Bonita – Superior Metals TMDLs

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TABLE OF CONTENTS

Acronyms ... viii
Document Summary ... 1
1.0 Introduction ... 1-1
1.1 Background ... 1-1
1.2 Water Quality Impairments and TMDLs Addressed by this Document ... 1-5
1.3 Document Layout ... 1-7
2.0 Watershed Descriptions ... 2-1
2.1 Cramer Creek & Wallace Creek Watersheds ... 2-1
2.1.1 Physical Characteristics ... 2-1
2.1.2 Ecological Profile ... 2-2
2.1.3 Cultural Profile ... 2-2
2.2 Flat Creek Watershed ... 2-3
2.2.1 Physical Characteristics ... 2-3
2.2.2 Ecological Profile ... 2-4
2.2.3 Cultural Profile ... 2-5
3.0 Montana Water Quality Standards ... 3-1
3.1 Bonita – Superior TMDL Project Area Stream Classifications and Designated Uses ... 3-1
3.2 Numeric and Narrative Water Quality Standards ... 3-2
4.0 Defining TMDLs and Their Components ... 4-1
4.1 Developing Water Quality Targets ... 4-2
4.2 Quantifying Pollutant Sources ... 4-2
4.3 Establishing the Total Allowable Load ... 4-3
4.4 Determining Pollutant Allocations ... 4-3
4.5 Implementing TMDL Allocations ... 4-5
5.0 Metals TMDL Components ... 5-1
5.1 Effects of Metals on Designated Beneficial Uses ... 5-1
5.2 Stream Segments of Concern ... 5-1
5.3 Water Quality Data and Information Sources ... 5-2
5.4 Water Quality Targets and Comparison to Existing Conditions ... 5-2
5.4.1 Metals Evaluation Framework ... 5-2
5.4.2 Metals Water Quality Targets ... 5-3
5.4.3 Existing Conditions and Comparison with Water Quality Targets ... 5-5
5.4.4 Metals Target Comparison and TMDL Development Summary ... 5-13

5.5 Metals Source Assessments 5-13
5.5.1 Cramer Creek MT76E004_020 5-13
5.5.2 Wallace Creek MT76E004_020 5-15
5.5.3. Flat Creek MT76M002_180 and Hall Gulch MT76M002_200 5-16
5.6 Metals TMDLs and Allocations 5-18
5.6.1 Metals TMDLs 5-18
5.6.2 Metals Allocations 5-23
5.6.3 Allocations by Waterbody Segment 5-24
5.7 Seasonality and Margin of Safety 5-27
5.7.1 Seasonality 5-28
5.7.2 Margin of Safety 5-28
5.8 Uncertainty and Adaptive Management 5-29
6.0 Restoration Strategy 6-1
6.1 Water Quality Restoration Objectives 6-1
6.2 Montana DEQ and Other Agency Roles 6-1
6.3 Metals Restoration Strategy for Mining Sources 6-2
6.3.1 Superfund Authority in the Bonita – Superior Project Area 6-2
6.3.2 The Surface Mining Control and Reclamation Act (SMCRA) 6-3
6.3.3. Other Historical Mine Remediation Programs 6-4
6.4 Watershed Restoration Plan Development 6-4
6.5 Potential Funding Sources 6-4
6.5.1 Section 319 Nonpoint Source Grant Program 6-5
6.5.2 Future Fisheries Improvement Program 6-5
6.5.3 Watershed Planning and Assistance Grants 6-5
6.5.5 Resource Indemnity Trust/Reclamation and Development Grants Program 6-5
6.6 Temporary Disturbances and Water Quality Impacts 6-5
7.0 Monitoring for Effectiveness 7-1
7.1 Restoration Effectiveness Monitoring 7-1
7.2 Baseline and Impairment Status Monitoring 7-2
7.3 Source Assessment Refinement 7-2
8.0 Stakeholder and Public Participation 8-1
8.1 Participants and Roles 8-1
8.2 Response to Public Comments 8-2
9.0 References 9-1

APPENDICES

Appendix A – Maps
Appendix B – Metals Data
Appendix C – Cleanup/Restoration and Funding Options for Mine Operations or Other Sources of Metals Contamination

LIST OF TABLES

Table DS-1. List of Impaired Waterbodies and their Impaired Uses in the Bonita – Superior TMDL Project Area with Completed Metals TMDLs Contained in this Document 2
Table 1-1. Status of Waterbody Impairments in the Bonita – Superior Project Area based on the 2012 Integrated Report 1-3
Table 1-2. Water Quality Impairment Causes for the Bonita – Superior TMDL Project Area Addressed within this Document........ 1-6
Table 3-1. Impaired Waterbodies and their Designated Use Support Status on the "2012 Water Quality Integrated Report" in the Bonita – Superior Project Area* 3-2
Table 5-1. Metals impairment causes for the Bonita – Superior Project Area addressed via TMDL development within this document 5-1
Table 5-2. Metals numeric water chemistry targets applicable to the Bonita – Superior TMDL Project Area 5-4
Table 5-3. Screening level criteria for sediment metals concentrations 5-5
Table 5-4. Cramer Creek Metals Water Quality Data Summary and Target Exceedances 5-5
Table 5-5. Cramer Creek Metals Sediment Quality Data Summary and Target Exceedances 5-6
Table 5-6. Cramer Creek Metals TMDL Decision Factors 5-7
Table 5-7. Wallace Creek Metals Water Quality Data Summary and Target Exceedances 5-8
Table 5-8. Wallace Creek Metals Sediment Quality Data Summary and Target Exceedances 5-8
Table 5-9. Wallace Creek Metals TMDL Decision Factors 5-9
Table 5-10. Flat Creek Metals Water Quality Data Summary and Target Exceedances 5-9
Table 5-11. Flat Creek Metals Sediment Quality Data Summary and Target Exceedances 5-9
Table 5-12. Flat Creek Metals TMDL Decision Factors 5-11
Table 5-13. Hall Gulch Metals Water Quality Data Summary and Target Exceedances 5-11
Table 5-14. Hall Gulch Metals Sediment Quality Data Summary and Target Exceedances 5-11
Table 5-15. Hall Gulch Metals TMDL Decision Factors 5-12
Table 5-16. Detailed inputs for example TMDLs in the Bonita - Superior TMDL project area 5-22
Table 5-17. Metals Detection Limits and Inferred Naturally Occurring Concentrations 5-24
Table 5-18. Cramer Creek: Metals TMDLs and Allocation Examples 5-26
Table 5-19. Wallace Creek: Metals TMDLs and Allocation Examples 5-26
Table 5-20. Flat Creek: Metals TMDLs and Allocation Examples 5-27
Table 5-21. Hall Gulch: Metals TMDLs and Allocation Examples 5-27
Table 6-1. Priority Abandoned Mine Sites in the Bonita – Superior TMDL Project Area 6-3

LIST OF FIGURES

Figure DS-1. Bonita – Superior project area watersheds.. 1
Figure 4-1. Schematic Example of TMDL Development...4-2
Figure 4-2. Schematic Diagram of a TMDL and its Allocations 4-4
Figure 5-1. Metals sources and sample locations in the Cramer Creek watershed 5-14
Figure 5-2. Metals sources and sample locations in the Wallace Creek watershed...............................5-15
Figure 5-3. Metals sources and sampling locations in the Flat Creek watershed..................................5-17
Figure 5-4. Hardness-independent metals TMDLs as functions of flow 5-19
Figure 5-5. Cadmium TMDL as a function of flow..5-19
Figure 5-6. Copper TMDL as a function of flow 5-20
Figure 5-7. Lead TMDL as a function of flow 5-20
Figure 5-8. Zinc TMDL as a function of flow...5-21

ACRONYMS

Acronym	Definition
AL	
AMB	Abandoned Mine Bureau
AML	Abandoned Mine Lands
ARM	Administrative Rules of Montana
BLM	Bureau of Land Management (federal)
BMP	Best Management Practices
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CWA	Clean Water Act
DEQ	Department of Environmental Quality (Montana)
DNRC	Department of Natural Resources & Conservation
DQO	Data Quality Object
EPA	Environmental Protection Agency (US)
FWP	Fish, Wildlife, and Parks (Montana)
GIS	Geographic Information System
HHS	Human Health Standard
IR	Integrated Report
LA	Load Allocation
MBMG	Montana Bureau of Mines and Geology
MCA	Montana Code Annotated
MOS	Margin of Safety
MPDES	Montana Pollutant Discharge Elimination System
NHD	National Hydrography Dataset
NOAA	National Oceanographic and Atmospheric Administration
NPL	National Priorities List
OSM	Office of Surface Mining Reclamation and Enforcement
PA	Preliminary Assessment
PEL	Probable Effects Levels
RIT/RDG	Resource Indemnity Trust/Reclamation and Development Grants Program
RIT	Reach Indexing Tool
ROD	Record of Decision
SMCL	Secondary Maximum Contamination Level
SMCRA	Surface Mining Control & Reclamation Act
TCRA	Time Critical Removal Action
TIE	TMDL Implementation Evaluation
TMDL	Total Maximum Daily Load
USFS	United States Forest Service
WLA	Wasteload Allocation
WRP	Watershed Restoration Plan

DOCUMENT SUMMARY

This document presents a total maximum daily load (TMDL) and framework water quality improvement plan for four impaired streams in the Clark Fork River basin: Cramer Creek, Wallace Creek, Flat Creek and Hall Gulch. These streams are located in three tributary watersheds, shown on **Figure DS-1**.

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

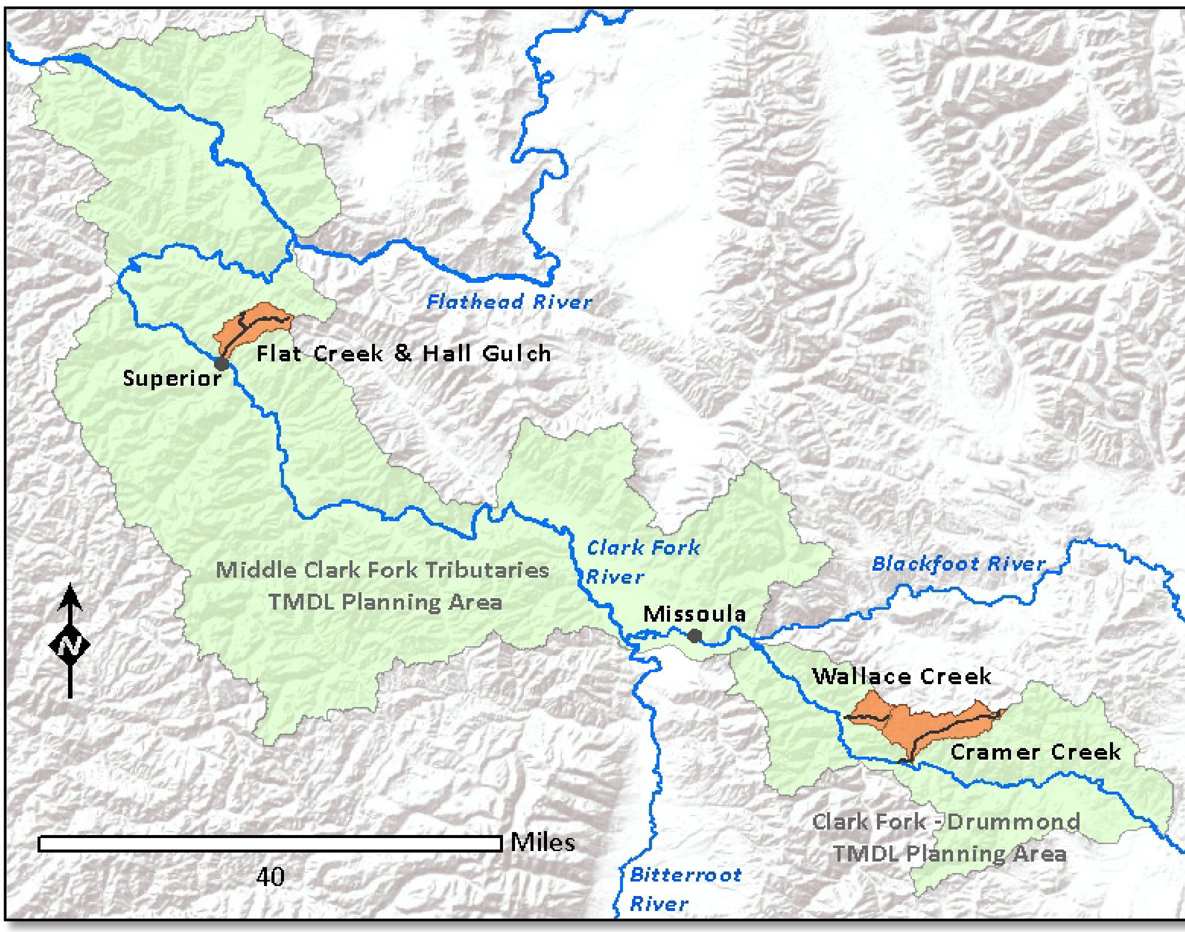

Figure DS-1. Bonita – Superior project area watersheds

The Bonita – Superior TMDL project area encompasses approximately 50 square miles in western Montana, near the former townsite of Bonita and the town of Superior. The project area includes three watersheds tributary to the Clark Fork River. Flat Creek and Hall Gulch are within the Middle Clark Fork Tributaries TMDL Planning Area, and both Cramer and Wallace creeks are located in the Clark Fork Drummond TMDL Planning Area. These TMDL planning area boundaries were defined in 2000, but only a portion of each is included in this project. The Bonita – Superior Metals TMDL project represents all

Clark Fork River tributaries in both of these TMDL planning areas where metals impairments have been identified.

DEQ determined that these four streams do not meet the applicable water quality standards. Although DEQ recognizes that there are other pollutant listings for several of these streams, this document addresses only metals (see **Table DS-1**). While arsenic and antimony are metalloids, they are treated as metals for TMDL development due to the similarity in sources, environmental effects and restoration strategies. Metals concentrations exceeding the aquatic life and/or human health standards can impair support of numerous designated uses including: aquatic life, coldwater fisheries, drinking water, and agriculture. Within aquatic ecosystems, metals can have a toxic, carcinogenic, or bioconcentrating effect on biota. Likewise, humans and wildlife can suffer acute and chronic effects from consuming water or fish with elevated metals concentrations. Because high metals concentrations can be toxic to plants and animals, impaired irrigation or stock water may affect agricultural uses.

Implementation of most water quality improvement measures described in this plan is based primarily on government agency remedial action, with potential for voluntary actions of watershed stakeholders. Ideally, local watershed groups and/or other watershed stakeholders will use this TMDL document, and associated information, as a tool to guide local water quality improvement activities. Such activities can be documented within a watershed restoration plan consistent with DEQ and EPA recommendations.

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

Table DS-1. List of Impaired Waterbodies and their Impaired Uses in the Bonita – Superior TMDL Project Area with Completed Metals TMDLs Contained in this Document

Waterbody & Location Description	TMDL Prepared	TMDL Pollutant Category	Impaired Uses
Cramer Creek, from headwaters to mouth (Clark Fork River)	Aluminum	Metals	Aquatic Life
	Lead	Metals	Aquatic Life, Drinking water
Wallace Creek, from headwaters to mouth (Clark Fork River)	Copper	Metals	Aquatic Life
Flat Creek, from headwaters to mouth (Clark Fork River)	Antimony	Metals	Drinking Water
	Arsenic	Metals	Drinking Water
	Cadmium	Metals	Aquatic Life
	Lead	Metals	Aquatic Life, Drinking Water
	Mercury	Metals	Drinking Water
	Zinc	Metals	Aquatic Life
Hall Gulch, from headwaters to mouth (Flat Creek)	Antimony	Metals	Drinking Water
	Arsenic	Metals	Aquatic Life, Drinking Water
	Iron	Metals	Aquatic Life
	Lead	Metals	Aquatic Life, Drinking Water
	Zinc	Metals	Aquatic Life, Drinking Water

1.0 INTRODUCTION

This document presents an analysis of water quality information and establishes total maximum daily loads (TMDLs) for metals problems in the Bonita – Superior TMDL project area. This document also presents a general framework for resolving these problems. The project area encompasses approximately 50 square miles in western Montana, near the town of Superior and former townsite of Bonita. The project area includes three watersheds tributary to the Clark Fork River. Flat Creek and Hall Gulch are within the Middle Clark Fork Tributaries TMDL Planning Area, and both Cramer and Wallace creeks are located in the Clark Fork Drummond TMDL Planning Area **(Figure 1** in **Appendix A)**. The Bonita – Superior Metals TMDL project area only includes portions of these TMDL planning areas, but includes all streams in both of these TMDL planning areas with identified metals impairments.

1.1 BACKGROUND

In 1972, the U.S. Congress passed the Water Pollution Control Act, more commonly known as the Clean Water Act (CWA). The CWA's goal is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." The CWA requires each state to designate uses of their waters and to develop water quality standards to protect those uses.

Montana's water quality designated use classification system includes the following:

- fish and aquatic life
- wildlife
- recreation
- agriculture
- industry
- drinking water

Each waterbody in Montana has a set of designated uses from the list above. Montana has established water quality standards to protect these uses, and a waterbody that does not meet one or more standards is called an impaired water. Each state must monitor their waters to track if they are supporting their designated uses, and every two years DEQ prepares a Water Quality Integrated Report (IR) which lists all impaired waterbodies and their identified impairment causes. Impairment causes fall within two main categories: pollutant and non-pollutant.

Montana's biennial IR identifies all the state's impaired waterbody segments. The 303(d) list portion of the IR includes all of those waterbody segments impaired by a pollutant, which require a TMDL, whereas TMDLs are not required for non-pollutant causes of impairments. **Table 1-1** identifies all impaired waters for the Bonita – Superior project area from Montana's 2012 303(d) List, and includes non-pollutant impairment causes included in Montana's "2012 Water Quality Integrated Report." **Table 1-1** provides the current status of each impairment cause, identifying whether it has been addressed by TMDL development.

Both Montana state law (Section 75-5-701 of the Montana Water Quality Act) and section 303(d) of the federal CWA require the development of total maximum daily loads for all impaired waterbodies when water quality is impaired by a pollutant. A TMDL is the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards.

Developing TMDLs and water quality improvement strategies includes the following components, which are further defined in **Section 4.0**:

- Determining measurable target values to help evaluate the waterbody's condition in relation to the applicable water quality standards
- Quantifying the magnitude of pollutant contribution from their sources
- Determining the TMDL for each pollutant based on the allowable loading limits for each waterbody-pollutant combination
- Allocating the total allowable load (TMDL) into individual loads for each source

In Montana, restoration strategies and monitoring recommendations are also incorporated in TMDL documents to help facilitate TMDL implementation.

Basically, developing a TMDL for an impaired waterbody is a problem-solving exercise: The problem is excess pollutant loading that impairs a designated use. The solution is developed by identifying the total acceptable pollutant load (the TMDL), identifying all the significant pollutant-contributing sources, and identifying where pollutant loading reductions should be applied to achieve the acceptable load.

Table 1-1. Status of Waterbody Impairments in the Bonita – Superior Project Area based on the 2012 Integrated Report

Waterbody & Location Description	Waterbody ID	Impairment Cause	TMDL Pollutant Category	Impaired Use(s)*	Impairment Cause Status
Cramer Creek, headwaters to mouth (Clark Fork River)	MT76E004_020	Arsenic	Metals	Aquatic Life	Not impaired based on updated assessment
		Barium	Metals	Aquatic Life	Not impaired based on updated assessment
		Cobalt	Metals	Aquatic Life	Not impaired based on updated assessment
		Copper	Metals	Aquatic Life	Not impaired based on updated assessment
		Lead	Metals	Aquatic Life	Lead TMDL contained in this document
		Mercury	Metals	Aquatic Life	Not impaired based on updated assessment
		Physical substrate habitat alterations	Not applicable: non-pollutant	Aquatic Life	To be completed in a future project
		Sedimentation/Siltation	Sediment	Aquatic Life	To be completed in a future project
Wallace Creek, headwaters to mouth (Clark Fork River)	MT76E004_010	Copper	Metals	Aquatic Life	Copper TMDL contained in this document
		Zinc	Metals	Aquatic Life	Not impaired based on updated assessment

Table 1-1. Status of Waterbody Impairments in the Bonita – Superior Project Area based on the 2012 Integrated Report

Waterbody & Location Description	Waterbody ID	Impairment Cause	TMDL Pollutant Category	Impaired Use(s)*	Impairment Cause Status
Flat Creek, headwaters to mouth (Clark Fork River)	MT76M002_180	Antimony	Metals	Drinking water	Antimony TMDL contained in this document
		Arsenic	Metals	Agricultural, Aquatic Life, Drinking Water	Arsenic TMDL contained in this document
		Cadmium	Metals	Agricultural, Aquatic Life, Drinking Water	Cadmium TMDL contained in this document
		Copper	Metals	Agricultural, Aquatic Life, Drinking Water	Not impaired based on updated assessment
		Lead	Metals	Agricultural, Aquatic Life, Drinking Water	Lead TMDL contained in this document
		Mercury	Metals	Agricultural, Aquatic Life, Drinking Water	Mercury TMDL contained in this document
		Physical substrate habitat alterations	Not applicable: non-pollutant	Aquatic Life, Primary Contact Recreation	To be completed in a future project
		Sedimentation/Siltation	Sediment	Aquatic Life, Primary Contact Recreation	To be completed in a future project

*Impaired uses given in this table are based on the “2012 Integrated Report” and may not match use support determinations from assessments performed after the 2012 IR and documented in Table DS-1 of the main document.

1.2 Water Quality Impairments and TMDLs Addressed by this Document

Table 1-2 below lists all of the impairment causes from the "2012 Water Quality Integrated Report" that are addressed in this document Each pollutant impairment falls within a TMDL pollutant category (e.g., metals, nutrients, sediment), and this document is limited to metals impairments.

New data assessed immediately prior to this project identified new metals impairment causes. These impairment causes are also identified in **Table 1-2** and noted as not being on the 2012 303(d) List (within the integrated report). Instead, these waterbody – impairment cause combinations are documented within DEQ assessment files and will be incorporated into the 2014 IR.

TMDLs are completed for each waterbody – pollutant combination, and this document contains 14 TMDLs (**Table 1-2**).

Although DEQ recognizes that there are other pollutant listings for the Bonita – Superior TMDL project area without completed TMDLs (**Table 1-1**), this document only addresses those identified in **Table 1-2**. This is because DEQ sometimes develops TMDLs in a watershed at varying phases, with a focus on one or more related specific pollutant types. Sediment within this project area are addressed in separate TMDL projects and documents.

Table 1-2. Water Quality Impairment Causes for the Bonita – Superior TMDL Project Area Addressed within this Document

Waterbody & Location Description*	Waterbody ID	Impairment Cause	Pollutant Category	Impairment Cause Status	Included in 2012 Integrated Report**
Cramer Creek, headwaters to mouth (Clark Fork River)	MT76E004_020	Aluminum	Metals	Aluminum TMDL completed	No
		Arsenic	Metals	Not impaired based on updated assessment	Yes
		Barium	Metals	Not impaired based on updated assessment	Yes
		Cobalt	Metals	Not impaired based on updated assessment	Yes
		Copper	Metals	Not impaired based on updated assessment	Yes
		Lead	Metals	Lead TMDL completed	Yes
		Mercury	Metals	Not impaired based on updated assessment	Yes
Wallace Creek, headwaters to mouth (Clark Fork River)	MT76E004_010	Copper	Metals	Copper TMDL completed	Yes
		Zinc	Metals	Not impaired based on updated assessment	Yes
Flat Creek, headwaters to mouth (Clark Fork River)	MT76M002_180	Antimony	Metals	Antimony TMDL completed	Yes
		Arsenic	Metals	Arsenic TMDL completed	Yes
		Cadmium	Metals	Cadmium TMDL completed	Yes
		Lead	Metals	Lead TMDL completed	Yes
		Zinc	Metals	Zinc TMDL completed	No
		Mercury	Metals	Mercury TMDL completed	Yes
Hall Gulch, headwaters to mouth (Flat Creek)	MT76M002_200	Antimony	Metals	Antimony TMDL completed	No
		Arsenic	Metals	Arsenic TMDL completed	No
		Copper	Metals	Not impaired based on updated assessment	Yes
		Iron	Metals	Iron TMDL completed	No
		Lead	Metals	Lead TMDL completed	No
		Zinc	Metals	Zinc TMDL completed	No

*All waterbody segments within Montana's Water Quality Integrated Report are indexed to the National Hydrography Dataset (NHD)
**Impairment causes not in the "2012 Water Quality Integrated Report" were recently identified and will be included in the 2014 Integrated Report.

1.3 Document Layout

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

Section 2.0 Watershed Descriptions:
Describes the physical characteristics and social profiles of the Cramer Creek, Wallace Creek and Flat Creek watersheds.

Section 3.0 Montana Water Quality Standards:
Discusses the water quality standards that apply to the Bonita – Superior project area.

Section 4.0 Defining TMDLs and Their Components:
Defines the components of TMDLs and how each is developed.

Section 5.0 Metals TMDL Components:
This section includes (a) a discussion of the affected waterbodies and the pollutant's effect on designated beneficial uses, (b) the information sources and assessment methods used to evaluate stream health and pollutant source contributions, (c) water quality targets and existing water quality conditions, (d) the quantified pollutant loading from the identified sources, (e) the determined TMDL for each waterbody, (f) the allocations of the allowable pollutant load to the identified sources.

Section 6.0 Restoration Strategy:
Discusses water quality restoration objectives and presents a framework for implementing a strategy to meet the identified objectives and TMDLs.

Section 7.0 Monitoring for Effectiveness:
Describes a water quality monitoring plan for evaluating the long-term effectiveness of the Bonita – Superior Metals TMDLs.

Section 8.0 Public Participation & Public Comments:
Describes other agencies and stakeholder groups who were involved with the development of the plan and the public participation process used to review the draft document. Addresses comments received during the public review period.

2.0 WATERSHED DESCRIPTIONS

This watershed description provides a general overview of the physical and cultural characteristics of the Cramer Creek, Wallace Creek and Flat Creek watersheds. The Cramer and Wallace Creek watersheds are contiguous and therefore described together in Section 2.1. The Flat Creek watershed (which includes Hall Gulch) is described separately in Section 2.2. Accompanying figures are provided in **Appendix A**. Unless otherwise noted, geospatial used for the figures and accompanying discussion is obtained from the Montana GIS Portal (http://gisportal.msl.mt.gov/geoportal/catalog/main/home.page).

2.1 CRAMER CREEK & WALLACE CREEK WATERSHEDS

2.1.1 Physical Characteristics

The following information describes the physical characteristics of the Cramer Creek and Wallace Creek watersheds.

2.1.1.1 Location

These watersheds encompass approximately 34.5 square miles (22,102 acres) in Missoula and Granite counties, draining a portion of the southern flank of the Garnet Mountains. The Cramer Creek watershed is approximately 26.4 square miles, and the Wallace Creek watershed is approximately 8.1 square miles (**Figure 2** in **Appendix A**). Both streams flow into the Clark Fork River, although Wallace Creek is intercepted by a series of ditches between the community of Clinton and the Clark Fork. Elevation ranges from 3,465 feet at Clinton to over 6,500 feet at the southern border of the Cramer Creek watershed (**Figure 3** in **Appendix A**).

2.1.1.2 Climate

Average precipitation in the watershed ranges from 17 inches per year in the Clark Fork River valley to 27 inches per year at the highest elevations (**Figure 4** in **Appendix A**). May and June are consistently the wettest months of the year and winter precipitation is dominated by snowfall. Temperature records from a (short-lived) climate station 6 miles southeast of Clinton (station 241831) show that July is the hottest month and January is the coldest. Summertime highs are typically in the high eighties Fahrenheit, and winter lows average in the mid-teen degrees Fahrenheit. Climate data are provided by the Western Regional Climate Center (Western Regional Climate Cente, 2012).

2.1.1.3 Hydrology

Cramer Creek is 11.98 miles long. Wallace Creek is 4.32 miles long. These streams are not gaged. Streamflow presumably follows a hydrograph typical for the region, and would accordingly be highest in May and June. These are the months with the greatest amount of precipitation and snowmelt runoff. Streamflow begins to decline in late June or early July, reaching minimum flow levels in September when many streams go dry. Streamflow generally begins to rebound in October and November when fall storms supplement the base-flow levels. Cramer and Wallace creeks are the only perennial streams in their respective watersheds. All tributaries to these streams are intermittent. The hydrography of these watersheds is shown on **Figure 5** in **Appendix A**.

2.1.1.4 Geology, Soils, and Stream Morphology

The watersheds are underlain by carbonate and siliciclastic metasedimentary rocks of the Belt Supergroup and lower Paleozoic sedimentary rocks, as well as Tertiary granodiorite and sediments (Lonn et al., 2010). The granodiorite is mapped north of Wallace Creek (**Figure 6** in **Appendix A**). The area underlain by the granodiorite corresponds to the area that was subject to the most intense mineral exploration, shown by the number of mining claim sized parcels on property ownership maps. The majority of soils are mapped with low or low-moderate susceptibility to erosion (**Figure 7** in **Appendix A**).

2.1.2 Ecological Profile

The following information describes the ecology of the Cramer Creek and Wallace Creek watersheds. These watersheds are found in the Middle Rockies Level III ecoregion, primarily in the Deer Lodge-Philipsburg-Avon Grassy Intermontane Hills and Valleys and the Southern Garnet Sedimentary-Volcanic Mountains Level IV ecoregions (Woods et al., 2002) Ecoregions are mapped on **Figure 8** in **Appendix A**.

2.1.2.1 Land Cover and Land Use

The watersheds are dominated by mixed conifer forest on the hillsides, and riparian woodland and shrubland in the valley bottoms. Regenerating timber harvests are widespread in the Cramer Creek watershed. Land cover and land use from the 2001 National Land Cover Dataset (Homer et al., 2007) are shown on **Figure 9** in **Appendix A**. A more detailed analysis of vegetative cover and land surface types is provided by the Montana Natural Heritage Program's ReGap project (Montana Natural Heritage Program,2009), shown on **Figure 10** in **Appendix A**.

2.1.2.2 Aquatic Life

Fish distribution is mapped by Montana Fish Wildlife and Parks (**Figure 11** in **Appendix A**) and reported on the Internet (Montana Fish, Wildlife and Parks, 2013). No fish are mapped in Wallace Creek. Cramer Creek is mapped with slimy sculpin and brook trout (both common) as well as westslope cutthroat trout (rare).

2.1.2.3 Fires

Portions of three recent fires extend into the Cramer Creek and Wallace Creek watersheds (**Figure 12** in **Appendix A**). The Ryan Gulch fire of 2000 is the largest of these burns, but the impact to the Cramer Creek watershed was mostly limited to the ridgeline on the southern edge of the watershed. The Mile Marker 124 fire of 2007 was smaller, but it burned much of the western slopes in the southern part of the Cramer Creek drainage. The Dirty Ike fire of 2003 burned a minor part of the northernmost Wallace Creek drainage.

2.1.3 Cultural Profile

The following information describes the social profile of the Cramer Creek and Wallace Creek watersheds.

2.1.3.1 Population

There is no census geometry that corresponds exactly to these drainages, so the resident population can only be estimated. According to the 2010 census, the population of the Cramer Creek and Wallace Creek watersheds is approximately 260 persons, concentrated mostly in lower Wallace Creek (**Figure 13** in **Appendix A**).

2.1.3.2 Land Ownership
Private lands owned by The Nature Conservancy dominate the watersheds, with 15.3 square miles, or 44% of the total. The Stimson Lumber Company is the other large private landowner, with 3.86 square miles (11%). The remaining private lands total 7.25 square miles. The State of Montana owns 3.11 square miles (9%). The US Forest Service administers 5.1 square miles; the US Bureau of Land Management 0.8 square miles. Lastly, 1.0 square miles are composed of 24 parcels for which available GIS data do not record ownership. Land ownership is illustrated on **Figure 14** in **Appendix A**.

2.1.3.3 Transportation Networks
Roads in the Cramer and Wallace watersheds are relatively limited, according to the Montana Department of Transportation data. However, aerial photographs reveal an extensive network of haul roads in timber cuts on the hillsides (**Figure 15** in **Appendix A**). Many of these haul roads are likely now closed to vehicles.

2.1.3.4 Mining History
Two open-pit mines operated in the Cramer Creek watershed during the late 1940s and 1950s: the Blacktail (silver-lead) and Arrowhead (manganese) mines (Montana Department of Environmental Quality, 1998). Ore was milled on the Blacktail (aka Linton) property, adjacent to Cramer Creek. This site (**Figure 16** in **Appendix A**) is listed as a Priority Abandoned Mine by DEQ Remediation Division, and was referred to the BLM, which administers the land. The BLM reclaimed the property in 2001-2004. The activity consisted of removing 130,000 cubic yards of mine waste from the creek bottom. Some was used to backfill open adits and the remainder went to a waste repository.

The Wallace Creek drainage includes the Cape Nome, Aladdin and Hidden Treasure mines (**Figure 17** in **Appendix A**). A mill was constructed along Wallace Creek to process copper ore bound for smelters in Anaconda. Mining operations in this watershed were generally small-scale and short-lived. The site is listed as a Priority Abandoned Mine by DEQ Remediation Division, but no remedial actions have been performed. The millsite is currently operated as a gravel pit.

2.2 Flat Creek Watershed

2.2.1 Physical Characteristics
The following information describes the physical characteristics of the Flat Creek watershed.

2.2.1.1 Location
The Flat Creek watershed encompasses approximately 16 square miles (10,188 acres) in Mineral, Missoula and Sanders counties, beginning at the divide with Siegel Creek and Ninemile Creek and extending to its confluence with the Clark Fork River near Superior (**Figure 18** in **Appendix A**). The watershed area includes several smaller tributary streams including Siekrest Creek, Hall Gulch and Wood Gulch. Ownership includes a mix of federal, state, and private lands. Elevation ranges from over 6,500 feet around the crown of the watershed to 2,700 feet at the confluence with the Clark Fork River (**Figure 19** in **Appendix A**).

2.2.1.2 Climate
Average precipitation in the watershed ranges from 17 inches per year in the Clark Fork River valley to 49 inches per year at the highest elevations (**Figure 20** in **Appendix A**). May and June are consistently the wettest months of the year and winter precipitation is dominated by snowfall. Temperature

patterns reveal that July is the hottest month and January is the coldest throughout the watershed. Summertime highs are typically in the high seventies to mid-eighties Fahrenheit, and winter lows average in the high teens to low twenties Fahrenheit. Climate data are provided by the Western Regional Climate Center (Western Regional Climate Cente, 2012), based upon the Superior climate station (248043).

2.2.1.3 Hydrology

Flat Creek is 8.02 miles long. Hall Gulch is 1.94 miles long. Neither stream is gaged. Flat Creek is the only perennial stream in the watershed. Hall Gulch is an intermittent stream. Streamflow presumably follows a hydrograph typical for the region, and would accordingly be highest in May and June. These are the months with the greatest amount of precipitation and snowmelt runoff. Streamflow begins to decline in late June or early July, reaching minimum flow levels in September when many streams go dry. Streamflow begins to rebound in October and November when fall storms supplement the base-flow levels. Hydrology of the Flat Creek watershed is shown on **Figure 21** in **Appendix A**.

2.2.1.4 Geology and Soils

The majority of soils are mapped with low-moderate susceptibility to erosion. Quaternary sediments near the mouth of the Flat Creek valley are mapped with moderate-high susceptibility. The watershed is underlain by carbonate and siliciclastic metasedimentary rocks of the Belt Supergroup (Lonn et al., 2007). Some Glacial Lake Missoula lake and flood deposits are present near the mouth of the canyon, but they are not extensive. The geology of Flat Creek is shown on **Figure 22** in **Appendix A**. Nearly the entire watershed is mapped with soils of low-moderate erodibility. The exception is the area near the mouth of Flat Creek, which is underlain by soils of moderate-high erodibility (**Figure 23** in **Appendix A**).

2.2.2 Ecological Profile

The following information describes the ecology of the Flat Creek and Hall Gulch watersheds. The Flat Creek watershed is located entirely within the Grave Creek-Ninemile Level IV Ecoregion (**Figure 24** in **Appendix A**), which is in the Northern Rockies Level III Ecoregion (Woods et al., 2002).

2.2.2.1 Land Cover and Land Use

The watersheds are dominated by mixed conifer forest on the hillsides, and riparian woodland and shrubland in the valley bottoms. There are numerous regenerating timber harvests and burns on the hillsides in the Flat Creek watershed. Land cover and land use from the 2001 National Land Cover Dataset (Homer et al., 2007) are shown on **Figure 25** in **Appendix A**. A more detailed analysis of vegetative cover and land surface types is provided by the Montana Natural Heritage Program's ReGap project (Montana Natural Heritage Program,2010), shown on **Figure 26** in **Appendix A**.

2.2.2.2 Aquatic Life

Fish distribution is mapped by Montana Fish Wildlife and Parks. Flat Creek is mapped with brook trout (common) as well as westslope cutthroat trout (rare). The westslope trout population in Flat Creek is resident and genetically pure (Montana Fish, Wildlife and Parks, 2013). Bull Trout are not reported in Flat Creek. No fish distribution is mapped for Hall Gulch. Fish distribution is mapped on **Figure 27** in **Appendix A**.

2.2.2.3 Fires

Much of the southeastern half of the Flat Creek watershed burned during 2000 in a complex of several fires including the Big S and Thompson Flat fires. Two small, isolated fires burned high on the northern half of the Flat Creek watershed in 1994. The fire history is shown on **Figure 28** in **Appendix A**.

2.2.3 Cultural Profile

The following information describes the social profile of the Flat Creek watershed.

2.2.3.1 Population

The Flat Creek watershed is sparsely populated. Aside from a few homes near the mouth of the canyon, there are only two permanent residences in the watershed (**Figure 29** in **Appendix A**).

2.2.3.2 Land Ownership

US Forest Service land dominates the Flat Creek watershed, with 88.4% of the total. Private lands account for 5.1% of the area, and the State of Montana owns 6.2%. Local government lands occupy 0.3% of the total area. The former Iron Mountain mine and millsite property (129 acres) was owned by ASARCO, but title was transferred to the Montana Environmental Trust Group, and the property is administered by Montana DEQ. Land ownership is shown on **Figure 30** in **Appendix A**.

2.2.3.3 Transportation Networks

An improved gravel road extends up the Flat Creek valley to the Iron Mountain mine and mill site, near the confluence with Hall Gulch. An improved spur was recently constructed for haulage operations to a waste repository in Wood Gulch. An unimproved road leads up Hall Gulch, and logging roads are present on the hillslopes (**Figure 31** in **Appendix A**).

2.2.3.4 Mining History

The Flat Creek watershed includes the Iron Mountain Mine Mill site, which is an abandoned mine/mill site currently listed on EPA's National Priority List (aka "Superfund"). The Flat Creek watershed downstream of the mine site is an operable unit (OU2) of the NPL site. The tributary drainage of Hall Gulch contains additional mines, including the Belle of the Hills mine and the Dillon Millsite, both of which are included in DEQ's inventory of Priority Abandoned Mines (**Figure 32** in **Appendix A**). The ghost town of Pardee is located in Hall Gulch. The history of the Iron Mountain mining district is summarized in DEQ's Abandoned Mine Lands historical narratives (Montana Department of Environmental Quality, 1998).

3.0 Montana Water Quality Standards

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

Montana's water quality standards include three main parts:

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

Nondegradation provisions are not applicable to the TMDLs developed within this document because of the impaired condition of the streams. Those components that apply to this document are reviewed briefly below. More detailed descriptions of Montana's water quality standards may be found in the Montana Water Quality Act (75-5-301,302 MCA) and Circular DEQ-7 (Montana Department of Environmental Quality, 2012).

3.1 Bonita – Superior TMDL Project Area Stream Classifications and Designated Uses

Waterbodies are classified based on their designated uses. All Montana waters are classified for multiple uses. All streams and lakes within the project area are classified as B-1, which specifies that the water must be maintained suitable to support all of the following uses: drinking, culinary and food processing purposes after conventional treatment for removal of impurities, naturally occurring or not. 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. While some of the waterbodies might not actually be used for a designated use (e.g., drinking water supply), their water quality still must be maintained suitable for that designated use. More detailed descriptions of Montana's surface water classifications and designated uses are provided in Montana Administrative Rules ARM 17.30.601 through 17.30.607.

Three waterbodies in the Bonita – Superior TMDL project area are listed in the "2012 Water Quality Integrated Report" as not supporting or partially supporting one or more designated uses (**Table 3-1**). A fourth, Hall Gulch, was not assessed for the 2012 Integrated Report. However, the 2014 Integrated Report will list Hall Gulch as not fully supporting human health and aquatic life. Waterbodies that are "not supporting" or "partially supporting" a designated use are impaired and require a TMDL if the cause of impairment is a pollutant. A TMDL is written to protect all designated uses potentially impaired by the pollutant, regardless of whether the use is fully supporting, partially supporting, not supporting or not assessed. DEQ describes impairment as either partially supporting or not supporting based on assessment results. Not supporting is applied to not meeting a drinking water standard, and is also applied to conditions where the assessment results indicate a severe level of impairment of aquatic life. Even so, identification of a use as not supported does not mean the use is completely eliminated.

Table 3-1. Impaired Waterbodies and their Designated Use Support Status on the "2012 Water Quality Integrated Report" in the Bonita – Superior Project Area*

Waterbody & Location Description	Waterbody ID	Use Class	Agriculture	Aquatic Life	Drinking Water	Primary Contact Recreation
Cramer Creek, headwaters to mouth (Clark Fork River)	MT76E004_020	B-1	F	P	F	P
Wallace Creek, headwaters to mouth (Clark Fork River)	MT76E004_010	B-1	F	P	F	X
Flat Creek, headwaters to mouth (Clark Fork River)	MT76M002_180	B-1	N	N	N	N
Hall Gulch, headwaters to mouth (Flat Creek)	MT76M002_200	B-1	X	X	X	X

F = Fully Supporting, P = Partially Supporting, N= Not Supporting, X = Not Assessed
*Impaired uses given in this table are based on the "2012 Integrated Report" and may not match use support determinations from assessments performed after the 2012 IR and documented in Table DS-1.

3.2 Numeric and Narrative Water Quality Standards

In addition to the use classifications described above, Montana's water quality standards include numeric and narrative criteria that protect the designated uses. Numeric standards define the allowable concentrations, duration and frequency of specific pollutants so as not to impair designated uses. They apply to pollutants that are known to have adverse effects on human health or aquatic life (e.g., metals, organic chemicals, and other toxic constituents). Human health standards are set at levels that protect against long-term (lifelong) exposure via drinking water and other pathways such as fish consumption, as well as short-term exposure through drinking and direct contact such as swimming. Numeric standards for aquatic life include chronic and acute values. Chronic aquatic life standards prevent long-term, low level exposure to pollutants. Acute aquatic life standards protect from short-term exposure to pollutants. Numeric standards also apply to other designated uses such as protecting irrigation and stock water quality for agriculture.

Narrative standards are developed when there is insufficient information to develop numeric standards, or natural variability makes numeric standards impractical. Narrative standards describe the allowable or desired condition.

For the Bonita – Superior project area, numeric standards are applied as the primary targets for impairment determinations and subsequent TMDL development. These targets address allowable water column chemistry concentrations. Narrative standards are also used to develop supplemental targets to address metals concentrations in stream sediments. **Section 5.4** defines the water quality criteria for the Bonita – Superior project area.

4.0 DEFINING TMDLS AND THEIR COMPONENTS

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

Pollutant sources are generally defined as two categories: point sources and nonpoint sources. Point sources are discernible, confined and discrete conveyances, such as pipes, ditches, wells, containers, or concentrated animal feeding operations, from which pollutants are being, or may be, discharged. Some sources such as return flows from irrigated agriculture are not included in this definition. All other pollutant loading sources are considered nonpoint sources. Nonpoint sources are diffuse and are typically associated with runoff, streambank erosion, most agricultural activities, atmospheric deposition, and groundwater seepage. Naturally occurring background loading is a type of nonpoint source.

As part of TMDL development, the allowable load is divided among all significant contributing point and nonpoint sources. For point sources, the allocated loads are called “wasteload allocations” (WLAs). For nonpoint sources, the allocated loads are called “load allocations” (LAs).

A TMDL is expressed by the equation: $TMDL = \Sigma WLA + \Sigma LA$, where:

ΣWLA is the sum of the wasteload allocation(s) (point sources)
ΣLA is the sum of the load allocation(s) (nonpoint sources)

TMDL development must include a margin of safety (MOS), which may be explicitly incorporated into the above equation. Alternatively, the MOS can be implicit in the TMDL. A TMDL must also ensure that the waterbody will be able to meet and maintain water quality standards for all applicable seasonal variations (e.g., pollutant loading or use protection).

Development of each TMDL has four major components:

- Determining water quality targets
- Quantifying pollutant sources
- Establishing the total allowable pollutant load
- Allocating the total allowable pollutant load to their sources

Although the way a TMDL is expressed can vary by pollutant, these four components are common to all TMDLs, regardless of pollutant. Each component is described in further detail in the following subsections.

Figure 4-1 illustrates how numerous sources contribute to the existing load and how the TMDL is defined. The existing load can be compared to the allowable load to determine the amount of pollutant reduction needed.

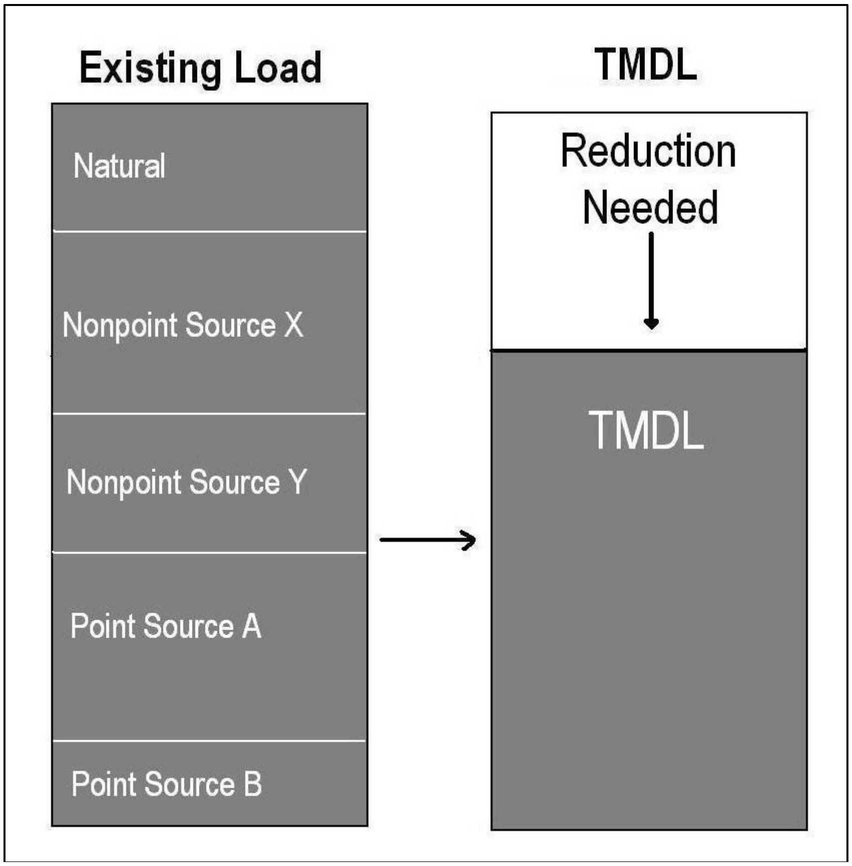

Figure 4-1. Schematic Example of TMDL Development

4.1 Developing Water Quality Targets

TMDL water quality targets are a translation of the applicable numeric or narrative water quality standard(s) for each pollutant. For pollutants with established numeric water quality standards, the numeric value(s) are used as the TMDL targets. For pollutants with narrative water quality standard(s), the targets provide a waterbody-specific interpretation of the narrative standard(s).

Water quality targets are typically developed for multiple parameters that link directly to the impaired beneficial use(s) and applicable water quality standard(s). Therefore, the targets provide a benchmark by which to evaluate attainment of water quality standards. Furthermore, comparing existing stream conditions to target values allows for a better understanding of the extent and severity of the problem.

4.2 Quantifying Pollutant Sources

DEQ quantifies all significant pollutant sources, including naturally occurring background loading, in order to determine the relative pollutant contributions. Because the effects of pollutants on water quality can vary throughout the year, the seasonal variability of the pollutant loading must also be considered. The source assessment helps to define the extent of the problem by linking the pollutant load to specific sources in the watershed.

A pollutant load is usually quantified for each point source permitted under the Montana Pollutant Discharge Elimination System (MPDES) program. Nonpoint sources are quantified by source categories (e.g., abandoned / inactive mining) and/or by land uses (e.g., crop production or forestry). These source categories and land uses can be divided further by ownership, such as federal, state, or private. Alternatively, most, or all, pollutant sources in a sub-watershed or source area can be combined for quantification purposes.

Because all potentially significant sources of the water quality problems must be evaluated, source assessments are conducted on a watershed scale. The source quantification approach may produce reasonably accurate estimates or gross allotments, depending on the data available and the techniques used for predicting the loading (40 CFR Section 130.2(I)). Montana TMDL development often includes a combination of approaches, depending on the level of desired certainty for setting allocations and guiding implementation activities.

4.3 Establishing the Total Allowable Load

Identifying the TMDL requires a determination of the total allowable load over the appropriate time period necessary to comply with the applicable water quality standard(s). Although "TMDL" implies "daily load," determining a daily loading may not be consistent with the applicable water quality standard(s), or may not be practical from a water quality management perspective. Therefore, the TMDL will ultimately be defined as the total allowable loading during a time period that is appropriate for applying the water quality standard(s) and which is consistent with established approaches to properly characterize, quantify, and manage pollutant sources in a given watershed. For example, sediment TMDLs may be expressed as an allowable annual load.

If a stream is impaired by a pollutant for which there are numeric water quality criteria, the TMDL, or allowable load, is typically calculated as a function of streamflow and the numeric criteria. This same approach can be applied when a numeric target is developed to interpret a narrative standard.

Some narrative standards, such as those for sediment, often have a suite of targets. In many of these situations it is difficult to link the desired target values to highly variable, and often episodic, instream loading conditions. In such cases the TMDL is often expressed as a percent reduction in total loading based on source quantification results and an evaluation of load reduction potential (**Figure 4-1**). The degree by which existing conditions exceed desired target values can also be used to justify a percent reduction value for a TMDL.

Even if the TMDL is preferably expressed using a time period other than daily, an allowable daily loading rate will also be calculated to meet specific requirements of the federal Clean Water Act. Where this occurs, TMDL implementation and the development of allocations will still be based on the preferred time period, as noted above.

4.4 Determining Pollutant Allocations

Once the allowable load (the TMDL) is determined, that total must be divided among the contributing sources. The allocations are often determined by quantifying feasible and achievable load reductions through application of a variety of best management practices and other reasonable conservation practices.

Under the current regulatory framework (40 CFR 130.2) for developing TMDLs, flexibility is allowed in allocations in that "TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure." Allocations are typically expressed as a number, a percent reduction (from the current load), or as a surrogate measure (e.g., a percent increase in canopy density for temperature TMDLs).

Figure 4-2 illustrates how TMDLs are allocated to different sources using WLAs for point sources and LAs for naturally occurring and nonpoint sources. Although some flexibility in allocations is possible, the sum of all allocations must meet the water quality standards in all segments of the waterbody.

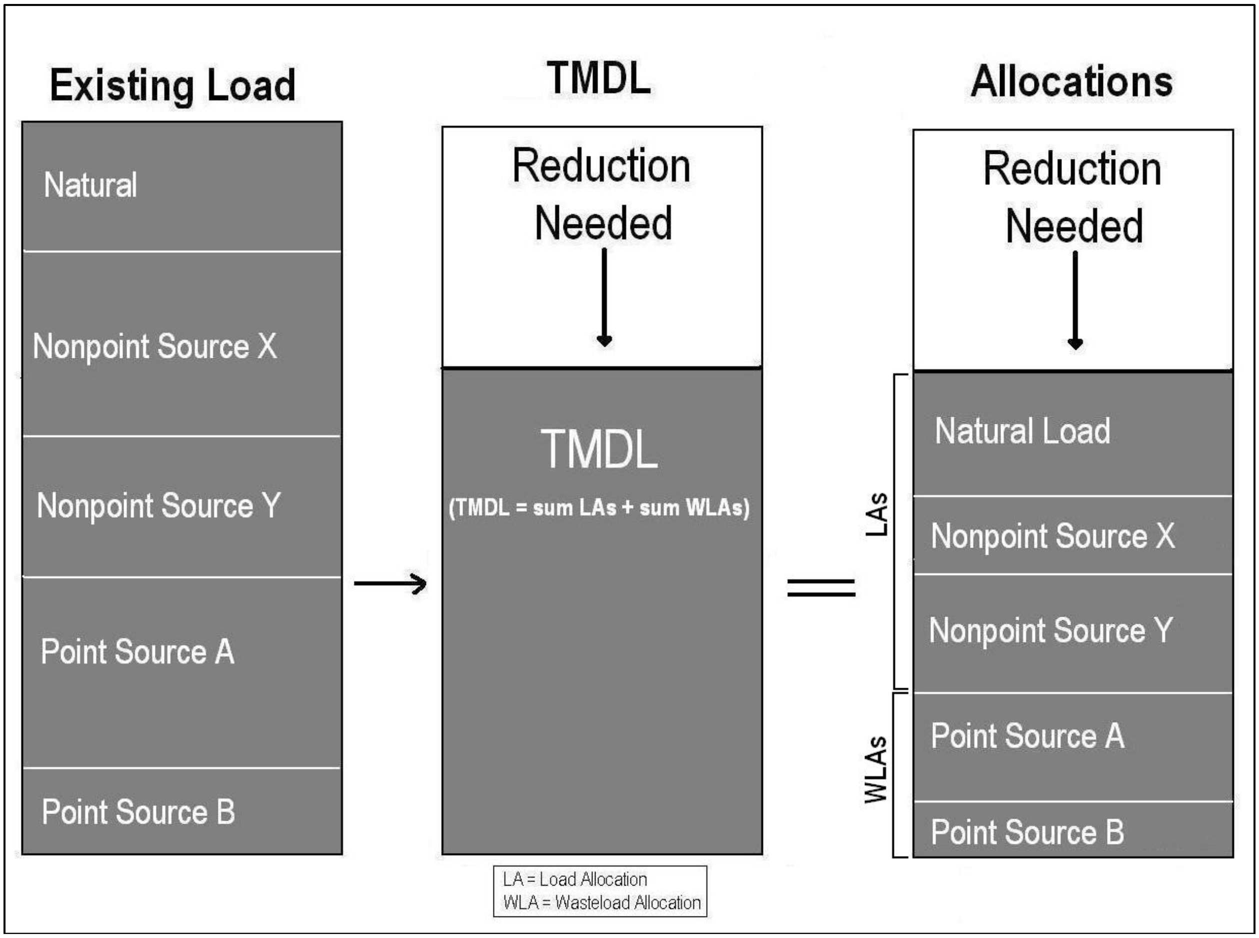

Figure 4-2. Schematic Diagram of a TMDL and its Allocations

TMDLs must also incorporate a margin of safety. The margin of safety accounts for the uncertainty, or any lack of knowledge, about the relationship between the pollutant loads and the quality of the receiving waterbody. 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 (i.e., a TMDL = WLA + LA + MOS) (U.S. Environmental Protection Agency, 1999). The margin of safety is a required component to help ensure that water quality standards will be met when all allocations are achieved. In Montana, TMDLs typically incorporate implicit margins of safety.

When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA for a MPDES-permitted point source is based on an assumption that nonpoint source load reductions will occur, the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions. Because the TMDLs in this document do not include MPDES-permitted point sources, this level of reasonable assurance is not required.

4.5 Implementing TMDL Allocations

The Clean Water Act (CWA) and Montana state law (Section 75-5-703 of the Montana Water Quality Act) require wasteload allocations to be incorporated into appropriate discharge permits, thereby providing a regulatory mechanism to achieve load reductions from point sources. Nonpoint source reductions linked to load allocations are not required by the CWA or Montana statute, and are primarily implemented through voluntary measures. This document contains several key components to assist stakeholders in implementing nonpoint source controls. **Section 6.0** discusses a restoration and implementation strategy by pollutant group and source category, and, where relevant, provides recommended best management practices (BMPs) per source category (e.g., grazing, cropland, urban, etc.). **Section 6.3** discusses potential funding sources that stakeholders can use to implement BMPs for nonpoint sources. Other site-specific pollutant sources are discussed throughout the document, and can be used to target implementation activities. DEQ's Watershed Protection Section helps to coordinate nonpoint implementation throughout the state and provides resources to stakeholders to assist in nonpoint source BMPs. Montana's Nonpoint Source Management Plan (available at http://www.deq.mt.gov/ wqinfo/nonpoint/nonpointsourceprogram.mcpx) further discusses nonpoint source implementation strategies at the state level.

DEQ uses an adaptive management approach to implementing TMDLs to ensure that water quality standards are met over time (outlined in **Section 6**). This includes a monitoring strategy and an implementation review that is required by Montana statute (see **Section 7**). TMDLs may be refined as new data become available, land uses change, or as new sources are identified.

5.0 METALS TMDL COMPONENTS

This portion of the document addresses all metals water quality impairment in the Bonita —Superior TMDL project area. It includes:

- Metals designated use impacts
- Stream segments of concern
- Water quality data and information sources
- Metals source assessments
- Water quality targets and comparison to existing conditions for each impaired stream
- Metals total maximum daily loads and allocations
- Seasonality and margin of safety
- Uncertainty and adaptive management

5.1 EFFECTS OF METALS ON DESIGNATED BENEFICIAL USES

Metals concentrations exceeding the aquatic life and/or human health standards can impair support of numerous designated uses including: aquatic life, coldwater fisheries, drinking water, and agriculture. Within aquatic ecosystems, metals can have a toxic, carcinogenic, or bioconcentrating effect on biota. Likewise, humans and wildlife can suffer acute and chronic effects from consuming water or fish with elevated metals concentrations. Because high metals concentrations can be toxic to plants and animals, impaired irrigation or stock water may affect agricultural uses. Although arsenic and antimony are metalloids, they are treated as metals for TMDL development due to the similarity in sources, environmental effects and restoration strategies.

5.2 STREAM SEGMENTS OF CONCERN

Three waterbody segments in the Bonita – Superior TMDL Project Area are listed as impaired due to metals in the 2012 Montana Integrated Water Quality Report (**Table 5-1**). A fourth stream, Hall Gulch, has been determined to have several metals impairment causes that will be added to the 2014 Integrated Report. These impairments are included in **Table 1-1** and the designated use support status of impaired segments are presented in **Table 3-1**. Metals causes for which DEQ determined there is no longer an impairment (summarized in **Section 5.4**) are not included in **Table 5-1**.

Table 5-1. Metals impairment causes for the Bonita – Superior Project Area addressed via TMDL development within this document

Waterbody & Location Description	Waterbody ID	Impairment Cause	TMDL Document Resolution	Included in 2012 Integrated Report*
Cramer Creek headwaters to mouth (Clark Fork River)	MT76E004_020	Aluminum	TMDL Completed	No
		Lead	TMDL Completed	Yes
Wallace Creek, headwaters to mouth (Clark Fork River)	MT76E004_010	Copper	TMDL Completed	Yes
Flat Creek, headwaters to mouth (Clark Fork River)	MT76M002_180	Antimony	TMDL Completed	Yes
		Arsenic	TMDL Completed	Yes
		Cadmium	TMDL Completed	Yes
		Lead	TMDL Completed	Yes
		Zinc	TMDL Completed	No
		Mercury	TMDL Completed	Yes

Table 5-1. Metals impairment causes for the Bonita – Superior Project Area addressed via TMDL development within this document

Waterbody & Location Description	Waterbody ID	Impairment Cause	TMDL Document Resolution	Included in 2012 Integrated Report*
Hall Gulch, headwaters to mouth (Flat Cr.)	MT76M002_200	Arsenic	TMDL Completed	No
		Lead	TMDL Completed	No
		Iron	TMDL Completed	No
		Zinc	TMDL Completed	No
		Antimony	TMDL Completed	No

*Impairment causes not in the 2012 Water Quality Integrated Report were recently identified and will be included in a future Integrated Report.

5.3 Water Quality Data and Information Sources

The data used in this report was obtained from the DEQ Abandoned Mines Program, Montana Bureau of Mines and Geology, U.S. Forest Service, and DEQ water and sediment quality sampling from 2009-2012.

In accordance with DEQ's data quality objectives guidance (discussed further in **Section 5.7**) the data used for impairment assessment and target evaluation is no older than 10 years. Older data is considered descriptive and may be used for source characterization, loading analysis and trend evaluation. In cases where there has been significant cleanup action, data predating the cleanup was not considered.

The DEQ data is the most recent, and provides the basis for the existing condition analyses, TMDLs and allocations in this document. The water and sediment metals data used for analysis in this report is attached in **Appendix B**. Data summaries of relevant water quality and sediment quality parameters for each metals-impaired waterbody segment are provided in **Section 5.5**.

5.4 Water Quality Targets and Comparison to Existing Conditions

DEQ compiled the water quality data described in **Section 5.2** for comparison to water quality targets. These targets are established using the most stringent water quality standard, in order to protect all designated uses. **Section 5.4** presents the evaluation framework, the metals water quality targets used in the evaluation, and the results of these evaluations for each impaired waterbody given in **Table 5-1**.

5.4.1 Metals Evaluation Framework

The metals evaluation process includes:

1. Evaluation of metals sources.
   Metals sources may be both naturally occuring and anthropogenic (i.e. human-caused). TMDLs are developed for waterbodies that do not meet standards, at least in part, due to anthropogenic sources.

2. Development of numeric water quality targets that represent unimpaired water quality (**Section 4.1**).
   TMDL plans must include numeric water quality criteria or *targets* that represent a condition that meets Montana's ambient water quality standards. Numeric targets are measurable water quality indicators. They may be used separately or in combination with other targets to

represent water quality conditions that comply with Montana's water quality standards (both narrative and numeric). Metals water quality targets are presented in **Section 5.4.2**.

3. Comparison of water quality with water quality targets to determine whether a TMDL is necessary.
   DEQ determines whether a TMDL is required by comparing recent water quality data to metals water quality targets. In cases where one or more targets are not met, a TMDL is developed. If data demonstrates no impairment, the waterbody – cause combination is recommended for removal from the 303(d) list.

5.4.2 Metals Water Quality Targets

Water quality targets for metals-related impairments in the Bonita – Superior TMDL Project Area include both water chemistry targets and sediment chemistry targets. The water chemistry targets are based on numeric human health standards and both chronic and acute aquatic life standards as defined in DEQ Circular DEQ-7. Sediment chemistry targets are adopted from numeric screening values for metals in freshwater sediment established by the National Oceanographic and Atmospheric Administration.

5.4.2.1 Water Chemistry Targets

Most metals pollutants have numeric water quality criteria defined in DEQ Circular DEQ-7 (Montana Department of Environmental Quality, 2008). These criteria generally include values for protecting human health and for protecting aquatic life. Aquatic life criteria include values for both acute and chronic effects. For any given pollutant, the most stringent of these criteria is adopted as the water quality target.

The aquatic life criteria for most metals are dependent upon water hardness values: usually increasing as the hardness increases. Water quality criteria (acute and chronic aquatic life, human health) for each parameter of concern at water hardness values of 75 mg/L and 400 mg/L are shown in **Table 5-2**. The targets are expressed in micrograms per liter, equivalent to parts per billion. Acute and chronic toxicity aquatic life criteria are intended to protect aquatic life uses, while the human health standard is intended to protect drinking water uses. Note that there is no numeric human health standard for aluminum; antimony and barium do not have numeric aquatic life standards; and the chronic and acute aquatic life standards for zinc are identical. Additionally, cobalt is not included within **Table 5-2** as there are no numeric water quality standards for cobalt in DEQ-7.

The human health criteria given in DEQ-7 for iron (300 µg/L) is based on a secondary maximum contaminant level (SMCL) established by EPA to prevent unwanted tastes, odors, or staining. This value provides a guide for determining interference with the specified uses after conventional water treatment. Therefore, the chronic aquatic life criterion of 1,000 µg/L is the water quality target for iron.

The evaluation process summarized below is derived from DEQ's Monitoring and Assessment program guidance for metals assessment methods (Montana Department of Environmental Quality, Water Quality Planning Bureau, Montioring and Assessment Section, 2012).

- A waterbody is considered impaired if a single sample exceeds the human health target.
- If more than 10% of the samples exceed the aquatic life target, then the waterbody is considered impaired for that pollutant.

- If the exceedance rate is equal to or less than 10%, then the waterbody is considered not impaired for that pollutant. A minimum 8 samples are required, and samples must represent both high and low flow conditions.
- There are two exceptions to the 10% aquatic life exceedance rate rule: a) if a single sample exceeds the acute aquatic life standard by more than a factor of two, the waterbody is considered impaired regardless of the remaining data set; and b) if the exceedance rate is greater than 10% but no anthropogenic metals sources are identified, management is consulted for a case-by-case review.

Table 5-2. Metals numeric water chemistry targets applicable to the Bonita – Superior TMDL Project Area

Metal of Concern	Aquatic Life Criteria (µg/L) at 75 mg/L Hardness		Aquatic Life Criteria (µg/L) at 400 mg/L Hardness		Human Health Criteria
	Acute	Chronic	Acute	Chronic	
Aluminum, D*	750	87	750	87	N/A
Arsenic, TR**	340	150	340	150	10
Antimony, TR	N/A	N/A	N/A	N/A	5.6
Barium, TR	N/A	N/A	N/A	N/A	1,000
Cadmium, TR	1.59	0.22	8.73	0.76	5
Cobalt, TR	N/A	N/A	N/A	N/A	N/A
Copper, TR	10.68	7.3	51.68	30.5	1,300
Iron, TR	N/A	1,000	N/A	1,000	N/A
Lead, TR	55.61	2.21	476.82	18.51	15
Mercury, TR	1.70	0.91	1.70	0.91	0.05
Zinc, TR	93.9	93.9	387.83	387.83	2,000

*D = dissolved
**TR = total recoverable

5.4.2.2 Metals Sediment Chemistry Targets

Montana does not currently have numeric water quality criteria for metals in stream sediment, although general water quality prohibitions (Montana Department of Environmental Quality, 2012) state that *"state surface waters must be free from substances…that will…create concentrations or combinations of materials that are toxic or harmful to aquatic life".* Stream sediment metals concentrations are used as supplementary indicators of impairment. In addition to directly impairing aquatic life in contact with stream sediments, high metals values in sediment commonly correspond to elevated concentrations of metals in water during high flow conditions. Where in-stream water quality data exceeds water quality targets, sediment quality data provide supporting information, but is not necessary to verify impairment.

In the absence of numeric criteria for metals in stream sediment, DEQ bases sediment quality targets on values established by the National Oceanic and Atmospheric Administration (NOAA). NOAA has developed Screening Quick Reference Tables for stream sediment quality, including concentration guidelines for metals in freshwater sediments. These criteria come from numerous studies and investigations, and are expressed in Probable Effects Levels (PEL). PELs represent the sediment concentration above which toxic effects to aquatic life frequently occur, and are calculated as the geometric mean of the 50th percentile concentration of the toxic effects data set and the 85th percentile of the no-effect data set (Buchman, 1999). PEL values are therefore used by DEQ as supplemental targets to evaluate whether streams are "*free from substances…that will…create* *concentrations or combinations of materials that are toxic or harmful to aquatic life."* If the water quality targets are met but a sediment concentration is more than double the PEL (100% exceedance magnitude), then this result can be used as an indication of a water quality problem and additional sampling may be necessary to fully evaluate target compliance.

Table 5-3 contains the PEL values (in parts per million) for parameters of concern in the Bonita - Superior TMDL Planning Area. Note that antimony, aluminum and cobalt do not have PEL values.

Table 5-3. Screening level criteria for sediment metals concentrations

Metal of Concern	PEL (mg/kg or parts per million)
Antimony	N/A
Arsenic	17.0
Aluminum	N/A
Barium	N/A
Cadmium	3.53
Cobalt	N/A
Copper	197
Iron	N/A
Lead	91.3
Mercury	0.486
Zinc	315

5.4.3 Existing Conditions and Comparison with Water Quality Targets

For each waterbody segment included in the 2012 Integrated Report for metals (**Table A-1**), DEQ evaluates recent water quality and sediment data relative to the water quality targets to make a TMDL development determination. Many metals impairment determinations were intially based on data collected by the DEQ Abandoned Mines Bureau in the 1990s and may not reflect current conditions. DEQ has recently completed several years of water and stream sediment sampling in the Bonita – Superior TMDL project area for the purpose of reassessing the metals impairment determinations. This data provides the basis for the metals target evaluations below.

5.4.3.1 Cramer Creek MT76E004_020

Cramer Creek is in the 2012 Integrated Report as impaired by metals: arsenic, barium, cobalt, copper, lead and mercury. Data compilation, collection and analysis demonstrate the need for aluminum and lead TMDLs.

Available Water Quality Data

DEQ used recent metals water quality and sediment data to evaluate current conditions relative to water quality targets. Due to the availability of recently-collected water quality data in the watershed, data used were recent 2009-2011 synoptic high and low flow sampling data collected by DEQ for subsequent TMDL development support. The water and sediment sample results are compared to water chemistry standards and targets in **Tables 5-4** and **5-5**.

Table 5-4. Cramer Creek Metals Water Quality Data Summary and Target Exceedances

Parameter*	Aluminum	Arsenic	Barium	Copper	Lead	Mercury
# Samples	18	21	15	21	21	15
Min	<30	<3	60	<1	<0.5	<0.05
Max	490	3	150	2	15.4	0.018

Table 5-4. Cramer Creek Metals Water Quality Data Summary and Target Exceedances

Parameter*	Aluminum	Arsenic	Barium	Copper	Lead	Mercury
# Acute Exceedances	0	0	N/A	0	0	0
Acute Exceedance Rate	0%	0%	N/A	0%	0	0%
# Chronic Exceedances	3	0	N/A	0	3	0
Chronic Exceedance Rate	17%	0%	N/A	0%	10%	0%
# Human Health Exceedances	N/A	0	0	0	1	0
HHS Exceedance Rate	N/A	0%	0%	0%	5%	0%

*all units in µg/L; total recoverable fraction, except for aluminum (dissolved)

Table 5-5. Cramer Creek Metals Sediment Quality Data Summary and Target Exceedances

Parameter*	Arsenic	Copper	Lead	Mercury
# Samples	7	7	7	7
Min	7	17	59	0.084
Max	18	32	304	0.46
PEL Value	17	197	91	0.49
# Samples>PEL	1	0	4	0
PEL Exceedance Rate	6%	0%	57%	0%
Max PEL Exceedance Magnitude	5%	N/A	234%	N/A

*All units in mg/kg dry weight

Comparison of Metals Concentrations to Water Quality Targets and TMDL Determination

Each pollutant is discussed individually. The discussions are summarized below in **Table 5-6**.

<u>Aluminum</u>

Cramer Creek is listed as impaired by aluminum in the 2012 Integrated Report. The listing was originally based on older sampling from the 1980s and 1990s. Recent data collection from 2009-2011 established a chronic aquatic life standard exceedance rate of 17%. Therefore, aluminum remains a cause of impairment and a TMDL is developed.

<u>Arsenic</u>

Cramer Creek is listed as impaired by arsenic in the 2012 Integrated Report. This listing was originally based upon older sampling results from the 1980s and 1990s. Recent data collected from 2009-2011 included no water samples exceeding the human health criterion, the most stringent target value. Additionally, sediment samples yielded only one arsenic concentration slightly (5%) above the PEL. Therefore, no TMDL is developed for arsenic, and DEQ will remove arsenic as a cause of impairment to Cramer Creek.

<u>Barium</u>

Cramer Creek is listed as impaired by barium in the 2012 Integrated Report. There are no aquatic life standards for barium. The highest barium concentration in water quality samples collected from 2009-2011 is less than 10% of the target (human health standard). Because no barium targets were exceeded, no TMDL will be developed and DEQ will remove barium as a cause of impairment to Cramer Creek.

<u>Cobalt</u>

Cramer Creek is listed as impaired by cobalt in the 2012 Integrated Report, based on sediment samples from 1993. These sediments were removed from the stream during remediation in the early 2000s. As there are no aquatic life standards, sediment PELs, nor a human health standard for cobalt, DEQ will remove cobalt as a cause of impairment to Cramer Creek. No TMDL will be developed.

Copper
Cramer Creek is listed as impaired by copper in the 2012 Integrated Report. This listing was originally based on sampling from the 1980s and 1990s. Recent data from sampling conducted from 2009-2011 shows no target exceedances. Because no copper targets were exceeded, no TMDL is developed and DEQ will remove copper as a cause of impairment to Cramer Creek.

Lead
Cramer Creek is listed as impaired by lead in the 2012 Integrated Report. The listing was originally based upon older sampling from the 1980s and 1990s. Water quality and sediment quality data from recent sampling (2009-2011) demonstrates that Cramer Creek is still impaired by lead. Lead concentrations in water exceeded the chronic aquatic life criteria in nearly 10% of samples and on one occasion exceeded the human health standard. Additionally, over half the sediment samples had lead concentrations exceeding the PEL, with the maximum value at more than 3 times the PEL. Therefore, a lead TMDL is developed for Cramer Creek.

Mercury
Cramer Creek is listed as impaired by mercury in the 2012 Integrated Report. The listing was originally based on older sampling from the 1980s and 1990s. Recent data from sampling conducted from 2009-2011 shows no target exceedances. Because no mercury targets were exceeded, no TMDL is developed and DEQ will remove mercury as a cause of impairment to Cramer Creek.

Cramer Creek TMDL Development Summary
As discussed above and summarized in **Table 5-6**, aluminum and lead TMDLs are developed for Cramer Creek. DEQ has concluded that all other causes of impairment from the 2012 303(d) List are no longer contributing to impairment on Cramer Creek. This information, also summarized in **Table 5-6**, is documented within DEQ's assessment files and will be included in the 2014 Integrated Report.

Table 5-6. Cramer Creek Metals TMDL Decision Factors

Parameter	Aluminum	Arsenic	Barium	Cobalt	Copper	Lead	Mercury
Number of Samples	18	21	15	0	21	21	15
Chronic AL exceedance rate >10%?	Yes	No	N/A	N/A	No	No	No
Greater than 2x acute AL exceeded?	No	No	N/A	N/A	No	No	No
Human Health Criterion exceeded?	No	No	No	N/A	No	Yes	No
NOAA PEL exceeded?	Yes	No	N/A	N/A	No	Yes	No
Human-caused sources present?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2012 303(d) Listed?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TMDL developed?	**Yes**	**No**	**No**	**No**	**No**	**Yes**	**No**

5.4.3.2 Wallace Creek MT76E004_020
Wallace Creek is in the 2012 Integrated Report as impaired by metals: copper and zinc. Data compilation, collection and analysis demonstrate the need for a copper TMDL.

Available Water Quality Data
Metals water and sediment quality data were used to compare current conditions to water quality targets. Due to the availability of recently-collected water quality data in the watershed, data used were recent 2009-2011 synoptic high and low flow sampling data collected by DEQ for subsequent TMDL

development support. Data collected along Wallace Creek is compared to water chemistry standards and targets in **Tables 5-7** and **5-8**.

Table 5-7. Wallace Creek Metals Water Quality Data Summary and Target Exceedances

Parameter*	Copper	Zinc
# Samples	9	9
Min	<1	<10
Max	6	<10
# Acute Exceedances	0	0
Acute Exceedance Rate	0%	0%
# Chronic Exceedances	1	0
Chronic Exceedance Rate	11%	0%
# Human Health Exceedances	0	0
HHS Exceedance Rate	0%	0%

*all units in µg/L; total recoverable fraction

Table 5-8. Wallace Creek Metals Sediment Quality Data Summary and Target Exceedances

Parameter*	Copper	Zinc
# Samples	1	1
Min	114	130
Max	114	130
PEL Value	197	310
# Samples>PEL	0	0
PEL Exceedance Rate	0%	0%
Max PEL Exceedance Magnitude	N/A	N/A

*All units in mg/kg dry weight

Comparison of Metals Concentrations to Water Quality Targets and TMDL Determination

Each pollutant is discussed individually. The discussions are summarized below in **Table 5-9**.

<u>Copper</u>

Wallace Creek is listed as impaired by copper in the 2012 Integrated Report. This impairment was originally based upon older sampling from the 1980s and 1990s. Recent (2009-2011) water chemistry data exceeded the chronic aquatic life standard in more than 10% of the samples and the copper impairment is retained. A copper TMDL is developed for Wallace Creek.

<u>Zinc</u>

Wallace Creek is listed as impaired by zinc in the 2012 Integrated Report. This impairment was originally based on older sampling from the 1980s and 1990s. Recent data from sampling conducted from 2009-2011 shows no target exceedances. Because no zinc targets were exceeded, no TMDL is developed and DEQ will remove zinc as a cause of impairment to Wallace Creek.

Wallace Creek TMDL Development Summary

As discussed above and summarized in **Table 5-9**, a copper TMDL is developed for Wallace Creek. DEQ concluded that zinc no longer contributes to impairment on Wallace Creek. This information, also summarized in **Table 5-9**, is documented within DEQ's assessment files and will be included in the 2014 Integrated Report.

Table 5-9. Wallace Creek Metals TMDL Decision Factors

Parameter	Copper	Zinc
Number of Samples	9	9
Chronic AL exceedance rate >10%?	Yes	No
Greater than 2x acute AL exceeded?	No	No
Human Health Criterion exceeded?	No	No
NOAA PEL exceeded?	No	No
Human-caused sources present?	Yes	Yes
2012 303(d) Listed?	Yes	Yes
TMDL developed?	**Yes**	**No**

5.4.3.3. Flat Creek MT76M002_180

Flat Creek is in the 2012 Integrated Report as impaired by metals: antimony, arsenic, cadmium, copper, lead, mercury, and zinc. Data compilation, collection and analysis demonstrate the need for antimony, arsenic, cadmium, lead and zinc TMDLs.

Available Water Quality Data

Due to the availability of recently-collected water quality data in the watershed, data used were recent 2009-2011 synoptic high and low flow sampling data collected by DEQ for subsequent TMDL development support. Exceedances occurred during both high and low flow conditions, but were both greater and more common during high flow. Data collected along Flat Creek is compared to water chemistry standards and targets in **Tables 5-10** and **5-11**.

Table 5-10. Flat Creek Metals Water Quality Data Summary and Target Exceedances

Parameter*	Antimony	Arsenic	Cadmium	Copper	Lead	Mercury	Zinc
# Samples	20	30	30	22	30	19	30
Min	<5	<3	<0.08	<1	<0.5	<0.005	<10
Max	39	45	2.51	4	498	0.425	560
# Acute Exceedances	0	0	0	0	2	0	5
Acute Exceedance Rate	N/A	N/A	N/A	N/A	7%	N/A	17%
# Chronic Exceedances	0	0	14	0	14	0	5
Chronic Exceedance Rate	N/A	N/A	47%	N/A	47%	N/A	17%
# Human Health Exceedance	5	2	0	0	5	2	0
Human Health Exceedance Rate	25%	7%	N/A	N/A	17%	11%	N/A

*all units in µg/L; total recoverable fraction

Table 5-11. Flat Creek Metals Sediment Quality Data Summary and Target Exceedances

Parameter*	Antimony	Arsenic	Cadmium	Copper	Lead	Mercury	Zinc
# Samples	3	8	8	8	8	11	8
Min	<0.5	<8	<0.2	16	15	0.05	112
Max	<0.5	741	20.7	44	5,570	8.6	4,700
PEL Value	N/A	17	3.53	197	91.3	0.486	315
# Samples>PEL	N/A	5	4	0	4	2	4
PEL Exceedance Rate	N/A	63%	50%	N/A	50%	18%	50%
Max PEL Exceedance Magnitude	N/A	4,259%	486%	N/A	6,001%	1,670%	1,392%

*all units in mg/kg; dry weight

Comparison of Metals Concentrations to Water Quality Targets and TMDL Determination
Each pollutant is discussed individually. The discussions are summarized below in **Table 5-12**.

Antimony
Flat Creek is listed as impaired by antimony in the 2012 Integrated Report. Water chemistry data from recent sampling (2009-2011) demonstrates that antimony concentrations in Flat Creek continue to exceed the human health standard. Therefore, antimony remains a cause of impairment to Flat Creek and a TMDL is developed for antimony.

Arsenic
Flat Creek is listed as impaired by arsenic in the 2012 Integrated Report. Water chemistry data from recent sampling (2009-2011) demonstrates that arsenic concentrations in Flat Creek continue to exceed the human health standard. Therefore, arsenic remains a cause of impairment to Flat Creek and a TMDL is developed for arsenic.

Cadmium
Flat Creek is listed as impaired by cadmium in the 2012 Integrated Report. Water chemistry data from recent sampling (2009-2011) demonstrate that cadmium concentrations in Flat Creek exceed the chronic aquatic life standard in nearly half the samples. Therefore, cadmium remains a cause of impairment to Flat Creek, and a TMDL is developed for cadmium.

Copper
Flat Creek is listed as impaired by copper in the 2012 Integrated Report. The listing was originally based upon older sampling from the 1980s and 1990s. Water and sediment chemistry data from recent sampling (2009-2011) did not exceed any targets. Therefore, no TMDL is developed for copper and DEQ will remove copper as a cause of impairment to Flat Creek.

Lead
Flat Creek is listed as impaired by lead in the 2012 Integrated Report. Water chemistry data from recent sampling (2009-2011) demonstrates that lead concentrations continue to exceed both the human health standard and the acute aquatic life criteria. Therefore, lead remains a cause of impairment to Flat Creek, and a TMDL is developed for lead.

Mercury
Flat Creek is listed as impaired by mercury in the 2012 Integrated Report. Water and sediment quality data from recent sampling (2009-2011) demonstrates that mercury concentrations in Flat Creek continue to exceed the human health standard. Therefore, mercury remains a cause of impairment to Flat Creek, and a TMDL is developed for mercury.

Zinc
Flat Creek is listed as impaired by zinc in the 2012 Integrated Report. Recent data from sampling conducted from 2009-2011 demonstrates that zinc concentrations in Flat Creek continue to exceed both the chronic and acute aquatic life criteria. Therefore, zinc remains a cause of impairment to Flat Creek, and a TMDL is developed for zinc.

Flat Creek TMDL Development Summary
As discussed above and summarized in **Table 5-12**, antimony, arsenic, cadmium, lead and zinc TMDLs are developed for Flat Creek. DEQ concluded that copper no longer contributes to impairment on Flat

Creek. This information, also summarized in **Table 5-12**, is documented within DEQ's assessment files and will be included in the 2014 Integrated Report.

Table 5-12. Flat Creek Metals TMDL Decision Factors

Parameter	Antimony	Arsenic	Cadmium	Copper	Lead	Mercury	Zinc
Number of Samples	20	30	30	22	30	19	30
Chronic AL exceedance rate >10%	N/A	No	Yes	No	Yes	No	Yes
Greater than 2x acute AL exceeded	N/A	No	No	No	Yes	No	Yes
Human Health Criterion exceeded	Yes	Yes	No	No	Yes	Yes	No
NOAA PEL exceeded	N/A	Yes	Yes	No	Yes	Yes	Yes
Human-caused sources present	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2012 303(d) Listed?	Yes	Yes	Yes	Yes	Yes	Yes	No
TMDL developed?	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**

5.4.3.4. Hall Gulch MT76M002_200

DEQ collected water and sediment samples from lower Hall Gulch as part of the Flat Creek sampling project. Hall Gulch has significant mining history and is a tributary to Flat Creek. Hall Gulch was not assessed in the 2012 Integrated Report, or in any previous Integrated Water Quality Report. Based on recent data collection and assessment completed by DEQ's Monitoring and Assessment Section, Hall Gulch will be added to the 2014 Integrated Report with five metals impairment causes: antimony, arsenic, iron, lead, and zinc. TMDLs for these metals are presented in this document.

Available Water Quality Data

Metals water quality and sediment data were used to compare current conditions to water quality targets. Due to the availability of recently-collected water quality data in the watershed, data used are recent 2009-2012 synoptic high and low flow sampling data collected by DEQ. Data collected along Hall Gulch is compared to metals chemistry targets in **Table 5-13** and **5-14**.

DEQ's recent sampling projects documented metals contamination of surface water and stream sediments (**Table 5-4**).

Table 5-13. Hall Gulch Metals Water Quality Data Summary and Target Exceedances

Parameter*	Antimony	Arsenic	Iron	Lead	Zinc
# Samples	7	9	9	9	9
Min	14	18	220	< 0.5	2,160
Max	37	317	3,280	22.7	5,930
# Acute Exceedances	N/A	0	N/A	0	9
Acute Exceedance Rate	N/A	0%	N/A	0%	100%
# Chronic Exceedances	N/A	1	2	1	9
Chronic Exceedance Rate	N/A	11%	22%	11%	100%
# Human Health Exceedance	7	9	0	1	9
Human Health Exceedance Rate	100%	100%	0%	11%	100%

*all units in µg/L; total recoverable fraction

Table 5-14. Hall Gulch Metals Sediment Quality Data Summary and Target Exceedances

Parameter*	Antimony	Arsenic	Iron	Lead	Zinc
# Samples	0	1	1	1	1
Min	-	16,100	178,000	1,370	115,000
Max	-	16,100	178,000	1,370	115,000

Table 5-14. Hall Gulch Metals Sediment Quality Data Summary and Target Exceedances

Parameter*	Antimony	Arsenic	Iron	Lead	Zinc
PEL Value	-	17	N/A	91.3	315
# Samples>PEL	-	1	N/A	1	1
PEL Exceedance Rate	-	100%	N/A	100%	100%
Max PEL Exceedance Magnitude	-	94,600%	N/A	1,400%	36,400%

*all units in mg/kg; dry weight

Comparison of Metals Concentrations to Water Quality Targets and TMDL Determination

Each pollutant is discussed individually. The discussions are summarized below in **Table 5-15**.

Antimony

Antimony concentrations in samples recently collected (2009-2012) from Hall Gulch exceeded the human health standard in every water sample. Therefore, DEQ determined that antimony is a cause of impairment to Hall Gulch, and a TMDL is developed for antimony.

Arsenic

Arsenic concentrations in samples recently collected (2009-2012) from Hall Gulch exceeded the human health standard in every water sample. Therefore, DEQ determined that arsenic is a cause of impairment to Hall Gulch, and a TMDL is developed for arsenic.

Iron

Iron concentrations in samples recently collected (2009-2012) from Hall Gulch exceeded the chronic aquatic life standard in more than 20% of the samples. Therefore, DEQ determined that iron is a cause of impairment to Hall Gulch, and a TMDL is developed for iron.

Lead

Water chemistry data from recent sampling (2009-2012) demonstrates that lead concentrations in Hall Gulch exceed the human health standard. Therefore, DEQ determined that lead is a cause of impairment to Hall Gulch, and a TMDL is developed for lead.

Zinc

Zinc concentrations in samples recently collected (2009-2012) from Hall Gulch exceeded the human health standard in every water sample. Therefore, DEQ determined that zinc is a cause of impairment to Hall Gulch, and a TMDL is developed for zinc.

Hall Gulch TMDL Development Summary

As discussed above and summarized in **Table 5-15**, antimony, arsenic, lead and zinc are determined to be causes of impairment to Hall Gulch, and TMDLs are developed for these causes. DEQ also sampled Hall Gulch for cadmium, copper and mercury and concluded that Hall Gulch is not impaired by these metals.

Table 5-15. Hall Gulch Metals TMDL Decision Factors

Parameter	Antimony	Arsenic	Iron	Lead	Zinc
Number of Samples	7	9	9	9	9
Chronic AL exceedance rate >10%	N/A	Yes	Yes	Yes	Yes
Greater than 2x acute AL exceeded	N/A	No	N/A	No	Yes
Human Health Criterion exceeded	Yes	Yes	N/A	Yes	Yes

Table 5-15. Hall Gulch Metals TMDL Decision Factors

Parameter	Antimony	Arsenic	Iron	Lead	Zinc
NOAA PEL exceeded	Yes	Yes	N/A	Yes	Yes
Human-caused sources present	Yes	Yes	Yes	Yes	Yes
2012 303(d) Listed?	No	No	No	No	No
TMDL developed?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

5.4.4 Metals Target Comparison and TMDL Development Summary

Three streams in the Bonita – Superior TMDL Planning Area are identified in the 2012 Integrated Report with metals impairment causes. Due to the age of these impairment determinations, DEQ recently reassessed these streams in order to better reflect current conditions in the 2014 Integrated Report. Additionally, DEQ assessed one stream (Hall Gulch) for the first time.

Reassessment of metals chemistry in Cramer and Wallace Creeks found that concentrations are within target values for the majority of the metals impairment causes identified in the 2012 Integrated Report. There are two exceptions: lead in Cramer Creek and copper in Wallace Creek. These impairment causes were confirmed and will be retained for the 2014 Integrated Report. Additionally, an aluminum impairment cause was identified for Cramer Creek, and will be added to the 2014 Integrated Report.

Conversely, reassessment of metals impairment causes in Flat Creek confirmed nearly all of the metals impairments (antimony, arsenic, lead, zinc, and mercury). The exception is copper, which was determined to be within target values and this impairment cause will be removed from the 2014 Integrated Report.

DEQ recently assessed Hall Gulch for the first time. Hall Gulch was determined to be impaired by antimony, arsenic, iron, lead and zinc. These impairment causes will be reported in the 2014 Integrated Report. During this assessment, DEQ determined that cadmium, copper and mercury are not causes of impairment to Hall Gulch.

Table 5-1 presents a summary of existing metals impairment causes and metals for which target exceedances were confirmed and for which TMDLs are prepared. A total of 14 metals/stream combinations requiring metals TMDLs are identified in this document. TMDLs and allocations for these streams and metals are provided in the following section.

5.5 Metals Source Assessments

There are no MPDES-permitted point sources in the Bonita – Superior project area. Identified metals sources linked to human activity are primarily related to Montana's mining legacy: abandoned and inactive hardrock mines. These metals sources include adits and seeps, metals-laden floodplain deposits, waste rock and tailings, or other features associated with abandoned and inactive mining operations. The specific sources identified in each watershed are described below.

5.5.1 Cramer Creek MT76E004_020

The major metals source identified in the Cramer Creek watershed is an abandoned/inactive mine on Montana's list of priority abandoned mine cleanup sites: the Linton mine/mill site. Waste rock and tailings, by-products of mining and milling processes, were formerly present in the valley bottom. Site investigations in the 1990s discovered high levels of metals in streambank soils and stream sediments, including: arsenic, barium, cobalt, copper, lead, and mercury (Montana Department of State Lands, 1995; Montana Bureau of Mines and Geology, 1997). The US BLM reclaimed the site in the 2000s and removed tailings and waste rock from the stream channel.

Mining-related metals sources were studied in a variety of investigation and remediation activities. These projects documented metals contamination of soil, groundwater, surface water and stream sediments. Most of this work was completed in the 1990s. The metals impairment listings for Cramer Creek were based primarily on sediment samples from the mine tailings present in the stream bottom. DEQ completed additional stream sampling from 2009-2011 to use for an updated assessment and to support subsequent TMDL development (**Appendix B**). **Figure 5-1** shows the location of the Linton Mine site and DEQ's sample locations.

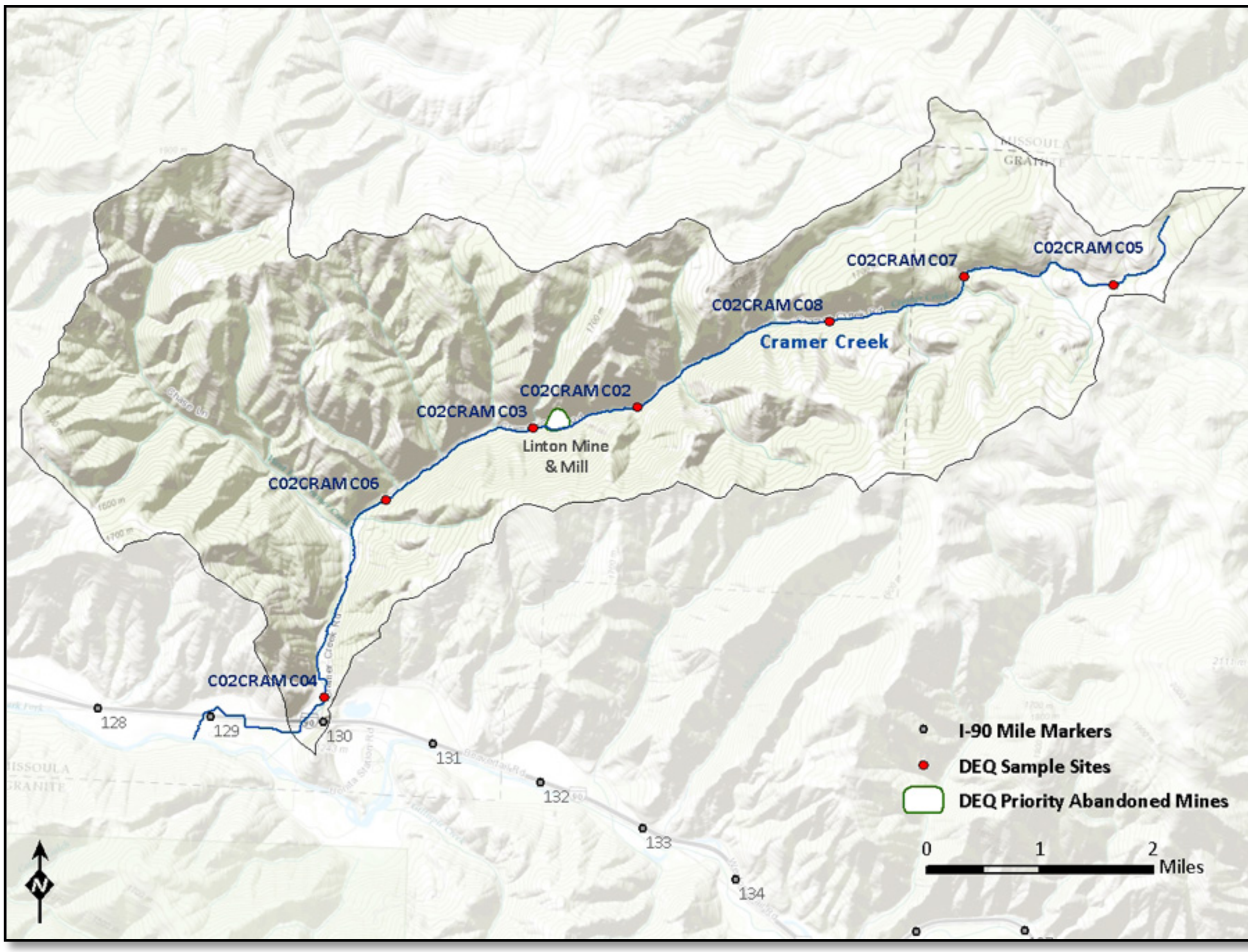

Figure 5-1. Metals sources and sample locations in the Cramer Creek watershed

BLM's remediation and restoration effort appears to be largely successful. As discussed above in **Section 5.4**, impaired conditions were not documented in Cramer Creek for the majority of the metals impairment causes. Lead, however, is consistently detected in water samples collected below the Linton Mine. Conversely, lead was detected only once above the mine site, at a concentration just over the detection limit. The Linton Mine site is the most probable source of lead in the watershed.

The aluminum target was exceeded twice at a site higher in the watershed (site C02CRAMC08), above the Linton mill site, and once lower in the watershed at site C02CRAMC04. Aluminum is likely derived from naturally-occurring aluminosilicate minerals in the soil, although the Linton site may also contribute to the aluminum load. Aluminum exceedances are reported only during high flow (runoff) conditions, suggesting that the aluminum is sediment-bound. The watershed has been logged historically and Cramer Creek has a sediment impairment cause (addressed in a separate document).

5.5.2 Wallace Creek MT76E004_020

Figure 5-2 shows the spatial extent of historic mining activity and mine wastes in the Wallace Creek watershed. Mining-related metals sources were studied in a variety of investigation and remediation activities. These projects documented metals contamination of soil, groundwater, surface water and stream sediments. Most of this work was completed in the 1990s by DEQ and the US BLM (Montana Department of State Lands, 1995; Montana Bureau of Mines and Geology, 1997). DEQ completed additional stream sampling from 2009-2011 to use for an updated assessment and to support subsequent TMDL development (**Appendix B**).

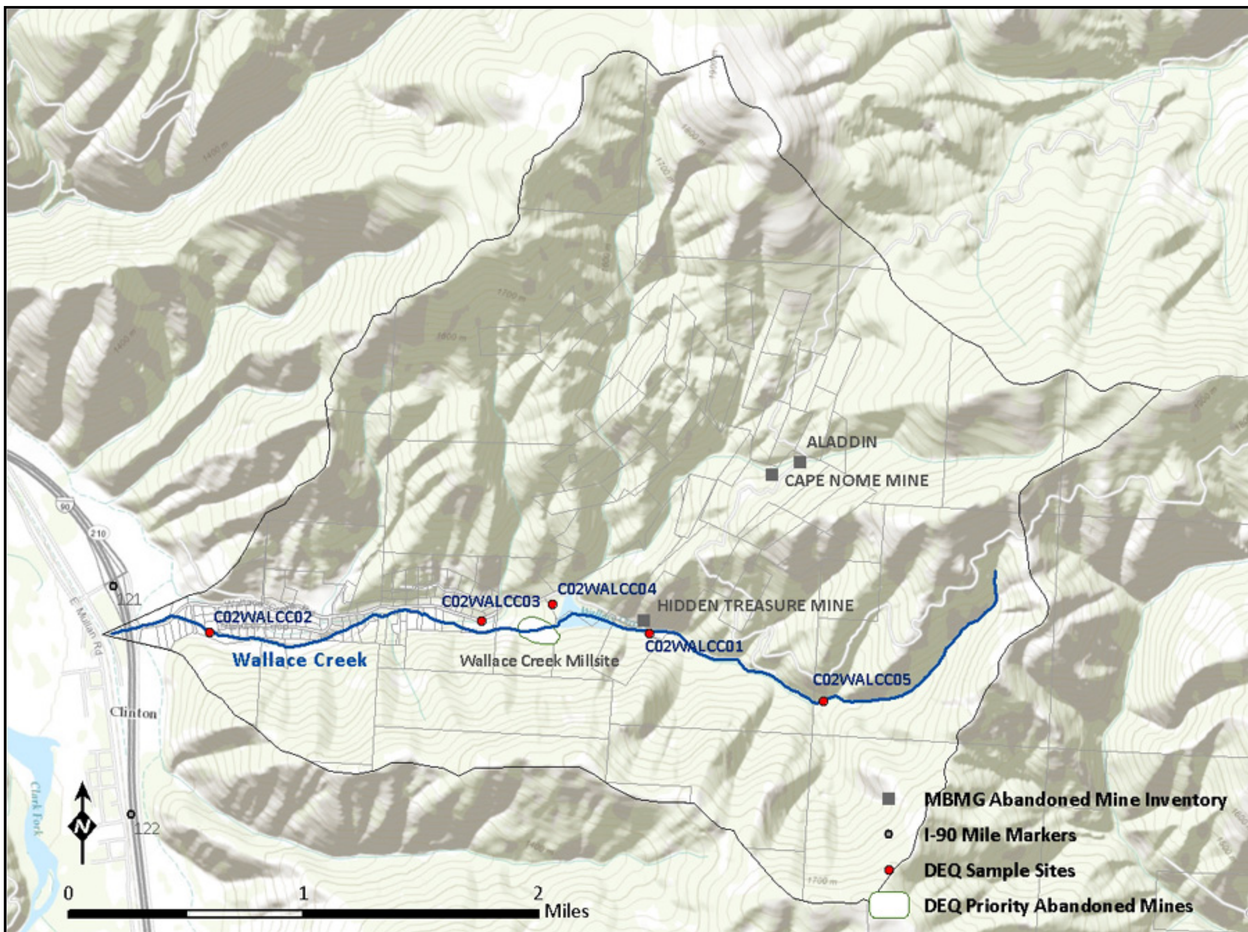

Figure 5-2. Metals sources and sample locations in the Wallace Creek watershed

Several abandoned mines and waste rock piles are present in the watershed. One of these is identified in Montana's list of priority abandoned mine cleanup sites: the Wallace Creek mill site. This mill site is below the Hidden Treasure mine and the associated tailings pond and dam. Although the site was identified as a priority cleanup site, no remediation or restoration projects were or are planned, according to DEQ's Abandoned Mine Cleanup program. The site is currently operated as a gravel pit (personal communication, 2012 J. Drygas). Other mines identified in the watershed by BLM include the Hidden Treasure mine, located at the eastern end of the tailings pond on Wallace Creek, and the Aladdin and Cape Nome mines. An adit discharging to the tailings pond was reported at the Hidden Treasure mine. The latter two mines are located along a small unnamed tributary that joins Wallace Creek from the north just below the mill site. This tributary drains an area of the watershed that shows many small property parcels, suggestive of extensive hardrock mining claims. There are no recent water chemistry samples from this tributary. BLM collected water samples from it in the 1990s, but from a location above the mines. The Wallace Creek Millsite is the most probable source of copper, however, the abandoned mining sources in the unnamed tributary subwatershed cannot yet be ruled out.

Copper was detected at every sample location on Wallace Creek, although one sample from the highest location (C02WALCC05) did not contain copper above the method detection limit.

5.5.3. Flat Creek MT76M002_180 and Hall Gulch MT76M002_200

Several agencies, including DEQ, EPA, and the USFS, have studied mining-related metals sources in the Flat Creek watershed (Montana Department of State Lands, 1995; Hargrave et al., 2003; MCS Environmental, Inc., 2004; United States Environmental Protection Agency, 2011). These projects documented metals contamination of soil, groundwater, surface water and stream sediments. **Figure 5-3** shows the spatial extent of historic mining activity and mine wastes in the watershed. DEQ completed additional stream sampling from 2009-2012 to use for an updated assessment and to support subsequent TMDL development (**Appendix B**).

Anthropogenic metals sources in the Flat Creek watershed are related primarily to abandoned / inactive mining from the Iron Mountain mine and associated workings near the former town of Pardee in Hall Gulch, and from the site of the mill and concentrator on Flat Creek. The Iron Mountain site is identified on the Montana list of priority abandoned mine cleanup site, and was referred to the US EPA, which added it to the National Priority List (aka Superfund). The Iron Mountain site has been subdivided into three operable units (OUs). Operable Unit 1 consists of waste rock and tailings from the Iron Mountain mill that was used as fill in the town of Superior. The millsite and a reach of Flat Creek filled with tailings comprise OU 2, and OU 3 is a waste rock repository in Wood Gulch, a tributary of Flat Creek below Hall Gulch.

The metals sources are well understood, and the major source of metals in Flat Creek is mill waste in the stream bed and in the floodplain. Adit discharge in Flat Creek has also been documented (MCS Environmental, Inc., 2004), and likely represents a secondary source of metals. Of the three adits that MCS Enviromental documented, only one was observed to discharge. This discharge was found to comply with aquatic life criteria, but exceeded human health standards for antimony.

All analyzed metals were below detectable levels in samples collected from the headwaters of Flat Creek. The samples just above the mill workings contained low concentrations (0.6 µg/L and 2.2 µg/L) of lead in 2 of 7 samples (**Appendix B**), but all other metals were below the detection limit (0.5 µg/L). This location is within OU2, however, and some influence from mining activity cannot be completely ruled out.

Hall Gulch is a tributary to Flat Creek. Anthropogenic metals sources in the Hall Gulch watershed are related to those in the Flat Creek watershed: abandoned mining features from the Iron Mountain mine and other abandoned mines in the Hall Gulch subwatershed, such as the Belle of the Hills mine and Dillon mill site (**Figure 5-3**). These sites are dry and isolated from surface water (Hargrave et al., 2003), although the Belle of the Hills adit probably intakes precipitation and snowmelt that may be hydrogeologically connected to water in the Iron Mountain Mine lower in the watershed. The Iron Mountain Mine adit is in lower Hall Gulch (Hargrave et al., 2003) and it discharges water. The adit discharge does not extend to Hall Gulch, but is probably hydrogeologically connected to either lower Hall Gulch or Flat Creek.

DEQ collected water and sediment samples from lower Hall Gulch as part of the Flat Creek sampling project. As shown on **Figure 5-3**, this portion of Hall Gulch is included within OU2 of the Iron Mountain Mill NPL site. Data from these samples is provided in **Appendix B**. Water hardness in Hall Gulch is extremely high, exceeding 400 mg/L in all samples DEQ collected (**Appendix B**). The high hardness suggests a large groundwater contribution to the surface water in Hall Gulch. Unlike Flat Creek, there is no evident pattern related to seasonality or flow regime in the metals concentrations. This suggests the adit discharge (or groundwater influenced by it) as the primary source of metals in Hall Gulch. There are no upstream water chemistry samples, so naturally occurring background concentrations are assumed to be identical to Flat Creek.

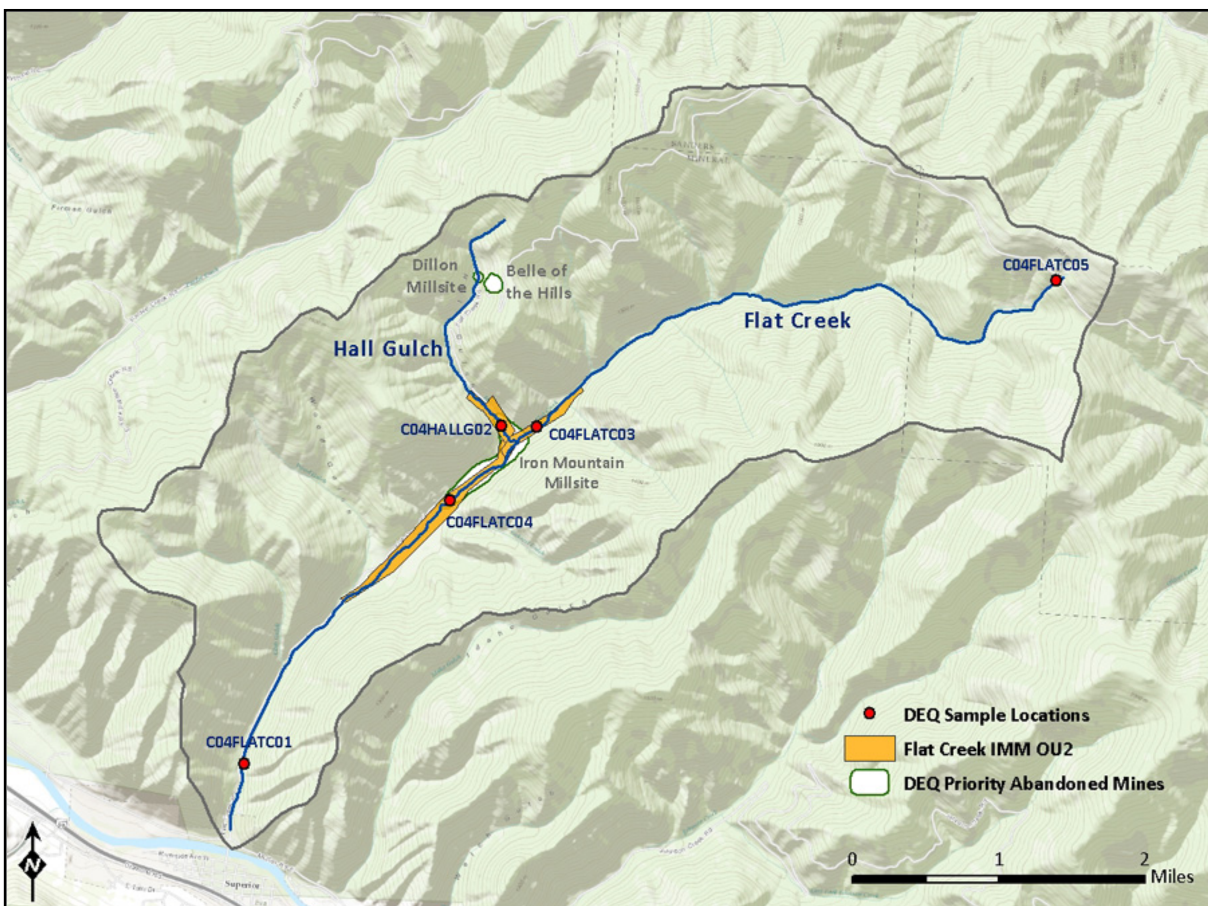

Figure 5-3. Metals sources and sampling locations in the Flat Creek watershed

The highest metals concentrations in Flat Creek are from the sites upstream of Siekrest Creek (C04FLATC04) and about one mile upstream from the mouth (C04FLATC01).

5.6 Metals TMDLs and Allocations

5.6.1 Metals TMDLs

DEQ presents metals total maximum daily loads for impaired waterbodies in the Bonita – Superior TMDL Project Area, summarized in **Table 5-1**. The TMDL is based on the most stringent water quality criteria or the water quality target, the water hardness if applicable, and the streamflow. Target development is discussed in detail above, in **Section 5.4.2.1**.

Because streamflow and hardness vary seasonally, the TMDL is not expressed as a static value, but as an equation of the appropriate target multiplied by flow. These equations are illustrated below in **Figures 5-4** through **5-8**. The TMDL under a specific flow condition is calculated using the following formula:

TMDL = (X) (Y) (k)

TMDL= Total Maximum Daily Load in lbs/day
X= lowest applicable metals water quality target in µg/L
Y= streamflow in cubic feet per second
k = conversion factor of 0.0054

Four metals impairment causes in the Bonita – Superior project area have standards for protection of aquatic life that vary according to water hardness as defined within DEQ-7 (Montana Department of Environmental Quality, 2012). Generally aquatic life standards become more stringent as water hardness decreases. Water hardness may vary seasonally, and instream water hardness is commonly higher under low flow conditions. For calculating example TMDLs in this section, the lowest applicable metals water quality target is based upon the measured hardness corresponding to that sample.

Figure 5-4 is a plot showing TMDLs versus flow for impairment causes that are not influenced by hardness. **Figures 5-5** through **5-8** show TMDLs versus flow for the hardness-dependent impairment causes at hardness conditions of 25mg/L and 400/mg/L. These values represent the complete range of variability of hardness per DEQ-7, as well as the naturally occurring conditions in the Bonita – Superior project area (**Appendix B**). Although a 10% target exceedance rate is allowed for aquatic life targets, the TMDLs are set so that these targets are satisfied 100% of the time. This provides a margin of safety by focusing remediation and restoration efforts toward 100% compliance to the extent practical.

The TMDL equation and curves apply to all metals TMDLs within this document and describe TMDLs for each metal under variable flow and hardness conditions. Metals TMDLs apply to any point along the waterbody and therefore protect uses along the entire stream. An exception may be found in a mixing zone established for a permitted discharge, but that does not apply within the Bonita – Superior TMDL project area since there are no permitted discharges.

Figure 5-4. Hardness-independent metals TMDLs as functions of flow

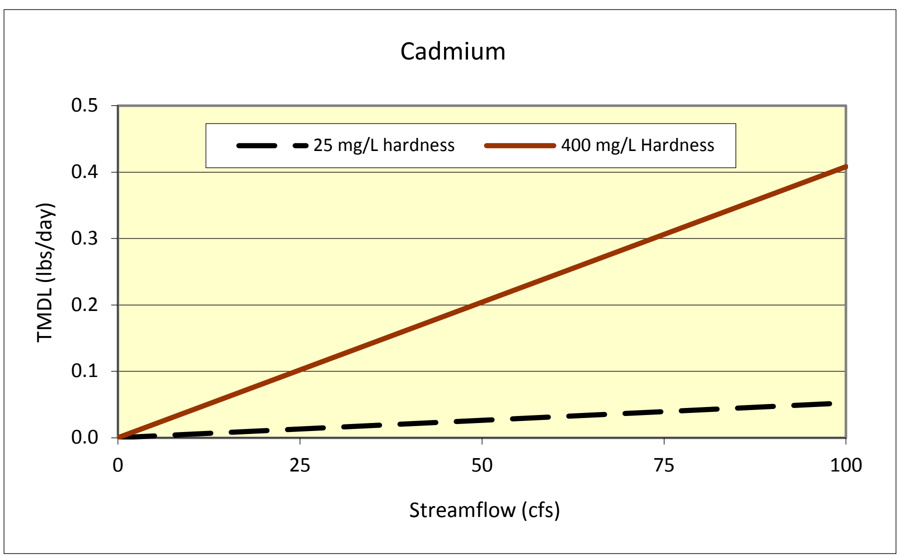

Figure 5-5. Cadmium TMDL as a function of flow

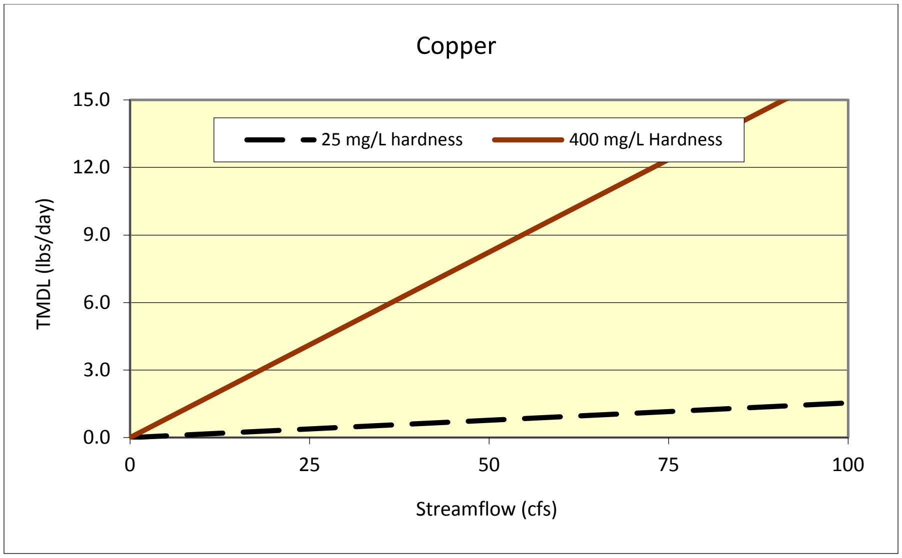

Figure 5-6. Copper TMDL as a function of flow

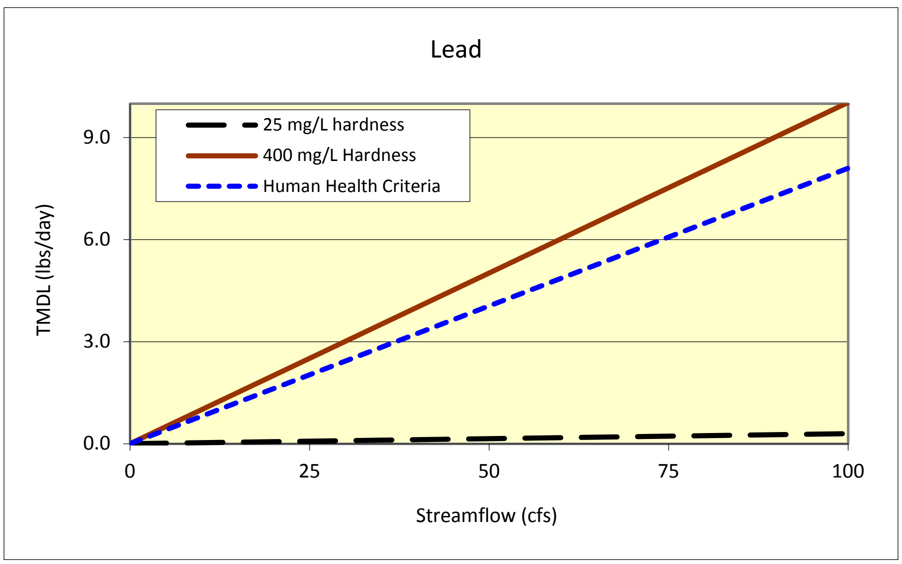

Figure 5-7. Lead TMDL as a function of flow

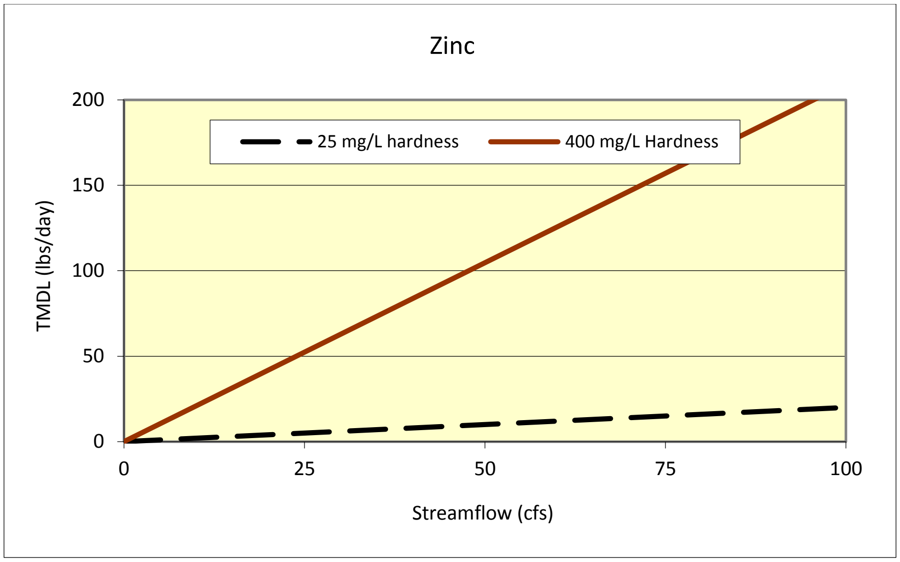

Figure 5-8. Zinc TMDL as a function of flow

Table 5-16 provides example TMDLs and the calculated load reduction requirements necessary to meet each TMDL for each of the 14 waterbody – impairment cause combinations in the Bonita – Superior project area. DEQ chose the data in **Table 5-16** by selecting the highest measured concentration for a given impairment cause for each flow regime. This accounts for seasonal variability by providing the full range of streamflow and water hardness for each waterbody –impairment cause combination (**Appendix B**). The TMDLs in **Table 5-16** are calculated according to the TMDL equation provided above.

The required percent reduction in total load is calculated by subtracting the TMDL from the existing load (measured concentration multiplied by flow multiplied by 0.0054), and dividing the difference by the existing load. In cases where the TMDL is being met, the percent reduction is reported as 0%. Note that the data for aluminum in Cramer Creek is from a site near the headwaters where the highest aluminum concentration was detected. Aluminum TMDL values per the TMDL equation and **Figure 5-4** will still apply through all of Cramer Creek.

The required percent reduction is quite high in many examples, since the examples are chosen to demonstrate the highest detected metals concentrations. This may provide a somewhat misleading idea of the magnitude of the impairments, and should be considered in conjunction with the percentage of samples that exceed the lowest applicable water quality target (e.g. “exceedance rates” in **Section 5.4.3**).

Table 5-16. Detailed inputs for example TMDLs in the Bonita - Superior TMDL project area

Stream	Station	Discharge (cfs)		Hardness (mg/L)		Metal	Measured Conc. (µg/L)		Target Conc. (µg/L)		TMDL (lbs/day)		% Required Load Reduction To Meet TMDL*	
		High Flow	Low Flow	High Flow	Low Flow		High Flow	Low Flow	High Flow	Low Flow	High Flow	Low Flow	High Flow	Low Flow
Cramer Creek (MT76E004_020)	CRAMC08	0.72	0.1	91	152	Aluminum	490	<30	87.0	87.0	0.338	0.047	82%	0%
	CRAMC06	19.11	7.79	156	214	Lead	8.5	15.4	5.60	8.38	0.578	0.353	34%	46%
Wallace Creek (MT76E004_010)	WALCC04	2.52	0.35	51	87	Copper	6	5	5.25	8.28	0.071	0.016	13%	0%
Flat Creek (MT76M002_180)	FLATC01	36.42	2.18	147	177	Antimony	39	37	6	6	1.180	0.071	85%	84%
						Arsenic	45	7	10	10	1.967	0.118	78%	0%
						Cadmium	2.51	0.92	0.36	0.41	0.071	0.005	86%	55%
						Lead	498	14.6	5.20	6.58	1.023	0.077	99%	55%
						Zinc	560	160	166.07	194.37	32.66	2.288	70%	0%
						Mercury	0.425	0.009	0.05	0.05	0.010	0.001	88%	0%
Hall Gulch (MT76GM002_200)	HALLG02	0.1	0.1	465**	512**	Antimony	18	37	6	6	0.003	0.003	67%	84%
						Arsenic	31	317	10	10	0.005	0.005	68%	97%
						Iron	3,280	1,100	1,000	1,000	0.540	0.540	70%	9%
						Lead	0.7	22.7	18.58	18.58	0.010	0.010	0%	18%
						Zinc	2,160	5,310	387.83	387.83	0.209	0.209	82%	93%

*Based on highest single sample concentrations (2009 through 2012)

**Hardness-dependent targets are calculated using maximum applicable hardness of 400 mg/L.

5.6.2 Metals Allocations

As discussed in **Section 4.0**, a TMDL equals the sum of all the wasteload allocations (WLAs), load allocations (LAs), and a margin of safety (MOS). WLAs are allowable pollutant loads that are assigned to permitted and non-permitted point sources. Mining-related waste sources (e.g. adit discharges, tailings accumulations, and waste rock deposits) are non-permitted point sources subject to WLAs. LAs are allowable pollutant loads assigned to nonpoint sources and may include the pollutant load from naturally occurring sources, as well as human-caused nonpoint loading. Where practical, LAs to human sources are provided separately from naturally occurring sources. In addition to metals load allocations, the TMDL must also take into account the seasonal variability of metals loads and adaptive management strategies in order to address uncertainties inherent in environmental analyses.

These elements are combined in the following equation:

TMDL = ∑WLA + ∑LA + MOS

WLA = Wasteload Allocation or the portion of the TMDL allocated to metals point sources.
LA = Load Allocation or the portion of the TMDL allocated to nonpoint metals sources and naturally occuring background
MOS = Margin of Safety or an accounting of uncertainty about the relationship between metals loads and receiving water quality.

Metals allocations in the Bonita – Superior TMDL project areas are provided for the following source categories:

- Abandoned or unpermitted mining sources (WLA_{ABDM})
- Naturally occurring metals sources (LA_{NAT})

Since there are no MPDES-permitted surface water discharges in the project area, no allocations are provided for them.

Abandoned mining sources

Within the Bonita – Superior TMDL Planning Area, the major metals sources are related to abandoned and inactive mining sites. Although prominent abandoned/inactive mines have been investigated in each of these watersheds (**Section 5.5**), data describing individual loading contributions from abandoned mines is typically insufficient to guide allocations for each individual abandoned mine feature. Furthermore, the nature of Montana's abandoned mining legacy is such that many small non-permitted point sources (adits, seeps, tailings piles, etc.) may be scattered throughout a watershed and pass undetected. Therefore a composite wasteload allocation (WLA_{ABDM}) for abandoned mining is provided in pounds/day to any and all metals sources related to abandoned or inactive mines. This composite wasteload allocation approach recognizes that abandoned mine remediation is best pursued in an adaptive manner that balances remediation costs with achievable load reductions within each watershed. The WLA_{ABMD} is calculated for each TMDL as the difference between the TMDL and the load allocation to naturally-occurring sources (described below).

Naturally occurring metals sources

Other metals sources unrelated to Montana's mining legacy appear to be within naturally-occurring concentrations and are not believed to contribute significantly to water quality impairment. Naturally occurring sources are provided a load allocation in pounds/day based on naturally occurring metals concentrations and streamflow. As defined in ARM 17.30.602, naturally occurring sources include metals loading from non-human (natural background) sources as well as *"those sources from developed areas where all reasonable land, soil and water conservation practices have been applied."* Within the Bonita – Superior TMDL project area, naturally-occurring metals concentrations are derived by using water chemistry upstream of mining sources where metals sources are limited to those associated with naturally occurring background and low-level development.

Copper was detected at low levels (2 µg/L and <1 µg/L) above identified mining sources in Wallace Creek and the naturally occurring concentration is inferred to be 1 µg/L (as this is the lowest possible mean value). In many other cases, non-detects were recorded upstream of mining sources; for purposes of load allocations to naturally-occurring metals, half the lowest detection limit is substituted for the non-detect result value (**Table 5.17**). Since there are no sample sites above the mining areas in Hall Gulch, water chemistry from the upper location on Flat Creek is used to estimate the naturally occurring metals concentrations for Hall Gulch. These values are below method detection limits for arsenic, antimony, lead and zinc. Iron was detected at this site, and the median value (50 µg/L) is used to estimate naturally occurring iron concentrations for Hall Gulch.

Table 5-17. Metals Detection Limits and Inferred Naturally Occurring Concentrations

Metal	Method Detection Limit	½ Method Detection Limit
Antimony*	3	1.5
Arsenic	3	1.5
Cadmium	0.08	0.04
Lead	0.5	0.25
Mercury	0.005	0.0025
Zinc	10	5

Units are µg/L
*Antimony analyses had detection limits of both 3 µg/L and 5 µg/L.

The aluminum impairment to Cramer Creek appears to be primarily related to aluminum-bearing minerals in soils. Cramer Creek also has a sediment impairment cause and the impairments are likely related. Nevertheless, elevated aluminum levels below the abandoned mine and limited sample data precludes eliminating abandoned mining as an aluminum source. In this case, DEQ uses a composite wasteload allocation that combines all metals sources in the watershed, including naturally occurring and abandoned mining sources.

Margin of Safety (MOS)
DEQ provides an implicit margin of safety by using assumptions known to be conservative, discussed further in **Section 5.7.2**. Because an implicit MOS is applied, the MOS in the TMDL equation above equals zero and is not included in the equations provided below.

5.6.3 Allocations by Waterbody Segment

In the sections that follow, load and wasteload allocations are provided for each pollutant-waterbody combination for which a TMDL is prepared (see **Table 5-1**). The allocations are presented in **Tables 5-18** through **5-21**. Load estimations and allocations are based on a limited data set and are assumed to approximate general metals loading during high and low flow conditions. Due to the limited number of samples, examples are based on the highest detected pollutant concentration for each flow regime and the corresponding flow from that sampling event (**Table 5-16**).

Every TMDL in this document is calculated as the sum of LA_{nat} and WLA_{ABDM}. However, in the case of the aluminum TMDL for Cramer Creek, these two allocations are not parsed out.

$$TMDL = LA_{nat} + WLA_{ABDM}$$

The TMDL and allocation tables in the following sections give example TMDLs for each metal pollutant parameter under both high- and low-flow conditions for each stream segment. The TMDLs are calculated according to the TMDL formula (provided in **Section 5.6.1**) of lowest target concentration multiplied by the flow, multiplied by a unit conversion factor of 0.0054, to arrive at units of lbs/day. For example, lead TMDL in Cramer Creek under high flow conditions is 0.578 pounds per day (lbs/day).

High flow lead TMDL: [5.6 µg/L X 19.11 cfs X 0.0054 = 0.578 lbs/day]

The load allocation to natural sources (LA_{nat}) is the same the estimated naturally occurring load. In the case of Cramer Creek, the naturally occurring lead load (LA_{nat}) is estimated as half the detection level, or 0.25 µg/L (**Table 5-17**). For a flow of 19.11 cfs, this is 0.0258 lbs/day.

High flow naturally occurring lead load: [0.25 µg/L X 19.11 cfs X 0.0054 = 0.0258 lbs/day]

The wasteload contributed by abandoned mines (WLA_{ABDM}) is calculated by subtracting the naturally occurring load (LA_{nat}) from the TMDL. The WLA_{ABDM} for every TMDL in this document may be calculated by this formula:

$$WLA_{ABDM} = TMDL - LA_{nat}$$

For lead in Cramer Creek under high flow conditions, this is 0.578 lbs/day minus 0.0258 lbs/day, resulting in 0.552 lbs/day.

The existing loads are calculated using the highest values from the water quality monitoring data for each flow condition. For example, **Table 5-18** for Cramer Creek gives values of 0.877 lbs/day for existing high-flow lead loads. This is calculated by multiplying the highest measured lead concentration during high flows (8.5 µg/L) by the corresponding observed high flow in Cramer Creek of 19.11 cfs (from **Table 5-18**). The product of concentration multiplied by flow is multiplied by the conversion factor of 0.0054, giving an existing high flow lead load of 0.877 lbs/day.

The last column in the example tables contains the reductions (expressed in percent) in anthropogenic loading necessary in order to meet the TMDLs. These reductions are calculated by dividing the difference between the WLA_{ABDM} and the existing total load by the existing total load. Note that this is not the same as the percent reduction provided in **Table 5-16**, which is the required reduction of the total load, not the anthropogenic abandoned mine load. The percent reduction required for WLA_{ABMD} is greater than the overall reduction required, since DEQ assumes that the naturally occurring load will not be reduced where abandoned mine remediation is the proposed solution and the very low naturally occurring loads cannot reasonably be reduced. In the case of lead in Cramer Creek under high flow conditions, the WLA_{ABDM} must be reduced by 37% in order to meet the TMDL.

Required reduction in lead WLA_{ABDM}: [(0.877 lbs/day – 0.552 lbs/day) ÷ 0.877 lbs/day = 0.37]

In the case of high uncertainty in the degree of naturally occurring loads, such as aluminum in Cramer Creek, DEQ uses a composite wasteload allocation that combines naturally occurring and human-caused sources. In this case, the final column in the allocation tables quantifies the reduction in total pollutant load needed to meet the TMDL.

The examples provided for existing loads, TMDLs, LAs, and WLAs under both high flow and low flow conditions are based upon the following conditions:

1. The hardness values used for determining hardness-based standards and associated TMDLs, LAs, and WLAs are the values recorded with the corresponding metals sample.
2. TMDL examples use the streamflow recorded while collecting the metals sample used as the basis for TMDL load examples.
3. Existing condition load summaries use the maximum concentration in a data set.
4. The existing condition and TMDL examples provided in the following metals TMDL sections are located at the most contaminated location that was sampled for each metal.

In some cases, targets are exceeded under one flow regime but not the other. In these cases, the needed reduction is reported as 0% for the flow regime under which targets are met.

5.6.3.1 Cramer Creek MT76E004_020

The aluminum TMDL for Cramer Creek is expressed by the following formula:

$$TMDL_{Cramer} = WLA_{Composite} \ (LA_{nat} + WLA_{ABMD})$$

The lead TMDL for Cramer Creek is expressed by the following formula:

$$TMDL_{Cramer} = LA_{nat} + WLA_{ABMD}$$

Table 5-18. Cramer Creek: Metals TMDLs and Allocation Examples

Metal	Flow	TMDL	LA_{nat}	WLA_{ABDM}	Existing Load	WLA_{ABMD} % Reduction
Aluminum	High flow	0.338	0.338		1.905	82%
	Low flow	0.047	0.047		0.008	0%
Lead	High flow	0.578	0.0258	0.5521	0.877	37%
	Low flow	0.353	0.0105	0.3420	0.648	47%

Units are lbs/day

Aluminum reductions are required only during high flow conditions; impairment is not documented during low flow. As noted in the source assessment, smaller percent reductions are also required near the mouth of Cramer Creek during high flow conditions. Reductions in lead concentrations are required to meet the TMDL under both flow regimes.

5.6.3.2 Wallace Creek MT76E004_010

The copper TMDL for Wallace Creek is expressed by the following formula:

$$TMDL_{Wallace} = LA_{nat} + WLA_{ABDM}$$

Table 5-19. Wallace Creek: Metals TMDLs and Allocation Examples

Metal	Flow	TMDL	LA_{nat}	WLA_{ABDM}	Existing Load	WLA_{ABMD} % Reduction
Copper	High flow	0.071	0.0136	0.0578	0.082	29%
	Low flow	0.016	0.0019	0.0138	0.009	0%

Units are lbs/day

Copper reductions are required only during high flow conditions. The copper TMDL is met during low flow.

5.6.3.3 Flat Creek MT76M002_180

All the metals TMDLs for Flat Creek are expressed by the following formula:

$$TMDL_{Flat} = LA_{nat} + WLA_{ABDM}$$

Table 5-20. Flat Creek: Metals TMDLs and Allocation Examples

Metal	Flow	TMDL	LA_{nat}	WLA_{ABDM}	Existing Load	WLA_{ABMD} % Reduction
Antimony	High flow	1.180	0.2950	0.8850	7.670	88%
	Low flow	0.071	0.0177	0.0530	0.436	88%
Arsenic	High flow	1.967	0.2950	1.6717	8.850	81%
	Low flow	0.118	0.0177	0.1001	0.082	0%
Cadmium	High flow	0.071	0.0079	0.0629	0.494	87%
	Low flow	0.005	0.0005	0.0044	0.011	60%
Lead	High flow	1.023	0.0492	0.9735	97.941	99%
	Low flow	0.077	0.0029	0.0745	0.172	57%
Mercury	High flow	0.010	0.0005	0.0093	0.084	89%
	Low flow	0.001	0.00001	0.0006	0.0001	0%
Zinc	High flow	32.661	0.9833	31.677	110.134	71%
	Low flow	2.288	0.0589	2.229	1.884	0%

Units are lbs/day

All metals impairments for Flat Creek require greater reductions during high flow than during low flow. The TMDLs for arsenic, mercury and zinc are currently being met during low flow conditions.

5.6.3.4 Hall Gulch MT76M002_200

All the metals TMDLs for Hall Gulch are expressed by the following formula:

$$TMDL_{Hall} = LA_{nat} + WLA_{ABDM}$$

Table 5-21. Hall Gulch: Metals TMDLs and Allocation Examples

Metal	Flow	TMDL	LA_{nat}	WLA_{ABDM}	Existing Load	WLA_{ABMD} % Reduction
Antimony	High flow	0.003	0.0008	0.0024	0.010	75%
	Low flow	0.003	0.0008	0.0024	0.020	88%
Arsenic	High flow	0.005	0.0008	0.0046	0.017	73%
	Low flow	0.005	0.0008	0.0046	0.170	97%
Iron	High flow	0.540	0.0270	0.5130	1.771	71%
	Low flow	0.540	0.0270	0.5130	0.594	14%
Lead	High flow	0.010	0.0001	0.0099	0.0001	0%
	Low flow	0.010	0.0001	0.0099	0.012	19%
Zinc	High flow	0.209	0.0027	0.2067	1.166	82%
	Low flow	0.209	0.0027	0.2067	2.8671	93%

Units are lbs/day

All metals impairments for Hall Gulch require greater reductions during low flow conditions than during high flow. The lead TMDL is met during high flow in this example.

5.7 SEASONALITY AND MARGIN OF SAFETY

Streamflow, water hardness, and climate vary seasonally. All TMDL documents must consider the effects of this variability on water quality impairment conditions, maximum allowable pollutant loads in a stream (TMDLs), and load allocations. TMDL development must also incorporate a margin of 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 designated uses. This section describes the considerations of seasonality and a margin of safety (MOS) in the Bonita – Superior metal TMDL development process.

5.7.1 Seasonality

Seasonality addresses the need to ensure year round designated use support. Seasonality is considered for assessing loading conditions and for developing water quality targets, TMDLs, and allocation schemes. For metals TMDLs, seasonality is important because metals loading pathways and water hardness change from high to low flow conditions. During high flows, loading associated with overland flow and erosion of metals-contaminated soils and mine wastes tend to be the major cause of elevated metals concentrations. During low flow, groundwater transport and/or adit discharges tend to be the major source of elevated metals concentrations. Hardness tends to be lower during higher flow conditions, which leads to more stringent water quality standards for hardness-dependent metals during the runoff season. Seasonality is addressed in this document as follows:

- Metals concentrations and loading conditions are evaluated for both high flow and low flow conditions. DEQ's assessment method requires a combination of both high and low flow sampling for target evaluation since abandoned mines and other metals sources can lead to elevated metals loading during high and/or low flow conditions.
- Metals TMDLs incorporate streamflow as part of the TMDL equation.
- Metals concentration targets apply year round, with monitoring criteria for target attainment developed to address seasonal water quality extremes associated with loading and hardness variations.
- A sediment chemistry target is applied as a supplemental indicator to help capture impacts from episodic metals loading events that could be attributed to high flow seasonal runoff conditions.
- Example targets, TMDLs and load reduction needs are developed for high and low flow conditions. The TMDL equation incorporates all potential flow conditions that may occur during any season.

5.7.2 Margin of Safety

The margin of safety is to ensure that TMDLs and allocations are sufficient to sustain conditions that will support designated uses. All metals TMDLs incorporate an implicit MOS in several ways, using conservative assumptions throughout the TMDL development process , as summarized below:

- DEQ's assessment process includes a mix of high and low flow sampling since abandoned mines and other metals sources can lead to elevated metals loading during high and/or low flow stream conditions. The seasonality considerations help identify the low range of hardness values and thus the lower range of applicable TMDL values shown within the TMDL curves and captured within the example TMDLs.
- Target attainment, refinement of load allocations, and, in some cases, impairment validations and TMDL-development decisions are all based on an adaptive management approach that relies on future monitoring and assessment for updating planning and implementation efforts.
- Although a 10% exceedance rate is allowed for chronic and acute based aquatic life targets, the TMDLs are set so the lowest applicable target is satisfied 100% of the time. This focuses remediation and restoration efforts toward 100% compliance with all targets, thereby providing a margin of safety for the majority of conditions where the most protective (lowest) target value is linked to the numeric aquatic life standard. As part of this, the existing water quality

conditions and needed load reductions are based on the highest measured value for a given flow conditions in order to consistently achieve the TMDL.

- The monitoring results used to estimate existing water quality conditions are instantaneous measurement used to estimate a daily load, whereas chronic aquatic life standards are based on average conditions over a 96-hour period. This provides a margin of safety since a four-day loading limit could potentially allow higher daily loads in practice.
- The lowest or most stringent numeric water quality standard was used for TMDL target and impairment determination for all waterbody – pollutant combinations. This ensures protection of all designated beneficial uses.
- Sediment metals concentration criteria were used as a supplemental indicator target. This helps ensure that episodic loading events were not missed as part of the sampling and assessment activity.
- The TMDLs are based on numeric water quality standards developed at the national level via EPA and incorporate a margin of safety necessary for the protection of human health and aquatic life.

5.8 Uncertainty and Adaptive Management

The environmental studies required for TMDL development include inherent uncertainties: accuracy of field and laboratory data, for example. Data concerns are managed by DEQ's data quality objective (DQO) process. The use of DQOs ensures that the data is of known (and acceptable) quality. The DQO process develops criteria for data performance and acceptance that clarify study intent, define the appropriate type of data, and establish minimum standards for the quality and quantity of data.

The accuracy of source assessments and loading analyses is another source of uncertainty. An adaptive management approach that revisits, confirms, or updates loading assumptions is vital to maintaining stakeholder confidence and participation in water quality improvement. Adaptive management uses updated monitoring results to refine loading analysis, to further customize monitoring strategies and to develop a better understanding of impairment conditions and the processes that affect impairment. Adaptive management recognizes the dynamic nature of pollutant loading and water quality response to remediation.

Adaptive management also allows for continual feedback on the progress of restoration and the status of beneficial uses. Additional monitoring and resulting refinements to loading can improve t achieving and measuring success. A remediation and monitoring framework is closely linked to the adaptive management process, and is addressed in **Section 7.0**.

The metals TMDLs developed for the Bonita – Superior TMDL Project Area are based on future attainment of water quality standards. In order to achieve this, all significant sources of metals loading must be addressed via all reasonable land, soil, and water conservation practices. DEQ recognizes however, that in spite of all reasonable efforts, this may not be possible due to natural background conditions and/or the potential presence of unalterable human-caused sources that cannot be fully addressed via reasonable remediation approaches. For this reason, an adaptive management approach is adopted for all metals targets described within this document. Under this adaptive management approach, all metals impairments that required TMDLs will ultimately fall into one of the three categories identified below:

- Restoration achieves the metal pollutant targets and all beneficial uses are supported.

- Targets are not attained because of insufficient controls; therefore, impairment remains and additional remedies are needed.
- Targets are not attained after all reasonable BMPs and applicable abandoned mine remediation activities are applied. Under these circumstances, site-specific standards may be necessary.
- Targets are unattainable due to naturally-occurring metals sources. Under this scenario, site-specific water quality standards and/or the reclassification of the waterbody may be necessary. This would then lead to a new target (and TMDL) for the pollutant(s) of concern, and the new target would reflect the background condition.

The Abandoned Mines Section of DEQ's Remediation Division will lead abandoned mine restoration projects funded by provisions of the Surface Mine Reclamation and Control Act of 1977. DEQ's Federal Superfund Bureau (also in the Remediation Division) will provide technical and management assistance to EPA for remedial investigations and cleanup actions at NPL mine sites in federal-lead status, such as the Iron Mountain Mine site in Flat Creek.

Monitoring and restoration conducted by other parties (e.g. USFS, BLM, the Montana Department of Natural Resources and Conservation's Trust Lands Management Division, The Nature Conservancy) should be incorporated into the target attainment and review process as well. Cooperation among agency land managers in the adaptive management process for metals TMDLs will help identify further cleanup and load reduction needs, evaluate monitoring results, and identify water quality trends.

6.0 RESTORATION STRATEGY

Resource development (historical mining) is the primary source of metals impairment to the four streams within the Bonita – Superior project area. This section describes an overall strategy and specific on-the-ground measures designed to attain metals water quality standards in the Bonita – Superior project area. The strategy includes general measures for reducing loading from significant metals pollutant sources and would apply adaptive management (**Section 5.7**) for adjusting restoration plans in response to monitoring results and advances in reclamation technology.

6.1 WATER QUALITY RESTORATION OBJECTIVES

The general water quality goal of this TMDL document is to provide technical guidance for recovery of aquatic life and drinking water uses to all metal impaired streams within the Bonita – Superior project area. The components of this guidance are:

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

6.2 MONTANA DEQ AND OTHER AGENCY ROLES

Successful restoration requires collaboration among private landowners, government land managing agencies, and other interested stakeholders. Stakeholders in the Bonita – Superior project area include:

- Montana Region 8 EPA
- DEQ Federal Superfund Bureau
- DEQ Abandoned Mines Bureau
- Project area landowners
- Lolo National Forest
- Bureau of Land Management
- Mineral County Conservation District
- Missoula County Conservation District
- The Montana Department of Fish, Wildlife, and Parks
- The Nature Conservancy

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

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

6.3 Metals Restoration Strategy for Mining Sources

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

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

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

6.3.1 Superfund Authority in the Bonita – Superior Project Area

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly referred to as Superfund, is a Federal statute that addresses cleanup on sites, such as historic mining areas, where there has been a release, or threat of a release of hazardous substances. Sites are prioritized on the National Priority List (NPL) using a hazard ranking system focused on human health effects. CERCLA authorizes two kinds of response actions:

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

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

The Iron Mountain Mine/Mill is the only NPL site in the project area. The area was added to the NPL in 2009 following site investigations instigated at the request of DEQ and the Town of Superior in 2001. The principal contaminants are antimony, arsenic, lead, mercury, and zinc The Iron Mountain Mine NPL site is divided into the following operable units (OUs) for planning and administrative purposes.

OU1 - The Town of Superior
OU2 – The Flat Creek watershed
OU3 - The Wood Gulch Repository

The Town of Superior (OU1) was the initial focus of investigation and remediation. During the preliminary assessment (PA) phase, 33 properties were identified with very high metals concentrations in soils. These concentrations warranted a time critical removal action (TCRA). The remedial investigation (RI) was published in 2011 and a record of decision (ROD) for OU1 is expected to be published in 2013. Additional soil removal will be performed in OU1, but this is outside the scope of this document.

The Flat Creek Watershed (OU2) includes the Iron Mountain Mine and Mill site and the stream corridor downstream of the site. The extent of OU2 is shown in **Figure 5-3**. Land ownership in OU2 includes USFS land and the former ASARCO property, now administered by DEQ. OU2 includes mine waste from the mill that was disposed of into Flat Creek. These wastes have been washed downstream and deposited in the streambed and floodplain. Proposed remedial action for OU2 includes removal of the mine wastes and restoration of the stream channel. Remediation and restoration plans are in development as of this writing, but work will probably begin by 2014 or 2015 and likely be implemented by USFS and DEQ rather than EPA.

OU3 is a waste repository in Wood Gulch. The repository will hold both mine waste removed from the town of Superior (OU1) and from Flat Creek (OU2).

Once the nature and extent of contamination is known and remediation alternatives identified in the feasibility study, a ROD establishes the chosen remediation approach. When removal is complete an NPL site can undergo additional remediation or be scored low enough to no longer qualify for listing. A site could conceivably remain a water quality concern after CERCLA removal activities are completed.

6.3.2 The Surface Mining Control and Reclamation Act (SMCRA)

DEQ's Abandoned Mines Bureau (AMB) is responsible for reclamation of abandoned mines in Montana. The AMB reclamation program is funded through the Surface Mining Control and Reclamation Act of 1977 (SMCRA). SMCRA funding is collected as a per ton fee on coal production that is then distributed to states by the federal Office of Surface Mining Reclamation and Enforcement (OSM). Funding eligibility is based on land ownership and date of mining disturbance. Eligible abandoned coal mine sites have a priority for reclamation construction funding over eligible non-coal sites. Areas within federal Superfund sites and areas where there is a reclamation obligation under state or federal law are not eligible for expenditures from the abandoned mine reclamation program. **Table 6-1** lists the priority abandoned mines in the Bonita – Superior TMDL project area.

Table 6-1. Priority Abandoned Mine Sites in the Bonita – Superior TMDL Project Area.

Site Name	Receiving Stream	Disturbance Area (acres)	Ranking Score
BELL OF THE HILLS	HALL GULCH	7.6	1.50
DILLON MILLSITE	HALL GULCH	2.3	6.10
IRON MOUNTAIN MILL	FLAT CREEK	66.3	4.07
LINTON MINE & MILLSITE	CRAMER CREEK	18.6	49.35
WALLACE CREEK MILL	WALLACE CREEK	9.4	1.96

The Belle of the Hills mine and the Dillon millsite are likely to be stabilized as part of the EPA remediation and restoration of the Flat Creek Iron Mountain Mill site. The Linton mine and millsite was restored by BLM in the early 2000s. The Wallace Creek millsite is currently operated as a gravel pit and may not require restoration (see **Section 7.1**).

6.3.3. Other Historical Mine Remediation Programs

Appendix C provides a summary of mining remediation programs and approaches that can be or currently are being applied within the Bonita – Superior watersheds. The extent that these programs may be necessary will depend in part on the success of ongoing CERCLA work in the Flat Creek / Hall Gulch watershed and the level of stakeholder involvement and initiative throughout the watersheds with metals impairment causes.

6.4 Watershed Restoration Plan Development

As noted in **Table 1-1**, Flat and Cramer Creeks still require sediment TMDL development. This additional TMDL work is being pursued as part of a larger project area that includes several other Clark Fork River tributaries with sediment, nutrient and temperature causes of impairments. These TMDLs will be provided in a separate document.

The restoration strategy for sediment and other non-metals pollutants would ideally involve development of a watershed restoration plan (WRP). A WRP is an analytical framework for restoring water quality in impaired waters by reducing loading from pollutant sources (U.S. Environmental Protection Agency, 2008). A WRP focuses on achieving the TMDLs presented in this document, address related water quality problems with local interest, and help develop a detailed and locally organized process for prioritizing, funding, and completing restoration projects.

The WRP is an adaptive document that can be revised when new information on water quality conditions, restoration effectiveness, and stakeholder priorities becomes available. The following are suggested elements of a WRP:

- Expressed support for restoration projects that achieve and maintain the TMDLs established in this document and protect good water quality water conditions for all streams in the watershed
- A detailed analysis of the costs, benefits, and spatial effects of water quality improvement projects
- An efficient means of installing future BMPs and tracking results
- An educational component that helps stakeholders understand the benefits of water quality restoration and provides knowledge of available funding assistance
- Expressed support for meeting other natural resource goals linked to water quality such as riparian grazing controls, timber harvest management, and road erosion abatement.

DEQ envisions that the development of a WRP for sediment and other pollutants can be integrated to include ongoing metals remediation activities defined above as well as potential future metals remediation projects based on approaches outlined in **Appendix C**. A WRP can also be used to identify and prioritize metals monitoring activity using the monitoring recommendations provided in **Section 7** and other relevant information.

6.5 Potential Funding Sources

Funding of water quality restoration or improvement project is essential for completing restoration activities and evaluating the resulting load reductions. Several government agencies fund watershed or water quality improvement projects. Below is a brief summary of potential funding sources for such projects.

Other funding opportunities exist for addressing nonpoint source pollution. Additional information regarding funding opportunities from state agencies is contained in Montana's Nonpoint Source Management Plan (Montana Department of Environmental Quality, 2007) and information regarding additional funding opportunities can be found at http://www.epa.gov/nps/funding.html.

6.5.1 Section 319 Nonpoint Source Grant Program

Section 319 of the federal Clean Water Act makes grant funds available to help identify, prioritize, and implement water quality improvement protection projects addressing nonpoint pollutant sources. The funding program focuses on WRP development to identify projects that obtain the highest and most efficient return in load reductions toward meeting TMDLs. Individual contracts under the annual grant cycle range from $20,000 to $150,000, with a 25% or greater matching funds requirement. Section 319 projects are typically administered through a non-profit or local government entity, such as a watershed planning group, conservation district board, or other county government office.

6.5.2 Future Fisheries Improvement Program

The Future Fisheries grant program is administered by FWP and offers funding for on-the-ground projects focusing on habitat restoration to benefit wild and native fish. Eligible grantees range from private landowners and local community-based groups to state or local government agencies. Applications are reviewed annually in December and June. Projects that may be applicable to the project area include streambank restoration, and restoring or protecting fish spawning habitats.

6.5.3 Watershed Planning and Assistance Grants

The MT DNRC administers Watershed Planning and Assistance Grants to watershed groups that are sponsored by a Conservation District. Funding is capped at $10,000 per project and the application cycle is quarterly. The grant focuses on locally developed watershed planning activities; eligible activities include developing a WRP, planning, group coordination costs, environmental data collection, and educational activities.

6.5.5 Resource Indemnity Trust/Reclamation and Development Grants Program

The Resource Indemnity Trust/Reclamation and Development Grants Program (RIT/RDG) is a biennial program administered by MT DNRC that can provide up to $300,000 to address environmental issues. This money can be applied to sites included on the Abandoned Mine Lands (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. RIT/RDG projects typically need to be administered through a non-profit or local government such as a conservation district, a watershed planning group, or a county government office.

6.6 Temporary Disturbances and Water Quality Impacts

DEQ acknowledges that construction or maintenance activities related to restoration, construction/maintenance, and future development may result in short term increase in surface water metals concentrations. For any activities that occur within the stream or floodplain, all appropriate permits should be obtained prior to work. Federal and State permits necessary to conduct work within a stream or stream corridor are intended to protect the resource and reduce or eliminate, pollutant loading or degradation from the permitted activity. The permit requirements typically have mechanisms that allow for some short term impacts to the resource, as long as all appropriate measures are taken to reduce impact to the least amount possible.

7.0 Monitoring for Effectiveness

The monitoring framework discussed in this section is an important component of watershed restoration, a requirement of TMDL development under Montana's TMDL law, and the foundation of the adaptive management approach to water quality improvement. An implicit margin-of-safety has been incorporated into the TMDLs developed in this document. Although loading and load allocations are calculated from the most recent data, the calculations are only estimate of a more complex seasonal loading system. The margin of safety is intended to offset the effect of this uncertainty, but complications related to the strength and volume of pollutant sources often become apparent only after restoration activities have begun. Monitoring during restoration can determine whether TMDL targets are being met, whether all significant sources have been identified, and whether attainment of TMDL targets is feasible in light of new information about pollutant strength and sources. Data from long-term monitoring provides technical justification for modifying restoration strategies, targets, or allocations schemes.

Rather than a fixed monitoring program with assigned responsibilities, the initial monitoring framework presented here allows for future adjustment to refine monitoring needs to field conditions. The recommendations are intended to assist local land managers, stakeholder groups, and federal and state agencies in developing appropriate monitoring plans that measure the effects of water quality restoration practices. Funding for future monitoring is uncertain and can vary with economic and political changes. Monitoring priorities depend on restoration progress, stakeholder priorities, and funding availability.

The objectives for future monitoring in the Bonita – Superior project area include:

- tracking restoration activities and evaluating the effectiveness of individual and cumulative restoration activities
- baseline and impairment status monitoring to assess attainment of water quality targets and identify long-term trends in water quality, and
- refining the source assessments. Each of these objectives is discussed below.

7.1 Restoration Effectiveness Monitoring

Monitoring should occur before and after restoration projects are implemented to tracks the degree and rate of recovery of the aquatic system. Effectiveness monitoring should address a targeted set of pollutants for each project. Each monitoring project should begin with compiled information on source locations, spatial extent, surface ownership, remediation design, and the location and nature of BMP applications elsewhere in the watershed.

The Linton Mine section of Cramer Creek was restored in the early 2000s and this effort appears to have been largely successful. Future monitoring should be planned to track lead concentrations in Cramer Creek. A monitoring program should also track aluminum concentrations, with attention to any soil and land conservation BMPs that may be implemented to meet the sediment TMDL that will be developed for Cramer Creek (as part of a separated project and document).

DEQ recommends additional monitoring of copper concentrations in Wallace Creek. The copper impairment determination was based on the detected concentration exceeding the chronic aquatic life standard in greater than 10% of the samples, however the sample population was small (9 samples).

Future reassessment based on a larger sample population may conclude that copper is no longer an impairment cause to Wallace Creek.

The remediation and restoration activities in Flat Creek related to the Iron Mountain Mill OU2 site will include post-restoration monitoring. This should be a collaborative project, incorporating EPA, USFS, DEQ Federal Superfund Bureau and DEQ Water Quality Planning Bureau.

BMP effectiveness in reducing metals loading can best be evaluated by comparisons of water sample analysis results with metals targets. Also, photo documentation of BMP-affected source reductions is appropriate in cases where significant lag time may occur between BMP application and water quality improvement.

DEQ will conduct a TMDL Implementation Evaluation (TIE) within a watershed to determine whether monitoring results document sufficient in water quality improvement. The TIE process consists of compiling recent data, conducting additional monitoring when needed, completing target comparisons, summarizing the applied BMPs, determining the degree of TMDL achievement, and identifying water quality trends post-dating TMDL development.

If the TIE results indicate the TMDL is being achieved, the waterbody is recommended for a formal reassessment of its use-support status. If TMDLs are not being met, DEQ evaluates the recent progress toward restoring water quality and the effectiveness of land, soil, and water conservation practices in place in the watershed. The evaluation determines whether the solution requires improved BMP application, more time for currently effective BMPs to work, or reevaluating the feasibility of meeting standards with complete BMP application.

7.2 Baseline and Impairment Status Monitoring

In addition to tracking BMP effectiveness, monitoring locations should, in many cases, be distributed to provide adequate knowledge of water quality conditions and loading sources throughout the drainage. These additions to the dataset can be used during the TIE. Since DEQ is the lead agency for evaluating use impairment, the data types and collection methodologies should be compatible with DEQ assessment methods. Other agencies or entities collecting water quality and aquatic life data are encouraged to provide compatible information wherever possible. Guidance for monitoring water quality for metal pollutants is helpful for ensuring that the data quality is adequate as a basis for standards comparisons, impairment evaluations, and trend detection.

7.3 Source Assessment Refinement

The level of detail of the source assessment allows allocations to broad source categories and geographic areas. Additional monitoring may be helpful to better partition pollutant loading at mine sites with multiple sources. The needed refinements may require more seasonally stratified sampling or a more detailed field reconnaissance and follow-up sampling to better locate stream segments representing background loading.

In Cramer Creek, the inability to distinguish background aluminum loading from human-caused aluminum loading led to use of a broad composite allocation. In Wallace Creek, further sampling would allow better delineation of copper sources between potential abandoned / inactive mining sources.

8.0 Stakeholder and Public Participation

Stakeholder and public involvement is a component of TMDL planning supported by EPA guidelines and required by Montana state law (MCA 75-5-703, 75-5-704) which directs DEQ to consult with watershed advisory groups and local conservation districts during the TMDL development process. Technical advisors, stakeholders and interested parties, state and federal agencies, interest groups, and the public were solicited to participate in differing capacities throughout the TMDL development process in the Bonita – Superior TMDL project area.

8.1 Participants and Roles

Throughout completion of the Bonita – Superior TMDLs, DEQ maintained contacts with stakeholders to keep them apprised of project status and solicited input from a TMDL advisory group. A description of the participants in the development of the TMDLs in the Bonita – Superior TMDL project area and their roles is contained below.

Montana Department of Environmental Quality
Montana state law (MCA 75-5-703) directs DEQ to develop all necessary TMDLs. DEQ has provided resources toward completion of these TMDLs in terms of staff, funding, internal planning, data collection, technical assessments, document development, and stakeholder communication and coordination. DEQ has worked with other state and federal agencies to gather data and conduct technical assessments.

United States Environmental Protection Agency
EPA is the federal agency responsible for administering and coordinating requirements of the Clean Water Act (CWA). Section 303(d) of the CWA directs states to develop TMDLs (see **Section 1.1**), and EPA has developed guidance and programs to assist states in that regard. EPA has provided funding and technical assistance to Montana's overall TMDL program and is responsible for final TMDL approval. Additionally, EPA is the federal agency overseeing remediation and restoration activities in the Flat Creek drainage, in conjunction with DEQ and the USFS.

Montana Conservation Districts
The Bonita – Superior TMDL project area falls mostly within Mineral and Missoula counties with minor portions in Sanders and Granite counties. Therefore, DEQ provided the Missoula County and Mineral County Conservation Districts with consultation opportunities during development of TMDLs. This included opportunities to provide comment during the various stages of TMDL development, and an opportunity for participation in the advisory group discussed below.

TMDL Advisory Group
The Bonita – Superior TMDL Advisory Group consisted of selected resource professionals who possess a familiarity with water quality issues and processes in the project area, and also representatives of applicable interest groups. All members were solicited to participate in an advisory capacity per Montana state law (75-5-703 and 704). DEQ requested participation from the interest groups defined in MCA 75-5-704 and included local city and county representatives, conservation groups, watershed groups, state and federal land management agencies, and representatives of recreation and tourism interests. The advisory group also included additional stakeholders and landowners with an interest in maintaining and improving water quality and riparian resources.

Advisory group involvement was voluntary and the level of involvement was at the discretion of the individual members. Members had the opportunity to provide comment and review of technical TMDL assessments and reports and to attend meetings organized by DEQ for the purpose of soliciting feedback on project planning. Typically, draft documents were released to the advisory group for review under a limited timeframe, and their comments were then compiled and evaluated. Final technical decisions regarding document modifications resided with DEQ.

Communications with the group members was typically conducted through e-mail and draft documents were made available through DEQ's wiki for TMDL projects (http://montanatmdlflathead.pbworks.com). Opportunities for review and comment were provided for participants at varying stages of TMDL development, including opportunity for review of the draft TMDL document prior to the public comment period.

Area Landowners
Since portions of the project area are in private ownership, local landowner cooperation in the TMDL process has been important for stream sampling. The DEQ sincerely thanks the project area landowners for their logistical support and informative participation in impromptu water resource and land management discussions with our field staff.

8.2 Response to Public Comments

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

This public review period was initiated on March 6th, 2013 and ended on April 5th, 2013. At public meetings on March 18th in Missoula and Superior, Montana, DEQ provided an overview of the TMDLs for metals in the Bonita – Superior TMDL Planning Area, made copies of the document available to the public, and solicited public input and comment on the plan. The announcement for that meeting was distributed among the Watershed Advisory Group, and advertised in the following newspapers: The Missoulian in Missoula and the Mineral Independent in Superior. This section includes DEQ's response to all public comments received during the public comment period.

One letter from the US Forest Service was submitted to the DEQ during the public comment period. Comments submitted in the letter are provided below, with responses from DEQ. The original comment letter is held on file at the DEQ and may be viewed upon request.

Comment #1
Of concern is the lack of discussion on the likelihood of natural sources of metal occurrences in Flat Creek & Hall Gulch. The document partially addresses this issue (page 5-24, first full paragraph). It is stated that natural occurrences are part of the metals evaluation framework (page 5-2) and naturally elevated occurrences of aluminum in Crammer [sic] Creek are discussed (page 5-15). It appears that this is not a consideration in the evaluation of Flat Creek and Hall Gulch downstream of the sample site described on page 5-34. Given the extensive mineralization in this area, there could be naturally occurring sources downstream of the mine sites, and this should be presented in this document.

Comment #2
Was antimony considered to be naturally elevated after evaluation Superior's water source investigation results? It is our opinion that natural sources would be difficult to quantify given the magnitude of impacts from historic mining practices; however, they should be described.

Response to #1 and #2
DEQ agrees that distinguishing naturally occurring sources from historic mining sources is difficult in this watershed. Water quality in Flat Creek consistently meets metals targets at a point not far above Hall Gulch (sample site C04FLATC03). Metals were detected at this location, although without exceeding any targets. However, this sample location is located within the IMM site and therefore contribution from historic mining sources could not be ruled out. In accordance with the conservative approach DEQ uses for a margin of safety, the higher sample site was chosen to represent background conditions.

One characteristic of this mining district, and of the genetically similar Coeur d'Alene district, is that the mineral deposits are largely found in and north of the Osburn fault zone (Campbell, 1960). This fault cuts across the Flat Creek valley in the broad area around Siekrest Gulch. Therefore, while there is extensive mineralization in this watershed, it is likely to be most prominent in a 1-2 mile belt north of Woods Gulch.

The Town of Superior's inactive infiltration gallery appears to introduce antimony from groundwater into Flat Creek. To what degree the antimony in groundwater is naturally occurring or derived from historical mining sources is unresolved. Adit drainage and streamflow in Hall Gulch is lost to groundwater before reaching Flat Creek. Whether this water recharges Flat Creek (which is perched) or instead drains to the deeper aquifer is uncertain.

ASARCO geologists estimated that ⅓ of the lead produced from the Iron Mountain Mine derived from boulangerite, a lead-antimony sulfide mineral (Campbell, 1960). It is possible that there are undiscovered veins of boulangerite contributing naturally occurring antimony to groundwater, perhaps in the Osburn Fault zone. However, this would be difficult to confirm or quantify without a subsurface investigation. In light of a documented association between antimony sources and the ore bodies worked in the Iron Mountain Mine and mill (and therefore the tailings in the Flat Creek floodplain), DEQ believes that the current antimony allocation scheme is reasonable. As discussed in **Section 5.8**, adaptive management allows for this to change if restoration work or further investigation shows otherwise.

Comment #3
We believe that it may not be possible to achieve all water quality standards post-remediation, especially given the elevated metal levels contribution from ground water. This is discussed in general on page 5-3, 3rd bullet. However, it may be warranted to include a location specific nonattainment discussion for the Flat Creek area in this document.

Response to #3
DEQ recognizes the potential for restoration and remediation activities to fall short of attaining water chemistry targets. This possibility is discussed in more detail in **Section 5.8**, page 5-31. This section presents three nonattainment scenarios and the respective recommended actions. Predicting the likelihood of successful restoration for Flat Creek and Hall Gulch is beyond the scope of this document.

Comment #4
Page 5-30 – Given DEQ CECRA's involvement on this site, it unclear why they are not mentioned in the first full paragraph.

Comment #5
Page 7-1, Section 6.2. CECRA is missing from this list.

Response to #4 and #5
The IMM site is no longer a CECRA (aka "State Superfund") site. After the IMM site was added to EPA's National Priority List (aka "Superfund"), DEQ's involvement transferred to the Federal Superfund Bureau (FSB).

Comment #6
Page 7-5, Section 6.5.5. The RIT grant program is biennial, not an annual program, as stated.

Response to #6
Correction made.

Comment #7
Page, 7-2, Section 7.2. Collaborative post-remediation monitoring with the DEQ Superfund, DEQ-TMDL, FS and EPA should be considered.

Response to #7
DEQ agrees, and added a sentence to this effect in **Section 7.1**: Restoration Effectiveness Monitoring.

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APPENDIX A – MAPS

Figure A-1. Project Area Overview A-3
Figure A-2. Wallace Creek and Cramer Creek Location A-4
Figure A-3. Wallace Creek and Cramer Creek Topography and Elevation A-5
Figure A-4. Wallace Creek and Cramer Creek Average Annual Precipitation A-6
Figure A-5. Wallace Creek and Cramer Creek Hydrography A-7
Figure A-6. Wallace Creek and Cramer Creek Geology A-8
Figure A-7. Wallace Creek and Cramer Creek Soil Erodibility A-9
Figure A-8. Wallace Creek and Cramer Creek Level IV Ecoregions A-10
Figure A-9. Wallace Creek and Cramer Creek Land Use and Land Cover A-11
Figure A-10. Wallace Creek and Cramer Creek Land Cover: Regional GAP A-12
Figure A-11. Wallace Creek and Cramer Creek Fish Distribution A-13
Figure A-12. Wallace Creek and Cramer Creek Fire History A-14
Figure A-13. Wallace Creek and Cramer Creek Population Density: 2010 Census A-15
Figure A-14. Wallace Creek and Cramer Creek Land Ownership A-16
Figure A-15. Wallace Creek and Cramer Creek Roads A-17
Figure A-16. Cramer Creek Abandoned Mines A-18
Figure A-17. Wallace Creek Abandoned Mines A-19
Figure A-18. Flat Creek Location A-20
Figure A-19. Flat Creek Topography and Elevation A-21
Figure A-20. Flat Creek Average Annual Precipitation A-22
Figure A-21. Flat Creek Hydrography A-23
Figure A-22. Flat Creek Geology A-24
Figure A-23. Flat Creek Soil Erodibility A-25
Figure A-24. Flat Creek Level IV Ecoregions A-26
Figure A-25. Flat Creek Land Use and Land Cover A-27
Figure A-26. Flat Creek Land Cover: Regional GAP A-28
Figure A-27. Flat Creek Fish Distribution A-29
Figure A-28. Flat Creek Fire History A-30
Figure A-29. Flat Creek Population Density: 2010 Census A-31
Figure A-30. Flat Creek Land Ownership A-32
Figure A-31. Flat Creek Roads A-33
Figure A-32. Flat Creek Abandoned Mines A-34

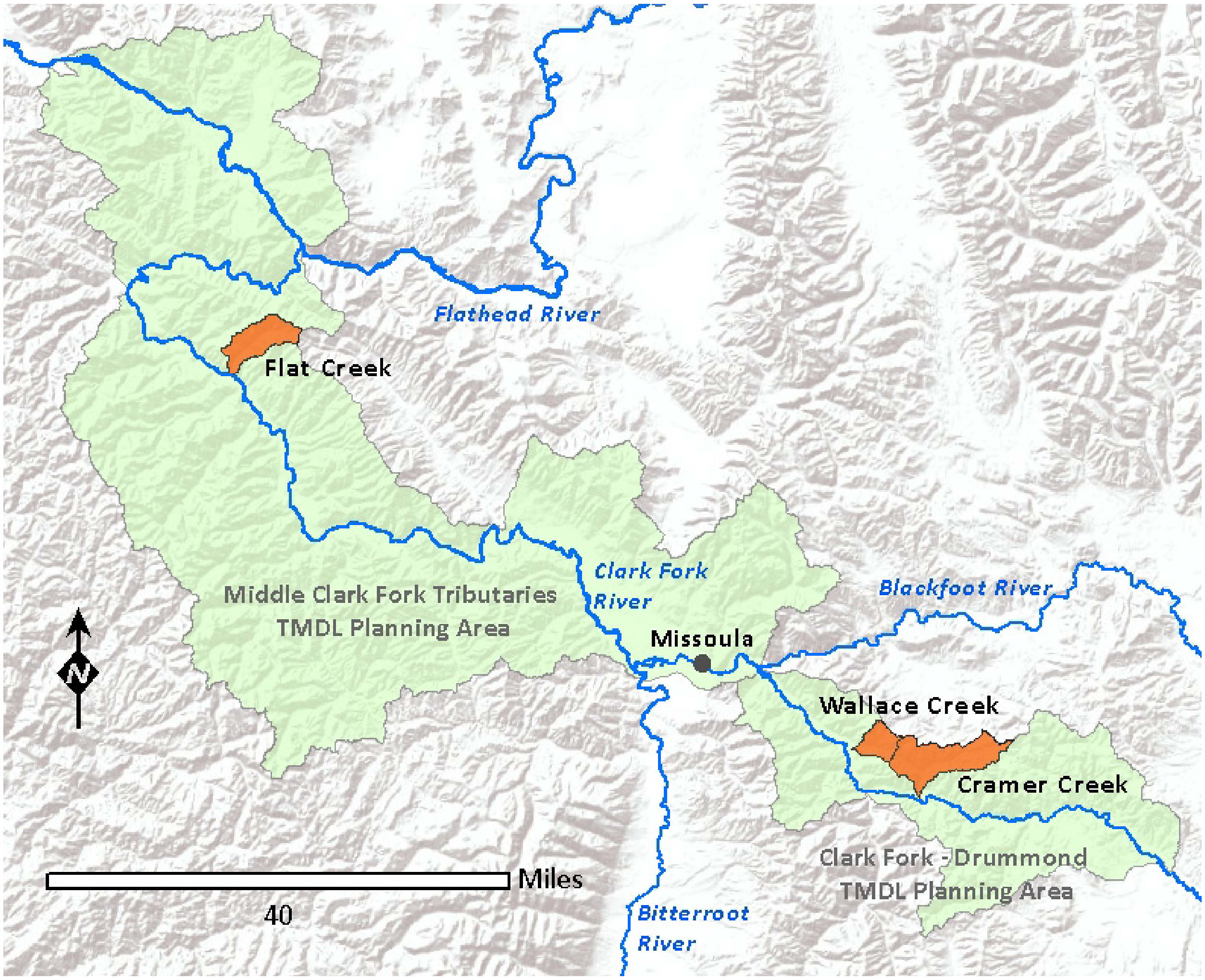

Figure A-1. Project Area Overview

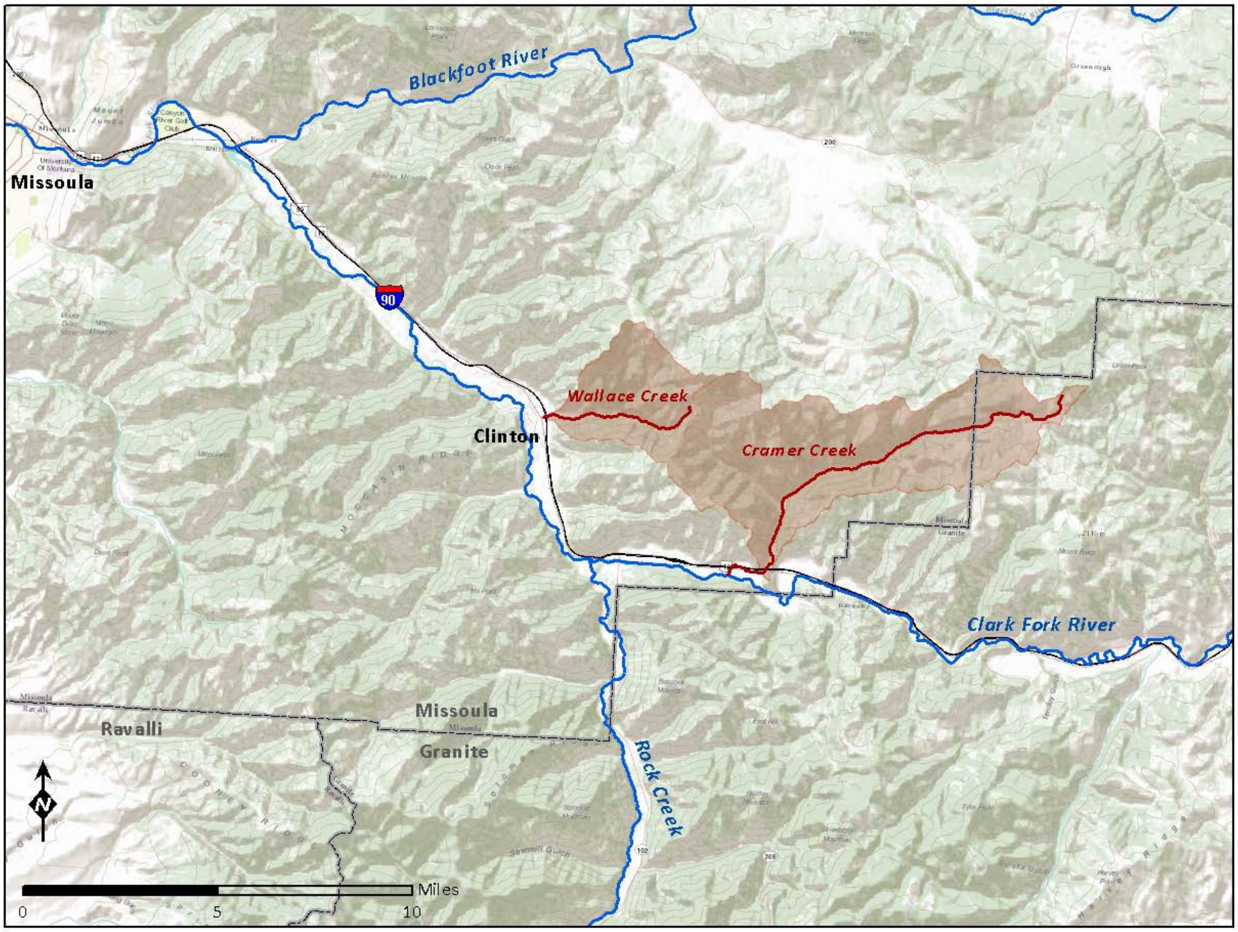

Figure A-2. Wallace Creek and Cramer Creek Location

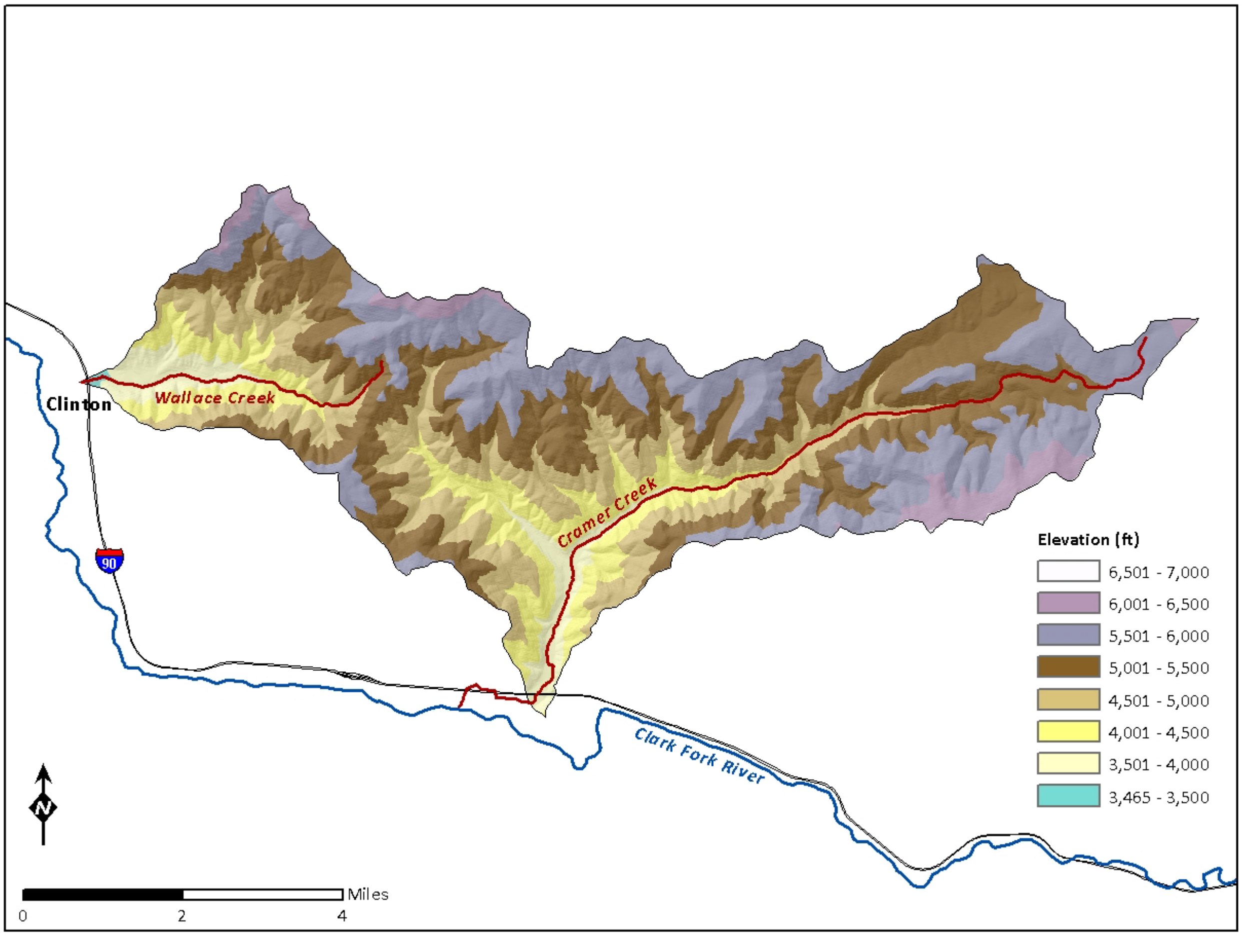

Figure A-3. Wallace Creek and Cramer Creek Topography and Elevation

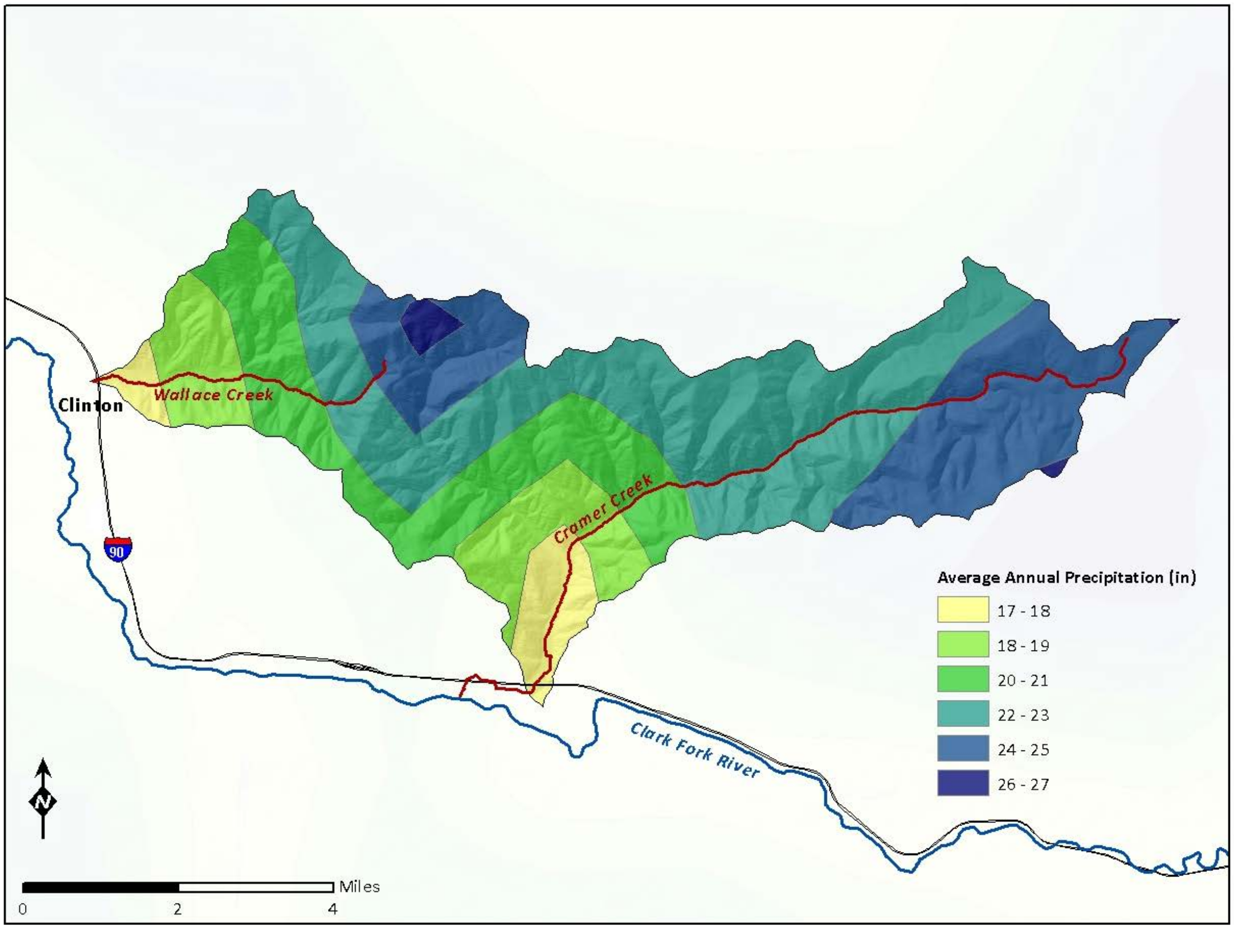

Figure A-4. Wallace Creek and Cramer Creek Average Annual Precipitation

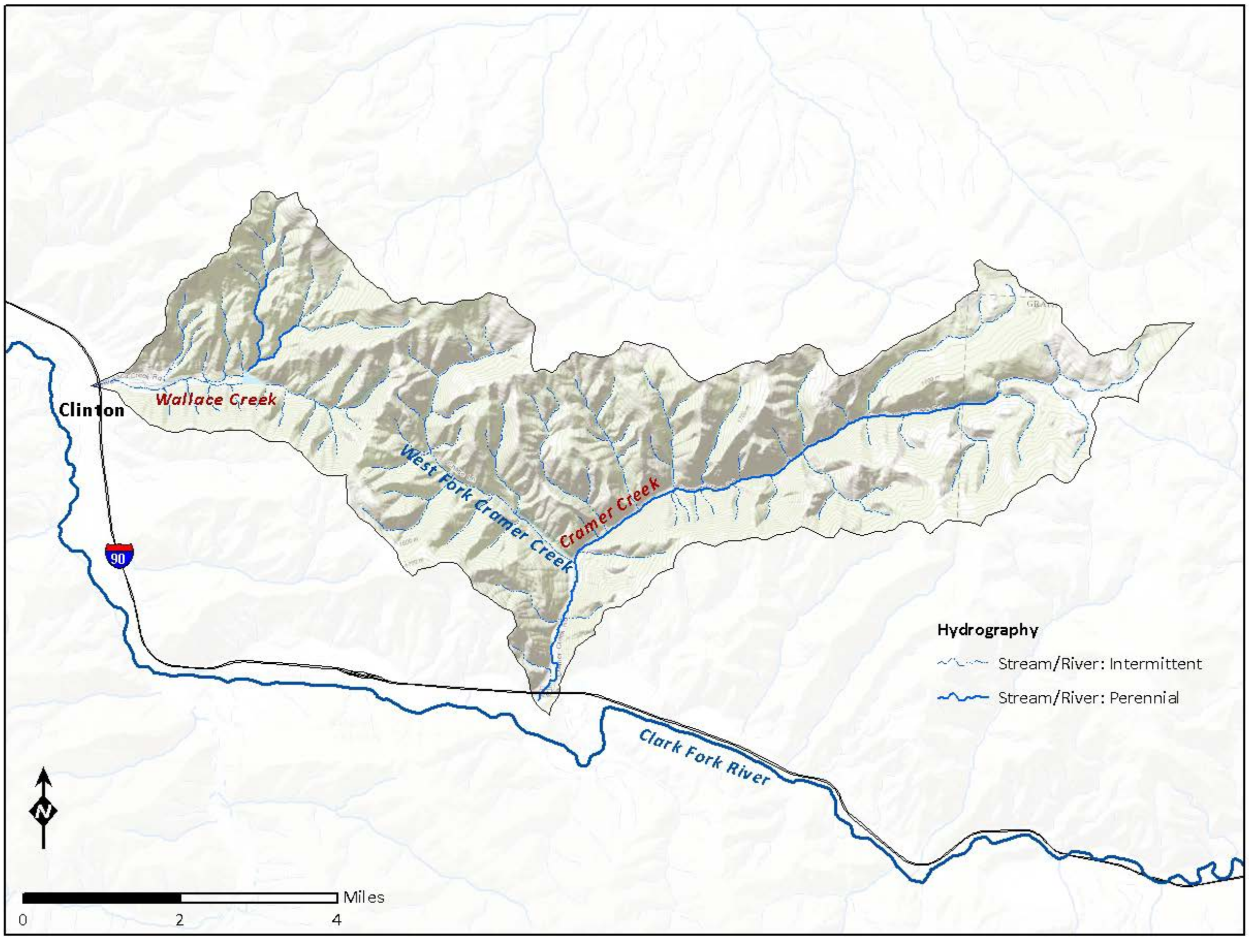

Figure A-5. Wallace Creek and Cramer Creek Hydrography

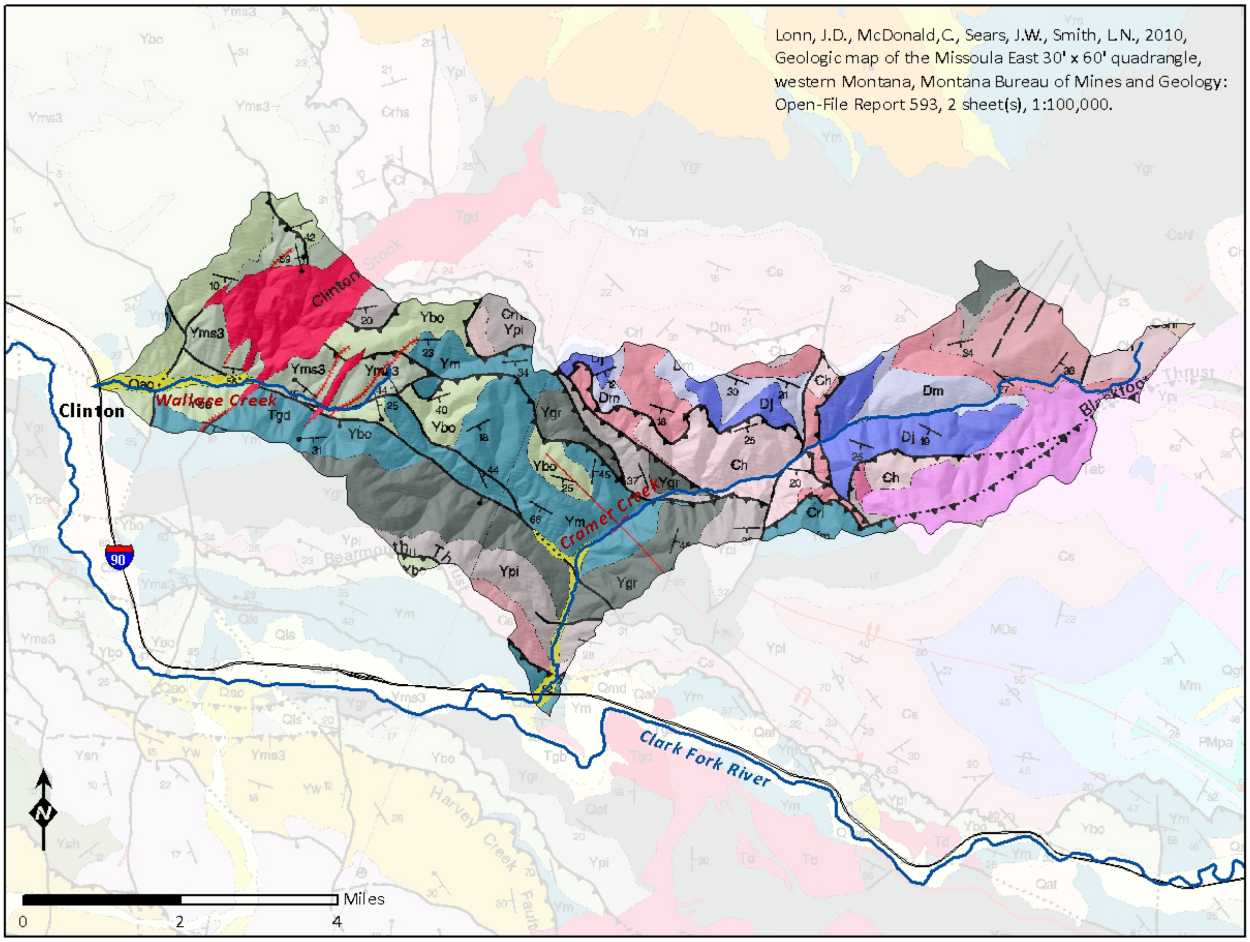

Figure A-6. Wallace Creek and Cramer Creek Geology

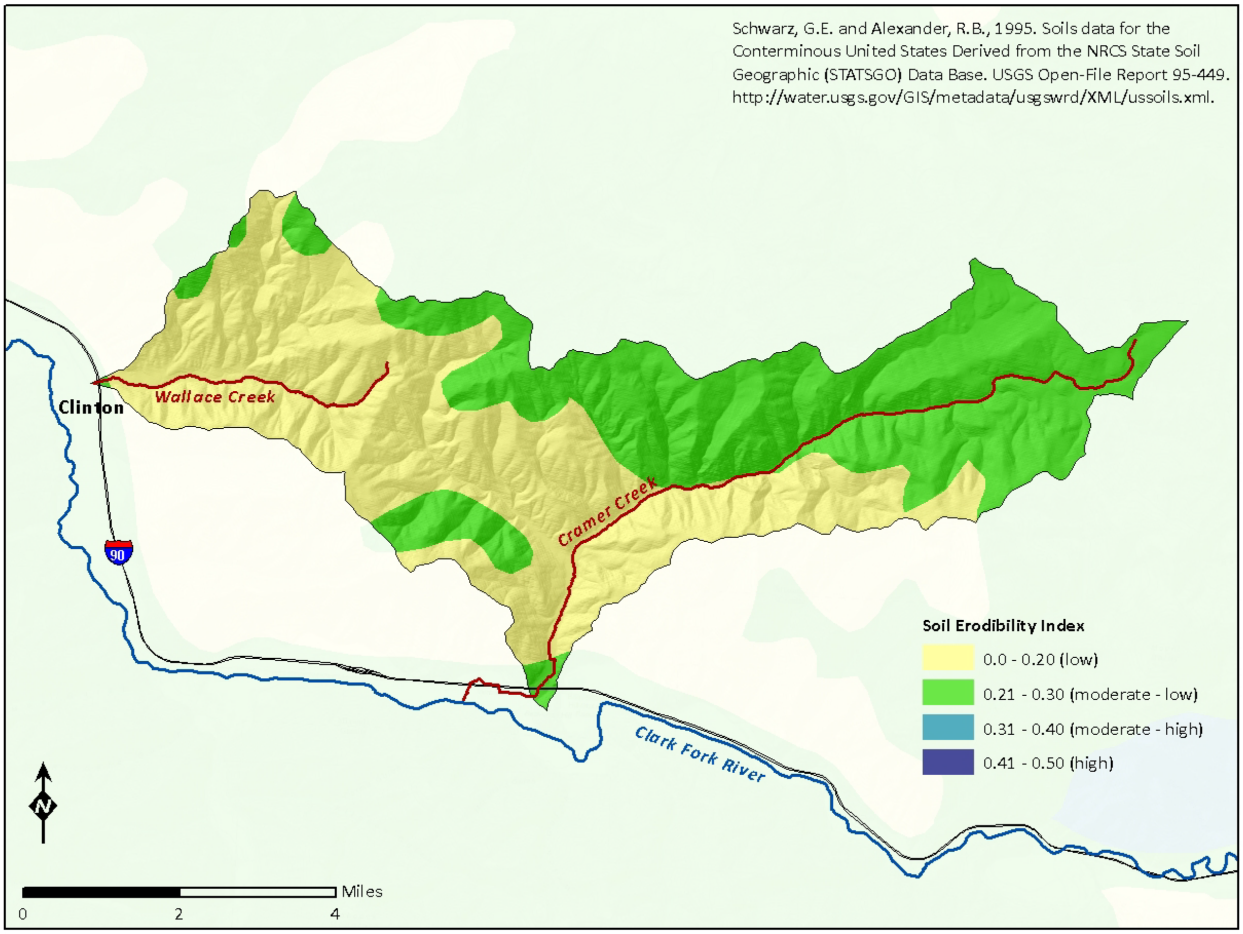

Figure A-7. Wallace Creek and Cramer Creek Soil Erodibility

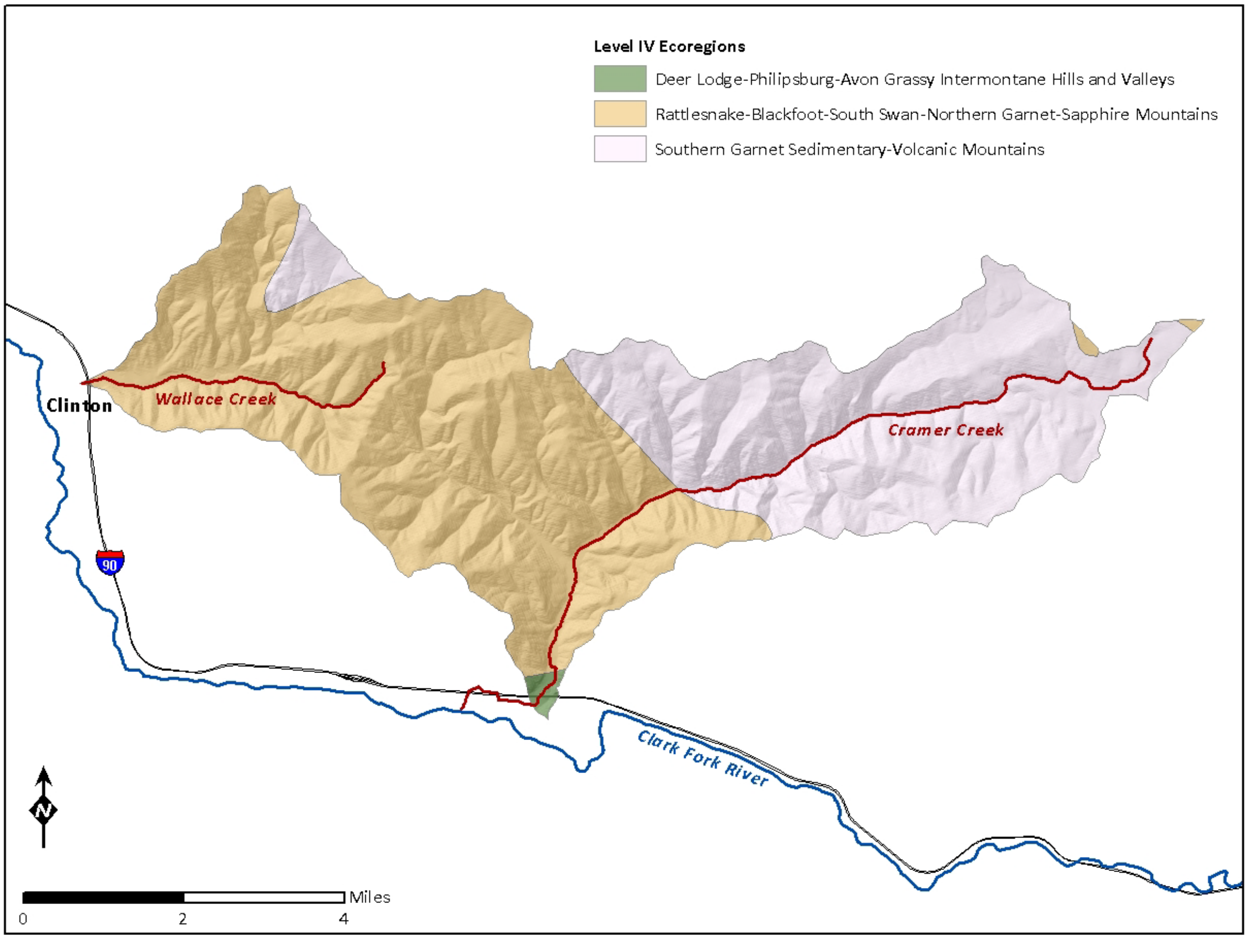

Figure A-8. Wallace Creek and Cramer Creek Level IV Ecoregions

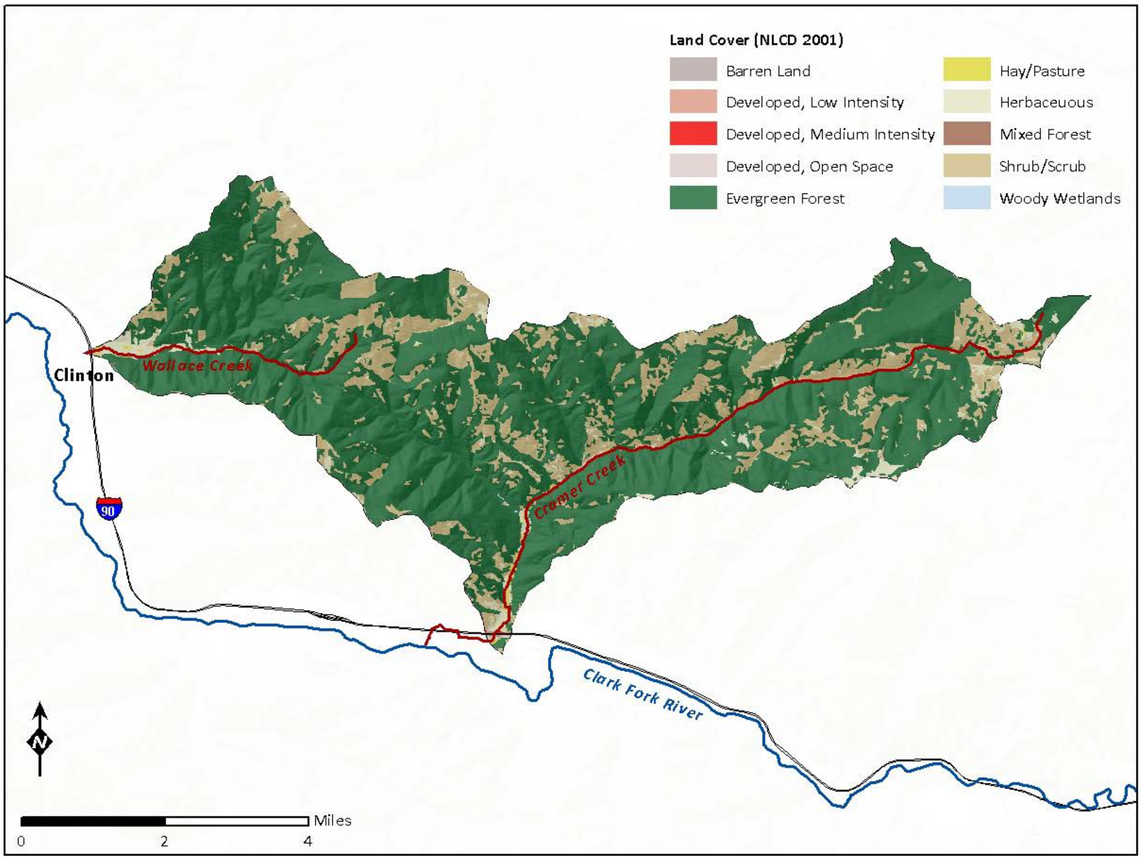

Figure A-9. Wallace Creek and Cramer Creek Land Use and Land Cover

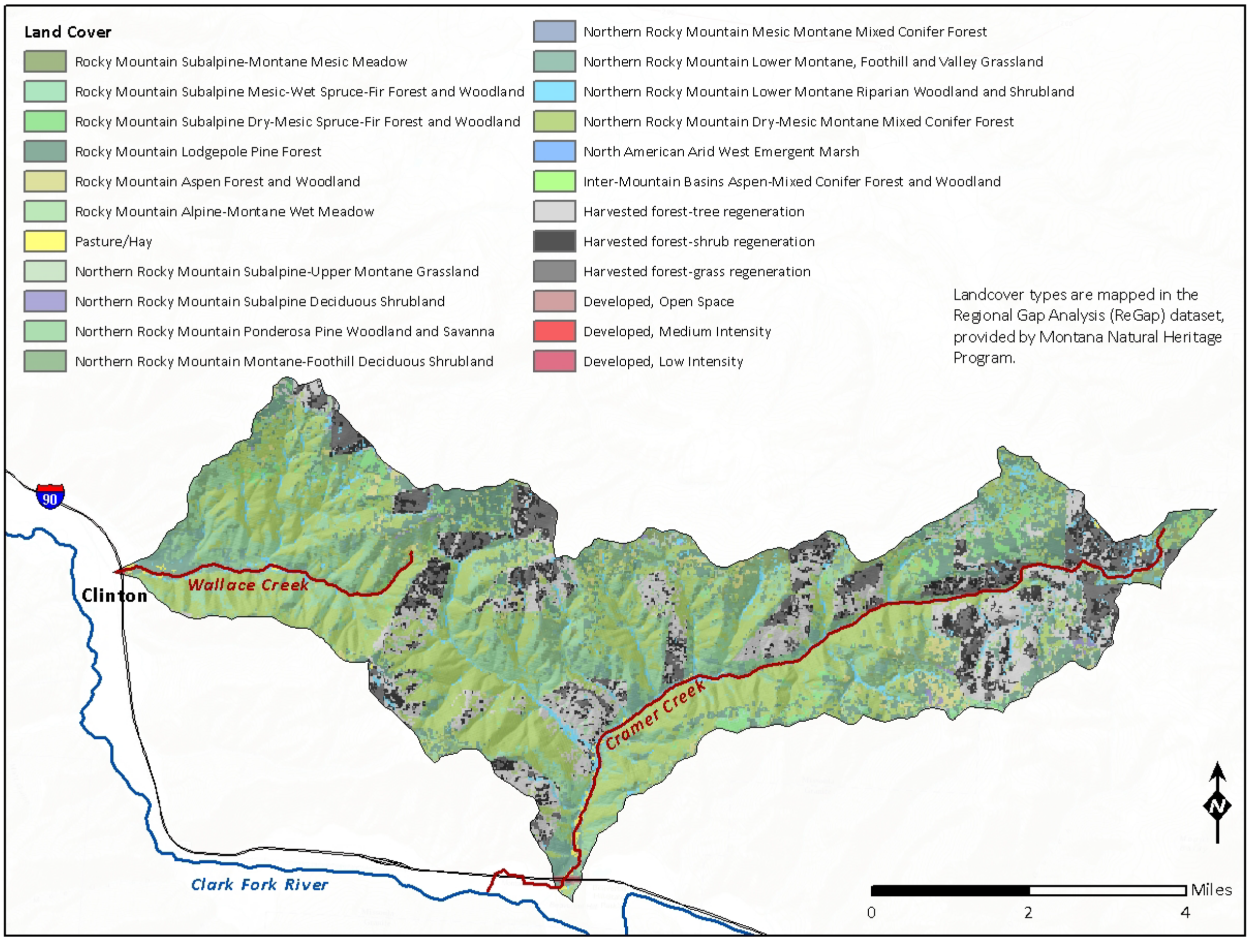

Figure A-10. Wallace Creek and Cramer Creek Land Cover: Regional GAP

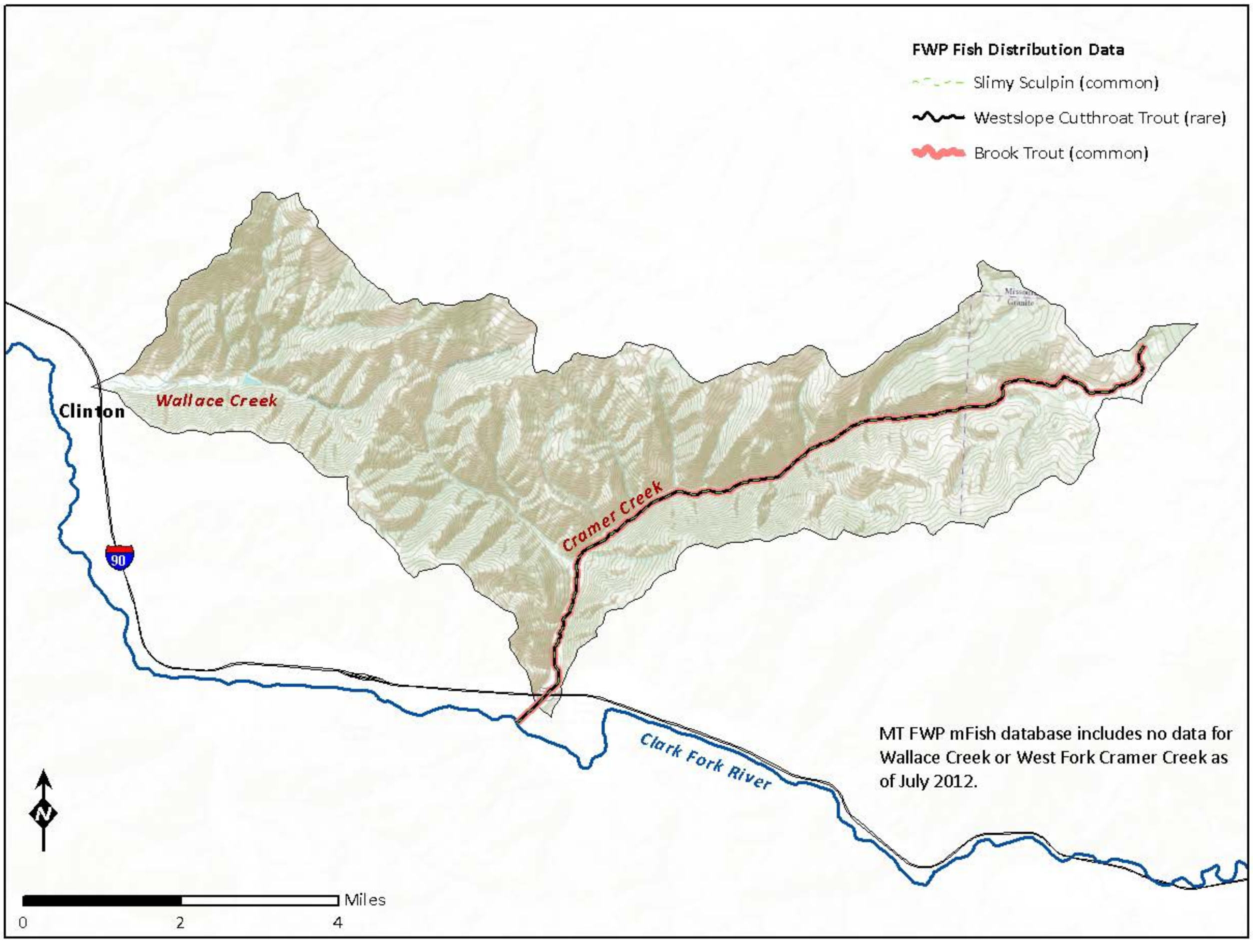

Figure A-11. Wallace Creek and Cramer Creek Fish Distribution

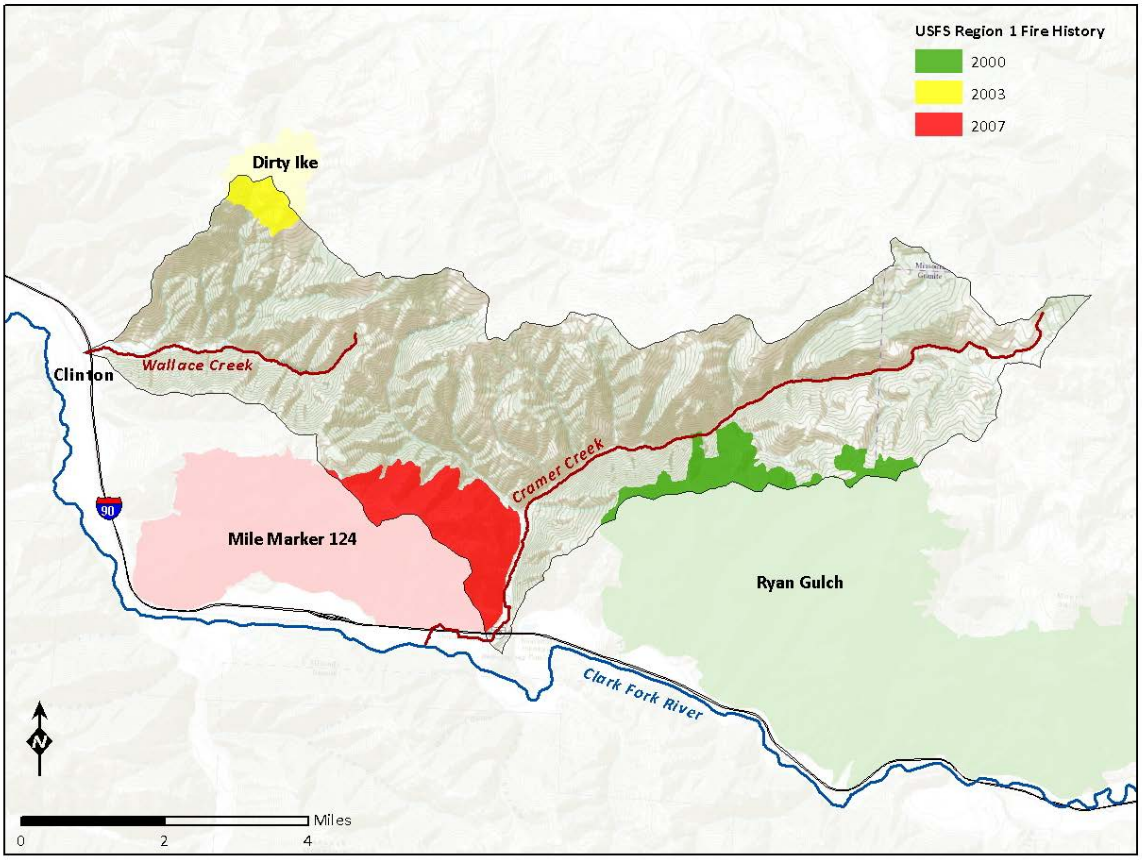

Figure A-12. Wallace Creek and Cramer Creek Fire History

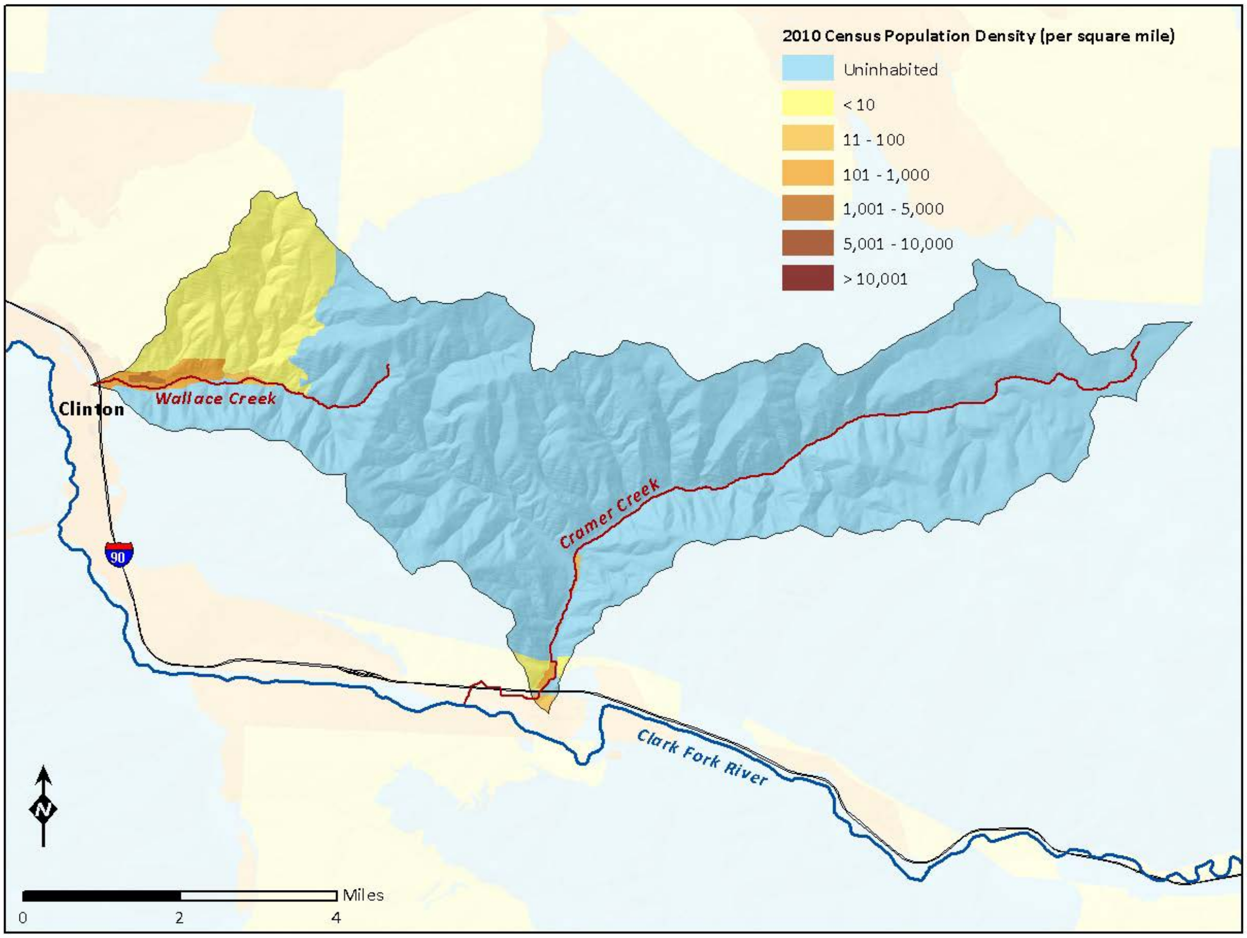

Figure A-13. Wallace Creek and Cramer Creek Population Density: 2010 Census

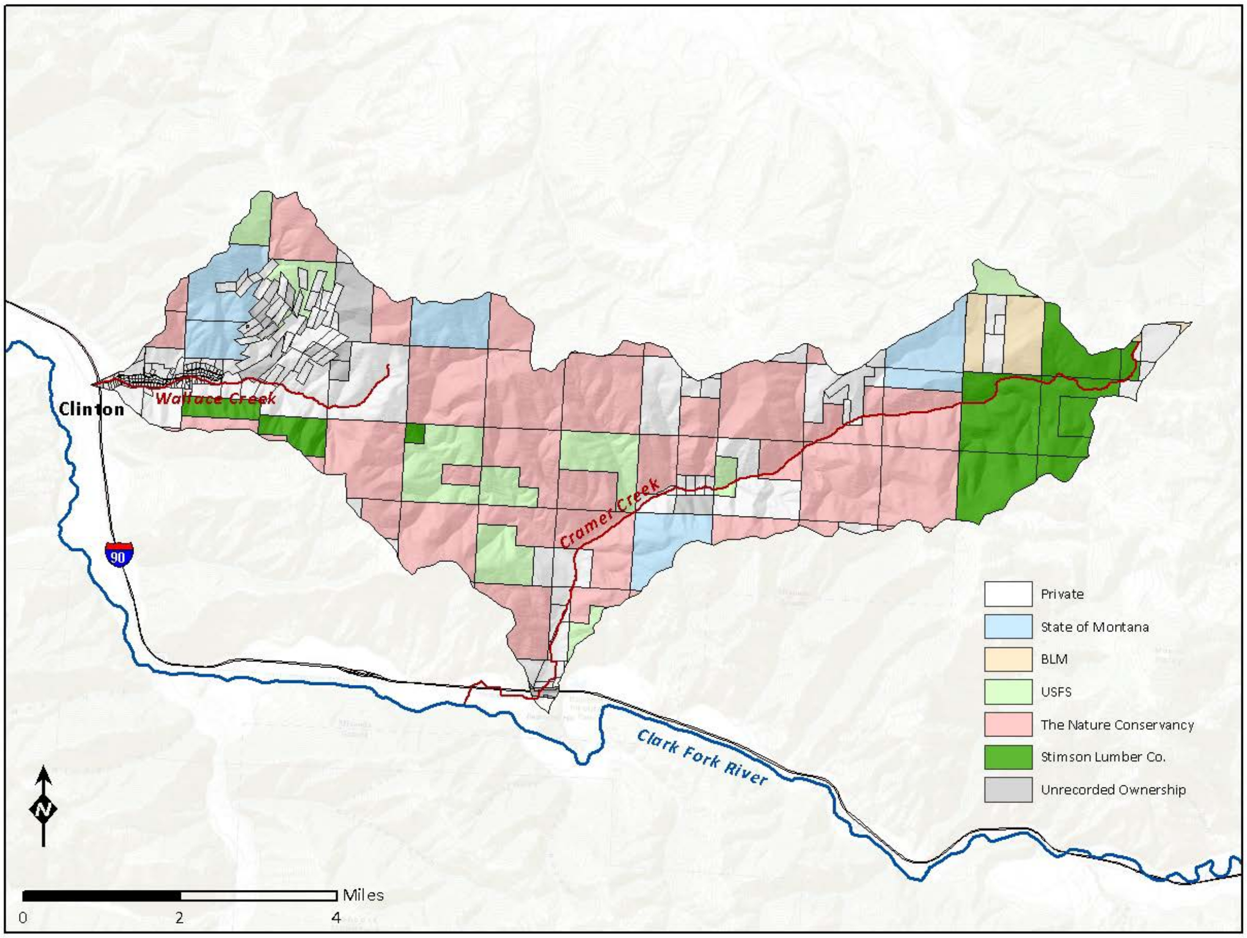

Figure A-14. Wallace Creek and Cramer Creek Land Ownership

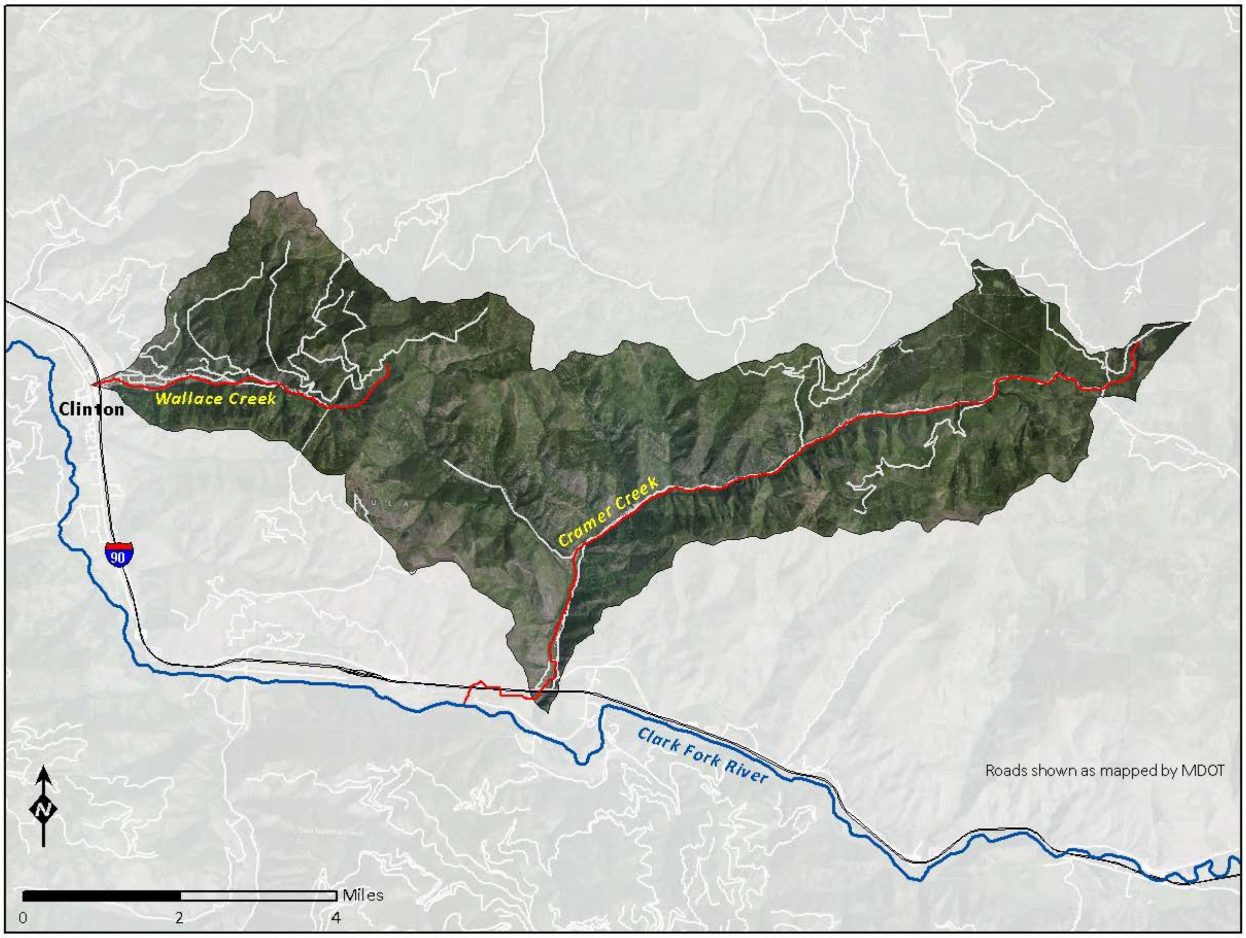

Figure A-15. Wallace Creek and Cramer Creek Roads

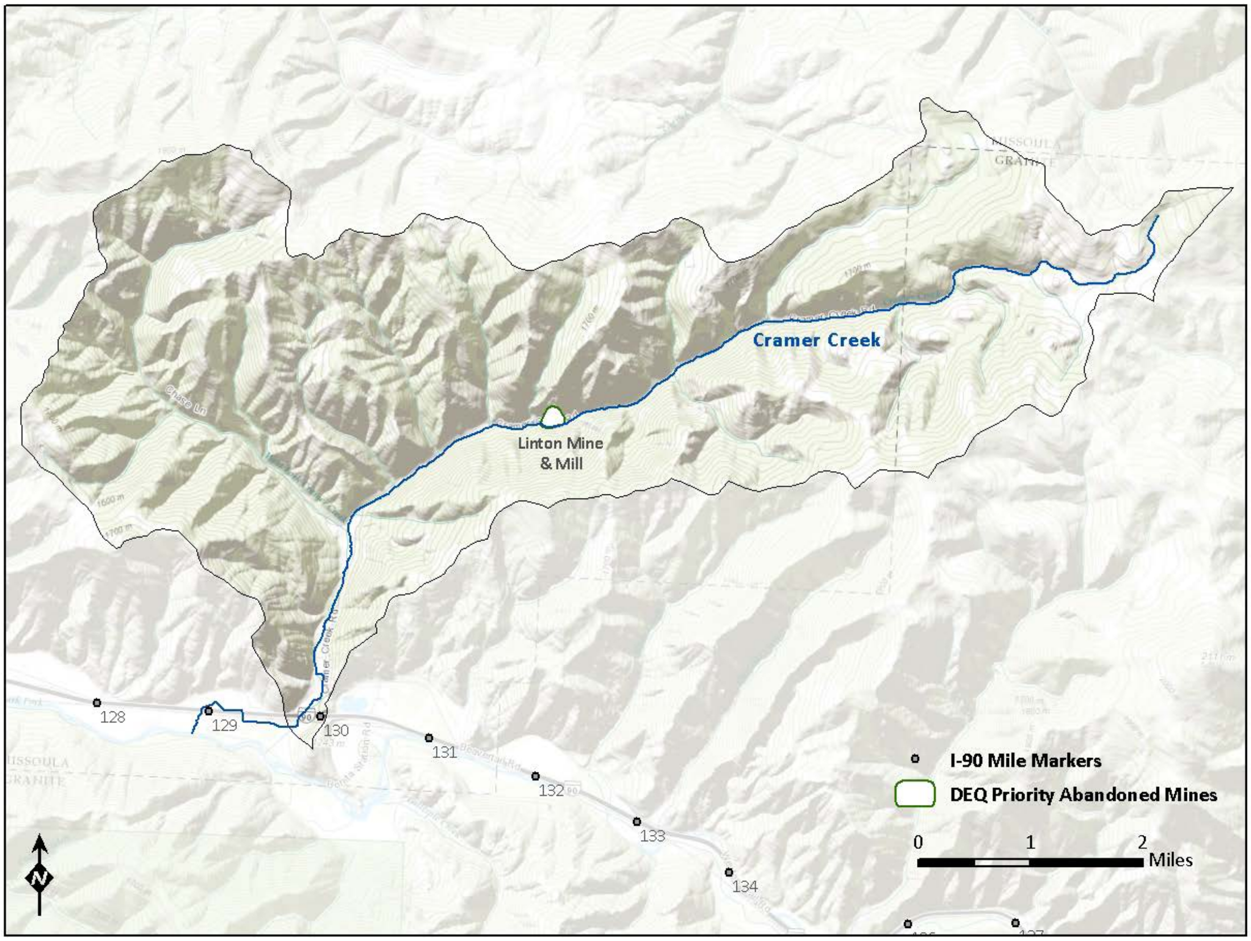

Figure A-16. Cramer Creek Abandoned Mines

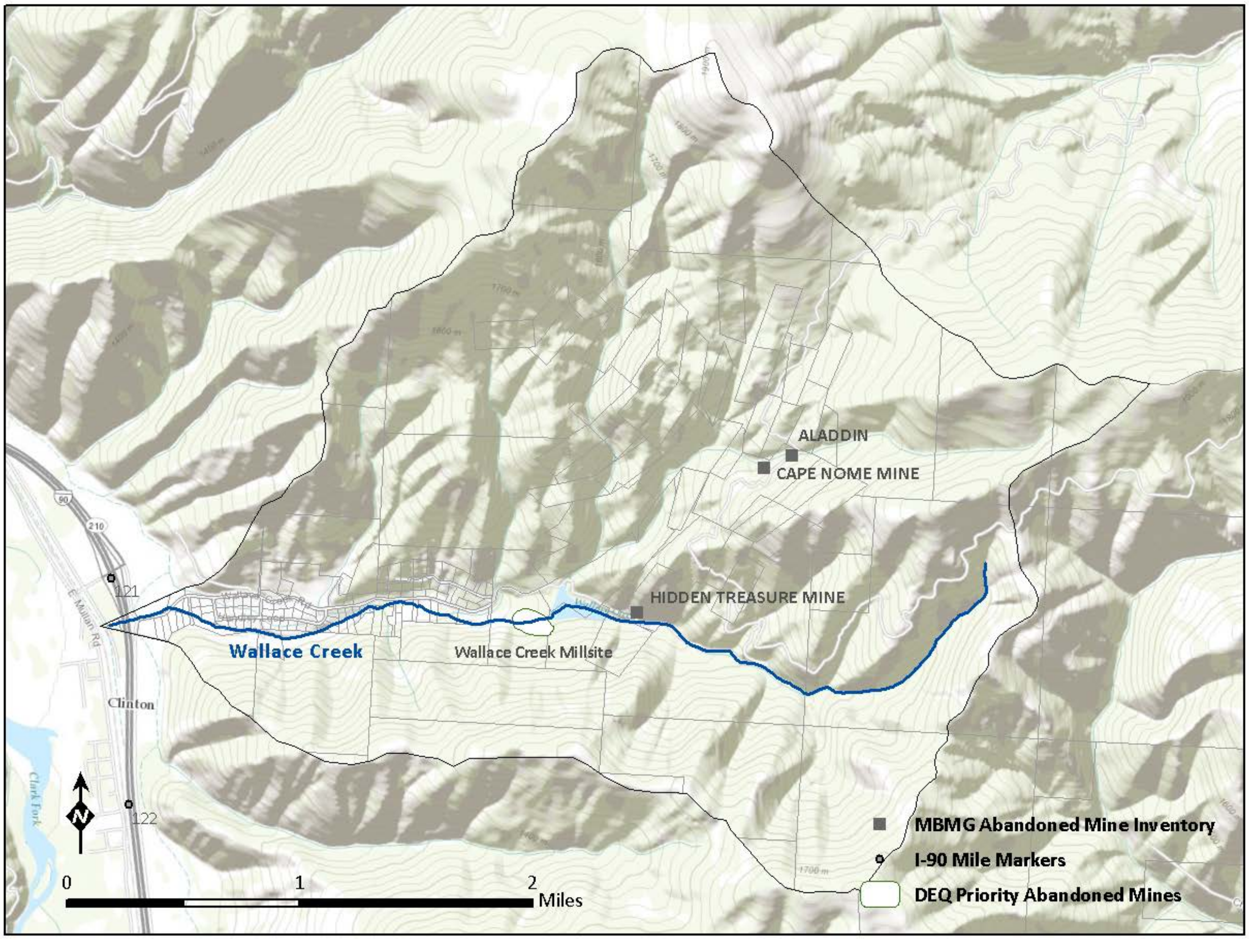

Figure A-17. Wallace Creek Abandoned Mines

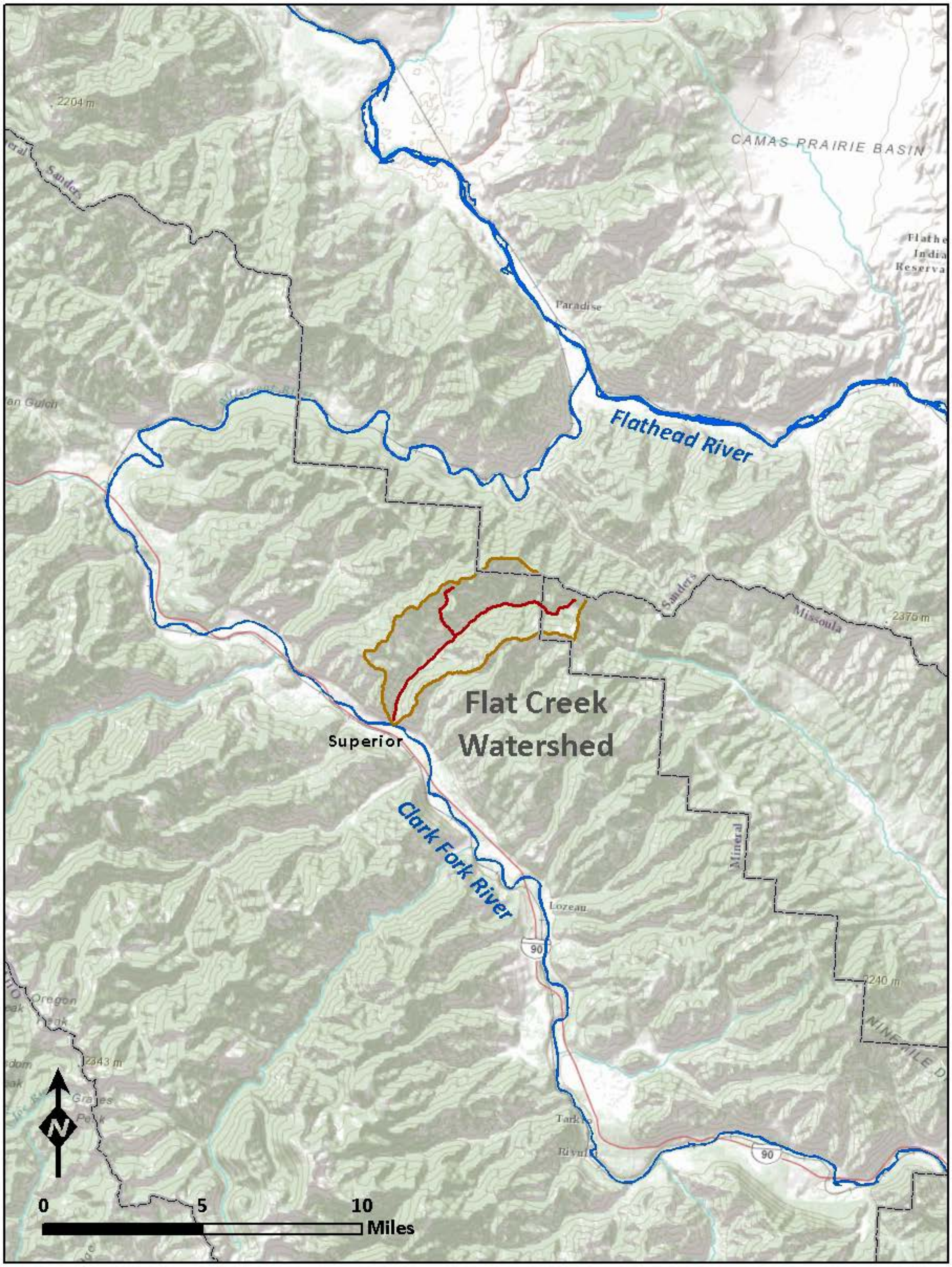

Figure A-18. Flat Creek Location

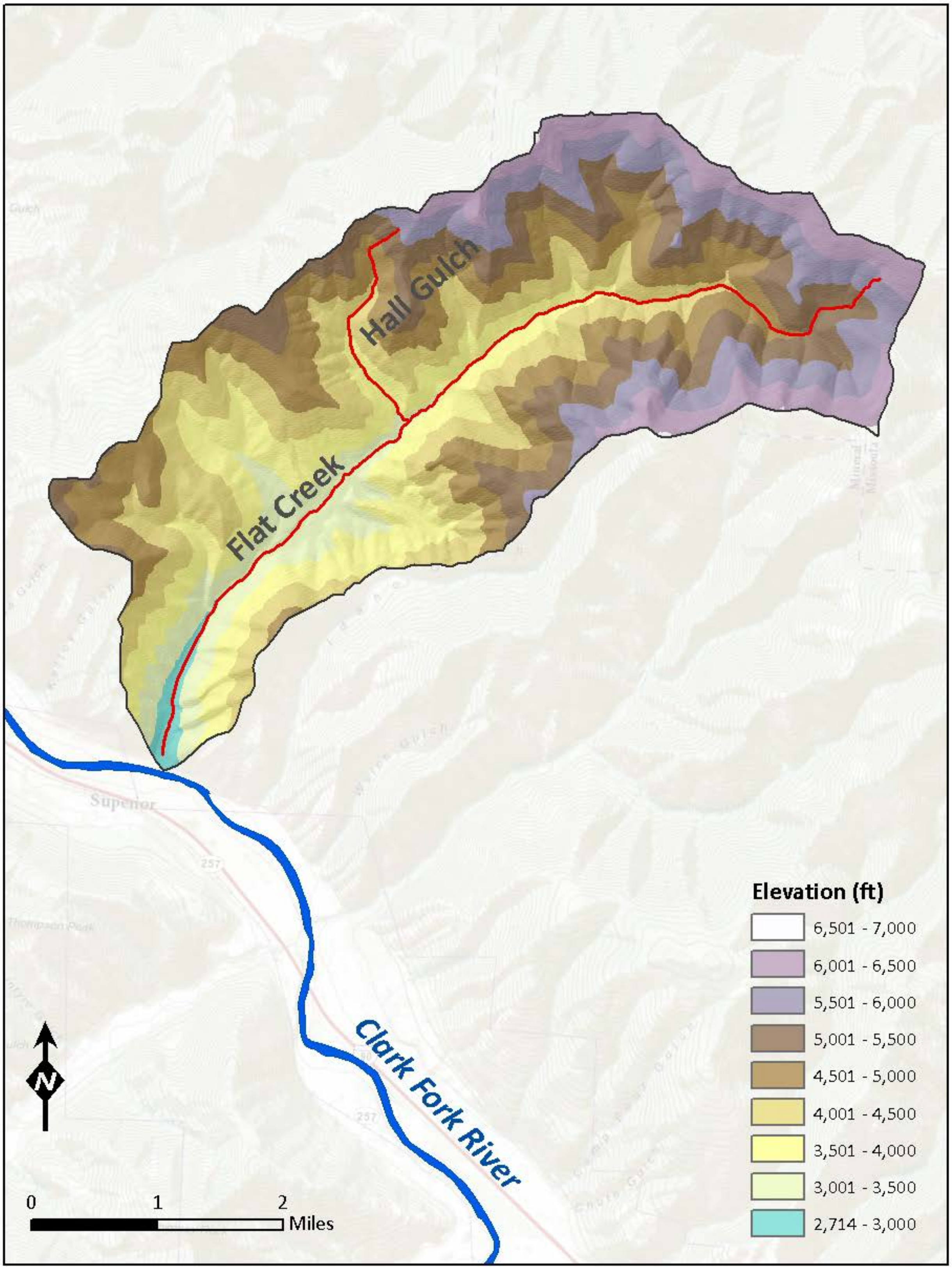

Figure A-19. Flat Creek Topography and Elevation

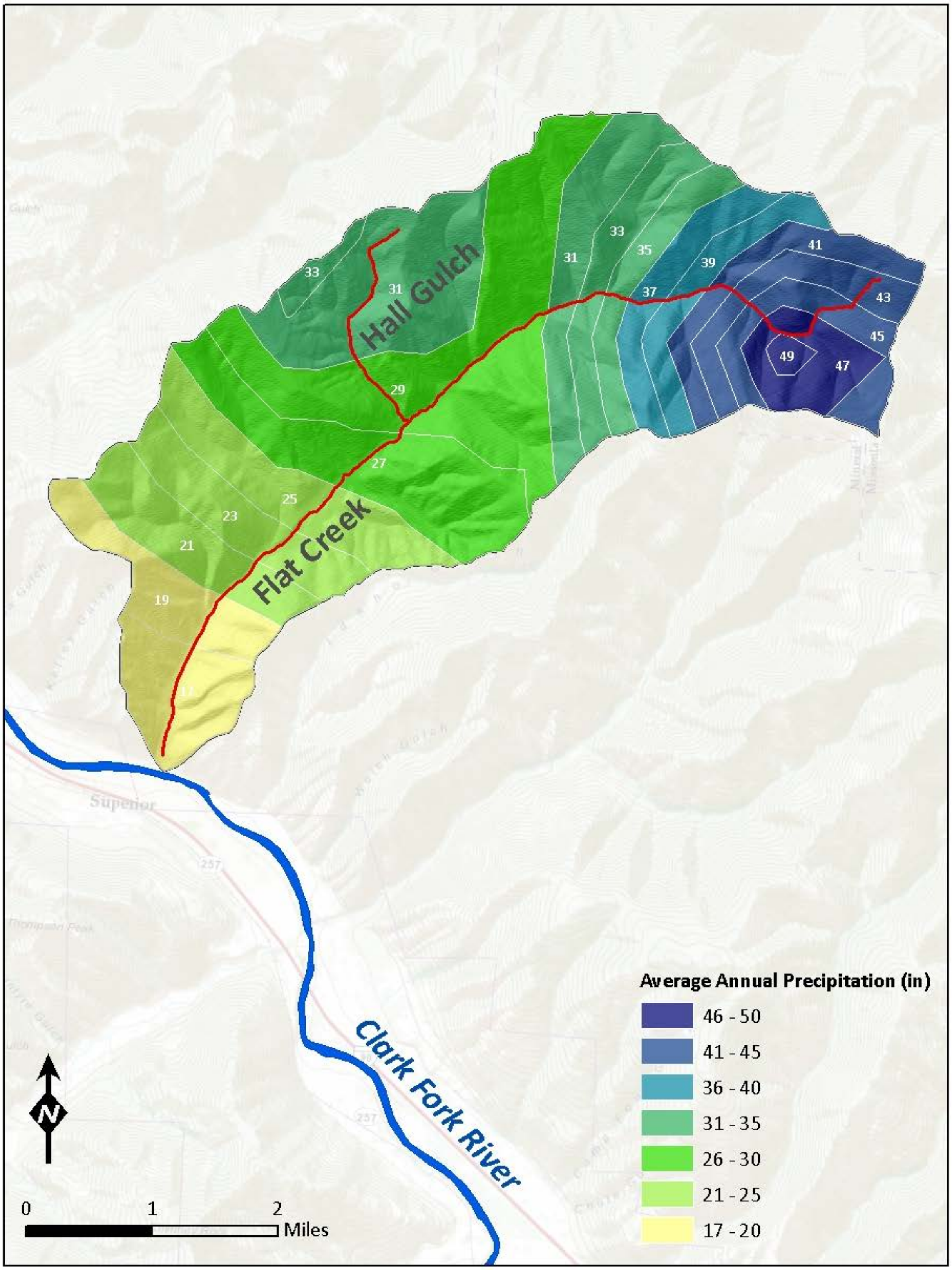

Figure A-20. Flat Creek Average Annual Precipitation

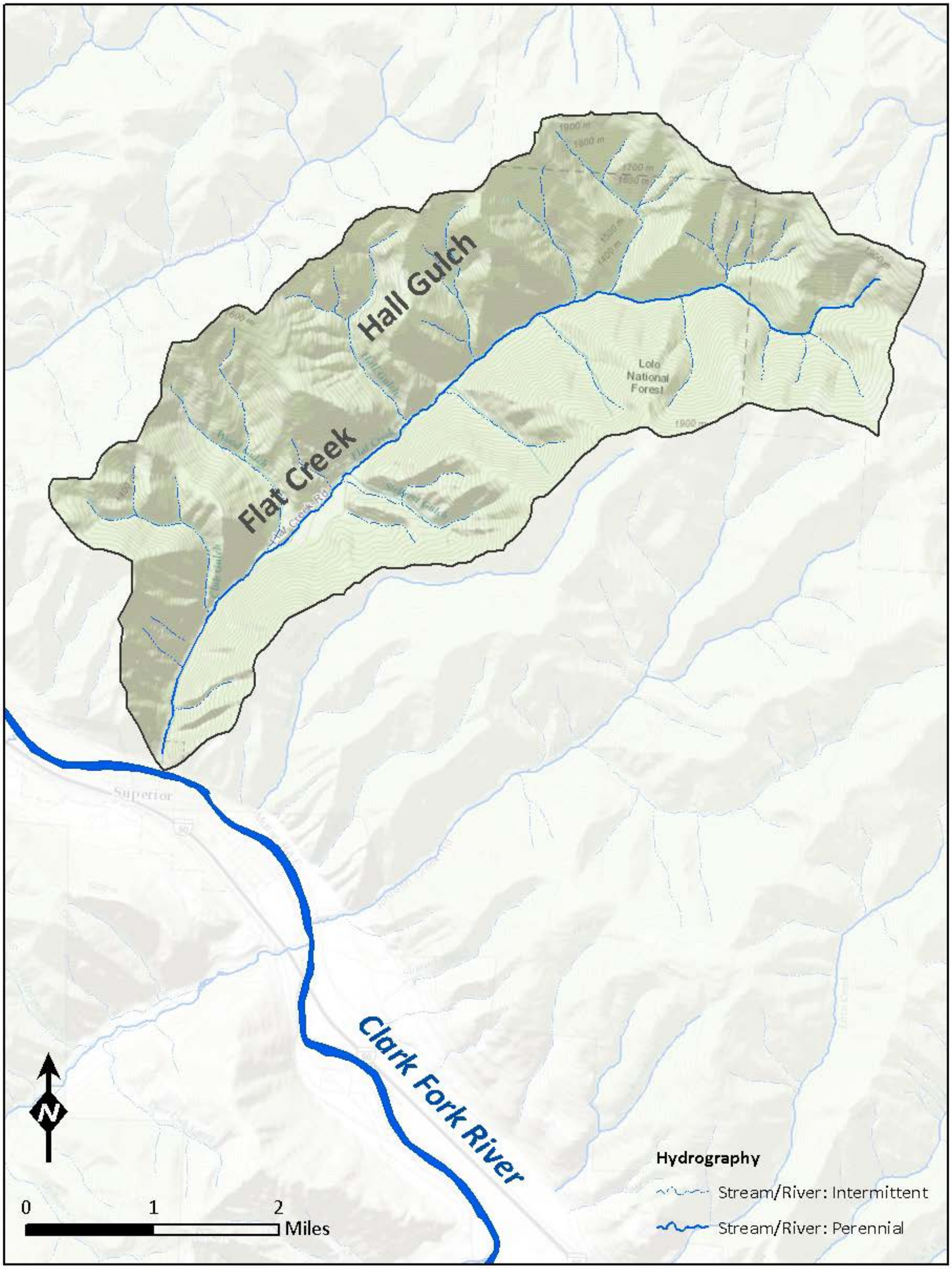

Figure A-21. Flat Creek Hydrography

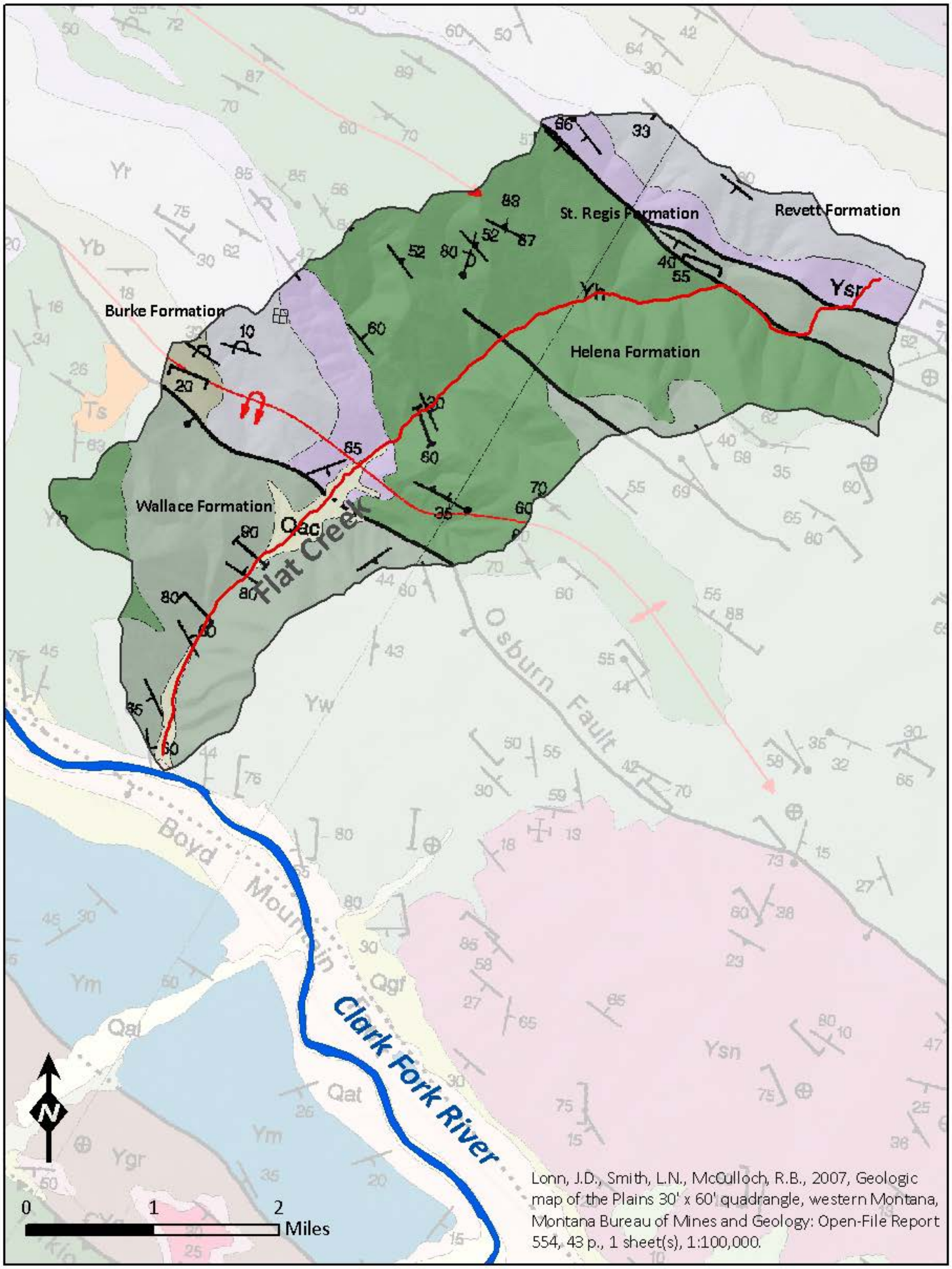

Figure A-22. Flat Creek Geology

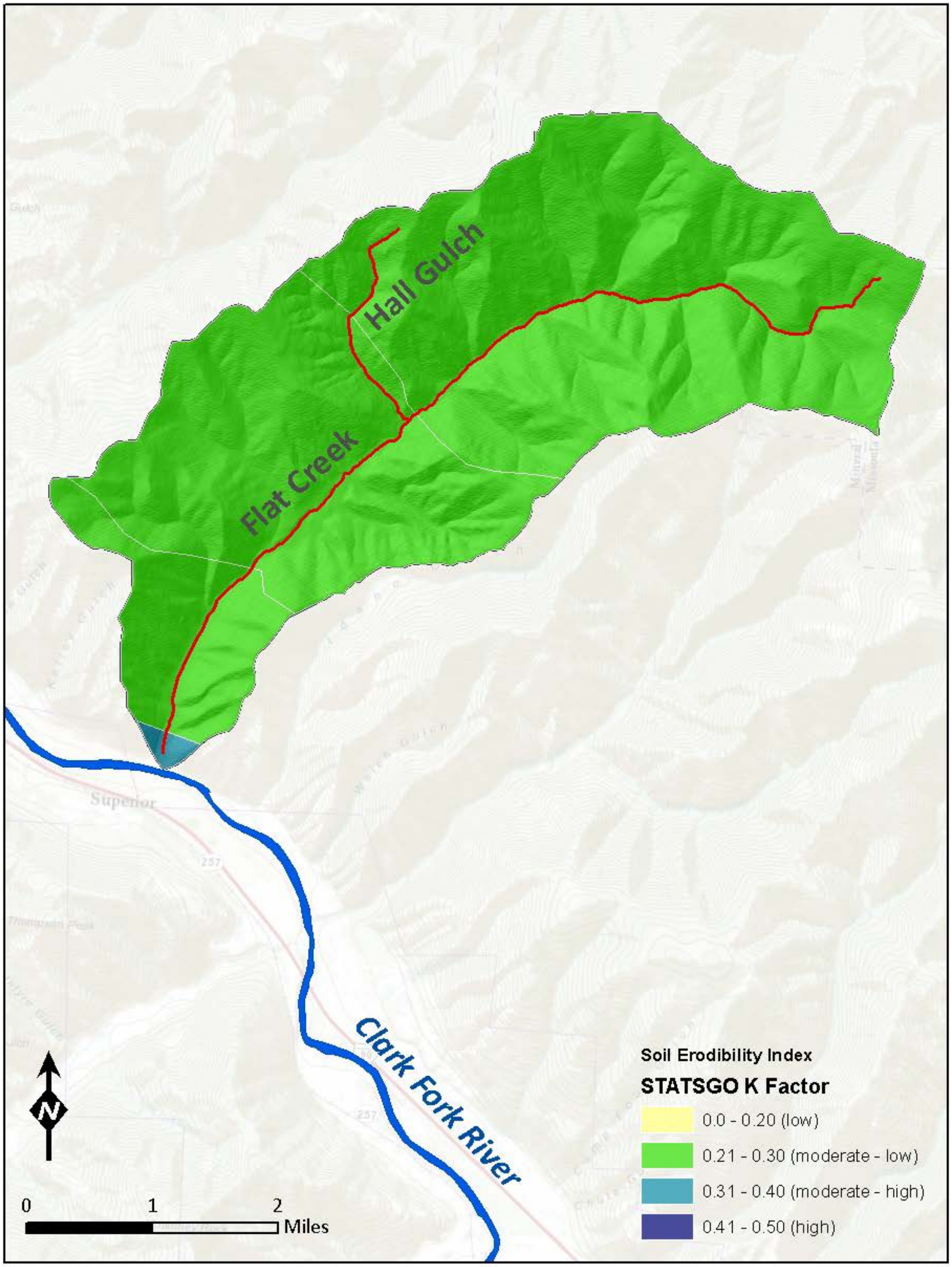

Figure A-23. Flat Creek Soil Erodibility

Figure A-24. Flat Creek Level IV Ecoregions

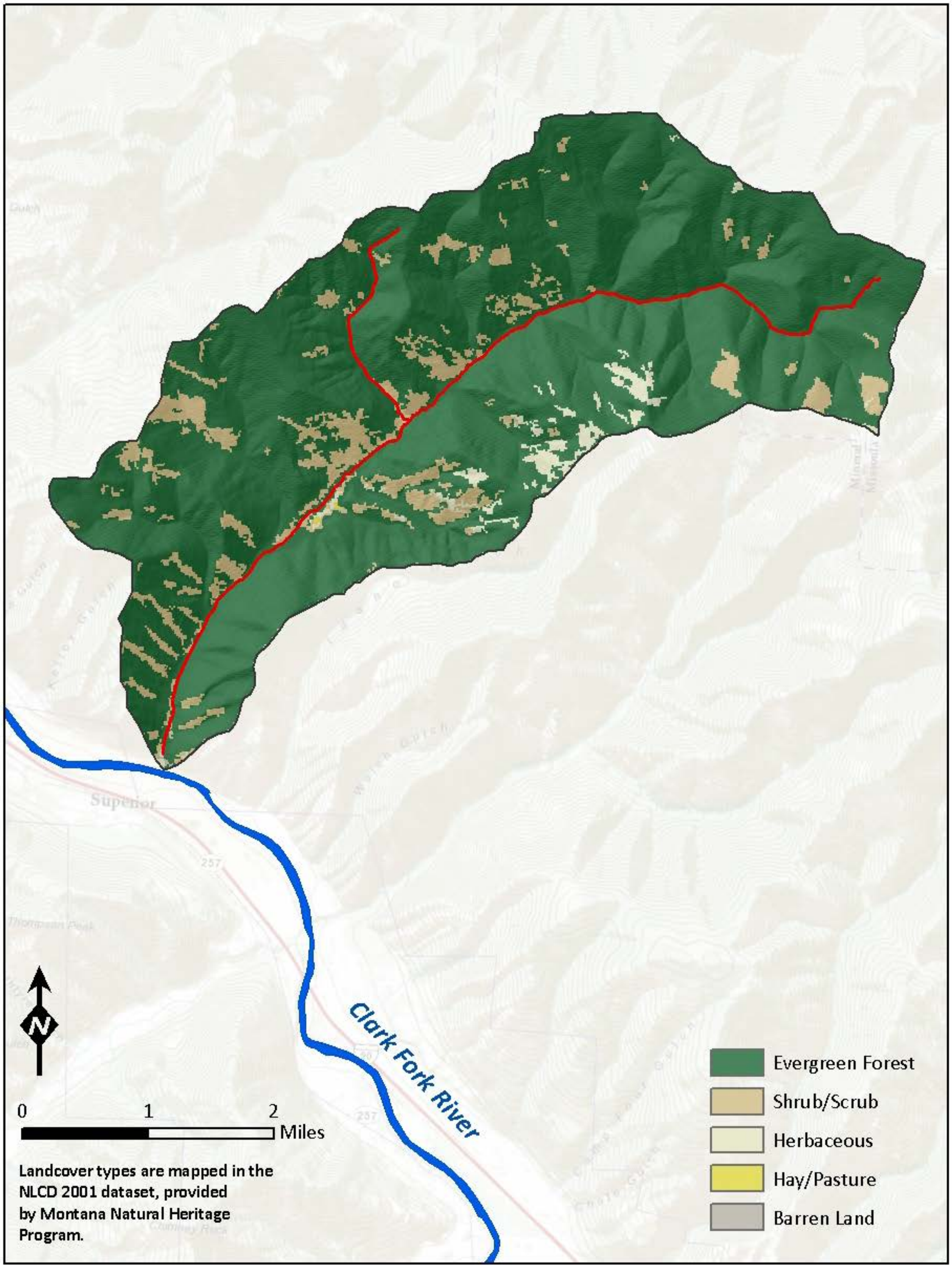

Figure A-25. Flat Creek Land Use and Land Cover

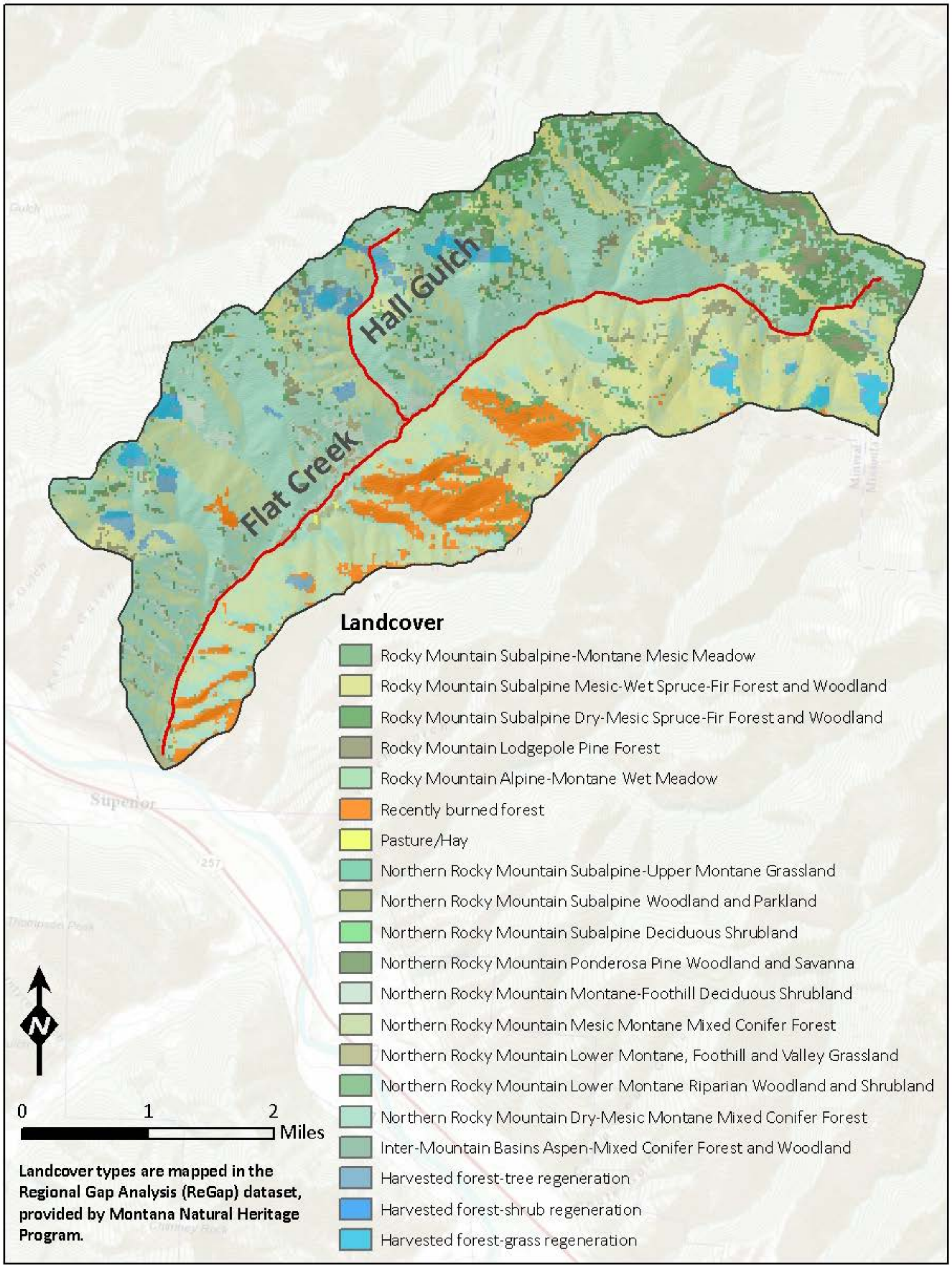

Figure A-26. Flat Creek Land Cover: Regional GAP

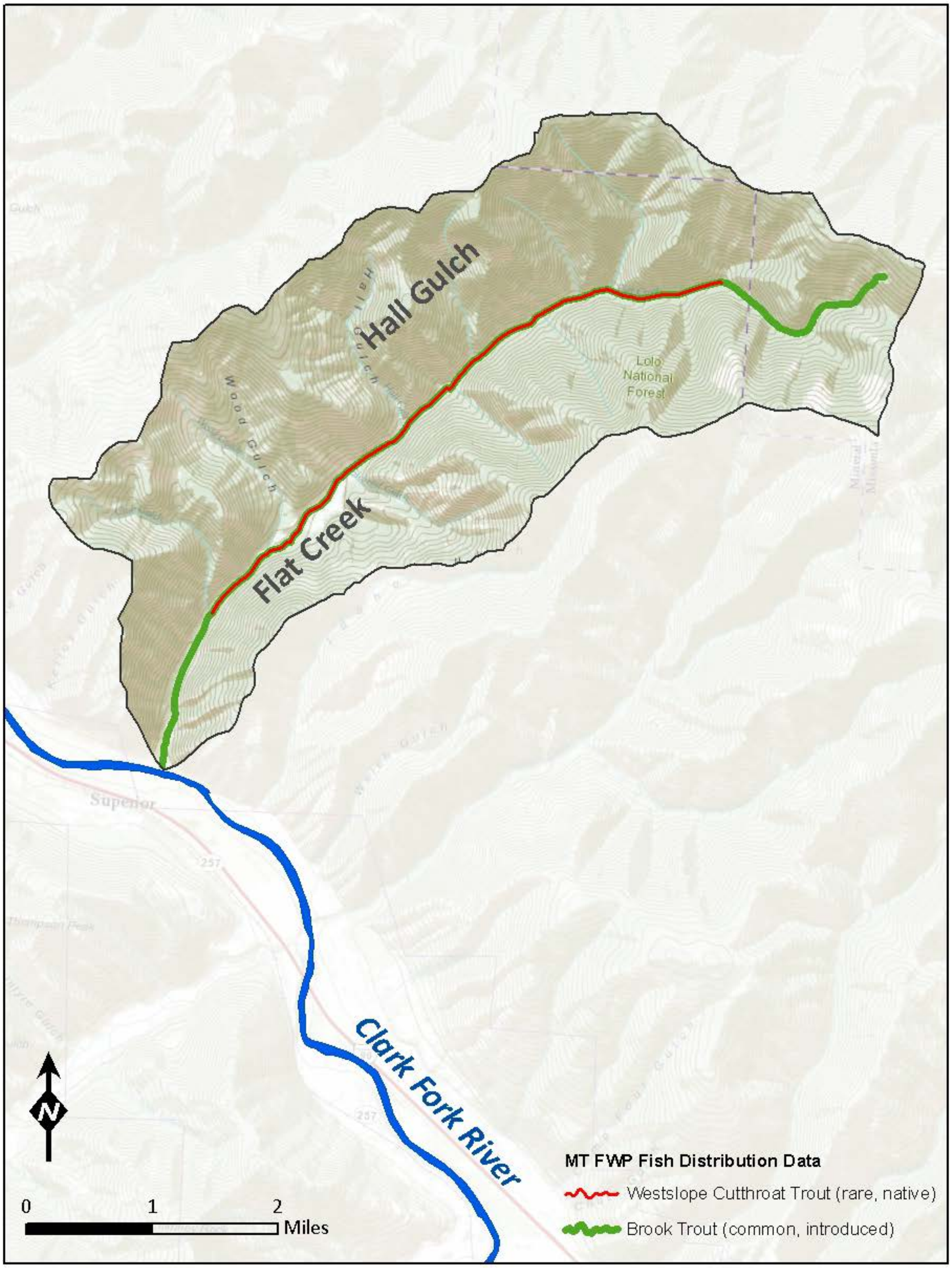

Figure A-27. Flat Creek Fish Distribution

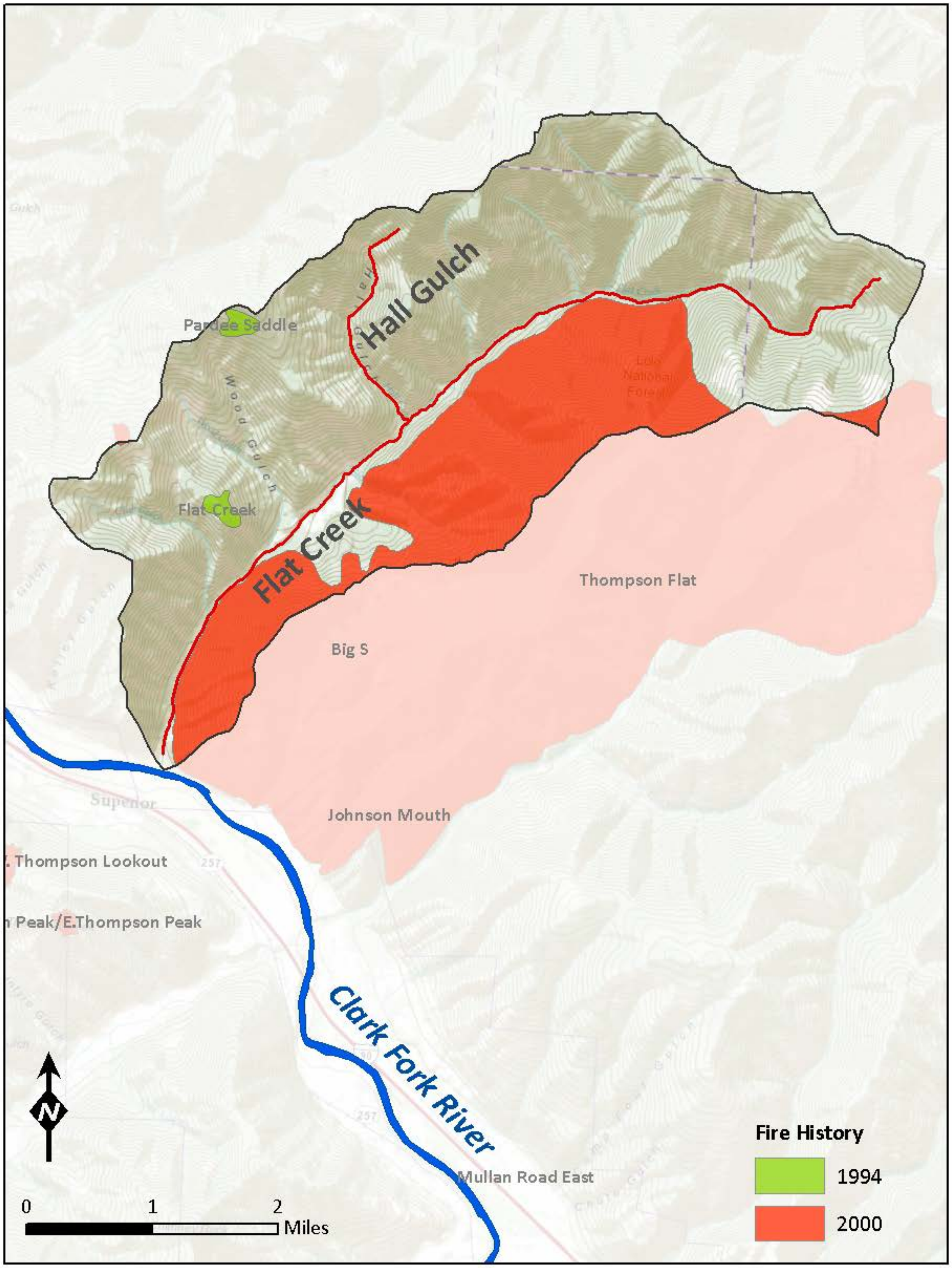

Figure A-28. Flat Creek Fire History

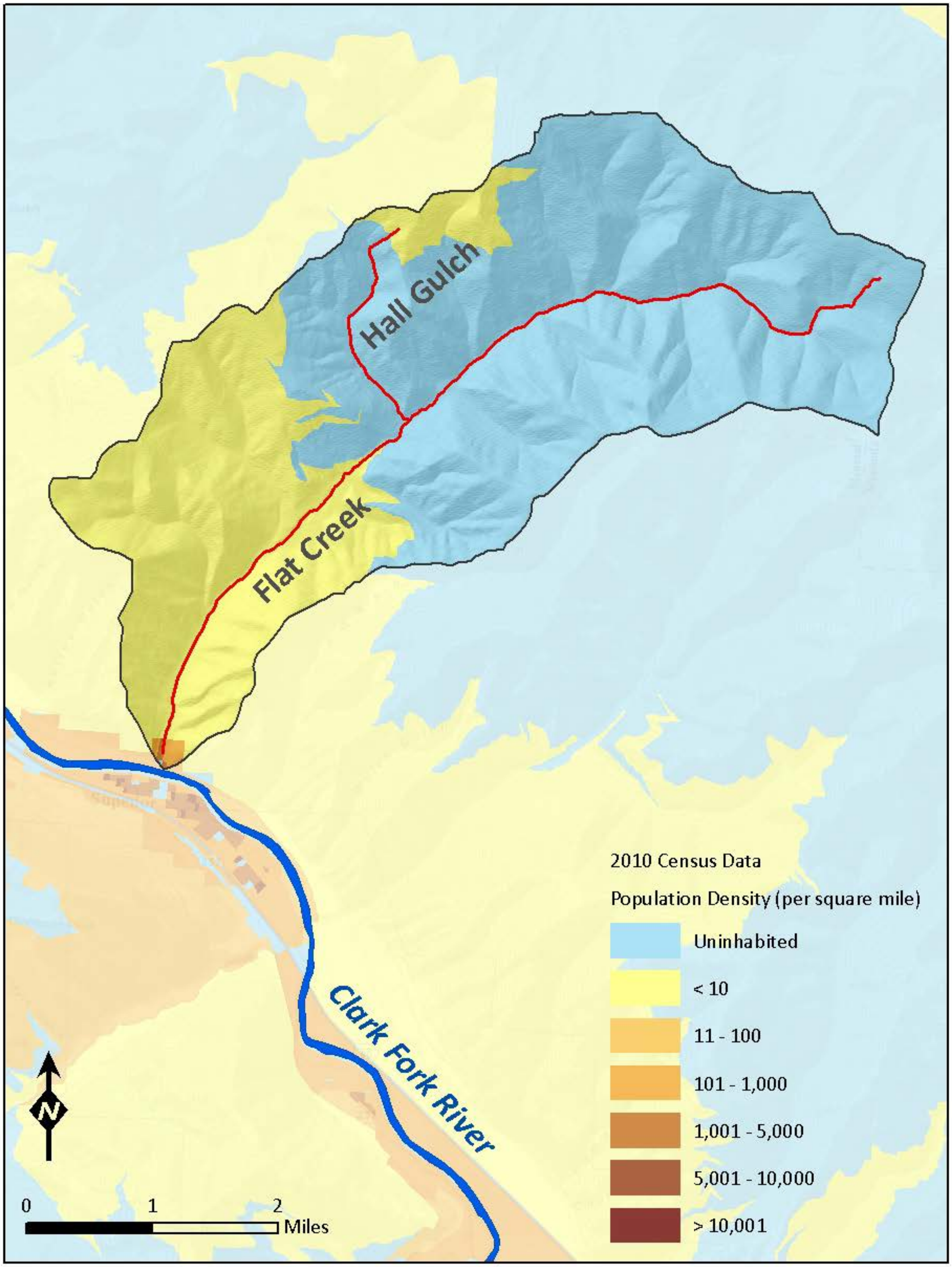

Figure A-29. Flat Creek Population Density: 2010 Census

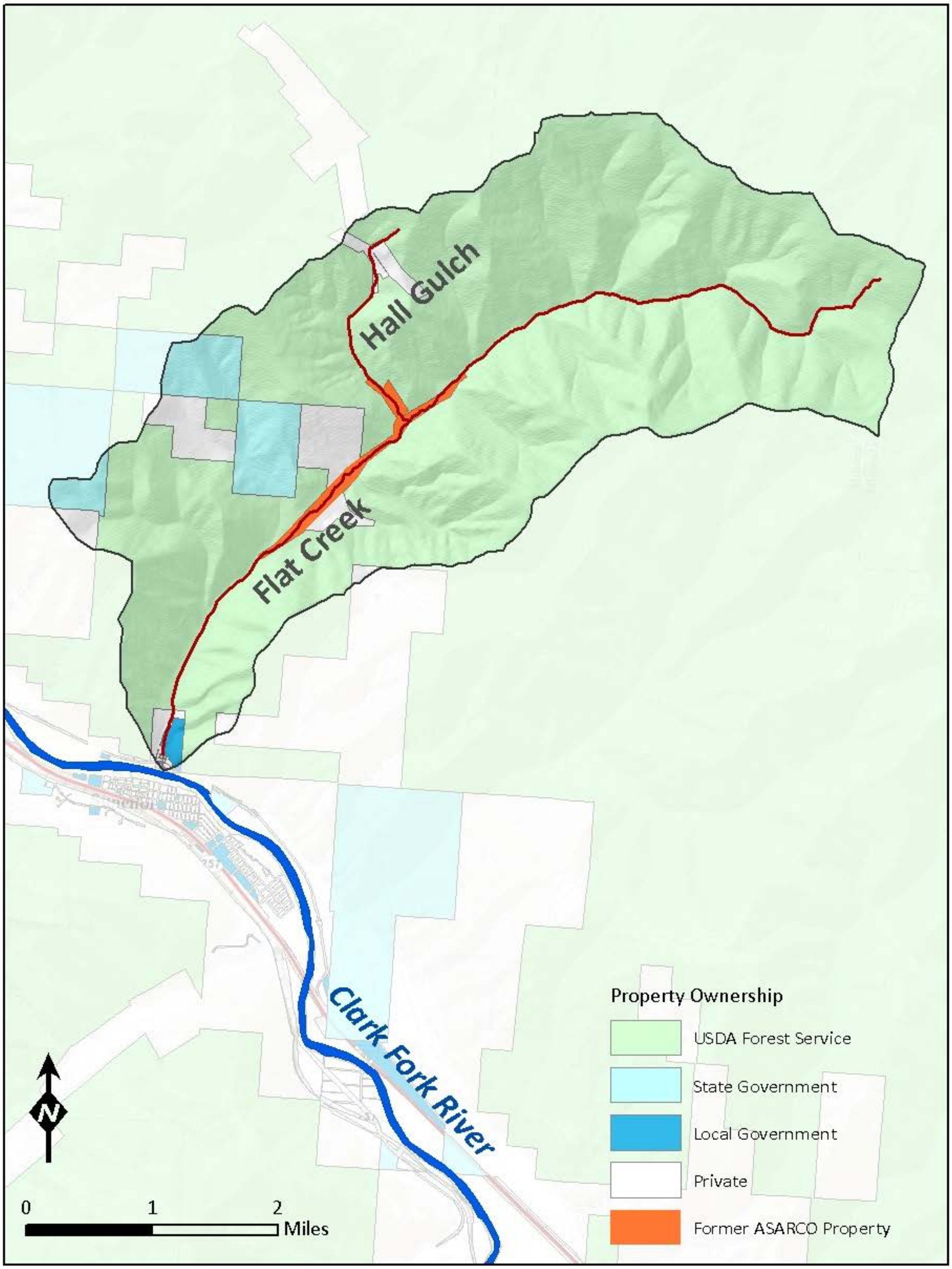

Figure A-30. Flat Creek Land Ownership

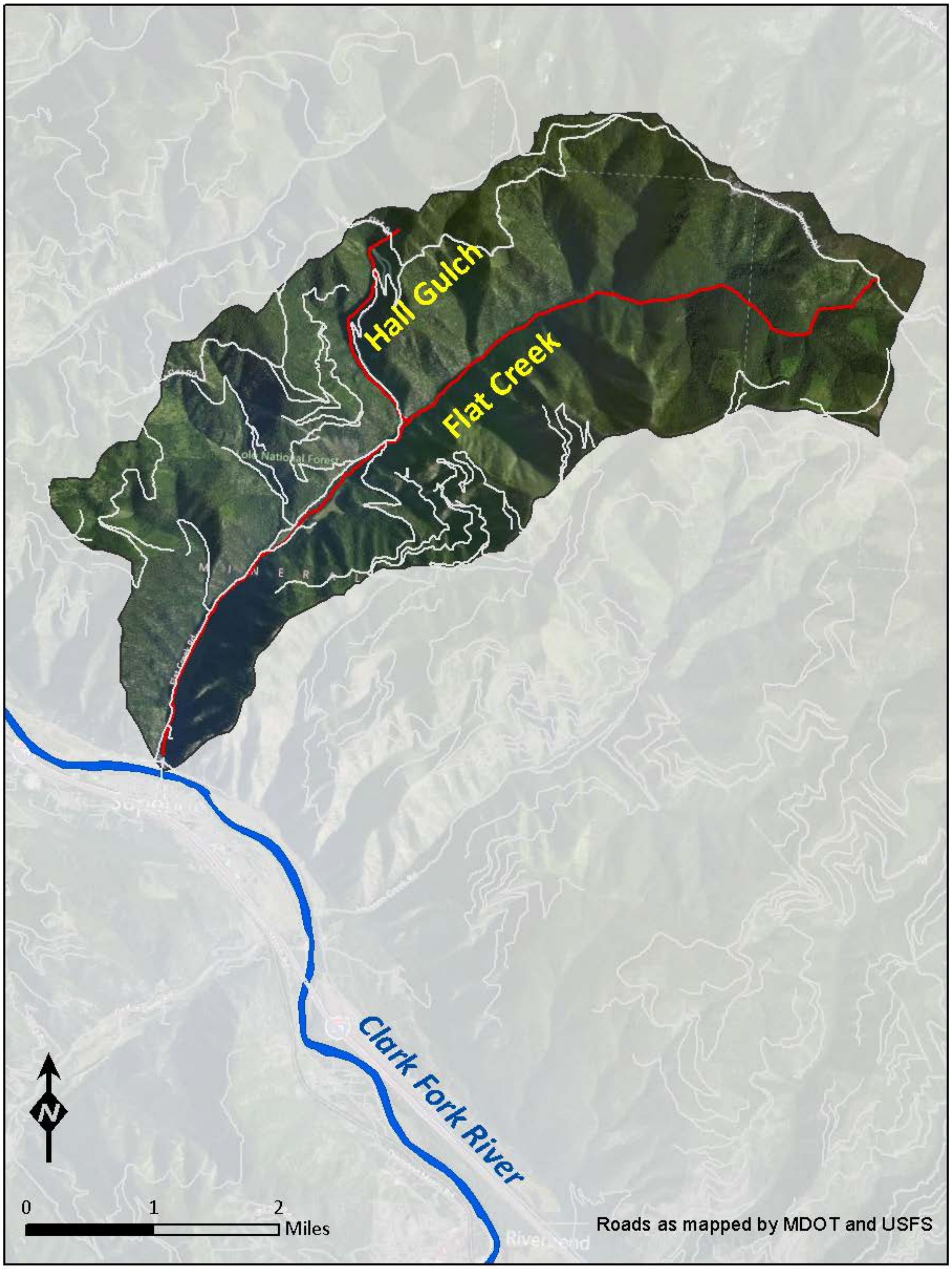

Figure A-31. Flat Creek Roads

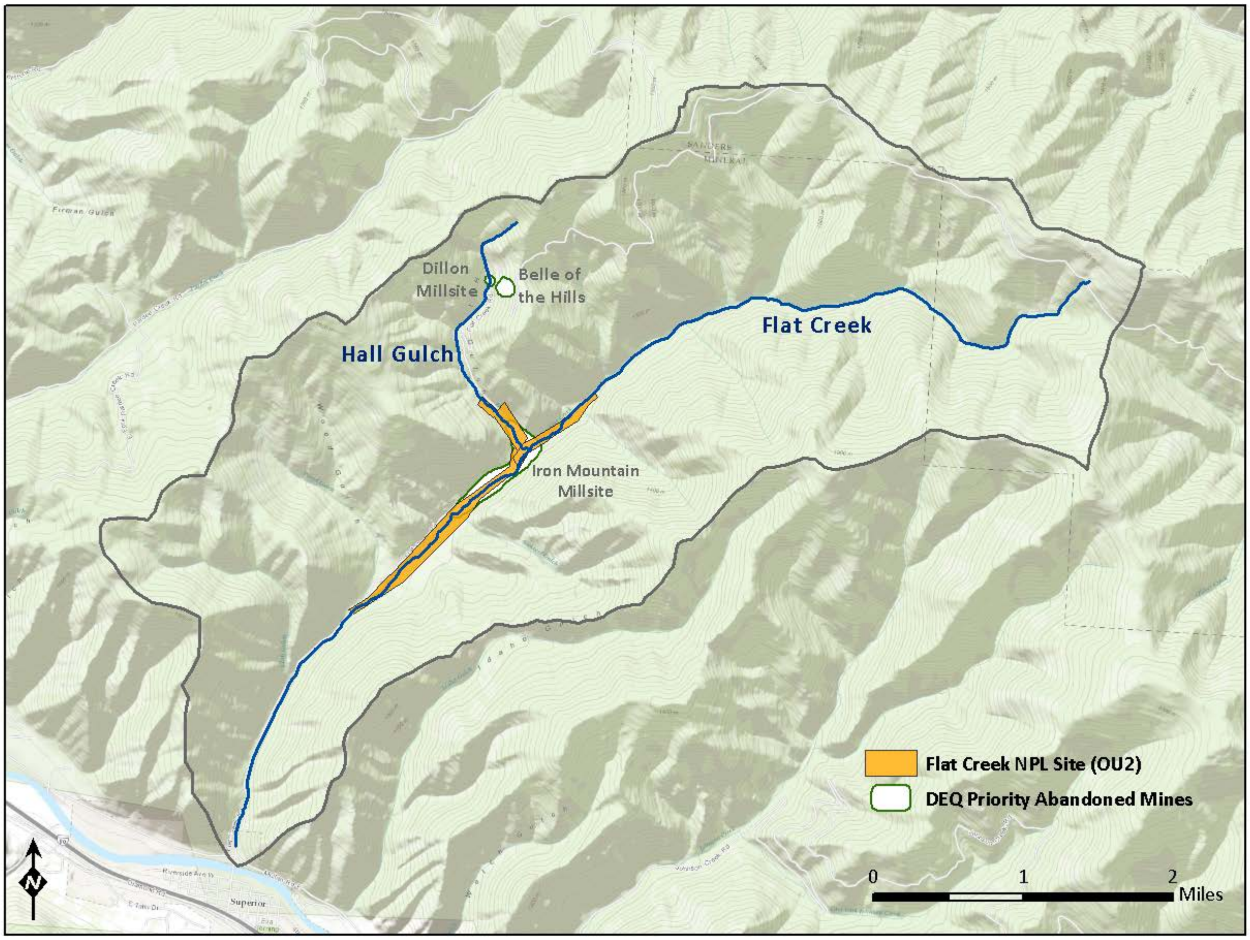

Figure A-32. Flat Creek Abandoned Mines

APPENDIX B –METALS DATA

Table B-1. Recent Surface Water Metals Data for the Bonita - Superior TPA

Waterbody Segment	Site ID	Sample Date	Organization	Hardness (mg/L)	Flow (cfs)	pH	Al (µg/L) D	Sb (µg/L) TR	As (µg/L) TR	Ba (µg/L) TR	Cd (µg/L) TR	Cu (µg/L) TR	Fe (µg/L) TR	Pb (µg/L) TR	Hg(µg/L) T	Zn (µg/L) TR
Cramer Creek	C02CRAMC02	9/14/11	DEQ	226	2.92	-	< 30	-	< 3	54	< 0.08	< 1	70	< 0.5	< 0.005	< 10
Cramer Creek	C02CRAMC02	7/21/11	DEQ	225	4.31	8.5	< 30	< 5	< 3	< 100	< 0.08	< 1	<50	< 0.5	< 0.005	< 10
Cramer Creek	C02CRAMC02	6/30/11	DEQ	205	6.26	8.6	< 30	-	3	< 100	< 0.08	< 1	70	< 0.5	< 0.005	< 10
Cramer Creek	C02CRAMC02	6/16/11	DEQ	174	9.71	8.8	40	-	< 3	70	< 0.08	< 1	200	0.5	< 0.005	< 10
Cramer Creek	C02CRAMC02	9/16/09	DEQ	223	-	8.9	< 30	-	< 3	-	< 0.08	< 1	70	< 0.5	-	< 10
Cramer Creek	C02CRAMC02	8/21/09	DEQ	221	-	8.6	-	-	< 3	-	< 0.08	< 1	<30	< 0.5	-	< 10
Cramer Creek	C02CRAMC03	9/16/09	DEQ	228	-	8.4	< 30	-	< 3	-	< 0.08	< 1	90	2.1	-	< 10
Cramer Creek	C02CRAMC03	8/21/09	DEQ	221	-	8.1	-	-	< 3	-	< 0.08	< 1	90	1.6	-	< 10
Cramer Creek	C02CRAMC04	9/14/11	DEQ	209	5.2	9.2	< 30	-	< 3	135	< 0.08	< 1	90	2.1	< 0.005	< 10
Cramer Creek	C02CRAMC04	7/21/11	DEQ	179	8.91	8.7	< 30	< 5	< 3	100	< 0.08	1	120	3.3	< 0.005	< 10
Cramer Creek	C02CRAMC04	6/30/11	DEQ	145	15.96	8.8	< 30	-	< 3	100	0.16	2	160	3.1	< 0.005	< 10
Cramer Creek	C02CRAMC04	6/16/11	DEQ	109	26.5	8.2	150	-	< 3	150	< 0.08	2	400	4.1	0.012	< 10
Cramer Creek	C02CRAMC04	9/16/09	DEQ	213	-	7.9	< 30	-	< 3	-	< 0.08	1	140	4.1	-	< 10
Cramer Creek	C02CRAMC04	8/20/09	DEQ	208	-	8.3	-	-	< 3	-	< 0.08	1	170	4.2	-	< 10
Cramer Creek	C02CRAMC06	9/14/11	DEQ	223	5.59	9.1	< 30	-	3	94	< 0.08	< 1	<50	4.8	0.0057	< 10
Cramer Creek	C02CRAMC06	7/21/11	DEQ	214	7.79	8.7	< 30	< 5	3	< 100	< 0.08	2	210	15.4	0.018	< 10
Cramer Creek	C02CRAMC06	6/30/11	DEQ	183	10.81	8.7	< 30	-	< 3	< 100	< 0.08	1	120	6.4	0.0089	< 10
Cramer Creek	C02CRAMC06	6/16/11	DEQ	156	19.11	8.5	60	-	< 3	100	< 0.08	2	310	8.5	0.0085	< 10
Cramer Creek	C02CRAMC08	7/21/11	DEQ	152	0.1	8	< 30	< 5	< 3	< 100	< 0.08	2	<50	< 0.5	< 0.005	< 10
Cramer Creek	C02CRAMC08	6/30/11	DEQ	114	0.29	8.4	90	-	3	< 100	< 0.08	2	220	< 0.5	< 0.005	< 10
Cramer Creek	C02CRAMC08	6/21/11	DEQ	91	0.72	8.6	490	-	< 3	60	< 0.08	1	470	< 0.5	< 0.005	< 10
Wallace Creek	C02WALCC02	7/5/11	DEQ	67	2.61	8.5	< 30	-	< 3	200	< 0.08	4	220	0.6	-	< 10
Wallace Creek	C02WALCC02	6/2/10	DEQ	55	1.26	-	< 30	-	< 3	-	< 0.08	5	220	0.6	-	< 10
Wallace Creek	C02WALCC03	10/1/10	DEQ	85	0.27	8.5	< 30	-	< 3	-	< 0.08	2	110	< 0.5	-	< 10
Wallace Creek	C02WALCC03	6/2/10	DEQ	50	2.12	-	50	-	< 3	-	< 0.08	5	230	0.5	-	< 10
Wallace Creek	C02WALCC04	10/1/10	DEQ	87	0.35	8.3	< 30	-	< 3	-	< 0.08	5	240	< 0.5	-	< 10
Wallace Creek	C02WALCC04	6/2/10	DEQ	51	2.52	-	50	-	< 3	-	< 0.08	6	250	0.6	-	< 10
Wallace Creek	C02WALCC05	7/5/11	DEQ	127	0.52	8.5	< 30	-	< 3	500	< 0.08	< 1	<50	< 0.5	-	< 10
Wallace Creek	C02WALCC05	6/2/10	DEQ	93	0.21	-	< 30	-	< 3	-	< 0.08	2	80	< 0.5	-	< 10
Flat Creek	C04FLATC01	9/15/11	DEQ	177	2.18	8.4	< 30	37	7	-	0.92	< 1	<50	14.6	0.0086	160
Flat Creek	C04FLATC01	8/18/11	DEQ	170	4.27	8.7	< 30	30	6	-	0.78	< 1	<50	12.9	< 0.005	150
Flat Creek	C04FLATC01	7/20/11	DEQ	156	7.42	8.7	< 30	20	6	-	0.68	< 1	<50	19.5	0.0074	130
Flat Creek	C04FLATC01	6/28/11	DEQ	143	20.9	8.5	< 30	25	17	-	1.11	1	600	153	0.124	210
Flat Creek	C04FLATC01	6/14/11	DEQ	147	36.42	8.5	< 30	39	45	-	2.51	4	1,690	498	0.425	560
Flat Creek	C04FLATC01	9/17/09	DEQ	188	-	7.9	< 30	-	8	-	0.96	< 1	<30	11.4	-	180
Flat Creek	C04FLATC01	8/22/09	DEQ	173	-	8.2	< 30	-	8	-	0.95	< 1	<30	11.7	-	150
Flat Creek	C04FLATC03	9/15/11	DEQ	149	2.13	8.6	< 30	< 3	< 3	-	< 0.08	< 1	<50	< 0.5	< 0.005	< 10
Flat Creek	C04FLATC03	8/18/11	DEQ	147	3.73	8.8	< 30	< 5	< 3	-	< 0.08	< 1	<50	< 0.5	< 0.005	< 10
Flat Creek	C04FLATC03	7/20/11	DEQ	134	7.35	8.5	< 30	< 5	< 3	-	< 0.08	< 1	<50	< 0.5	< 0.005	< 10
Flat Creek	C04FLATC03	6/28/11	DEQ	121	17.47	8.6	< 30	< 5	< 3	-	< 0.08	< 1	150	0.6	< 0.005	< 10
Flat Creek	C04FLATC03	6/14/11	DEQ	131	33.01	8.4	< 30	< 5	< 3	-	< 0.08	1	570	2.2	< 0.005	< 10
Flat Creek	C04FLATC03	9/17/09	DEQ	159	-	8.1	< 30	-	< 3	-	< 0.08	< 1	<30	< 0.5	-	< 10
Flat Creek	C04FLATC03	8/23/09	DEQ	142	-	8.4	< 30	-	< 3	-	< 0.08	< 1	<30	< 0.5	-	< 10
Flat Creek	C04FLATC04	9/15/11	DEQ	164	2.81	8.6	< 30	11	4	-	0.83	< 1	<50	8.9	< 0.005	180
Flat Creek	C04FLATC04	8/18/11	DEQ	160	4.46	8.7	< 30	8	3	-	0.6	< 1	<50	7.6	< 0.005	150
Flat Creek	C04FLATC04	7/20/11	DEQ	144	8.74	8.6	< 30	5	< 3	-	0.5	1	80	12.2	0.0207	110
Flat Creek	C04FLATC04	6/28/11	DEQ	129	18.04	8.6	< 30	< 5	4	-	0.46	< 1	220	33.7	0.0254	110

Table B-1. Recent Surface Water Metals Data for the Bonita - Superior TPA

Waterbody Segment	Site ID	Sample Date	Organization	Hardness (mg/L)	Flow (cfs)	pH	Al (µg/L) D	Sb (µg/L) TR	As (µg/L) TR	Ba (µg/L) TR	Cd (µg/L) TR	Cu (µg/L) TR	Fe (µg/L) TR	Pb (µg/L) TR	Hg(µg/L) T	Zn (µg/L) TR
Flat Creek	C04FLATC04	6/14/11	DEQ	135	30.8	8.4	< 30	5	7	-	0.91	2	810	99.2	< 0.005	180
Flat Creek	C04FLATC04	9/17/09	DEQ	176	-	8.1	< 30	-	5	-	1.04	< 1	<30	11.3	-	250
Flat Creek	C04FLATC04	8/22/09	DEQ	156	-	8.2	< 30	-	5	-	0.84	< 1	<30	9.7	-	180
Flat Creek	C04FLATC05	9/15/11	DEQ	< 1	0.1		< 30	< 3	< 3	-	< 0.08	< 1	<50	< 0.5		< 10
Flat Creek	C04FLATC05	9/15/11	DEQ	7	1	8.3	< 30	< 3	< 3	-	< 0.08	< 1	<50	< 0.5	< 0.005	< 10
Flat Creek	C04FLATC05	8/18/11	DEQ	7	0.1	9.6	< 30	< 5	< 3	-	< 0.08	< 1	<50	< 0.5	< 0.005	< 10
Flat Creek	C04FLATC05	7/20/11	DEQ	7	0.05	7.7	< 30	< 5	< 3	-	< 0.08	< 1	480	< 0.5	< 0.005	< 10
Flat Creek	C04FLATC05	9/18/09	DEQ	8	-	8.1	< 30	-	< 3	-	< 0.08	1	40	1.2	-	< 10
Flat Creek	C04FLATC05	8/23/09	DEQ	7	-	-	< 30	-	< 3	-	< 0.08	< 1	1,100	< 0.5	-	< 10
Hall Gulch	C04HALLG02	8/8/12	DEQ	509	0.1	8.3	< 30	19	118	-	0.2	< 1	220	5.3	< 0.005	4,410
Hall Gulch	C04HALLG02	7/17/12	DEQ	515	0.1	8.19	< 30	-	18	-	0.12	< 1	360	< 0.5	0.0116	2,890
Hall Gulch	C04HALLG02	6/29/12	DEQ	491	0.1	8	< 30	14	27	-	0.12	< 1	510	< 0.5	< 0.005	5,350
Hall Gulch	C04HALLG02	9/15/11	DEQ	487	0.1	8.2	< 30	16	42	-	0.13	< 1	420	< 0.5	< 0.005	5,310
Hall Gulch	C04HALLG02	8/18/11	DEQ	507	0.1	-	< 30	17	34	-	0.13	< 1	270	0.5	< 0.005	3,550
Hall Gulch	C04HALLG02	7/20/11	DEQ	469	0.1	8.2	< 30	18	23	-	0.12	< 1	340	< 0.5	< 0.005	3,690
Hall Gulch	C04HALLG02	6/28/11	DEQ	465	0.1	8.3	< 30	18	31	-	0.11	< 1	3,280	0.7	< 0.005	2,160
Hall Gulch	C04HALLG02	6/14/11	DEQ	512	0.1	8.3	< 30	37	317	-	0.43	1	560	22.7	< 0.005	5,310
Hall Gulch	C04HALLG02	9/17/09	DEQ	525	0.1	-	< 30	-	58	-	0.14	< 1	70	< 0.5	-	5,930

Table B-2. Recent Sediment Metals Data for the Bonita - Superior TPA

Waterbody Segment	Site ID	Sample Date	Organization	Al (µg/g)	Sb (µg/g)	As (µg/g)	Ba (µg/g)	Cd (µg/g)	Cu (µg/g)	Fe (µg/g)	Pb (µg/g)	Hg(µg/g)	Zn (µg/g)
Cramer Creek	C02CRAMC02	8/21/09	DEQ	-	-	7	-	0.4	18	12,500	59	0.084	194
Cramer Creek	C02CRAMC02	9/16/09	DEQ	-	-	8	-	0.3	17	12,100	62	0.092	198
Cramer Creek	C02CRAMC03	8/21/09	DEQ	-	-	18	-	0.3	24	12,000	264	0.29	137
Cramer Creek	C02CRAMC03	9/16/09	DEQ	-	-	16	-	0.3	26	12,800	304	0.42	156
Cramer Creek	C02CRAMC04	8/20/09	DEQ	-	-	9	-	< 0.2	32	13,700	207	0.43	76
Cramer Creek	C02CRAMC04	9/16/09	DEQ	-	-	7	-	0.3	31	12,300	197	0.46	72
Wallace Creek	C02WALCC02	7/5/11	DEQ	-	-	14	-	0.5	114	-	71	< 0.74	130
Flat Creek	C04FLATC01	8/22/09	DEQ	-	-	633	-	18.6	36	23,500	3,810	6.4	4,180
Flat Creek	C04FLATC01	9/17/09	DEQ	-	-	709	-	20.7	38	26,600	4,200	8.6	4,700
Flat Creek	C04FLATC03	8/23/09	DEQ	-	-	15	-	0.5	16	16,400	47	0.092	149
Flat Creek	C04FLATC03	9/17/09	DEQ	-	-	20	-	0.4	16	16,500	52	0.12	160
Flat Creek	C04FLATC04	8/22/09	DEQ	-	-	679	-	17.9	41	22,700	5,570	14	3,750
Flat Creek	C04FLATC04	9/17/09	DEQ	-	-	741	-	19.8	44	24,400	5,660	11	4,130
Flat Creek	C04FLATC05	8/23/09	DEQ	-	-	3	-	< 0.2	< 20	<10,000	15	< 0.05	130
Flat Creek	C04FLATC05	9/18/09	DEQ	-	-	< 8	-	0.3	< 20	8,820	19	< 0.05	112
Hall Gulch	C04HALLG02	9/17/09	DEQ	-	-	16,100	-	15.3	39	178,000	1,370	2.9	115,000

Appendix C - Cleanup/Restoration And Funding Options For Mine Operations Or Other Sources Of Metals Contamination

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

C1.0 The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

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

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

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

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

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

C2.0 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(2011)). In October 1987, the Department began addressing state Superfund facilities. Temporary grant funding was used between 1987 and 1989 to clean up two facilities and rank approximately 250 other facilities. Beginning in fiscal year 1995, the 4 percent allocation was changed to 6 percent to adjust for other legislative changes in RIT allocations. Effective July 1, 1999, the 6 percent allocation was increased to 9 percent.

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

As of December 2012, there were 208 facilities on the CECRA Priority List (Montana Department of Environmental Quality, 2011a). CECRA facilities are ranked maximum, high, medium, low and operation and maintenance priority based on the severity of contamination at the facility and the actual and potential impacts of contamination to public health, safety, and welfare and the environment. The Department maintains database narratives that explain contamination problems and status of work at each state Superfund facility.

C2.1 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 (Montana Department of Environmental Quality, 2011b)is a voluntary process that allows Potentially Responsible Parties (PRP) to petition for an allocation of liability as an alternative to the strict, joint and several liability scheme included in CECRA. CALA provides a streamlined alternative to litigation that involves negotiations designed to allocate liability among persons involved at facilities requiring cleanup, including bankrupt or defunct persons. Cleanup of these facilities must occur concurrently with the CALA process and CALA provides the funding for the orphan share of the cleanup. Since CECRA cleanups typically involve historical contamination, liable persons often include entities that are bankrupt or defunct and not affiliated with any viable person by stock ownership. The share of cleanup costs for which these bankrupt or defunct persons are responsible is the orphan share. Department represents the interests of the orphan share throughout the CALA process.

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

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

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

C2.2 The Voluntary Cleanup and Redevelopment Act (VCRA)

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

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

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

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

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

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

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

C3.0 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. There are no collections or contributions to the Abandoned Mine Fund from mineral production beyond coal production fees. Expenditures under the abandoned mine program can only be made on “eligible” abandoned mine sites. For a site to be eligible, mining must have ceased prior to August 4, 1977 (private lands, other dates apply to federal lands). In addition, there must be no continuing reclamation responsibility under any state or federal law. No continuing reclamation responsibility can mean no mining bonds or permits have been issued for the site, however, it has also been interpreted to mean that there can be no viable responsible party under State or Federal laws such as CERCLA or CECRA. While lands eligible for the Abandoned Mine Funds include hard rock mines and gravel pits (collectively categorized as “non-coal”), abandoned coalmines have the highest priority for expenditures from the Fund. As part of the approved plan for Montana, abandoned coal mines are required to be prioritized and funded for reclamation ahead of eligible non-coal mine sites. . Cleanup of any eligible site is prioritized based primarily on human health, which can include health risks such as open shafts, versus risks only associated with hazardous substances, as is the case under CERCLA.

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

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

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

C4.0 Cleanup on Federal Agency Lands

A Federal land management agency may pursue cleanup actions outside of any requirements under CERCLA or CECRA where such activities are consistent with overall land management goals and funding availability. This is the anticipated solutions for USFS lands within the Flat Creek watershed.

C5.0 Permitted or Bonded Sites

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

C6.0 Voluntary Cleanup Agreement

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

C7.0 Landowner Voluntary Cleanup Outside of a State Directed or State Negotiated Effort

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

C8.0 State Emergency Actions

Where a major emergency exists, the State can undertake remedial actions and then pursue reimbursement from a responsible party. This situation does not exist within the Bonita – Superior TMDL project area.

C9.0 References

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