from Therriault Gulch
	P	Mouth of Crow Creek	Assess potential loading from Crow Creek
S-5**		Prospect Creek above Crow Creek confluence	
	S	Prospect Creek above Lucky Boy Gulch confluence	Further assess loading trends through mainstem Prospect Creek and assess potential loading from Lucky Boy Gulch
	P	Prospect Creek below Buster Brown Gulch	Further assess loading trends through mainstem Prospect Creek and assess potential loading from Buster Brown Gulch
	P**	Cox Gulch above Prospect Creek confluence	Assess potential loading from lower Cox Gulch
S-2**		Prospect Creek opposite mouth of Everson Gulch	
S-11		Cox Gulch above mill	
	S	Cox Gulch, near drainage midpoint	Further assess loading trends in Cox Gulch
	P	Cox Gulch at upstream end	Further assess loading trends in Cox Gulch
S-1		Prospect Creek above USAC mill site at bridge	
	P**	Mouth of Antimony Creek	Further assess loading trends in, and document total metals load from, Antimony Ck
A-1		Upper east fork Antimony Gulch	
A-2		Upper west fork Antimony Gulch	
A-3		Lower east fork Antimony Gulch	
A-4		Lower west fork Antimony Gulch	
	P	Prospect Creek above Antimony Gulch confluence	Assess potential metals load in Prospect Ck upstream of Antimony Ck
	P	Mouth of Cooper Gulch	Assess potential loading from Cooper Gulch

NOTE: *P = primary proposed site; S = secondary proposed site
**Proposed sediment monitoring location

Table D-2. Prospect Creek Supplemental Surface Water Monitoring Water and Sediment Analytical Parameter List

Parameter	Detection Limit (μg/L)
Field Parameters	
PH	Na
specific conductance	Na
dissolved oxygen	Na
water temperature	Na
Flow	Na
TSS	Na
Metals	
Antimony	3
arsenic	5
cadmium	0.1
copper	1
iron	30
lead	2
manganese	10
zinc	10
Major Minerals	
Calcium	1,000
Magnesium	1,000
Sulfate	1,000
Total dissolved solids	10,000
Sediment Parameter List	
Parameter	**Detection Limit (mg/Kg)**
antimony (total)	5
arsenic (total)	5
lead (total)	5
zinc (total)	5

NOTE: metals will be analyzed for both total recoverable and dissolved (field-filtered through 0.45 μm filter) concentrations in water samples and total metals based on acid digestion in sediment samples.

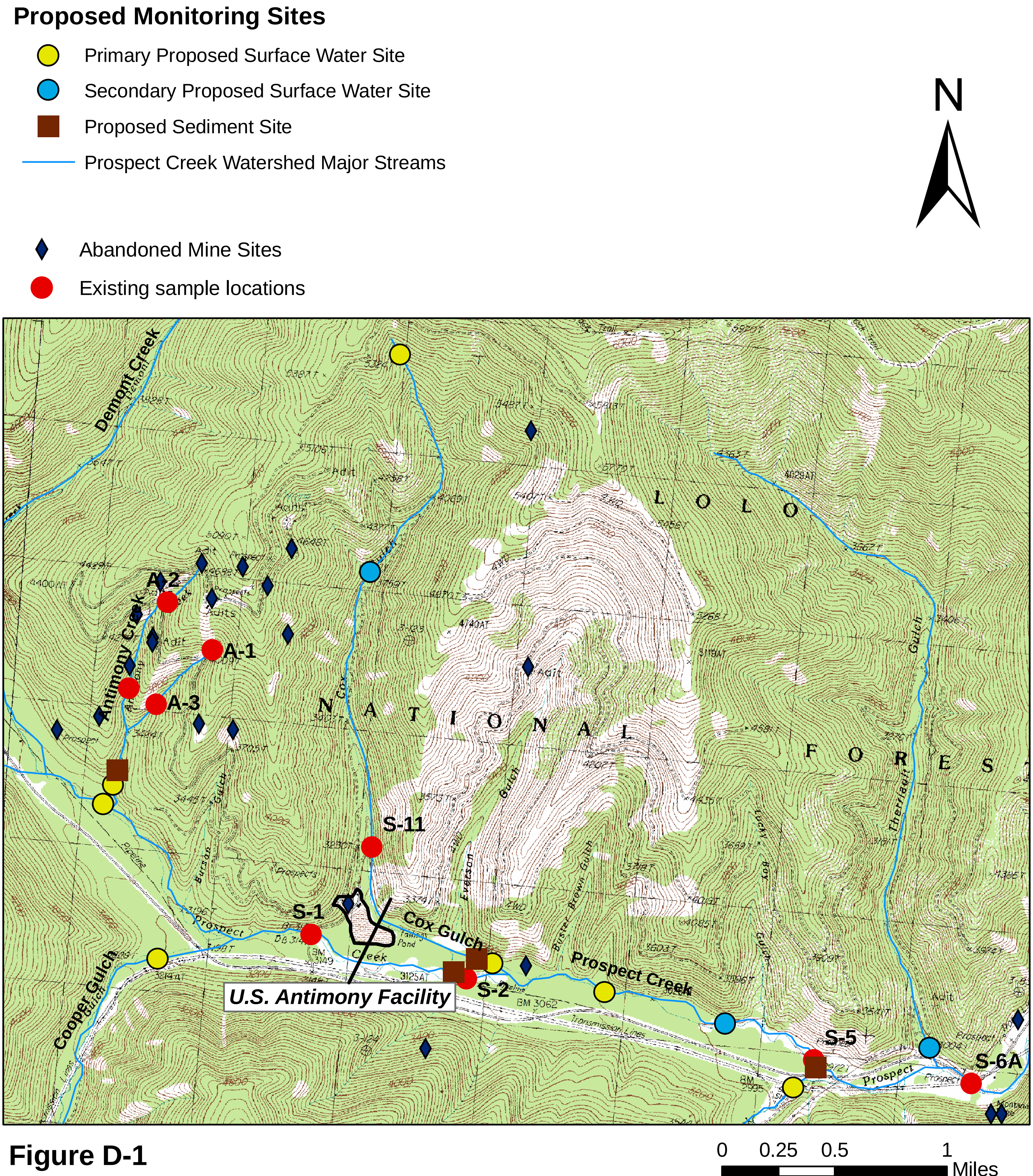

Figure D-1
Prospect Creek Watershed
Exisiting and Proposed Monitoring Locations

Basemap layers from Montana Natural Resources Information System
Monitroing site locations from EPA STORET, USGS NWIS, MDEQ

APPENDIX E

SOURCE ASSESSMENT AND LOADING ANALYSIS

APPENDIX E
SOURCE ASSESSMENT AND LOADING ANALYSIS

The information contained in the Source Assessment & Loading Summary provides data that aids the development of a generalized gross allocation strategy for the watershed. The results of the analysis exhibit exceedances at both high and low flow, and provide evidence that metals concentrations do increase in a downstream direction at some locations. This analysis is helpful in developing future monitoring efforts to further characterize and localize the metals inputs to Prospect Creek and its tributaries.

E.1 Source Assessment Results

As mentioned above, the exceedances are most frequent for antimony under both high and low flow conditions. Exceedances for other metals (arsenic, lead, and zinc) are less frequent, and are always accompanied by exceedances for antimony. Therefore, the metals loading analysis for the Prospect Creek watershed was conducted using antimony as a representative constituent. This analysis is done under both high and low flow conditions since different mechanisms for metals transport conditions can be occurring as a function of flow conditions, and the spatial distribution of metals loading sources may vary with stream flow conditions. This approach helps to ensure that water quality standards will be satisfied during both high and low flow conditions, and that the TMDL adequately accounts for seasonality-related trends.

Figure 3-1 shows abandoned mines in the Prospect Creek watershed (shown by the diamonds), as identified in the Montana Bureau of Mines and Geology abandoned and inactive mine database available from the Montana Natural Resources Information System (NRIS), and the USAC milling and metallurgical facilities near the mouth of Cox Gulch. Abandoned mines and associated mine waste material, and the USAC facility constitute potential sources of metals impairment in the Prospect Creek watershed, along with possible natural background loading. The USAC tailings impoundment was previously identified as a source of antimony contamination in shallow ground water and surface waters in the vicinity of the facility (Woessner and Shapley, 1985), although that was prior to reclamation of the three tailings impoundments in the late 1990s.

Specific sources associated with abandoned mines may include discrete mine waste or tailings piles, fluvial mine waste located along the floodplain or within stream channels, and discharging adits. Other potential sources include metals-bearing ground water (either natural or mining-related), and natural erosion or metals leaching from exposed mineralized bedrock. Specific sources associated with the USAC operation may include mine adits and/or mine waste material associated with USAC’s mining operations, storm water runoff from the milling and metallurgical facility, and leaching of materials from waste materials stored in the tailings impoundments.

In order to determine the most likely sources of metals loading in the Prospect Creek watershed, plots of antimony load in lb/day vs. streamflow were constructed for each of the three listed stream segments to evaluate the data for any general correlation between flow and metals loading (Figures 3-2, 3-4 and 3-5). As shown on Figures 3-2, 3-4, and 3-5, antimony loads generally increase with increasing flow in each of the stream segments. Increasing loads with increasing flow could result from erosion or leaching of metals from mine waste piles, or increased recharge to the streams from metals-bearing ground water under high flow conditions. More detailed water quality sampling, an improved understanding of ground water flow patterns, and/or comparison of total recoverable to dissolved metals concentrations in surface waters would aid in further definition of seasonal metals loading sources in the watershed. Regardless of the specific source types, water quality standard exceedances for antimony, and occasionally arsenic, lead and zinc, are observed under both high and low flow conditions.

Based on the available flow and water quality data, a representative set of monitoring events were examined in detail to evaluate high and low flow metals loading trends and potential source areas. Definition of high and low flow periods in the Prospect Creek watershed was determined by comparing individual flow measurements from site S-6A reported in the USAC dataset and by inspection of with the continuous flow hydrograph for Prospect Creek obtained from the USGS gage installed at the mouth of Prospect Creek (Figure E-1). As shown in the figure, the S-6A instantaneous flow measurements from the defined high flow and low flow periods correspond to the high flow and low flow portions of the continuous flow hydrograph. This indicates that the definition of water quality data collected between April through June as high flow data, and data collected from all other times of the year as low flow data, is an appropriate approximation.

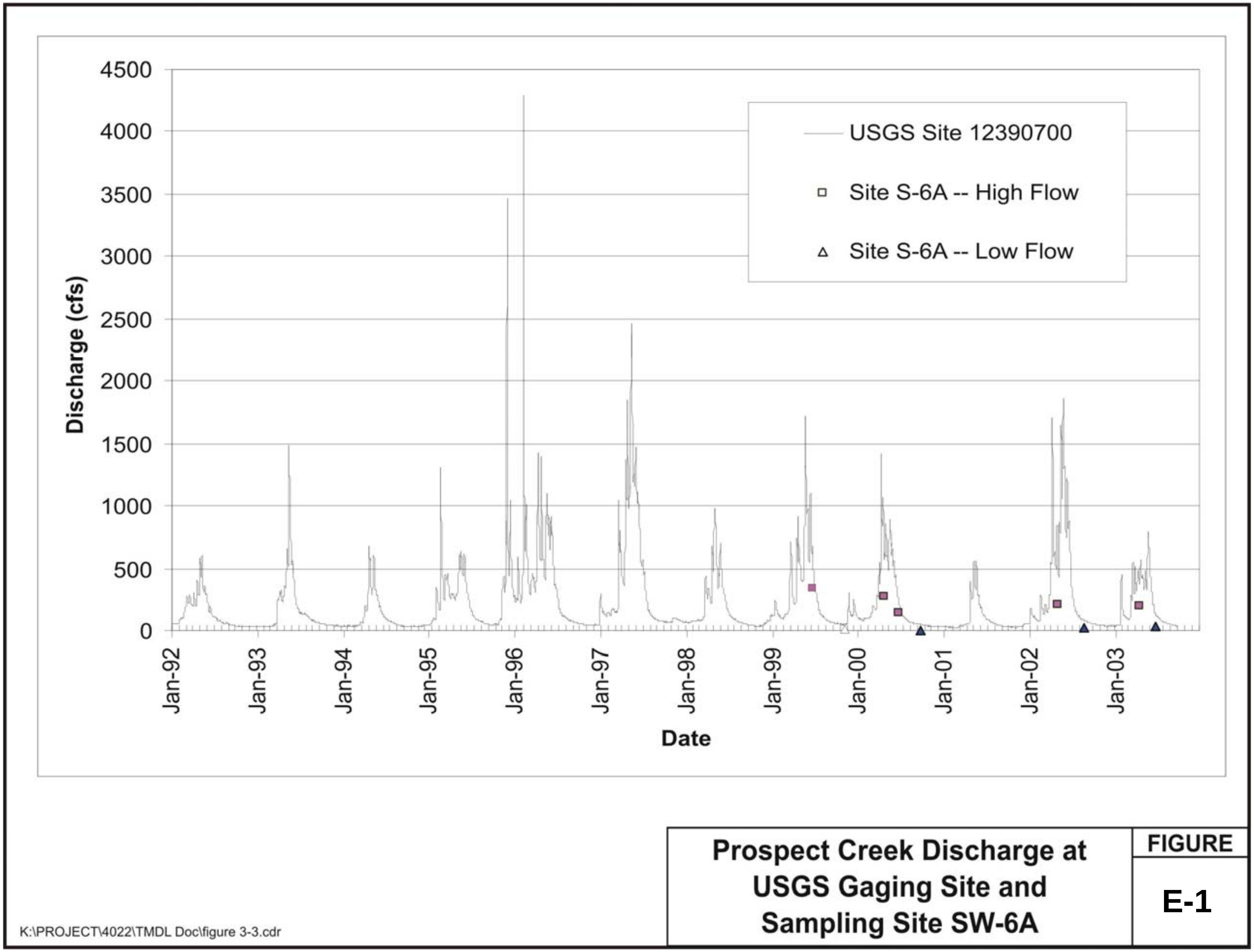

Figure E-1. Prospect Creek Discharge at USGS Gaging Site and Sampling Site SW-6A.

E.2 Load Assessment Results

E.2.1 Antimony Creek Loading

Figure E-2 presents the antimony load with respect to flow for those sampling events included in analysis of Antimony Creek. The antimony load is compared to the TMDL for given flow conditions. Table E-1 displays a representative set of high flow and low flow monitoring events for Antimony Creek. Observations and analysis of the data for Antimony Creek follows Table E-1.

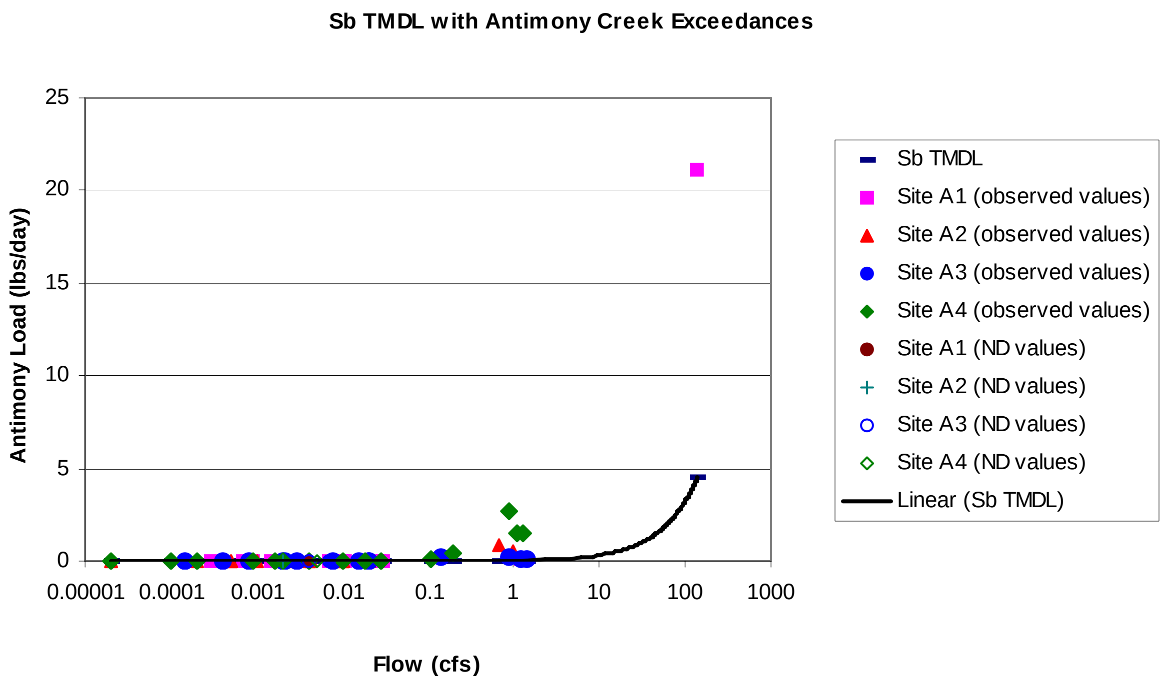

Figure E-2. Sb TMDL with Antimony Creek Exceedances.

Table E-1. Antimony Creek High and Low Flow Monitoring Data.

	High Flow Monitoring Date								
	6/25/99			**4/26/00**			**6/29/00**		
Site	Flow (cfs)	Concentration	Sb Load (lbs/day)	Flow (cfs)	Concentration	Sb Load (lbs/day)	Flow (cfs)	Concentration	Sb Load (lbs/day)
A-1	.011	**37**	**.0022**	1.2	**20**	**.129**	.007	**19**	**.0007**
A-3	.0021	**15**	**.0002**	1.45	**14**	**.109**	.016	**462**	**.0399**
A-2	.00438	**12**	**.0003**	.667	**230**	**.827**	.004	**614**	**.013**
A-4	.00167	**257**	**.0023**	1.12	**245**	**1.48**	.01	**16**	**.0009**
	5/9/02			**4/23/03**					
A-1	.027	**17**	**.002**	140*	**28**	**21.14**			
A-3	.14	**238**	**.18**	.02	**14**	**.002**			
A-2	.017	**229**	**.021**	.01	**400**	**.022**			

Table E-1. Antimony Creek High and Low Flow Monitoring Data.

A-4	.11	**248**	**.147**	.018	**428**	**.042**
	Low Flow Monitoring Date					
	11/12/99			**9/29/00**		
Site	Flow (cfs)	Concentration	Sb Load (lbs/day)	Flow (cfs)	Concentration	Sb Load (lbs/day)
A-1	.004	<3	<.00006	.002	**26**	**.0003**
A-3	.007	<3	<.00011	.003	**17**	**.0003**
A-2	.002	<3	<.00003	.002	**846**	**.0091**
A-4	.005	<3	<.00008	.002	**458**	**.0049**
	8/29/02			**6/29/03**		
A-1	.0007	**32**	**.00012**	ND	ND	ND
A-3	.0008	**14**	**.00006**	.002	**9**	**.0001**
A-2	.0005	**1060**	**.0029**	.001	**850**	**.0046**
A-4	.0009	**622**	**.003**	ND	**525**	NC

NOTES: *Reported value, probably an error.
ND = no data.
NC = not calculated.
Bold values indicate antimony concentrations exceeded water quality criteria for the given location.

The relatively low flow conditions in these two streams may add additional uncertainty to this analysis, particularly during the lower flow period when some measures flows are as low as 1 gallon per minute. The extremely low cfs values presented are a result of the conversion of field data to comparable units, e.g. gallons per minute to cubic feet per second.

- During high flow, antimony loads typically increase through the upper portion of the east and west forks of Antimony Creek (from A-1 to A-3, and from A-2 to A-4), with load increases more consistent in the west fork. Concentrations exceed water quality standards at the upstream sites A-1 and A-2, as well as the downstream sites A-3 and A-4. Thus, the data indicate the existence of one or more metals loading sources in the east and west forks of Antimony Creek, above sites A-1 and A-2 and between sites A-1/A-3 and A-2/A-4 during high flow conditions. It is possible that most or all of the metals load originates in the upper portions of the watershed above sites A-1 and A-2 and that some of this load is carried via subsurface flow and enters Antimony Creek between sites A-1/A-3 and A-2/A-4. Additional data would be necessary to make such a determination.
- For low flow, the data indicate the existing of one or more metals loading sources upstream of sites A-1 and A-3, but not between the upstream and downstream sites as indicated during the high flow period.
- Based on review of USGS topographic maps, aerial photos, and land use information, the most likely metals loading sources in Antimony Creek drainage include abandoned mines and natural background sources. Mining-related sources may include mine waste rock piles, discharging adits, or leaching of metals to ground water from underground mine workings. Background loading sources may include naturally mineralized ground

water or erosion of exposed mineralized bedrock. Resuspension of metals-bearing stream sediments during higher flows (derived either from natural or mining-related sources) are another potential metals loading source in Antimony Creek.

E.2.2 Cox Gulch Loading

Figure E-3 presents the Antimony load with respect to flow for those sampling events included in analysis of Cox Gulch. The Antimony load is compared to the TMDL for given flow conditions. As there is only one sampling location used for Cox Gulch, representative high flow and low flow data is included with the data for Prospect Creek (Table E-2). Observations and analysis of the data for Cox Gulch follows Figure E-3.

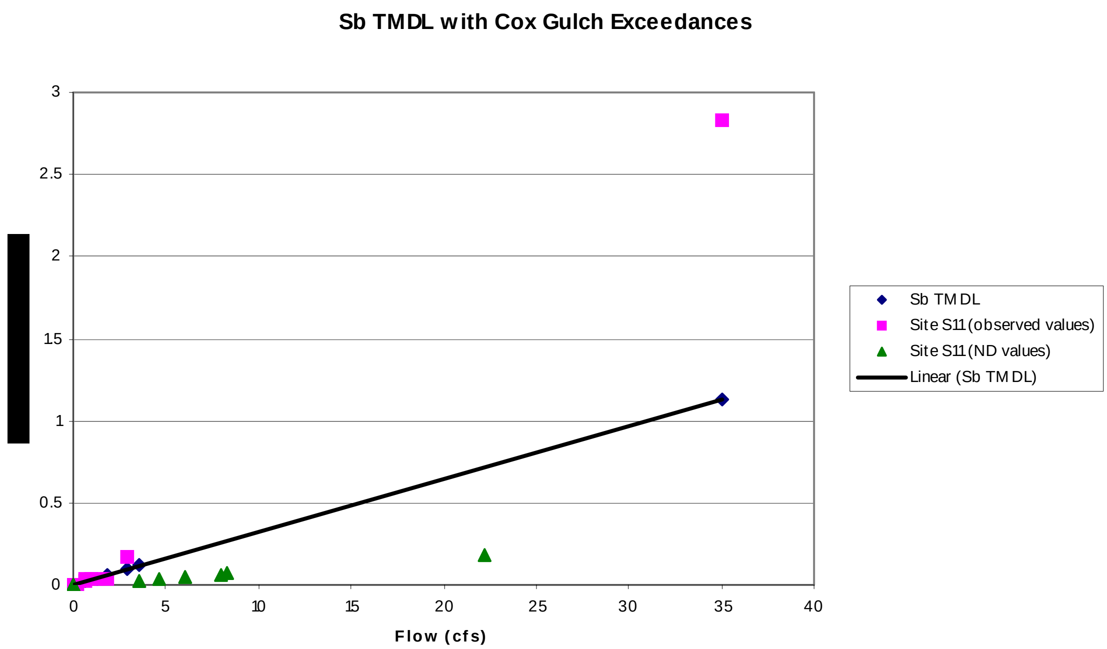

Figure E-3. Sb TMDL with Cox Gulce Exceedances.

- Only one monitoring site in Cox Gulch (S-11), located upstream of the USAC mill and tailings facility, has been sampled on a regular basis. Water quality exceedances for antimony are infrequent, but have been observed occasionally (Tables 3-2 through 3-4) during both low and high flows, along with one exceedance for lead during a relatively high flow (8 cfs). The limited data for this sample site suggests an increase in antimony loading as flow increases.
- The upper portion of Cox Gulch (upstream of site S-11) includes one or more source areas for antimony. Based on review of site maps and aerial photographs, potential sources include mine facilities, recharge from mineralized ground water (either natural or mining-related), and/or instream sources related to remobilization of previously precipitated metals.

As discussed in the introduction to this section, a number of water quality samples collected between 1995 and 1997 from site S-11 showed elevated lead and zinc concentrations on the order of 2 to 7 mg/L (100 to 1000 times the standard). However, this data was found to be erroneous and was not used in the Cox Gulch impairment determination or in the metals loading source assessment.

E.2.3 Prospect Creek Loading

Figure E-4 presents the Antimony load with respect to flow for those sampling events included in analysis of Prospect Creek. The Antimony load is compared to the TMDL for given flow conditions. Table E-2 displays a representative set of high flow and low flow monitoring events for Prospect Creek. Observations and analysis of the data for Prospect Creek follows Table E-2.

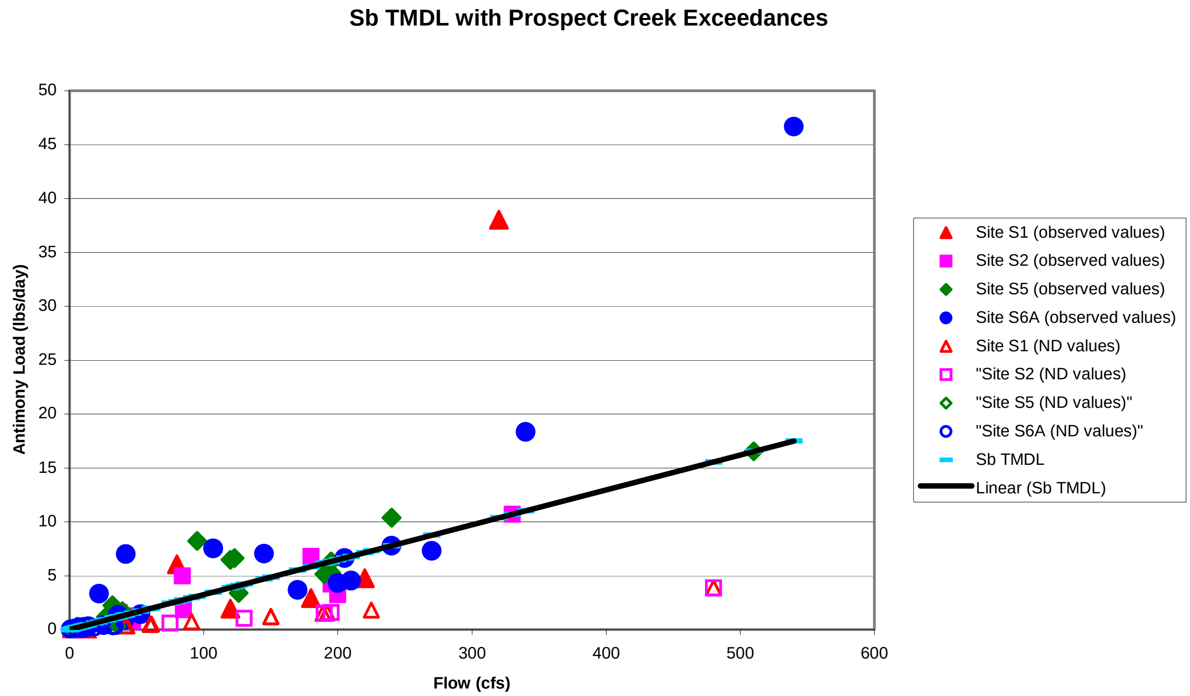

Figure E-4. Sb TMDL with Prospect Creek Exceedances.

Table E-2. Prospect Creek High and Low Flow Monitoring Data.

	High Flow Monitoring Dates								
	6/25/99			**4/26/00**			**6/29/00**		
Site	Flow (cfs)	Concentration	Sb Load (lbs/day)	Flow (cfs)	Concentration	Sb Load (lbs/day)	Flow (cfs)	Concentration	Sb Load (lbs/day)
S-1	320	**22**	**38.02**	225	<3	<3.645	150	<3	<2.43
S-2	330	6	10.69	200	3	3.24	75	<3	<1.21
S-11	.95	**7**	**.0359**	6	<3	<.0972	1.3	6	.0421
S-5	240	**8**	**10.37**	240	**8**	**10.37**	123	**10**	**6.63**
S-6A	340	**10**	**18.36**	270	5	7.29	145	**9**	**7.04**

Table E-2. Prospect Creek High and Low Flow Monitoring Data.

	5/9/02			**4/23/03**		
S-1	120	3	1.94	220	4	4.75
S-2	85	4	1.83	190	<3	<3.07
S-11	35	**15**	**2.83**	3.6	<3	<0.058
S-5	120	**10**	**6.47**	195	6	6.31
S-6A	205	6	6.63	200	4	4.32
	Low Flow Monitoring Dates					
	11/12/99			**9/29/00**		
Site	Flow (cfs)	Concentration	Sb Load (lbs/day)	Flow (cfs)	Concentration	Sb Load (lbs/day)
S-1	9.6	3	.155	Dry	ND	NC
S-2	Dry	ND	NC	Dry	ND	NC
S-11	.002	<3	<0.00003	.004	<3	.00006
S-5	10	5	.27	.9	4	.019
S-6A	14	4	.302	1.1	4	.024
	8/29/02			**6/29/03**		
S-1	Dry	ND	NC	41.6	<3	.6731
S-2	ND	ND	ND	Dry	ND	NC
S-11	.002	4	.00004	.017	<3	.0003
S-5	11	3	.178	36	<3	.583
S-6A	22	**28**	**3.32**	34	<3	.55

NOTES:*Reported value, probably an error.
ND = no data.
NC = not calculated.
Bold values indicate antimony concentrations exceeded water quality criteria for the given location.

- The upper Prospect Creek monitoring site (S-1), which is located between Antimony Creek and Cox Gulch (Figure 3-1), typically shows antimony loads that are at least one and sometimes several orders of magnitude greater that the estimated loads from the east and west forks of Antimony Creek, under both high and low flow conditions (Table E-1). Therefore, one or more additional sources of metals loading are indicated upstream of the S-1 monitoring site. The additional loading source(s) may be located in lower Antimony Creek or in Prospect Creek drainage upstream and/or downstream of the confluence with Antimony Creek (Figure 3-1). The potential for these existing sources within the upper portions of the Prospect Creek drainage and within tributary drainages such as Cooper Creek is supported by the existence of abandoned/inactive mines, as shown in Figure (3-1).
- Prospect Creek between sites S-1 and S-2 often goes dry over several sections where the flow is subsurface for large distances during part of the year, making evaluation of loading trends difficult in this reach. However, available data (Table 3-5) show that antimony loads typically remain constant or decrease over this reach. The decrease in load could be completely due to the fact that much of the flow goes subsurface along with the corresponding antimony load since antimony concentrations tend to remain

constant in this reach. Therefore, no apparent loading sources have been identified between sites S-1 and S-2.

- Prospect Creek between sites S-2 and S-5 generally shows an increase in antimony loading during high flow conditions; low flow conditions could not be evaluated due to predominantly dry conditions at site S-2 (Table 3-5). Potential metals sources in this reach of Prospect Creek include tributary drainages (including Cox Gulch), mining-related sources along the Prospect Creek floodplain, recharge from mineralized ground water (either natural or mining-related), or instream sources related to remobilization of previously precipitated metals.
- Between sites S-5 and S-6A on Prospect Creek, loads typically remain constant under both high and low flow conditions. However, during two of the monitoring events reviewed (June 1999 high flow and August 2002 low flow), loading increases were noted between these two locations (Table 3-5). Potential sources of the apparent load increase in this reach of Prospect Creek include ground water (alluvial or bedrock), floodplain or instream sources, two relatively large tributary drainages (Crow Creek and Therriault Creek), and one or more smaller tributary drainages that join Prospect Creek between S-5 and S-6A (Figure 3-1).

These trends in antimony loading for Antimony Creek, Cox Gulch, and Prospect Creek, are used to support TMDL development and load allocations in Section 4.0. It should be noted that the loading trends and potential source assessment have been completed using existing water quality data only. A more complete assessment of specific loading sources would require additional monitoring within the watershed, as discussed in Section 5.0.

APPENDIX F: RESPONSE TO PUBLIC COMMENTS

Comment #1 - No allocation or exception has been made for future construction or maintenance projects in or along Prospect Creek and its tributaries.

> **Response #1** - We agree with the concerns expressed in this comment and have added language in Section 4.3.3 that specifically recognizes that metals loading that has already reached the stream and is within bottom sediments is not included within the allocations and is not identified as a unique source of loading to the stream. The streams will continue to transport this metals load in a downstream direction as part of the sediment transport that has occurred for several decades since metals mining began in this watershed, and possibly prior to mining due to natural background conditions. The allocations are not intended to require instream or floodplain metals restoration work unless a specific problem area is encountered or later identified, such as an old mine waste pile along an eroding streambank or within the floodplain. Under these circumstances, the allocations linked to historical mining would apply and some form of remediation may be necessary to mitigate or remove this threat. It is also recognized that there may be natural sources along some stream locations where a metals bearing vein intersects the stream bed and impacts to these type of locations should be avoided to the extent possible.
>
> Federal and State permits necessary to conduct work within a stream or stream corridor are intended to protect the resource and reduce, if not completely prohibit, pollutant loading or degradation from the permitted activity. The permit requirements typically have mechanisms that allow for some short term impacts to the resource, as long as all appropriate measures are taken to reduce impact to the least amount possible. Language has also been added in Section 4.5 to note these protective requirements and to note that any future work should consider the potential metals loading that could occur if the work were to intersect a natural metals vein or where there is evidence of potential mining wastes other than deposited sediments from upstream and hillside erosional processes.

Comment #2 - We believe that sampling for Total Suspended Sediment (TSS), in addition to the proposed sampling for Total Dissolved Solids (TDS) will contribute substantially to the databases for both metals and sediment source identification.

> **Response #2** - TSS sampling has been added as a suggested sample parameter to the Preliminary Water and Sediment Sampling Analysis Plan (Appendix D) when evaluating metals conditions within the watershed. The TMDLs for Metals in Prospect Creek is one portion of the overall strategy to attain water quality standards for impaired water bodies within the Prospect Creek Watershed. An additional effort is underway to develop a companion document, to be completed by the end of 2006, that addresses impairments from pollutants other than metals, of which sediment is the major contributing factor. This document will include sediment monitoring suggestions and may include TSS monitoring recommendations based on an evaluation of monitoring goals and stakeholder comments such as the one provided here. Any information gathered to characterize pollutant conditions or sources within the watershed, regardless of the original pollutant

associated with the request or the source of that information, will be used conjunctively to assess the overall impact to the watershed.

Comment #3 - As noted in several places in section 3.2, Source Assessment Results, resuspension of metals-bearing stream sediments during higher flows (derived either from natural or mining-related sources) are another potential metals loading source in the streams. Consequently it is important to quantify the relationships between suspended or remobilized sediments and metals loading.

Response #3 TSS sampling is included in conjunction with metals sampling as discussed in Comment 2, but overall, we see the load from resuspension of metals bearing sediments within the substrate as a short-term, transient source which will flush through the system once the non-stream channel sources, other than natural, are mitigated. The goal is to identify any historical sources that are still providing new metals loading to the stream so that these sources can be remediated and the stream will eventually reach water quality standards, with recognition that this may take several years until existing metals within the streams are transported out of the system. Please note: the Section 3.2 referenced to has been moved to section E.1

Comment #4 - The draft TMDL proposes only four sites for sediment sampling.

Response #4 - As more information is gathered regarding potential sources, more sediment metals sampling locations may be added to better characterize stream and source conditions. Language has been added to Section 5.3.2 to reflect this increased sampling possibility.

Comment #5 - It appears that macroinvertebrate and periphyton samples will be the sole basis for determining sediment metals compliance. While it is true that there are no regulatory standards for metals in sediment, there are other published, quantitative guidelines. Biotic indicators have value as secondary indexes, but can be affected by many unrelated factors, including climatic events.

Response #5 - The metals target approach and application discussed in Section 4.1 recognizes these situations. This is why the biotic targets are only linked to conditions where it can be shown that impacts are due to metals. If such conditions exist, then the stream will be considered impaired for metals. Also, if a numeric standard is exceeded, then the stream will be considered impaired for metals independent of the biotic metals results. The published, quantitative guidelines for metals in sediment are used as part of the target suite, but only from the perspective that more data is necessary to ensure that there is not an impairment condition not yet observed due perhaps to a limited amount of spatial or temporal biotic or water chemistry data. Our narrative standards are related to metals sediment chemistry if they impact aquatic life.

Comment #6 - Is there a time-frame for re-opening the TMDL after the results of increased sampling are available? When and how are revisions of the TMDL initiated?

> **Response #6** - According to state law, all TMDLs are to undergo review five years after approval from U.S. EPA to determine their effectiveness in achieving the state standards for each impaired water body. A newly formed section within the Montana Department of Environmental Quality has been charged specifically with the review of completed TMDLs and effectiveness assessment. During this review process, MDEQ may conclude that modifications are necessary to the TMDL based on additional data or the results of implementation activities. The adaptive management Section 4.5 addresses this potential need for TMDL modifications in recognition of the MDEQ review process.

Comment #7 - Figures 1-1 and 3-1 are not readable. The locations of sampling sites and other activities are important for interpretation of the data.

> **Response #7** - Figure 3-1 has been modified to more clearly represent the sampling sites and abandoned mine locations. Figure 1-1 provides a general representation of the watershed and the resolution is appropriate for the related discussion.

Comment #8 - Section 2.1 states that the "Prospect Creek watershed drains 169 square miles," which does not agree with the USGS figure of 182 square miles.

> **Response #8** - The document has been corrected to reflect that the watershed drains 182 vs. 169 square miles.

Comment #9 - Section 2.2, "Land Ownership," states "The U.S. Forest Service is the dominant landowner in the Prospect Creek drainage, with YPL and private landowners owning a fraction of the overall watershed area." YPL owns no land in the Prospect Creek drainage.

> **Response #9** - Revision: The document has been changed to reflect the fact that YPL owns no land in the Prospect Drainage.

Comment #10 - Table 2-3 states that Lower Prospect creek is 84.7 miles in length and Upper Prospect Creek is 61.2 miles in length. Section 1.2 describes Prospect Creek as being 18.9 miles in length from the headwaters to the mouth.

> **Response #10** - Response: Table 2-3 includes summary information by HUC 6 watershed, as indicated in the first column heading within the table. The stream lengths are for all streams represented within each respective HUC 6 watershed. The stream length description as it appears in Section 1.2 is specific to the 303(d) listed segment of Prospect Creek itself. In researching the response to this comment, it was found that the Prospect Creek length as identified in Section 1.2 characterizes the listed length from Twentyfour mile Creek to the mouth, while the total length from the headwaters near the MT-ID border to the mouth is 24.3 miles. Additional clarifying language has been added to Table 2-3 to stress the point that the stream length values relate to all streams within a particular HUC.

Comment #11 - Section 2.6 states the following:

> …sediment sources and channel disequilibrium associated with the mainstem Prospect Creek have increased sediment production. The effects of these natural and anthropogenic watershed disturbances are reflected in the intermittent nature of Prospect Creek.
>
> If there is data to back up there generalizations it should be included as an appendix or, at the very least, referenced. Is there any evidence that Prospect Creek was ever perennial from headwaters to mouth? Is there any data demonstrating that Prospect Creek's excessive sediment load does not originate in the tributaries?

Response #11 - The section of 2.6 that you cite has been removed from the document. Data does exist that supports the claim that an increase in sediment has occurred due to anthropogenic sources and a change in channel geomorphology, however this data will be further detailed within the context of the companion TMDL document that focuses on impairments from non-metals pollutants.

Comment #12 - Section 2.6 lists 1964 as a "high magnitude flood" year, which disagrees with USGS records showing annual peak flows for the USGS Prospect Creek Gaging Station #12390700.

Response #12 - Given recent analysis of USGS gaging results on Prospect Creek (#12390700), the 1964 flood falls between a 2-5 year event, closer to a 5-year. We agree that based on the total period of record, the 1964 event does not stand out as necessarily "high magnitude". Based on the analysis, water years 1974 and 1996 are years that can reasonably be considered "high magnitude" flood years; years that equate to greater than a 25-year flood event. The document has been modified to reflect this comment and response.

Comment #13 - Section 2.9 on stream geomorphology states that "The combined effects of wildfire, floods, clearing and conversion of riparian vegetation, utility corridor and gas pipeline installation and associated maintenance activities, and highway encroachments have sensitized the river corridor." Here again there is no data to support the general statement. We are also unfamiliar with the term "sensitized" in this context. What is the time period associated with this statement, and how has the stream's geomorphology prior to that period been determined or surmised?

Response #13 - Sensitized has been removed and replaced with impacted. There exists volumes of information and references that show that wildfire, clearing and conversion of riparian vegetation, and any large scale disturbances within a watershed can alter the hydrology, pollutant loading, and geomorphology of fluvial ecosystems. Reference the work of Dr.'s Luna Leopold and Dave Rosgen for detailed descriptions of how these processes can alter stream form and function. For more detailed analysis of the geomorphology for Prospect Creek, please review the Prospect Creek TMDL for Sediment that will be available by the end of 2006.

Comment #14 - Figure 3-6 is not clear. Are the high flow and low flow points measured discharge or some other parameter? If they are discharge why do they not line up with the line graph?

> **Response #14** - The points shown on the graph on Figure 3-6 represent instantaneous flow measurements recorded at site S-6A. The purpose of Figure 3-6 is to show that measured streamflows from the defined high flow and low flow periods in the vicinity of where the metals loading analysis and source assessment were performed, correspond to high flow and low flow conditions documented by the continuous USGS stream gage near the mouth of Prospect Creek. Therefore, definition of high flow water quality data as that collected from April through June, and low flow data as that collected during other times of the year, appears to be valid. In order to clarify this, the following text changes/additions have been made to the first full paragraph on page 27:
>
> Definition of high and low flow periods in the Prospect Creek watershed was determined by comparing individual flow measurements from site S-6A reported in the USAC dataset and by inspection of with the continuous flow hydrograph for Prospect Creek obtained from the USGS gage installed at the mouth of Prospect Creek (Figure 3-6). As shown in the figure, the S-6A instantaneous flow measurements from the defined high flow and low flow periods correspond to the high flow and low flow portions of the continuous flow hydrograph. This indicates that definition of water quality data collected between April through June as high flow data, and data collected from all other times of the year as low flow data, is appropriate.

Comment #15 - In table 4-1, among others, the Targets are not identified as total recoverable concentrations. Should they be?

> **Response #15** – Yes they should be. The document will be edited to reflect that the metals concentration targets are all total recoverable concentrations.

Comment #16 - Table 4-3 does not specify the units used.

> **Response #16** - Table 4-3 presents load values in lbs/day. The table will be noted to reflect the units.

Comment #17 - At the bottom of page 32 (Section 4.1) it refers to Section 1.1.3, which does not exist. The information referred to is in Section 1.1.2.

> **Response #17** - The document will be corrected to refer to Section 1.1.2.

<u>Comment #18</u> - YPL applauds the good work that continues to be performed by fellow stakeholders in the Prospect Creek drainage; however, we hope that our own water quality improvement efforts in the watershed have had an equally positive effect.

<u>Response #18</u> - Response: Acknowledged and agreed.